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THE AUDIT OF TECHNOLOGY PARK STRUCTURES' INTELLECTUAL CAPITAL: SCIENTIFIC AND METHODOLOGICAL APPROACHES

The authors review the scientific and methodological approaches to conducting the intellectual audit which allows identifying different types of intellectual capital and their development level and impact on the effectiveness of organization. The research object is the technology park structures representing a complex multi-element economic entity for purposes of which the intellectual audit basis can be transformed as presented in this work.

Keywords: *technology park; intellectual capital; intellectual audit; human capital; intellectual property; reputation capital.*

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АУДИТ ІНТЕЛЕКТУАЛЬНОГО КАПІТАЛУ ТЕХНОПАРКОВИХ СТРУКТУР: НАУКОВО-МЕТОДИЧНІ ПІДХОДИ

У статті розглянуто науково-методичні підходи до проведення інтелектуального аудиту, який надає можливість ідентифікувати різні види наявного інтелектуального капіталу та рівень їх розвитку і впливу на результативність організації. Об'єктом дослідження є технопаркова структура, що представляє собою комплексний багатоелементний суб'єкт економіки, для цілей якої трансформовано і представлено основи інтелектуального аудиту.

Ключові слова: *технопаркова структура; інтелектуальний капітал; інтелектуальний аудит; людський капітал; інтелектуальна власність; репутаційний капітал.*
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АУДИТ ИНТЕЛЛЕКТУАЛЬНОГО КАПИТАЛА ТЕХНОПАРКОВЫХ СТРУКТУР: НАУЧНО-МЕТОДИЧЕСКИЕ ПОДХОДЫ *

В статье рассмотрены научно-методические подходы к проведению интеллектуального аудита, который позволяет идентифицировать различные виды наявного интеллектуального капитала и уровень их развития и влияния на результативность организации. Объектом исследования является технопарковая структура, представляющая собой комплексный многоэлементный субъект экономики, для целей которой трансформированы и представлены основы интеллектуального аудита.

Ключевые слова: *технопарковая структура; интеллектуальный капитал; интеллектуальный аудит; человеческий капитал; интеллектуальная собственность; репутационный капитал.*

Problem statement. Research on intellectual capital held by the authors faced a number of difficulties because of its virtual, non-financial and complex structuring. Research problems are associated with determining an exhaustive range of factors that have a significant impact on its value and dynamics and with their further formalization for the purposes of evaluation.

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Intellectual capital is self-expanding and continuously operates in three stages: investing; accumulation; usage.

For the purposes of effective management it is necessary to evaluate the accumulated intellectual capital, the effects from of its use and to identify the main areas of investment on the basis of calculations of performance indicators which are the ratio of the resulting effect and accumulated intellectual capital for each element of the company.

Evaluation of accumulated intellectual capital as the first stage of research is an intellectual auditing during which its specific types able to create added value are identified.

In contemporary scientific literature there is a growing number of research aimed at the audit of certain types of intellectual capital while the comprehensive researches on the subject are not sufficient. This determines the need for further study of this issue, in the framework of this article in particular.

In our previous studies (Maltseva, 2015) it is shown that intellectual capital of a technology park is an intangible resource that includes human capital, reputation capital, infrastructure capital, capital of intellectual property and is formed by main players and stakeholders in the process of purposeful activity providing additional income and increasing the value of technology park structure as a business.

Due to polystructural structure of a technology park as an economic entity the key feature of intellectual capital functioning is its integral nature, i.e. the sum of intellectual capitals of individual participants' mutual influence, and the interpenetration of which creates the so-called synergistic effect.

This requires the adaptation of standard instructional techniques of intellectual audit to the specifics of technology park structures functioning. Their management of intellectual capital provides significant effects on both micro- and meso-levels and as a result influences the development of innovative activity of territories as shown in (Maltseva, 2015).

Latest publications analysis. The issues of intellectual capital including its structural basis and classification are actively worked out in the papers of A. Maltseva (2015) using an extensive source base.

