Technological Capital Management as an Instrument of Industrial Enterprise Innovative Development

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Abstract
Innovative enterprise development, its efficiency measurement and increased stimulation is a vitally important domain of study both for academics and business practitioners. The article introduces the term of «technological capital» of an enterprise, which includes both tangible and intangible components. The article offers a new approach towards selecting the criterion of the innovative enterprise development level, which involves the aggregated value of technological capital growth, based on the advancing growth of intangible assets.
In order to gain better understanding of technological capital management, its main elements and structure are defined, and the practical methods of technological capital integral parts valuation are represented within the advancing intangible assets value growth framework.

Keywords
Innovative enterprise development, Enterprise intellectual capital, Enterprise technological capital

1 INTRODUCTION

The solution of the Russian economy modernization problem, whose topicality is continuously underlined at the summit state level, is impossible without reconsideration of fundamental approaches to the principal modernization driver – restructuring of technological processes. At the same time modernization issue is rarely considered in the process focus; the observed governmental and business measures in the field of modernization are typically industrial by their nature. However nowadays there is no doubt that, while industrial stage of economy development implies country competitiveness due to increased efficiency of certain production factors, in post-industrial economy the key part is assigned to the establishment and systematic development of an environment encouraging generation and integration of innovation.

From the point of view of post-industrial approaches the most important point is not in the technical upgrading and development of personnel competence as such, but in the process improvement of business and, narrower, production cycle, based on the modern approaches to the management of intangible assets, forming the enterprise fundamental value. The necessity to define the category comprising the identified aggregate of tangible and intangible components of the production process, influencing the enterprise competitiveness and value, brings to the idea of considering the technological capital as the main object of modernization policy.

One of the reasons for low performance of the modern innovative policy in Russia is the ambiguity of objectives and, consequently, evaluation of enterprises innovative development results as a whole and machine building enterprises in particular. It is obvious that amount of funds (or growth of that amount), appropriated by enterprises for technical upgrading and modernization, as well as for product competitive growth in local (regional) markets may not be the criteria of innovative development of enterprises. Only the growth of technological capital as a result of the enterprise innovative activity may be considered as the criterion of innovative development.

This paper reviews relevant literature and defines theories which may be accepted as a basis for the established category of "technological capital". Based on suggested category, including tangible and intangible components, it justifies the selection of the enterprise innovative development criterion, which implies the growth of the technological capital total value on condition of outrunning growth of the intangible component value. The present article also specifies actions making it possible to achieve the above.

2 LITERATURE REVIEW

It is obvious today for many scientists and practitioners from different countries that transition of economy into innovative stage of development is an obligatory condition of economic growth and prosperity. The fact is confirmed by a rapid increase of research, both highly theoretic as well as purely applied in their nature, devoted to different aspects of innovation management, mutual influence and dependence of innovative activity and competitiveness of enterprises, management of
intangible assets and intellectual capital of enterprises as the results of innovative activity.

In the context of literature sources, first of all it is necessary to determine the meaning of “innovation”. In a general sense innovation is understood as a purposeful change which introduces in the integration environment (enterprise, company etc.) new, relatively stable elements [1].

The researchers [2] consider the following criteria of enterprise innovative development efficiency evaluation:

- efficiency of costs for technological innovations (relation of the sold innovative products volume and the amount of costs for innovations);
- intensity of costs for technological innovations (specific weight of costs for innovations in the total volume of the shipped products, performed works and services);
- specific weight of innovative products, works, services in the volume of shipped products, performed works and services;
- specific weight of innovative products, works, services new for the market in the volume of innovative products, works and services.

It should be noted that provided indices are mainly of qualitative nature and do not fully characterize the innovative development efficiency. In this regard the qualitative criterion (outrunning growth of the technological capital intangible component value) suggested herein will restrictedly supplement the existing criterion base.

The whole set of literature sources describes the connection of innovations with the enterprise competitiveness [3], [4]. In particular, Michael Porter in his fundamental work [3] points out: “… the nature and evolution of all successful companies is basically similar. The company gains competitive advantages by means of innovations. They suit the novelties in the widest sense using both new technologies and new methods of work…". In another work [4] Porter describes how technological innovations give rise to the enterprise competitive advantages. The acquired or own technologies influence and modify the key factors of costs reduction and differentiation (influence of the scale effect, positive interrelations between business units, first-mover advantage etc.). In addition the technologies, directly influencing the costs reduction and differentiation, create the enterprise competitive advantages.

