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**SYSTEMIC MANAGEMENT OF NATIONAL INTELLECTUAL
CAPITAL: ANALYSIS OF FOREIGN EXPERIENCE**

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Abstract

This study is dedicated to the investigation of issues of management impact on national intellectual capital and its structural elements with the aim to ensure sustainable economic growth. The purpose of this paper was to identify a group of countries, for which systemic impact on national intellectual capital provides efficient development of the national economy, by establishing a relationship between elements of intellectual capital and such indicator of development of national economy as gross domestic product. The study used the methods of correlation and cluster analysis, and the systemic approach and the approach of Edvinsson and Lin to the structuring and estimation of national intellectual capital, according to which the latter comprises such elements as human, market, process and renewal capitals. The correlation analysis revealed a high positive relationship between the existing national intellectual capital and the level of economic development for the developed countries, but not for the developing ones. It is concluded that the observed trend for developed countries can be explained by the emergence property inherent to intellectual capital, due to which these countries provide combined management impact on all its structural elements, which produces a synergistic effect and stimulates the processes of development of the national economy. By using hierarchical cluster analysis, a group of developed countries is identified (Denmark, Norway, USA, Finland, Switzerland, Sweden) that have achieved leading positions in terms of GDP due to systemic management of national intellectual capital, primarily affecting its process and human components.

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Keywords: National intellectual capital, economic development, emergence, correlation analysis, cluster analysis.



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1. Introduction

In modern conditions, when development of the global community is characterized by many conflicting trends, among which of note are globalisation and digitalisation, issues of development and efficient management of intellectual capital (IC) are widely discussed within the scientific community. This, in particular, is evidenced by the increase in the annual number of publications on this topic over the past 7 years. As such, according to the statistic of econometric scientific databases SCOPUS and Web of Science, for the period from 2011 to 2018, the average annual number of publications more or less addressing the subject of IC was about 425.

Also worth noting that studies of the role of IC in economic development of countries have intensified in the late XX – early XXI centuries. To date, they have acquired a fairly vast geography and include, besides academic research, initiatives of international organizations (World Bank, OECD, UN, etc.), national governments (Germany, Israel, Sweden, Denmark, etc.) and associations (e.g. the Lisbon Strategy of the European Union).

At the same time, insufficient investigation on the problem of systemic management of intellectual capital on the national level, corresponding to the conflict between its multi-component and multi-subject nature and the need to ensure balanced development of the entire set of its structural elements, makes the relevance of this study evident.

2. Problem Statement

In recent decades, national intellectual capital serves as the most significant parameter of economic development of most developed countries (Skrodzka, 2018; Stähle, Stähle, & Lin, 2015), being the main element of generation of added value. It is the primary reason why these countries direct an increasing part of the investment flows to education, science, and social security and protection for their population. Furthermore, the role of IC in this process only increases over time. For example, if in 1980s intangible assets accounted for 37% of the market capitalization of companies, in the beginning of 2000s their share increased to 84% (Lin & Edvinsson, 2011). A similar situation is observed at the macro-economic level: as of 2015, the contribution of intellectual capital to the gross domestic product (hereinafter – GDP) of developed countries ranged from 52% to 72% (Stähle, Stähle, & Lin, 2015).

At the same time, according to a number of studies, the contribution of national intellectual capital in the GDP of developing countries is extremely low. For example, in Russia its share is only 36% (Makarov, 2016). Furthermore, IC of this group of countries is generally characterized by a low level of development of most components.

Based on the foregoing, the study of the issues of management of intellectual capital at the macroeconomic level seems relevant, particularly in order to test the hypothesis that, in order to stimulate the processes of economic growth of the national economy, management of intellectual capital must be systemic due to the latter having a property of being emergent.

3. Research Questions

To date, the concept of "intellectual capital" has firmly entered the categorical apparatus of management and economic branches of science. Following the approaches of L. Edvinsson, U. Daum, and other experts (Bounfour, 2018; Guthrie & Dumay, 2015; Pedro, Leitão, & Alves, 2018a; Pedro, Leitão, & Alves, 2018b) to defining the essential content of this category, the national IC can be defined as a set of intangible resources (knowledge, abilities, processes, organizational structures, databases, relationships, etc.), which are current or potential sources of prosperity of the nation and can be used in the activities of economic entities at different levels of the national economy (country, regions, organizations, collectives). Thus, the intangibility of resources, generalized by the category of "national intellectual capital", reveals the limitations of the possibility to influence them.

