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IMPACT OF INTELLECTUAL CAPITAL EFFICIENCY ON PROFITABILITY: THE CASE OF INFORMATION TECHNOLOGY COMPANIES ON THE NYSE

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Abstract: Intellectual capital (IC) contributes to the creation of benefits for companies regarding the generation of competitive advantages, as well as the increase of the economic results (revenue and earnings), economic efficiency (labour productivity and profitability) and the value of company. Total IC consists of two main segments: a) the visible IC, recognised and disclosed on the assets side of balance sheet - intangible assets, and b) the invisible IC, undisclosed on the assets side of balance sheet because it doesn't fulfil the defined conditions for accounting the recognition and disclosure. As a category in accounting theory, the first segment of total IC is the IC invested in intangible assets. The second segment of total IC is actually the IC itself that is in intellectual capital theory marked as a set of human, structural and relational capital. Starting with the structure of total IC, the aim of this study is the examination of influence of the efficiency of total IC and its elements (visible and invisible) on profitability of companies on the New York Stock Exchange (NYSE). The research is based on the sample of 63 IT companies which are selected according to S&P 500 Information Technology list. The analysis covers the period from 2010 to 2022, and the regression analysis is used for these reasons. Independent variables are following: the efficiency of total IC (EIC),the efficiency of IC which is undisclosed in balanced sheet (EΔIC) and the efficiency in the use of intangible assets (Eia), as well as its elements (the efficiency of goodwill (Eg), the efficiency in use of the intangible assets contained in customer relationships (Ecr), the efficiency in the use of internally generated intangible

assets (Eiia), and the efficiency in use of others intangible assets (Eoia). A dependent variable is a profitability of IT companies, which is measured by return on assets (ROA) as a profitability indicator. The research results pointed out that there is a positive, statistically relevant influence of efficiency of EIC and elements of Eia (as independent variables) on a dependent variable – ROA. Conducted research points out the relevance of efficiency of the usage of total IC and all its elements for accomplishing a targeted profitability of IT companies, and, at the same time, confirms the usefulness and validity of the implementation of the EIC methodology (Krstić & Bonić, 2016) in IT companies for the measurement of the efficiency of total IC, as well as its elements.

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Introduction

Compared to material (physical and financial) resources, the structure of assets in the balance sheet investments in intellectual resources have been growing at an extraordinary speed during the past decades (Ocean Tomo, 2020). In uncertain and dynamic business conditions, intellectual (non-material) assets are the key solution in doing efficient business. Intellectual resources or intellectual assets are considered a very important resource of potential competitive advantage (Ruta, 2009). During the last decades, the relevance of intellectual resources for accomplishing and maintaining competitive advantage have been highlighted more and more (Qureshi & Siddiqui, 2020; Aleksić et al, 2022). Intellectual resources contribute to the increase of value for consumers, the employed, the owners and other stakeholders (Marr & Schiuma, 2001). Great, long term and strategic relevance of intellectual resource for business success is the main reason why these resources in the theory of intellectual capital are called *intellectual capital* (IC) (Rađenović & Krstić, 2017). By adequate combination of various elements in the structure of total IC, as well as the effective and efficient usage of them, companies develop their business and increase their profits. An adequate combination of different components of total IC provide synergy which is reflected in creation of the value of the company (Petković et al., 2020). Sustainable IC is a vital factor of sustainable business and the competitive growth of companies in the knowledge economy era, especially in the new era of regenerative economy (Jovanović et al., 2021). An effective IC management requires a special methodology and new approaches in measuring, controlling, and monitoring the efficiency usage of total IC and its elements - visible and invisible.

Theoretical background

The essence of synergy in economic usage of different elements of total IC stems from the process of the value creation of companies and contribution to the growth of their profitability. Namely, the value could be created by combining of the following components of total IC (Krstić, 2014; Krstić & Bonić, 2016; Krstić & Rađenović, 2018):

a) *IC that is disclosed in balance* is actually IC invested in intangible assets. In accounting theory and standards there is a different definition and classification of the elements of intangible assets. According to the international professional accounting regulations, the intangible assets which fulfil the condition for recognition in the line of International Accounting Standard 38 (IAS 38 – *Intangible Assets*) are a disclosure on the assets side in the balance sheet (in the frame of group called Intangible assets). It is similar in the USA accounting principles for the intangible assets which fulfil the conditions for the recognition, according to FAS 141 and 142, which is superseded by the topics of Accounting standard codification (ASC): ASC 350 *Intangibles - Goodwill and Other*, ASC 340 *Other Assets and Deferred Cost* and ASC 985-20 *Software*.
b) *IC which is undisclosed on the asset side in the balance sheet* is usually a set of three components in the IC theory (Krstić, 2014; Krstić & Rađenović, 2019): human (Hc), structural (Sc) and relational capital (Rc). Namely, the values of these particular intellectual resources could not be disclosed on the assets side in the frame of group of Intangible assets, because they are difficult for evaluation in monetary value or they do not fulfil some of the conditions for the recognition according to the international and the USA professional accounting regulative.