Many works are devoted to different aspects of management of intangible assets and intellectual capital as embodiment of innovations. Thus, the questions concerning determination of different types of intangible assets value and intellectual property are considered in scientific works [5], [6]. Different aspects of the subsequent intellectualization of industrial production problem are described in scientific works of researchers [7], [8]. The issues of intellectual capital are considered in works [9], [10].

Technological capital as the analysis and control object is considered in the following works [11], [12]. For example, the author [12] understands technological capital as a total of economic relations originating between the subjects in the course of creation and application of technology as a combinatory resource implementing capital functions in post-industrial economy.

The analysis of the above-mentioned and other literature sources proves that some issues of grounded selection of evaluation criteria for innovative development efficiency, interrelation of problems concerning management of pricing tangible and intangible factors of technological nature and enterprise competitiveness assurance, remain insufficiently elaborated. In this regard the present work and obtained results are topical from both scientific and practical point of view.

3 METHODOLOGY

Selection of basic theories by development of “technological capital” category is based on the following key provisions:

- one of the leading theories, describing intangible assets, including those connected with production and production management, is the theory of intellectual capital;
- technological capital management is the factor of enterprise value formation, technological capital is the enterprise asset;
- nowadays there is a transition to the business model, providing for cooperation with external sources of new ideas and technologies.

Regarding the above the formation of “technological capital” category seems reasonable on the basis of the intellectual capital theory, value approach to management as well as open innovations model.

3.1 Intellectual capital theory

The basis for many approaches to management of intangible assets is the intellectual capital theory [9], [10]. Intellectual capital consists of the reserves and movement of knowledge useful for the enterprise. The knowledge can be considered as intangible resource, which together with tangible resources makes up market or total value of the enterprise. Intellectual capital is subdivided into human, market and structural. The structural capital includes innovative and process capitals. The interconnection of non-material elements of technological capital and components of intellectual capital is represented in figure 1.

The highlighting in the intellectual capital structure of the components forming technological capital – non-material assets (knowledge and business-processes including) connected with production proper and it’s management, is caused by specific tasks accomplished while managing these assets, and special instruments and methods of management,
used during the work being performed on them. It is also of necessity to note that contemporary industrial enterprises modernization first of all deals with this particular type of non-material assets.

3.2 Value based approach to management (value based management)
Value based management (VBM) is aimed at qualitative improvement of strategic and operational decisions at all levels of the enterprise due to concentration of efforts of all persons, making decisions, on key value factors. Technological capital management as one of the key factors of enterprise value formation shall be carried out within the frameworks of value ideology, based on its rules, approaches and principles. Only in this case one can increase activity efficiency and enterprise value and, consequently, its competitiveness.

3.3 Open innovations model
In conditions of constantly increasing market competition between multinational corporations a new business model is gradually moving to the forefront – “open innovations” model. It is based on extensive application of external sources of new technologies and know-how, as well as creation of multilevel research collaborations. As far as management of technological capital intangible component assumes systematic search for and work with external sources of knowledge and technologies, as well as efficient use of such knowledge both inside the enterprise and in the course of close cooperation with third-party organizations, the basic provisions of open innovations model shall be applied in this case.

4 BASIC IDEAS
Today the problem of improvement of enterprise innovative activity quality, efficiency of production system, assurance of competitiveness in the market is especially acute. All that requires one to define and consider in details the “technological capital” category.

However before examining this specific category it is necessary to give a definition to its content – technology. Within the frame of this particular work it is defined as a combination of means, processes, operations, and methods, with the help of which production inputs are transformed into its outputs. This technology encompasses machines, mechanisms and tools, skills and knowledge.

It is necessary to note that during the intensification of the process of the formation of new innovative economy technology becomes a factor increasingly defining economic growth, acquiring the form of technological capital.

Technological capital (TC) of the enterprise is understood as the total of two components: tangible component, including active part of the enterprise basic production assets (BPA) and intangible component, comprising intangible assets (IA) connected with manufacturing of products and production management.