The basis for the study on intellectual capital auditing is formed by the works of the following Russian authors:

- A.N. Asaul et al. (2006) on the audit of corporate culture;
- G. Pilnov et al. (2006), T.N. Batova et al. (2014) on the audit of intellectual property;
- M.V. Gundarin (2006), L.V. Saakova and K.V. Gavrishin (2011), L.S. Salnikova (2013) on reputation capital audit;
- A.Y. Dolinin (2011), O.V. Kaygorodtseva (2011), L.M. Kalashnikova and L.M. Shelyagov (2006) on human capital audit.

Domestic research is mostly sector-specific and relies on methodological approaches used by foreign companies and researchers.

The analysis of national scientifics and practical publications showed almost complete absence of comprehensive work aimed at creating a complex methodological framework of intelligent audit of companies because of the relative novelty of the research subject for Russian science and practice.

The first most comprehensive approach to intellectual audit is the model proposed by A. Brooking (1996) (1C Audit) which includes the documentation and evaluation of intellectual assets on the basis of cost, market and income approaches. The offered research tools are survey, interviews, tests, analysis of competitiveness, analysis of contracts, sales analysis, identification and analysis of knowledge and skills, assessment standards etc.

In foreign studies the issues of intellectual audit are closely intertwined with its assessment which, of course, it is an important step, in this case the process of evaluation objects identification is also noted as very important.

Among the authors of the most known models of intellectual capital assessment are J. Tobin and W.C. Brainard (1977), E. Flamholtz (1985), R.S. Kaplan and D.P. Norton (1992), A. Broking (1996), N. Bontis (1996), L. Edvinson and M.S. Malon (1997) and others.

In several studies intellectual audit is clearly associates with the audit of intangible assets (Guthrie and Petty, 2000) which significantly narrows the research boundaries.

There is also an approach based on knowledge audit which is directly related to intellectual capital audit (Chan and Lee, 2011; Zhou and Fink, 2003). Most researchers note that knowledge management makes a significant contribution to the development of intellectual capital herewith in a greater degree refers to tactical management. It may be concluded that knowledge audit should become an essential element of intellectual audit.

On the whole, the issues of intellectual audit are widely covered in literature but still require proper systematization and indepth analysis because of the nature of the study object.

The goal of the research is the development of scientific and methodological grounds for intellectual capital audit in technology park structures that would enable the identification of available intellectual capital of various types for the purposes of its subsequent management.

Key research findings. The essence of intellectual audit as the process and a result of monitoring and control of intellectual capital of the company is disclosed in the papers of A. Brooking (1996). Its integration function can be considered the union of professionals of different profiles for the purposes of further coordination and refinement of strategic objectives and company's activities.

Transforming the definition for the purposes of this study as proposed by E. Flamholtz (1985), intellectual audit is a systematic assessment of strengths, limitations and needs for the development of existing intellectual resources in the context of organizations' activities.

In domestic literature, for example, A.N. Asaul et al. (2006) introduces the concept of reputation audit. It is defined as the internal analytical activity the main task of which is the assessment of conformity of the values declared by the company to the methods of their implementation and developing proposals on the adjustment of management actions.

All of the above reveals the following approaches to intellectual audit implementation:

- the direct method: identification of main types of intellectual capital of the organization and their measurement on a single scale;

- the knowledge method: searching and systematization of information on existing knowledge in the organization, chains of their creation, conversion into a final product;
- the value method: identification of core values of a company (tangible and intangible), chains of their creation and revealing the role of the main elements of intellectual capital at every stage;
- strategic method: detection of strengths, limitations and needs for the organization development and the role of main elements of intellectual capital to achieve tactical and strategic competitive advantages.

The approaches described above are not mutually exclusive and in some cases can be implemented in parallel thus providing additional benefits associated for various parties and "entry points" of specific types of intellectual capital during the audit. As pointed out by G. Pilnov et al. (2006) the audit is not just a collection of information but giving it a "value added" due to the analysis based on the market approach. However, most of researchers, for example W.B. Werther and K. Davis (1996), agree that intellectual capital audit has analytical rather than prescriptive nature.

I. Abeysekera (2001) mentions two main kinds of intellectual audit: the audit of core competencies and the audit of individual elements of intellectual capital. The first kind involves a preliminary identification of main species of intellectual capital, searching for their relevance for the purposes of company and then creation of the spectrum of competencies which are most important for each type.