Professional accounting regulative defines only IC invested in intangible assets that could be recognized and disclosed in the balance sheet. The International Accounting Standards Board (IASB) tends to provide unique conditions for disclosure of information about the intangible assets. IASB gives definition of these assets and conditions for disclosure through the IAS 38. According to IAS 38, the intangible assets are: a) nonmonetary assets without physical substance that could be identified and measured, b) controlled by entity, and c) used in manufacturing or providing with goods or services, renting to others or in administrative purposes for gaining benefits in the long-term period. According to IAS 38, certain types of intangible assets are (IAS 38.63): brand names; mastheads and publishing titles; computer software; licenses and franchises; copyrights, patents and other industrial property rights, service and operating rights; recipes, formulae, models, designs and prototypes; intangible assets under development (an intangible asset arising from the research phase shall not be recognized as the intangible asset); and other intangible assets (internally generated intangible assets

under special conditions). In addition, the following standards - IFRS 3 *Business combinations*, IAS 20 *Accounting for government grants and disclosure of government assistance* and IAS 36 *Impairment of assets,* regulate separately the accounting treatment of a special type of intangible assets.

Until 2009 in the USA standards FAS 141 *Business combinations* and FAS 142 *Goodwill and Other Intangible Assets* regulated the issue of IC invested into intangible assets. This regulation was only valid at the USA capital markets, but from 2009 it has been superseded with certain topics in *Accounting standard codification* (ASC).

FAS 141 arranged financial reporting of business combinations and pointed out that valuation of business combination by using the purchase method.

FAS 142 regulated the Intangible assets which were acquired individually or with a group and, at the same time, not the result of business combination but the internal generation, should be disclosed in financial reports after the acquirement. Also, FAS 142 regulated the evaluation of goodwill and intangible assets after their initial recognition in financial reports. After the process of convergence, USA GAAP and IFRS, FAS 141 and 142 were superseded in 2009 with the codification standard (Accounting standard codification - ASC) by FASB. ASC contains certain topics which are complement to these standards in regard to accounting treatment of intangible assets. These topics are the following:

- *ASC 350 Intangibles - Goodwill and Other* (350-20 Goodwill; 350-30 General intangibles other than goodwill - *Intangible assets acquired individually or with a group of other assets and for the cost of developing, maintaining or restoring internally generated intangible assets*; 350-40 Internal-use software - *Certain costs incurred for the computer software, developed or obtained for the internal use that should be capitalized*, including costs for the purchase of the internal-use software in a multiple element transaction; 350-50 Website development costs - *Costs incurred to develop the website, the cost of hardware, the acquisitions of servers and the related hardware infrastructure*; 350-60 Crypto assets);
- *ASC 340 Other Assets and Deferred Cost* (340-20 Capitalized Advertising Cost, 340-30 Insurance contracts that do not transfer the insurance risk, 340-40 Contracts with Customers);
- *ASC 985-20 Software* – Cost of Software to be Sold, Leased or Marketed.

The accounting regulations (IAS, IFRS, and ASC) as intangible assets which should be disclosed on the assets side of the balance sheet, recognise the following assets: the assets acquired by purchase, government grants, and the assets acquired by business combination, exchange, or internally generated assets.

According to IAS 38, internally generated intangible assets from a development phase could be recognized under the following conditions (IAS

38.21): a) the technical feasibility of intangible assets for the future use or sale; b) intention and ability to use or sell the intangible asset; c) generation of probable future economic benefits; d) the availability of adequate resources to complete the development of intangible assets for the future use or sale; e) ability to measure the expenditure in relation to intangible assets during their development. On the other hand, investments in internally generated intangible assets from the research phase cannot be recognized as intangible assets in the balance sheet, but only as the period costs on the income statement when it was incurred.