When defining the criterion one shall take into account that in present conditions, at the time of transition to economy of knowledge, the objects, constituting TC intangible component, are becoming more important and exert greater influence on the innovative activity efficiency. Within this work TC intangible component is considered as control object. At the same time the growth of TC value shall be analyzed both from the point of view of total TC growth and growth of its intangible component.

Thus the necessary condition of technological capital efficient management is the compliance with the following equation:

$$\{TC_{t+1} - TC_t\} \rightarrow \max$$

(1)

where, $TC_{t+1}$ – enterprise TC value at the point of time $t+1$; $TC_t$ – enterprise TC value at the point of time $t$.

As mentioned before, enterprise TC consists of the active part of basic production assets and IA, connected with production and production management. In formalized form in can be presented as follows:

$$TC_t = FA_t + IA_t,$$

(2)

Figure 1 - Relationship between intellectual and technological capital.
where $FA_t$ – value of active part of basic production assets (BPA) at the point of time $t$, $IA_t$ – IA value, connected with production and production management, at time $t$.

For convenience of subsequent calculations let's divide both parts of equation by $TC_t$:

$$1 = \frac{FA_t}{TC_t} + \frac{IA_t}{TC_t} \quad (3)$$

For the purpose of structure optimization it is important to monitor the TC value growth quality. In this paper TC value growth quality is estimated based on increase of IA contribution into TC value growth, but not on increase of BPA active part contribution. The growth of share of BPA active part and IA value within TC value can be expressed in the following ratios:

$$\Delta\frac{FA}{TC} = \frac{FA_{t+1}}{TC_{t+1}} - \frac{FA_t}{TC_t} \quad (4) ; \quad \Delta\frac{IA}{TC} = \frac{IA_{t+1}}{TC_{t+1}} - \frac{IA_t}{TC_t} \quad (5)$$

where $\Delta\frac{FA}{TC}$ - growth share due to BPA active part, $\Delta\frac{IA}{TC}$ - growth share due to IA.

Consequently a sufficient condition of TC efficient management is the compliance with the following provision – growth of IA contribution $(\Delta\frac{IA}{TC})$ in TC value growth shall exceed the growth of BPA active part contribution $(\Delta\frac{FA}{TC})$:

$$\Delta\frac{IA}{TC} > \Delta\frac{FA}{TC} \quad (6)$$

Thus to make enterprise innovative development efficient one shall observe the necessary and sufficient provisions, expressed by the following equation:

$$\begin{cases} \left(TC_{t+1} - TC_t \right) \rightarrow \text{max} \\ \Delta\frac{IA}{TC} > \Delta\frac{FA}{TC} \end{cases} \quad (7)$$

To outpace the growth of TC intangible component value the enterprise should perform efficient management of intangible assets, connected with production and production management (TC IA). In particular one shall define the objectives and tasks of TC IA management, on which basis the key management functions can be implemented.

The objective of TC IA management is the creation of stable competitive advantages based on establishment of continuously developing enterprise capable of generating new knowledge about production processes and production management and transferring them in technologies and products.

TC IA management process provides for solution of the following tasks: creation of TC IA new objects, inventory, systematization, evaluation, selection of legal protection regime and use of existing objects (figure 2).

The quality of TC IA management is determined by the efficiency of each task solution. Hereafter the content of each task within TC IA management process is considered in details.

**Figure 2** - Key tasks of TC intangible assets management (TC IA).

**“Inventory/detection”**. By solution of this task:

- one detects the identifiable results of intellectual activity (TC IA objects), to which the enterprise has of may obtain exclusive rights and which may be protected by means of different regimes of legal protection;
- one determines the degree of object readiness for use;
- one determines the possibility or impossibility to enter the detected and identified TC IA object in the books of balance as intangible asset according to current regulatory acts;
- one determines the practicability of creation or acquisition of TC IA objects, required for enterprise successful development. Solution of the task is governed by the enterprise development strategy, its economic, scientific and technological potential, market situation and other conditions.