At the same time, there is a number of publications dedicated to the issues of estimation of national intellectual capital (Charmes, Gault, & Wunsch-Vincent, 2018; Fazlagić & Szczepankiewicz, 2018). Particularly, among the methodologies recognized at the international level, there are such models as "National Intellectual Capital Index (NICI)" model, developed by Bontis (2004), Weziak (2007), Lin and Edvinsson (2011), and "The Intellectual Capital Monitor" model, created by Andriessen and Stam (2009).

Without giving a detailed comparison of these methods in view of limitations in the volume of the article, we will note that "National Intellectual Capital Index (NICI)" model as interpreted by Lin and Edvinsson (2011) seems to be the most preferable for the following reasons:

- estimation of intellectual capital within the methodology of Edvinsson and Lin is performed by calculating four indices: Human Capital (HC), Process Capital (PC), Market Capital (MC), Renewal Capital (RC). In addition to the listed structural elements, NICI includes the composite index of national intellectual capital (IC), formed by adding these components, and the index of Financial Capital (FC), which is an estimate of GDP per capita (by purchasing power parity). Each of the indices can take values from 0 (minimum) to 10 (maximum).
- studies utilizing this model are widely represented in international publications and, despite some criticism, NICI is recognized as a reliable methodology for estimating national intellectual capital;
- this model serves as a basis for the most extensive database including panel data for 40 countries over more than 12 years.

The specified methodology, as well as the information base created by its developers, were used in searching for the answer to the research question of this paper, which is on whether there is a difference between the level of economic development of countries systematically utilizing national intellectual capital and the level of development of countries lacking the integrated approach to management of the latter. Based on the stated question, the following research hypothesis was formulated: in order to stimulate the processes of economic development of the national economy, management of intellectual capital should be systemic due to the latter having a quality of being emergent.

Note that the limitation of the selected methodology is related to the relevance of the time period: data for 1995-2007 and fragmentary data for 2008-2010 are available for research, while a number of indicators used in the calculation are based on expert estimates, which prevents the independent production

of comparable data. However, the above limitation, in our opinion, is of technical nature and does not impede the achievement of the objectives of this study, since testing the hypothesis requires only the total length of the time period and the sample size.

4. Purpose of the Study

Considering the research question formulated above, the purposes of the study are identified as follows:

1. To establish the presence/absence of a relationship between the elements of intellectual capital and such indicator of the development of the national economy as gross domestic product.
2. To identify a group of countries that have experience in systemic management of the national IC, including with the aim to assess the possibility of adaptation and further utilization of this management practice in Russia.

5. Research Methods

The method of correlation analysis was applied to establish the relationship between both IC as a whole and its components with GDP. Since the initial variables cannot be categorized as normally distributed (a necessary condition for using Pearson's correlation coefficient), and do not represent any of the types of monotonous sequence (a necessary condition for using Kendall's tau correlation coefficient), the analysis was performed by calculating Spearman's ρ coefficient.

Hierarchical cluster analysis was used to solve the problem of identifying a group of countries that have experience in systemic management of the national IC. Clustering was performed both by IC as a whole and by its individual structural components. In all cases, three clusters were formed: countries with high, medium and low indicators of national intellectual capital or its structural elements and GDP.

6. Findings

As a result of the performed correlation analysis for the study period, a strong relationship was established between both the general indicator of IC and its structural elements with GDP for a group of developed countries, and weak relationship for the developing ones (Fig. 01). The level of significance of the obtained results for developed countries is within a range from 0.000 to 0.003. This fact indicates that the identified trends are not random and can be used for further analysis. In turn, the significance of the calculated correlation coefficients for developing countries in all cases was higher than 0.05, which rejects the hypothesis on the truth and significance of the obtained estimates.

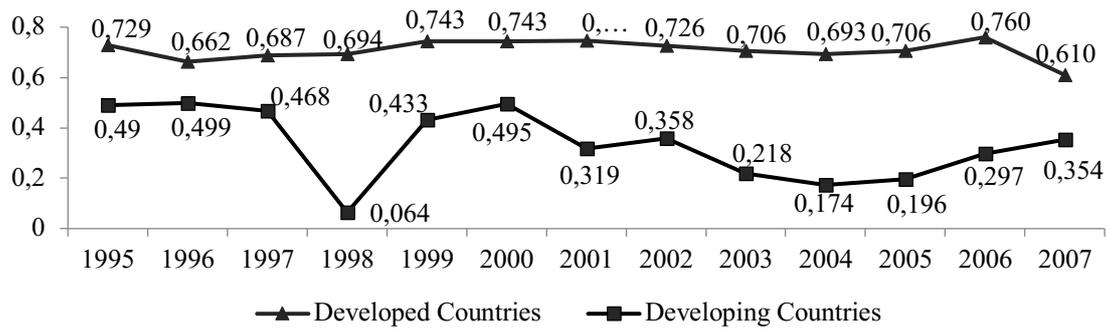


Figure 01. Dynamics of Intellectual Capital and GDP Correlation Coefficients for Developed and Developing Countries Source: authors based on the results of correlation analysis

Next, in order to deepen the findings, we further clustered the group of developed countries both by IC as a whole and by its individual structural components. As a result, in all cases, three clusters were formed: countries with high, medium and low indicators of national intellectual capital or its structural elements and GDP.