In intellectual capital theory, the invisible segment of total IC includes 3 components: human, structural and relational (Krstić, 2014; Rađenović & Krstić, 2017a). The dimensions and elements of human capital are: professional competencies, social skills, motivation of employees, ability of leadership (Jovanović, 2018). The dimensions and elements of structural capital are: organizational structure, organizational climate and culture, internal cooperation and knowledge transfer, informational systems and technologies, informational climate and culture, and the innovations of products/processes as the innovational R&D capital, efficient business processes and explicit knowledge incorporated in them, as well as different types of legally protected intellectual property (such as patents, trademarks, designs, etc.). The dimensions and elements of relational capital are: consumer relations, supplier relations, marketing channel relations, relations with owners and creditors, relations with community and other relevant stakeholders (Krstić, 2014).

Taking into consideration the relevance of all intellectual resources for the future business performance and competitiveness, it is pointed out that the efficient management of total IC and its visible and invisible elements is a primary task of the contemporary managers of companies.

Literature review

Researchers point out that intangible assets are highly important for the company survival and their business success (Satt et al., 2017). In the past, the business success of the company depended on material assets, i.e., physical resources (Nuryaman, 2015). In the current global economy based on knowledge, intangible assets often participate with over 80 percent of the market value of the company (Vodák, 2011).

Intangible assets are very important for generating the company's markets value and improving the current and future business performance (Gamayuni, 2015). The research have shown that the investment of IC into intangible assets is dominant in leading companies across the world and that they influence all developing aspects from product development to human resource management, as well as other functions (R&D, procurement, production, marketing, etc.) (Qureshi & Siddiqui,

2020). Peters & Taylor (2017) estimate that companies buy only 19% of intangible assets at the stock market externally. The patents of Apple, Pfizer, Coca-Cola, Amazon and Walmart have strengthened the competitive advantage and corporative value in the knowledge economy (Lev & Gu, 2016). Kampanje (2012) points out that growing relevance of intangible assets in the knowledge era. He indicates that the business performance of companies are not driven only by tangible assets, but more and more by intangible assets. Therefore, visible and invisible IC should be developed by competitive strategy of a company.

The use of indicators of accounting profitability to evaluate the success of the company dominates in the analysis of companies' profitability. The rules of disclosure of certain parts of intangible assets on the asset side on the balance sheet affects the precision in quantifying the indicators of profitability (Krstić et al., 2023). The authors (Krstić et al., 2023), in order to solve this problem, provide a valuable methodological solution for improving the accuracy of calculations by a traditional profitability indicator – the return on assets (ROA).

Theoretically, intangible assets that are disclosed in the balance sheet and those undisclosed, positively affect the company's profitability. The possession of valuable, unique, mutually compatible intellectual resources in companies contribute to companies' competitiveness and value creation (Clarke et al., 2011; Hsu & Chang, 2011; St-Pierre & Audet, 2011; Jelínková & Jiřincová, 2015).

According to Zegahal & Maaloul (2011), the non-recognition of intangible assets in the balance sheet has an impact on the relevance of financial information. A great part of intangible assets is created by R&D activities.

Numerous empirical studies pointed out that the quality of R&D activities is one of the factors that are the key solution for a new product success (Henard & Szymanski, 2001; Troy et al., 2008). The effects of investing in intangible assets could be realised in two to three years after investing (Troy et al., 2008). Li et al. (2014) for a 5-year period (2008-2012) analyzed a connection between the return on assets (ROA) and intangible assets of contemporary IT companies listed on the stock market in Hong Kong. They collected data on R&D, employee compensation and training for sales. Their results indicate that R&D and sales training have a positive relationship towards ROA, while the employee benefits have a negative impact on ROA.

Sedlaček (2010) investigated the role of intangible assets which weren't disclosed in the balance sheet of Slovenian and Czech firms and confirmed that these assets had the main role in the assessment of market value, as well as in the influence on the profitability rate. He also added that the identification of these assets was difficult, because it was impossible to identify the economic benefits arising from them.

Yuan & Riziki (2020) conducted a similar research which focused on the undisclosed intellectual capital and its influence on profitability. The sample consisted of 61 firms listed on the Indonesia Stock Exchange and used panel data regression. The mentioned authors concluded the there was a positive effect on the financial performance of manufacturing companies in the research sample. However, Ranani & Bijani (2014) pointed out that the determined total IC enabled a higher market value of firms.

Seo & Kim (2020) concluded that human capital, advertising and customer relations (relational capital) and R&D activities (structural capital) have a positive impact on profitability of small and medium size enterprises in Korea.

Gamainuni (2015) analysed the relationship between the intangible assets, the financing of enterprises (from internal and external sources), the financial performance and the firm value of companies in Indonesia. The performed analysis for 2007 to 2009 and the results showed that intangible assets have positive and statistically significant effects on ROA and the value of enterprises.