**“Creation/acquisition”**. TC IA objects can be created both using enterprise’s own resources and by means of third-party organizations involvement. Acquisition by the enterprise of TC IA objects created by other organizations is carried out on the bases of alienation contracts or license agreements. For creation/acquisition of TC IA objects one can make good use of all forms and practices of “open innovations”.

**“Systematization”**. Detected and identified intellectual activity results, as well as purposefully created or acquired TC IA objects require systematization. The goal of systematization is the distribution of new knowledge among specified accounting records and integration in existing data bases.
“Evaluation”. By solution of the task:
- one determines the goal and subject of evaluation;
- one collects and analyses the initial information about TC IA object under evaluation;
- one selects an evaluation approach, justifies the selection of corresponding approach and determines specific evaluation method within the frameworks of selected approach;
- one performs calculations and consolidates the evaluation results.

“Protection”. By solution of the task:
- one confirms the legal validity of holding the right to identified TC IA object;
- one selects the legal protection regime based on analysis of economic feasibility of this or that regime application;
- one specifies TC IA objects and their distinctive features, subject to obligatory protection in commercial secret regime;
- one develops measures, implements procedures according to selected legal protection regime.

“Use”. When selecting the variant of specific TC IA object use four major directions are distinguished:
1. Exclusion of TC IA object from the list of enterprise intangible assets.
2. Use of TC IA object in enterprise economic activity (as the object protected by patent right, copyright, in commercial secret regime etc.).
3. Complete cession of all rights to TC IA object under the contract of alienation of exclusive rights to invention, useful model, industrial sample etc.
4. Transfer of rights to TC IA object on the basis of license agreements. At the same time there is the possibility of simultaneous implementation of the second and fourth strategy in case of use of nonexclusive licenses.

When selecting this or that variant of TC IA object use (the variants can also be realized with the help of open innovations model) one shall evaluate long-term economic consequences of the made decision. The evaluation is to be carried out on the basis of indices of economic efficiency of investments, appropriately discounted.

Solution of the above-mentioned tasks forms the basis of efficient management of intangible assets, connected with production and production management, being a part of enterprise technological capital, ensuring growth of its value and structure optimization on account of intangible component.

Considering wide-spread occurrence of TC IA objects in enterprises, it is necessary to classify them as control objects. To prepare the classification it is reasonable to apply the basic principles used to characterize intangible assets [5], [6]. In addition the above classification shall take into account the life cycle stage, at which TC IA object is used, and type of activity for which it is used, and also the type of strategy to provide competitiveness, affected by TC IA [4]. Thus using the experience of existing theoretical practice let’s present the suggested classification of intangible components of enterprise TC (figure 3).

![Figure 3 - Classification of intangible components of enterprise technological capital.](image_url)
Let us examine in detail some of the classification attributes with the examples of object distribution TC IA according to these attributes.

**Per possibility to enter in books of balance TC IA** objects may represent objects, entered on the balance sheet as intangible assets (e.g. invention, computer program etc.), or non-balance sheet items (processing, measurement procedures, operating instructions etc.).

**Per separability from enterprise** TC IA objects can be non-separable from the enterprise, e.g. systems and methods of production management, developed as a constituent part of the enterprise etc., and separable from the enterprise, e.g. inventions, computer programs, objects representing production secrets etc.

**Per separability from individual** TC IA objects can be non-separable from individual, e.g. personal professional qualities of individuals, including particular knowledge and experience etc. and separable from individual, e.g. technical libraries, processing, measurement methods etc.

The provided classification can ensure extensive use of the term “technological capital intangible components” with regard to objects, which until now are not clearly assigned to this or that category or classification.

### 5 CONCLUSION

The “technological capital” category suggested in this paper can be considered as a representative criterion of the enterprise innovative development. Furthermore, the described approaches to the management of technological capital intangible components make it possible to optimize its structure and increase its value.

In view of the fact that today the total value of new technologies developed around the world amounts to 60% of the total global social product, and the trade growth rate exceeds the sales growth rate for other products, identification of this asset in form of technological capital intangible component seems timely and holds potential. It is obvious that in such areas of activities as intellectual property commercialization and transfer there is a significant potential for enterprise development and competitive growth, so the technological capital concept will by all means be developing in future.

### 6 REFERENCES


### 7 BIOGRAPHY

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