Comparative analysis of results of using assessment methods for intellectual capital

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Abstract. The importance of intellectualizing modern society means a more complete study of the role intellectual capital has in the development of industrial relations is required. This is due to the fact that increasing the intellectual component is integral to building an innovation economy. A fair assessment of intellectual capital should be given. This will allow its level in a specific organization to be identified and the amount of intellectual capital to be compared with other business entities. This paper gives a comparative analysis of the use of methods for assessing the intellectual capital of a business, namely: the cost approach method, the market capitalization method, and the intellectual value added method. When examining the intellectual capital, its various components, i.e., its relational, human, and organizational capital, were used. The synergy of these components helps maximize the positive effect. The methods listed above have a practical application and were tested on a business. Using these methods made it possible to determine the quantitative and qualitative value of the intellectual capital. Thus, it was possible to not only judge the availability of intellectual resources at the current time period, but also to study the dynamics of intellectual changes, as well as build a comparative characteristic both at a microlevel with other businesses and comparing it at the meso level with the whole industry. Such practice will make it possible to come up with recommendations on how to use intellectual capital, determine its sufficiency, taking into account the industry average parameters of intellectualization. Despite the growing significance of intellectual capital and the grand scale of this problem, there are big gaps in terms of its evaluation. The guidelines looked at in this paper allow the amount of a company’s intellectual capital to be assessed, thus giving the opportunity to come to objective conclusions about the level of intellectualization while taking into consideration the specifics of the business activities. It also reveals the main factors influencing intellectualization and allows suggestions to be made on how to use the intangible resources available in the most rational way.

1. Introduction
Information society determines the vector of economic growth with the help of scientific and technological progress. Today, it is intellectual capital that is becoming one of the main factors responsible for the innovative development of national economies [1; 2]. The main role in the intellectualization of economics is played by people who possess specific skills, abilities, and a wealth of information [3; 4]. In the most developed countries, material production has begun to give way to the service industry. This leads to a growing need for highly qualified personnel [5].

Problems relating to intellectual capital are examined over a long period. However, a final decision regarding its fair assessment and regulation has yet to be made. Regulating intellectual capital is
necessary both for the government as well as for the businesses themselves in order to ensure it is used to the maximum efficiency [6; 7].

A company’s intellectual capital is evaluated in the interests of a large number of users, e.g., on behalf of the business itself to increase returns on intellectual resources and to solve strategic problems, or in the interests of investors for making decisions about investing capital in a company with a certain level of intellectualization [8; 9; 10].

One of the founders of the concept of intellectual capital, Thomas Stewart, expressed the following opinion: “Intellectual capital is an intellectual material which includes knowledge, experience, information, intellectual property and which is involved in value creation. It is collective mental energy. It is difficult to discover and even harder to control. If you discover it though, and make it serve you, then you are the winner” [3].

Many modern organizations might not have any material components and are often simply made up of the intellectual capital, which is only partially owned by them [11]. Intellectual capital and intellectual property should not be equated. The relation between the concepts “intellectual capital”, “intellectual property”, and “intangible assets” is illustrated in Figure 1 [12]. The great significance of intellectual capital for an organization is likewise connected to the possibility of its repeated use [13; 14].

![Figure 1. Relation between intellectual capital, intangible assets, and intellectual property.](image)

When examining intellectual capital, it is necessary to analyze its three components: physical, human, and structural capital [3; 15]. Problems which occur during the estimation of the separate components of intellectual capital have to do with the inability to assign a specific intangible asset to specific capital [16]. It is also not possible to estimate the impact of a specific component on the intellectual capital as a whole since the competitive advantages necessary for businesses are only created by the complex of components [17; 15].

The economic relations prevalent under conditions of scientific and technological progress call attention to intellectual capital as a special factor of production which is concentrated in the high-tech sector of material production, in the area of education and science, and, contrary to popular belief, in industries of the information sector, which is usually associated with communications and information exchange [18]. The relevance of this research is confirmed by the fact that, despite the high significance of intellectual capital, there are problems with its evaluation. It is practically impossible to quantitatively measure the intellectual capital of a single organization, whose objective value can include such dynamic factors as the experience, skills, and specialties of the employees [4].