Audit of individual elements of intellectual capital conducted by each of its species as a separate event and the importance of specific types of intellectual capital is detected during the verification process.

The advantages of the first approach are the comparative brevity of procedures and the concentration on the most important elements of intellectual capital thus saving resources. Herewith it does not exclude the possibility of an inaccurate allocation of objects due to limited information about qualitative features of intellectual capital at the stage of audit program creating.

Audit of individual elements of intellectual capital is conducted mainly with certain target areas for solving specific problems the organization is facing. In some cases, the performers of its specific parts are different groups of employees (experts). Thus ultimately makes difficult to identify the relationships between different types of intellectual capital which often has the fundamental importance and significant impact on company's performance.

Based on the 1C Audit model by A. Brooking (1996) we highlighted the following steps of intellectual audit:

1. Definition of objectives and tasks of intellectual audit, subjects and depth of research.
2. Designing the program of intellectual audit with the following components:
- purpose and tasks;
- research subject (types of intellectual capital);
- research object (structural divisions or the company as a whole);
- audit model (in accordance with the kinds and types provided above);
- research methods;
- methods of intellectual capital evaluation;

- lead time;
- performers.

3. Implementation of the program of intellectual audit and its documentation.

4. Designing the optimal parameters of various kinds of intellectual capital of the organization and their comparison with the results.

5. Creation of measures' list to develop intellectual capital.

The main aspects of the program of integrated intellectual audit in accordance with classification of intellectual capital have been proposed in (Maltseva, 2015) and are shown in Table 1.

Selecting the method for intellectual capital assessment can be based on standard approaches ensuring results unification (the cost method, the income method, the market method) or on various types of models which are needed to fit the specific types of intellectual capital (the model of Hubert Saint-Onge, ICM Model, "Skandia Navigator", the Balanced Scorecard, Celemi Monitor of Intangibles Assets, Sveybi Monitor of Intangible Assets etc.).

It is desirable to use the second approach in the case of complex intellectual audit (audit of core competencies) due to the fact that the proposed models have some restrictions on the research subject and in the approaches to measurement. For a comprehensive intellectual audit it is also advisable to use the Index of intellectual capital (1C Index) by J. and G. Roos (1997). It is the integral index which allows determining the effect of different strategic decisions of intellectual assets management on obtained and expected results, the method of goodwill calculation by T. Stewart (1994) based on the definition of net operating income attributable to intellectual assets.

Evaluating intellectual capital is difficult due to its immaterial essence and high diversity. The cost determined by profitable and market approaches is based on expert assessments and cost method in most cases does not allows objective evaluation of the importance of different types of intellectual capital for an organization.

Herewith it clearly indicates that the evaluation of specific types of intellectual capital should be done not in isolation but taking into account their mutual influence on each other which will result in significant adjustments in the results of assessed cost (values).

In the 1C audit model the stage of introducing optimal and critical parameters of intellectual assets is of great importance. The identified deviations indicates the existence of problems in certain areas which require the development of measures to solve them. The model proposed by A. Brooking (1996) highlights another approach that can be used as a basis for the evaluation of intellectual capital depending on the level of compliance with optimum parameters.

For the purposes of strategic and tactical management it is one of the most convenient methods, however, with no possibility of comparing the assessment results for individual elements of intellectual capital with each other and further usage of evaluation results in company's operations (sale of certain intangible assets, contracts for the implementation of unique work with partners etc.).

In general, the authors' analytical generalization of theoretical and methodological approaches to intellectual audit the certain aspects of which are presented in this article helped transform its results for the purposes of technology park structures'

Table 1. **Main aspects of intellectual audit by types of intellectual capital** (Maltseva, 2015)