In order to identify specific countries that have experience that potentially can be further applied, particularly in Russia, to provide a systemic approach to managing the development of national IC, a group of countries was identified using hierarchical cluster analysis that achieved the highest results in utilizing both IC as a whole (IC-FC clustering performed) and its individual elements. The results of the analysis are presented in Table 01.

Table 01. Leading Countries from the Group of Developed Countries by Criteria of IC and Economy Development

Country	1995			2007		
	Leadership in IC	Leadership in PC	Leadership in HC	Leadership in IC	Leadership in PC	Leadership in HC
Denmark	✓	✓	✓	✓	✓	✓
Norway	✓	✓	✓	✓	✓	✓
USA	✓	✓	✓	✓	✓	✓
Finland	✓	—	✓	✓	✓	—
Switzerland	✓	✓	—	✓	✓	✓
Sweden	✓	—	✓	✓	✓	✓
Singapore	—	✓	—	✓	✓	✓
Iceland	—	—	—	✓	✓	✓

Source: authors based on the results of cluster analysis

Despite the fact that the conducted correlation analysis did not reveal any significant relationship between the level of development of IC and GDP for developing countries, the obtained results of clustering are of some interest both from the perspective of a general assessment of the progress achieved by them within the area of development of national intellectual capital, and for identifying specific features of different countries, including the Russian Federation.

When grouping countries according to FC-IC parameters, the cluster of leading countries included such countries as Chile, Malaysia and Hungary. Russia ended up in the second cluster, occupying middle positions within this group. Clustering by FC-HC criteria for the period from 1995 to 2002 showed that Hungary was decisive and sole member of the group with the highest indicators. Since 2002, Poland and Malaysia joined this cluster. In some periods (1995, 1997, 2003-2005, 2007), Russia gets close to the group of leaders, but does not join them. Clustering by FC-MC and FC-PC indicators produced the following results. Sustainable leaders: Malaysia, Chile, Hungary. Sustainable outsiders: India, China and Philippines. When clustering by FC-RC criteria for the whole study period, Russia is the consistent and nearly the sole leader of the group with the highest indicators.

7. Conclusion

In general, results of the study led to the following conclusions:

1. The fact that for a group of developed countries the average values of IC and FC correlation coefficients were higher than equivalent valued by individual components of IC, in our opinion, demonstrates a combined impact of the structural elements of intellectual capital, exerting synergistic effect on the level of development of the national economy. It seems that the above circumstance should be explained by the fact that, being a complex system, IC has a property of emergence, which is why management of production and reproduction of national intellectual capital at the state level should be systemic. Thus, the study hypothesis was confirmed.

2. The average values of correlation coefficients for the group of developed countries show that from a number of structural elements comprising IC, the Process (PC) and Human (HC) capitals have the strongest relationship with GDP (correlation coefficients of 0.679 and 0.673 respectively).

3. The component composition of the Process Capital within the approach of Edvinsson and Lin, in our opinion, allows it to be interpreted as an institutional environment focused on creating institutions that overcome spatial, functional, informational divergence of entities and subjects of management through the introduction of integrating processes, aimed at the defragmentation of economic environment by increasing the coherence of objects, goals, knowledge and actions (Matos, Vairinhos, Dameri, & Durst, 2017; North, 1990). Therefore, the conditions ("rules of the game") set and, which is fundamental, actively supported (!) by the state structures are crucial for the economic implementation of IC potential in developed countries.

4. There were countries identified based on the results of hierarchical cluster analysis, the experience of which confirms the hypothesis on achieving leading positions by preferential development of all elements of IC. The number of countries with the experience in systemic management of national IC include: Denmark, Norway, USA. The positive experiences of Finland, Switzerland, Sweden, and Singapore are also recommended for research.

5. The revealed trends of high importance of human capital confirm the conclusions made earlier by other researchers that, under conditions of development of informatisation and digitalisation of the innovative economy, investment in education, advanced training, etc., are one of the most important factors of the economic development of the country. At the same time, the conducted study expanded the already existing results as it pertains to determining the additional emergent effect from systemic approach to managing the national IC.

6. The question of the possibility of adapting the experience of above countries to utilize it in the practice of managing the national intellectual capital of the Russian Federation should be highlighted as a promising area for the continuation of this study.

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