A number of methods exist for assessing intellectual capital. They include: the amount spent on personnel; the amount spent on intellectual property; reevaluating additional profits, and so on. However, many of these are recognized as ineffective and testing them in companies is not possible or economical [3; 15].

Accordingly, the main goal of this research is to conduct a comparative analysis of the methods which have a practical application and more fully reflect the quantitative and qualitative value of a company’s intellectual capital.

In order to achieve this goal, more efficient methods need to be selected, an algorithm for using these methods needs to be examined, the advantages and disadvantages need to be identified, testing needs to take place in specific companies, and the appropriate conclusions should be made.
A practical look at the comparative characteristic of using various methods for evaluating intellectual capital is given in point 3 (Results and Discussion).

2. Methods
This research was conducted by analyzing a significant amount of scientific literature. In addition to basic research, articles by current authors in the field of intellectualization were used to form this study. These articles were used as a basis for selecting specific assessment methods for comparative analysis.

The importance of human capital and investments in intellectual resources was already being discussed in the 1970’s. These ideas in particular were examined by T.W. Schultz [19; 20] in his works “Investment in Human Capital: the Role of Education and of Research” and “Investing in People: The Economics of Population Quality”. Schultz’s research revealed the need for using investments in human capital and education in order to create an economic effect. Research in the field of intellectual capital was developed in T.A. Stewart’s [3] works, the most explanatory of which is “Intellectual Capital. The New Wealth of Organizations”. Stewart studied in detail questions on intellectual capital and stressed the need for its evaluation. The most recent work reflecting the interrelation between intellectual capital and innovation development is K. Schwab’s work [1] “The Fourth Industrial Revolution”. In particular, this work presents ideas of correlating the cost approach to the area of intellectual capital.

The works of Zarelli P., Selig P., Giugliani E. [21] speak in favor of the cost approach. They look at the system of assessing the dynamic possibilities from the side of intellectual capital. Also in favor are works based on analysis of the profitability of the innovation component in industrial resources examined by Zaytsev A., Kichigin O., Kozlov M. [22].

Intellectual capital is becoming an integral part of business relations for any country. Nevertheless, there are difficulties regarding the legal status of intellectual capital, for example, the problems of legal regulation. These problems are examined in the works of A. Atabekov and O. Yastrebov [23]. The lack of strict standards in the area of assessing intellectual capital leads to the creation of new methods. This makes comparing the results more complicated.

When making an evaluation, it should be separately noted that the current growth conditions of the social focus of businesses makes it necessary to consider the presence of corporate social responsibility in the company, which may have a significant impact on the effectiveness of using intellectual capital. This was looked at in the works of Gangi F., Salerno D., Meles A., and Daniele L. [24].

How company management impacts the development of intellectual capital was looked at by Novas J.C., Alves M., Sousa A. [11], Secundo G., Massaro M., Dumav J.C., Bagnoli C. [12]. The correlation between intellectual capital and investments can be studied using material by Massaro M., Dumav J.C., Bagnoli C. [10], Avduevskaja E.A., Kuporov Y.Y., Chepikova E.M., Bogacheva T.V. [25; 26], Zhilenkova E., Budanova M., Bulkov N., Rodionov D. [14].

Dal Mas F. [2], Abdullah D.F., Sofian S. [6], Scafarto V., Ricci F., Scafarto F. [16], Alauddin K. [13] examined how intellectual capital and the growth stability of an organization are interrelated as well as the effectiveness of introducing intellectual processes into the corporate environment. This research makes it possible to judge the possibility of using an analysis of market capitalization as one of the methods for assessing the intellectual capital of an organization.