Type of intellectual capital	Subjects of research	Objects of research	Methods of research
Human capital (HC)	Formal knowledge of employees. Creative abilities. Competences. Professional experience. Professional and personal reputation. Health	All structural divisions. HR department	The study of employees' personal files, interviewing employees, managers, focus group, sociometry, medical examination, social and psychological analysis, labor costs analysis, analysis of instructions and regulations
Reputation capital (RC)	Image. Brand. Customer base	PR department, marketing department	Consumer surveys, in-depth interviews with clients, sales analysis, market research, analysis of contracts, competitive analysis, analysis of payments
Infrastructure capital (IC)	Corporate culture. Business model. Organizational structure. Management system within organization	Top management, administration, PR department, all structural divisions	Interviews with tops, middle managers and specialists; questionnaires for focus groups; interviews with clients; analysis of document flows system, management systems, organizational model, corporate regulations, rules and other norms, analysis of internal and external communication
Capital of intellectual property (CIP)	Results of intellectual activity. Intangible assets	Research unit, accounting department	Study of patent information, surveys of consumers, surveys and interviews with developers, analysis of R&D quality, demand analysis, market analysis

intellectual audit methodology. They consider the integrated objects of innovative infrastructure of technology parks which provide innovative business with wide services and eventually promote outstripping innovative growth of regions.

The authors actively investigated specific aspects of intellectual capital of technology park structures in a number of papers, for example, A. Maltseva (2015).

Technology park structure as a study object is a complex organizational and economic system which for the purposes of the research on intellectual capital and intellectual audit can be structured by the levels:

- nanolevel: the level of individual employees;
- microlevel: the level of organizational structures with structure (Figure 1);
- mesolevel: the level of technology park structure as a whole.

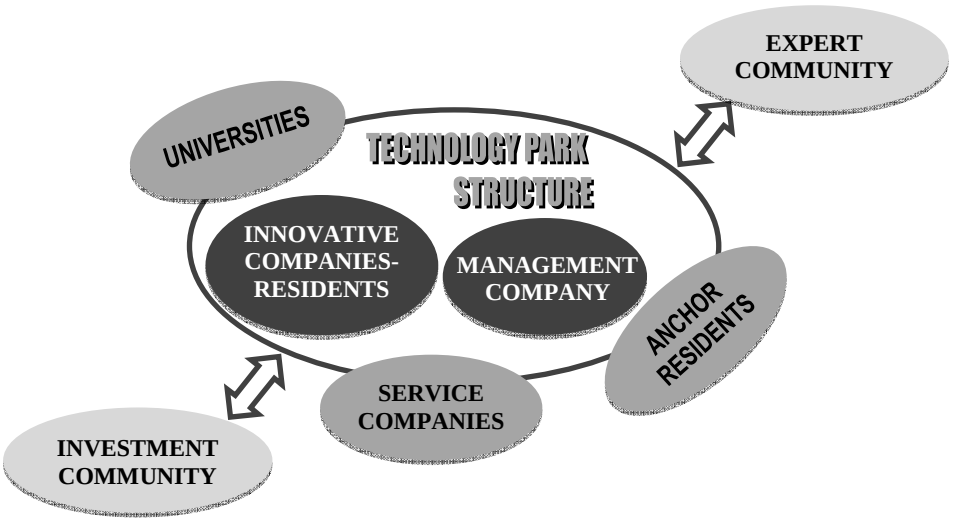

Figure 1. **Microlevel subjects as participants of technology park structure,** *authors'*

These microlevel subjects are fully or partially included into intellectual capital in its aggregate value of the whole technology park.

Audit of intellectual capital can be made for each structure individually thus the mutual influence of its homogeneous elements belonging to different structures is not taken into account.

It seems appropriate for the purposes of the subsequent management of intellectual capital to conduct a comprehensive intellectual audit in accordance with the algorithm presented above.

A special feature of intellectual audit will be a clear separation of audit items within each object (structure). The authors have investigated (Maltseva, 2015) the degree of integration of elements of intellectual capital of stakeholders into the aggregate intellectual capital of a technology park. The obtained results can be used to select the subject for intellectual capital audit.

In accordance with the typology written above the direct intellectual audit will include the identification and assessment of main types of intellectual capital included in the technology park structure on the mesolevel.

The authors compiled a hierarchical structural and factorial model of intellectual capital of a technology park (know-how # 01-075-201 registered in the Depository of transfer technologies of Tver State University) which contains a list of structured factors and indicators of intellectual capital that has a significant impact on the activity results of a structure as a whole and its individual stakeholders. Conducting the study of intellectual capital of a technology park structure based on the selected model will be a direct intellectual audit which ceteris paribus can be very costly and long in its procedures but it would provide management by most complete information though.