The personal intellectual potential of an individual in an information society was studied by Shipunova O.D., Berezovskaya I.P., Mureiko L.M., Evseev V.V., Evseeva L.I. [27], Vetrenko P.P., Chernysheva E.A., Levitina I.Y., Voronkova O.V. Mikhieva D.G. [5]. The impact intellectual capital has on the innovation processes of society was laid out in detail in the works of Zhang M., Qi Y., Guo H. [7], Wang C.H., Yen C.D., Liu G.H. [4], Ornek A.S., Ayas S. [28]. In their works, Onofrei G., Prester J., Fynes B., Humphreys P., Wiengarten F. [8] showed the most recent practices for using intellectual capital in industrial processes. A practical overview of the VAIC model was presented in the works of Molodchik M., Bykova A. [29], Salehi M., Enayati G., Javadi P. [18], Chan K.H. [30],
Paknezhad M., Ahmadkhani A. [31], Stahle P., Stahle S., Aho S. [32], Kehelwalatenna S., Premaratne G. [9]. The works listed above make it possible to speak about the intellectual value added method as a viable method with a practical application. Thereby, this approach is best used for reflecting the economic potential of a company. This was examined by Tkachenko E., Rogova E., Bodrunov S., Dmitriev N. [15]. The work by Malevksaia-Malevich E.D., Leonov S.A., and Zabrorovskii D. [17] can be used to assess the effectiveness of the research.

Thus, in order to make a comparative analysis, the following methods are suggested to be used:
1. Cost approach;
2. Market capitalization method;
3. Intellectual value added method.

To start, it is suggested to look at the theoretical component of the methodology for assessing the intellectual capital of an organization. The first method called “cost approach” was developed by James Tobin [1; 3; 21]. This method is the easiest to use. In order to implement it, the market value of the organization, along with its replacement value, must be known. The formula looks as follows:

\[
Tobin's \ Q = \frac{MVA}{RVA} \ (1)
\]

Tobin’s Q is the Tobin coefficient;
MVA is the Market Value of Assets of an organization;
RVA is the Replacement Value of Assets of an organization;
If Tobin’s Q > 1, then the organization has a high proportion of intellectual capital;
If Tobin’s Q < 1, then the level of intellectual capital is low.

This method is very conditional in nature since it does not take into account a number of factors, for example, intellectual capital risk [33]. Nevertheless, it is used to obtain a quick evaluation and, if necessary, to compare businesses involved in the same field of activity.

The second method for calculating intellectual capital is based on market capitalization and is calculated using the following formula:

\[
Intelectual \ C = MVA - BSV \ (2)
\]

Intellectual C is the Intellectual capital;
MVA is the Market Value of Assets;
BSV is the Book Value.

Depending on the activity specifics, this parameter can be either negative or positive and serves to determine the level of intellectual capital of an organization in monetary terms.

The third method is the most complex and at the same time the most difficult. This is Ante Pulic’s Value Added Intellectual Coefficient (VAIC).

The value added intellectual coefficient allows organizations to assess the contribution to the value added of fixed assets on the one hand, and intangible assets on the other. The better a company uses its potential, the higher their VAIC is [30; 32]. This model has been illustrated in Figure 2.

As can be seen in Figure 2, the model is based on the efficiency of using three types of resources:
1. SCE — Structural Capital Efficiency;
2. HCE — Human Capital Efficiency;
3. CEE — Capital Employed Efficiency.

Accordingly, the formula appears as a sum of these resources:

\[
VAIC = SCE + HCE + CEE \ (3)
\]

The intellectual capital can be assessed more conveniently by using the following sequence:
1. Calculation for the value added of a company.

\[
VA = Output - Input \ (4)
\]

VA is the Value added;
Output is the Total revenue;
Input is the Funds spent.
Figure 2. Calculation model for VAIC.

A more detailed version of the calculation looks as follows:

\[ VA = R + DD + T + EC + D + A \] (5)

R is the Retained earnings;
DD is the Dividends;
T is the Taxes;
EC is the Employee costs;
D + A are the Depreciation and Amortization.

2. Calculation for human capital efficiency.

\[ HCE = \frac{VA}{HC} \] (6)

HCE – Human capital efficiency;
HC – Human capital.

In a simplified version, human capital can be presented as labor costs.

3. Calculation for structural capital efficiency.

To start, the structural capital value must be determined.

\[ SC = VA - HC \] (7)

SC – Structural (organizational) capital;

It is worth noting that human and structural (organizational) capital have an inverse relation to each other. In other words, SC and HC are inversely proportional. Next, the structural capital efficiency needs to be calculated:

\[ SCE = \frac{SC}{VA} \] (8)

SCE – Structural capital efficiency.

4. Calculation for intellectual capital efficiency.

\[ ICE = HCE + SCE \] (9)

ICE – Intellectual capital efficiency.

5. Calculation for capital employed efficiency.

\[ CEE = \frac{VA}{CE} \] (10)

CEE – Capital employed efficiency;
CE – Capital employed.

6. Calculation for the final parameter (Value Added Intellectual Coefficient).

\[ VAIC = ICE + CEE \] (11)
The advantages of this method include the simplicity of the calculations and the availability of the financial statements of a number of companies. Furthermore, this method helps determine the component effect of intellectual capital on the results of a company’s activities. The main drawback of the model examined is its disregard of time factors, which can lower the value of the intellectual capital.

Table 1 lists the main advantages and disadvantages of the methods used.

| Methods                                  | Advantages                                                                 | Disadvantages                                                                 |
|------------------------------------------|---------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| James Tobin’s cost approach              | Easy to use; Does not require a lot of data; Sufficient for comparing under-diversified companies. | Conditional in nature; Does not take into account many factors; Not suited for comparing diversified companies. |
| Market capitalization                    | Shows the monetary expression of intellectual capital; Easy to use; Does not require a lot of data. | Difficult to draw conclusions based on the dynamics; Results can be either positive or negative. |
| Ante Pulic’s value added intellectualization coefficient (VAIC) | Quality evaluation of intellectual capital; Possibility to compare with other firms; Observes the change dynamics | Complex calculations; Complete data is not always available. |

Based on the suggested methods, it can be concluded that Ante Pulic’s method of intellectual value added is the most preferred due to being well-developed and its consideration of many factors such as revenue, costs, investments, and its ability to assess human capital, something which is of great significance for the domestic economy.

3. Results and Discussion

It is suggested to look at these methods using a practical example. Below are two industrial companies who operate in the development of modern medical component parts. This field is known for having a high level of intellectual resources. The input data for the calculations are given in Table 2.

| № | Parameter                  | Company X | Company Y |
|---|---------------------------|-----------|-----------|
| 1 | Market value of company   | 12.5      | 9.7       |
| 2 | Replacement value of company | 8.9   | 6.1       |
| 3 | Book value                | 10.3      | 7.4       |
| 4 | Total revenue             | 3.5       | 2.9       |
| 5 | Funds spent               | 1.7       | 1.5       |
1. Calculation for intellectual capital using James Tobin’s cost approach:

Tobin’s Q (x) = 12.5 / 8.9 = 1.4045
Tobin’s Q (y) = 9.7 / 6.1 = 1.59

Tobin’s Q is > 1, which means the organization’s intellectual capital is high. However, the parameter for company Y has a greater value than the one for company X. This indicates a higher level of intellectualization.

2. Calculation of intellectual capital using the market capitalization method:

Intellectual capital (x) = 12.5 – 10.3 = 2.2
Intellectual capital (y) = 9.7 – 6.1 = 2.3

Thus, in monetary terms, company X has at its disposal an intellectual capital in an amount equal to $2.2 million, while company Y shows an amount equal to $2.3 million.

3. Calculation of intellectual capital using Ante Pulic’s method for finding the value added intellectual coefficient.

Company X:
VA (x) = 3.5 – 1.7 = 1.8
HCE (x) = 1.8 / 0.25 = 7.2
SC (x) = 1.8 – 0.25 = 1.55
SCE (x) = 1.55 / 1.8 = 0.861
ICE (x) = 7.2 + 0.861 = 8.061
CEE (x) = 1.8 / 2.25 = 0.8
VAIC (x) = 8.061 + 0.8 = 8.861

Company Y:
VA (y) = 2.9 – 1.5 = 1.4
HCE (y) = 1.4 / 0.19 = 7.37
SC (y) = 1.4 – 0.19 = 1.21
SCE (y) = 1.21 / 1.4 = 0.8643
ICE (y) = 7.37 + 0.8643 = 8.233
CEE (y) = 1.4 / 1.8 = 0.778
VAIC (y) = 8.233 + 0.778 = 9.01

The limits of VAIC can change depending on the business sector. However, they almost always fall within the range of 2 to 15. This value should exceed 7 in the area of company activities, while for modern high-tech companies, it should aim for more than 10.