The following classification of knowledge that should be identified during the research is proposed as the basis of knowledge approach to implementing intellectual audit of a technology park:

- "know what": knowledge as a set of facts which is closest to the concept of "information";
- "know why": scientific knowledge as the basis for technological developments, products and processes determining of the branches functioning;
- "know how": knowledge as a set of skills and competences in a particular area;
- "know who": information on knowledge carriers for the types listed above.

During the intellectual audit of a technology park it is appropriate to allocate the research subjects on the basis of the data from Table 2.

Table 2. **Knowledge structure of a technology park,** *authors'*

Stakeholders of technology park structure	Types of knowledge			
	know what	know why	know how	know who
Management company. Innovative companies-residents. Anchor residents	Capital of professional experience. Capital of intellectual property	Knowledge capital Creative capital. Capital of professional experience	Capital of competences. Capital of professional experience. Capital of intellectual property	Capital of professional and personal reputation
Service companies	Capital of professional experience	Creative capital. Capital of professional experience	Capital of competences. Capital of professional experience	Capital of professional and personal reputation
Universities. Expert community. Investment community	Capital of professional experience	Knowledge capital. Creative capital. Capital of professional experience	Capital of competences. Capital of professional experience	Capital of professional and personal reputation

Specific types of knowledge are identified during the research of each stakeholder. It is important to examine precisely the cumulative knowledge of the whole technology park structure. In the process of intellectual audit reputational capital and infrastructure capital which has indirect effect on the cumulative knowledge of technology park are excluded from consideration. In fact, during the assessment direct

and indirect impact on the elements of reputational capital and infrastructure capital should be identified.

Audit of a technology park structure as an intellectual organization using the knowledge approach can be considered quite appropriate due to the fact that knowledge identified during the research can be the basis for the creation of new structures or transfer of the existing resident companies to a new level. Difficulties of this approach use are caused by the lack of unified tools and measuring instruments for different kinds of knowledge and this problem is eliminated when the value approach is applied.

The basis for the value approach is the chain of value creation in a technology park (Figure 2). The authors identified the main types of intellectual capital at each stage for the purposes of intellectual capital audit (Table. 3).