Based on the analysis conducted, it can be said that the level of intellectual capital according to VAIC is equal to 8.861 in company X and 9.01 in company Y. This is above the market average and indicates a sufficient intellectualization of the companies. However, company Y possesses a greater amount of intellectual capital which can serve as evidence for its more efficient use of available intellectual resources.

Thus, despite its lower market value and smaller revenue, company Y is shown by all three of the methods to be more developed in the realm of intellectual capital.

In order to conduct a more thorough analysis, the level of intellectual capital needs to be analyzed dynamically in order to create a possible trend for its changes in the coming periods.

The dynamics of the intellectual capital parameter using Ante Pulic’s method for finding the value added intellectual coefficient are looked at in Table 3 and laid out in a graph in Figure 3.
Table 3. VAIC dynamics for company X and company Y.

| Year | Company X | Company Y |
|------|-----------|-----------|
| 2013 | 8.54      | 7.13      |
| 2014 | 8.69      | 7.59      |
| 2015 | 8.37      | 7.931     |
| 2016 | 8.23      | 8.15      |
| 2017 | 8.75      | 8.69      |
| 2018 | 8.861     | 9.01      |

Figure 3. VAIC dynamics for company X and company Y (points)

After analyzing the dynamics, it can be suggested that company X is in an intellectual stagnation, while company Y is gaining intellectual opportunities. The conducted analysis allows recommendations and behavioral strategies for various users of information to be developed. Thus, company X’s management can find its weak spots and ensure the growth of intellectual opportunities. From an investor’s point of view, it would be logical to invest capital in company Y, which, although taking in less revenue and having a lower market value, is actively growing in the area of intellectual capital and, thus, is likely to surpass company X in terms of profitability in the near future.

The results obtained can be used to build a model for evaluating the intellectualization of a specific company and comparing it to the level of intellectual capital in other companies active in similar business activities.

Advantages of the cost approach method include: ease in understanding and use; availability of information necessary to calculate Tobin’s q. Drawbacks: inability to break down the costs of the individual elements of a company’s intellectual capital; no accounting for factors affecting the degree of market capitalization.

The advantages of the method based on market capitalization are seen in the availability of information necessary to calculate market capitalization and book value; its ease in understanding and using the parameters. Drawbacks: using the book value, which takes into account historical costs; neglecting factors influencing the dynamics of market capitalization; inability to break down the costs of the individual elements making up the intellectual capital of a company.

Advantages of Ante Pulic’s method of the value added intellectual coefficient (VAIC) include: use of publicly available information; evaluating individual components of intellectual capital.
Drawbacks: difficulty in interpreting this parameter and its conversion into cost valuation; minimal accounting of client capital.

Thus, the practical results obtained confirm that Ante Pulic’s method is the most fully developed and makes it possible to assess the efficiency of human capital in a company’s performance. This method includes a number of parameters which allow such characteristics as revenue, expenses, invested capital and value added to be considered. This reflects the intellectual capital more accurately than the other methods. However, in order to form a thorough analysis, it is recommended to use all three methods, after which their dynamics over the last period should be reviewed.

4. Conclusions

This paper covered the main methods for assessing intellectual capital as well as demonstrated a practical example of their calculations. The use of intellectual capital implies a strict accounting when analyzing the cost parameters of structural and human capital. Accordingly, intellectual capital creates a real opportunity to evaluate the results of any kind of collective activity and compare the dynamics of the cost parameters of any type of business.

It should be mentioned that methods for evaluating intellectual capital have virtually not been studied in this country. This is, firstly, due to the difficulty of comparing the amount of intellectual capital in organizations to the final results from business activities, as well as the lack of statistical data [29; 34].

Despite the difficulty of determining intellectual capital, it has long been one of the most effective, competitive advantages in an information economy. In connection to this, the existing methods and approaches to assessing intellectual capital will only improve in the future in hopes of getting the most adequate assessment of a company’s intellectualization.

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