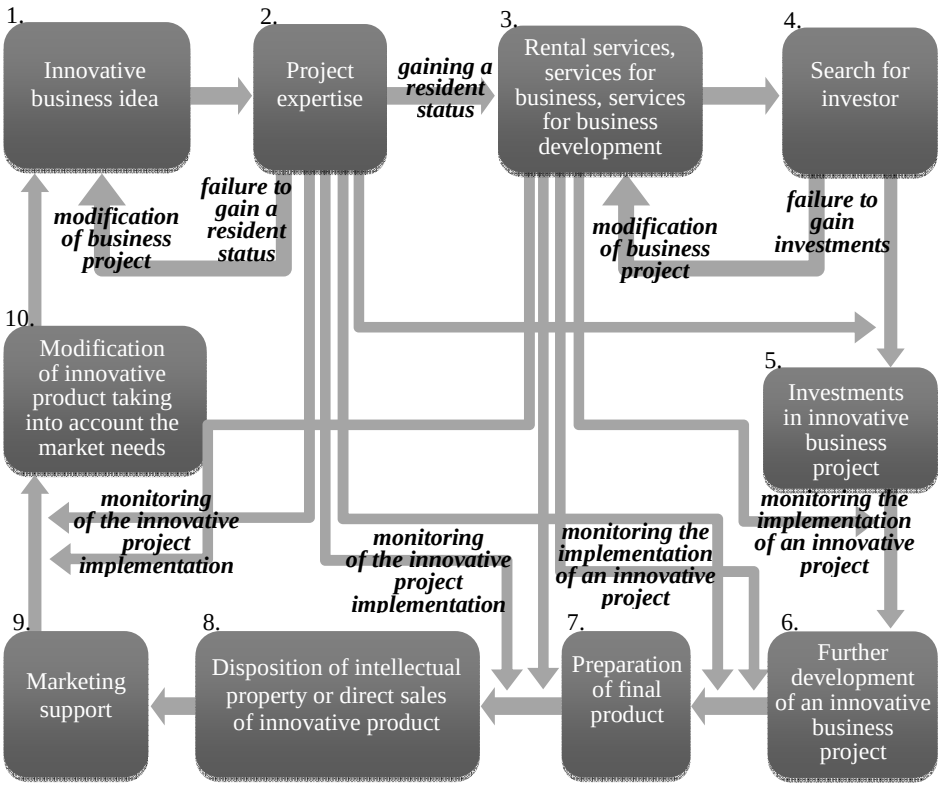

Figure 2. **The chain of value creation in a technology park,** *authors'*

Specification presented above allows concentrating the intellectual audit of technology park structure on the most important types of intellectual capital from the standpoint of creating value at different stages of the innovative process.

Using the value approach it is advisable to apply the evaluation of various types of intellectual capital from the point of their impact on value creation in future innovative product cost therefore it is proposed to use the income or the market approaches. At the same time due to complexity of prospects evaluation in some cases the cost approach can be used with expert adjustments depending on the result.

Table 3. **The role of main types of intellectual capital in value creation of in a technology park,** *authors'*

Stages of value creation	Managing company	Innovative companies. Anchor residents	Service companies	Universities	Expert community	Investment community
1. Innovative business idea		HC IC CIP		HC IC CIP		
2. Project expertise	HC RC IC				HC RC	
3. Services of technology park	HC RC IC CIP		HC RC IC			
4. Search for investors	HC RC	HC RC				
5. Investing in innovative project		HC RC				HC RC
6. Further development of an innovative project	HC RC IC	HC RC IC CIP	HC RC			
7. Preparation of a final product	HC RC IC	HC RC IC	HC RC			
8. Implementation of intellectual property or direct sales	HC RC	HC RC IC				
9. Marketing support	HC RC		HC RC			
10. Modification of an innovative product	HC RC	HC RC IC CIP	HC RC			

From the positions of each product (company) the value of each stage in the chain can be estimated and this will allow taking into account the proposed share for more accurate estimation of specific types of intellectual capital.

The basis for the strategic approach may be the system of business planning of technology park structure described by the authors (Figure 3).

Strategic planning in technology park is mainly focused on the activity of a managing company which defines the priority of all kinds of its intellectual capital during the process of intellectual audit thus other elements belonging to other stakeholders of a technology park should be also assessed separately (Table 4).

During the intellectual audit using the strategic approach particular types of intellectual capital are identified in accordance with strategic objectives and the indicators of technology park structure reveal their direct impact on the intended result as according to the income approach.

Figure 3. **Levels of strategic planning** (Maltseva, 2011)

Table 4. **The role of main types of intellectual capital in the elements of a strategy of a technology park,** *authors'*

Elements of the strategy	Managing company	Innovative companies. Anchor residents	Service companies	Universities	Expert community	Investment community
Resident strategy	HC RC IC	HC RC CIP		HC IC CIP	HC RC	
Development of business services	HC RC IC		HC RC CIP			
Investment strategy	HC RC IC	HC RC				HC RC
The strategy of cost management. Management strategy for finance	HC RC IC CIP		HC RC IC			

In general, the basis for intellectual audit of a technology park can be specified for a particular case and used both in conjunction and separately, depending on challenges. Direct intellectual audit can provide researchers with necessary information for its presentation in the framework of other approaches.

Conclusions. On the basis of theoretical analysis and generalization the authors showed the role of intellectual audit, its content, stages, highlighting different

approaches to the implementation of an audit program which allows changing its aspects depending on the problems faced by researchers.

The article describes the basics of intellectual audit in a technology park which is essentially the integrated elements of innovative infrastructure, including a variety of stakeholder groups each having its own intellectual capital contributing to the total value.

It is proposed to use different approaches to the intellectual audit of technology park structures (direct approach, knowledge approach, value approach, strategic approach) which are not mutually exclusive.

The aspects of implementation of these approaches demonstrates the main items and objects of research, "the points of application" for managerial actions after the audit results. Identification of available intellectual capital of a technology park is the foundation for its further development taking into account the synergies arising within the interaction of individual stakeholders.

It should be noted that intellectual audit is an integral part of the management system of intellectual capital in a technology park which according to the authors is the most effective tool to improve efficiency, effectiveness and competitiveness at the microlevel.

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