Daniel & Titman (2005) proved that the future stock returns are related to the financial performance from the previous period and that they have a significant negative relationship with intangible assets. M/B ratios could be a solid base for the prediction of future profitability, because they represent a good approximation of intangible assets. The value of intangible assets is changed more often than the change of the value of material assets on the assets side on the balance sheet. These changes influence the increase of difference between the book and the market value of the companies (Garger, 2010). Corrado et al. (2006) considered that the adequate disclosure of intangible assets has a positive relationship with business performance.

Bubic & Susak (2015) identified the relationship between the intangible assets and the business performance, which was measured by different indicators (ROA, ROE, net profit margin and gross profit margin). Their sample includes Croatian companies, based on data from the annual financial statements.

Nassari & Nasab (2014) examined the relationship between IC and the financial performance such as ROA, ROE and market to book ratio (M/B ratio). The sample consisted of 82 firms on the Teheran Stock Exchange. The authors concluded that the increase in the IC positively affects the market value and the profitability.

Ahmad & Ahmed (2016) examined the influence of efficiency of the IC (assessed through VAIC's performance) on the financial performance of 78 organisations in the financial sectors in Pakistan during the period from 2008 to 2013. VAIC indicator is a sum of 3 components: human capital efficiency (HCE), structural capital efficiency (SCE) and total employed assets (or capital employed) efficiency (CEE). They concluded that the efficiency of IC, which is assessed through VAIC's performance,e has positively and significantly (1%) influenced all the financial indicators (ROA, ROE and earning per share - EPS).

Alipour & Gorgizadeh (2017) by VAIC model, came to conclusion that the efficiency of human capital (HCE) significantly and positively affect the profit efficiency of enterprises in automobile and parts manufacturing industry, but the structural capital efficiency (SCE) is not associated significantly with profit efficiency. Profit efficiency is estimated by DEA technique and truncated regression based on the eight chosen variables, which affect the value of profit and profitability rate.

Radonić et al. (2021), on the sample of IT companies of South East Europe, analysed the influence of human, relational, structural capital and innovation capital on profitability (measured net profit, net profit per number of full-time employees, sales revenue, sales per number of full-time employees, ROA and ROE). The aim of their research was to determine which element of invisible IC is the most important for accomplishing the targeted financial performance. The authors collected primary data from 101 respondents – owners, managers and experts of growing IT ecosystem in South-East Europe. They point out that the companies in IT industry have shown a positive trend and a significant relevance of intangible assets for profitability.

Jovanović et al. (2021) in their study examined the relationship between the brand value (which can be considered an intangible assets of an enterprise) and market performance indicators (market capitalization, Tobin's Q, M/B ratio, and EPS ratio) using the correlation and regression analysis based on data on brand value and the annual reports of selected companies from the high-tech sector. The results discovered a statistically significant positive relationship between the brand value and the market performance indicators. The brand value positively influenced those performance indicators in the selected high-tech companies.

Ognjanović et al. (2022) analysed the contribution of human capital efficiency (HCE) and the structural capital efficiency (SCE) to the profitability of new and older hotels in the year before the Covid 19 pandemic crisis conditions (2019) and the year of crisis (2020) in the Republic of Serbia. The study's findings suggest that the intellectual capital efficiency (ICE) – HCE and SCE, have a partial impact on the profitability of new hotels in the 2019. In 2020, the results showed that single components of ICE have partially affect the realization of sustainable and profitable business among older hotels.

Krstić et al. (2023) based on EIC methodological approach investigated the influence of efficiency of visible IC (Eia), such as the efficiency of invisible IC (efficiency of human capital - Ehc, efficiency of structural and relational capital - Esc) on profitability (ROA indicators). The authors came to a conclusion that the efficiency of visible intangible assets and efficiency of two parts of the invisible intellectual capital positively influence four various ROA indicators.

Petrović et al. (2023), based on data on 12 leading companies in the automotive industry from 2010 to 2019, concluded that there is a positive impact between the

efficiency of visible IC (efficiency of intangible assets and goodwill - Eiag) and profitability indicators (ROA and ROE). Also, they confirmed that the increase of Eiag affects the increase of profitability indicators.

Summing up the previous research, it can be concluded that visible IC, as well as the invisible IC in the balance sheet, have a positive influence on the profitability.

Research Methodology

Based on the sample of IT companies on the NYSE, the aim of the study is to examine the influence of two profitability indicators of return on assets (ROA_1 and ROA_2) the following variables:

(a) efficiency of visible IC or IC invested in intangible assets (*Eia*),

(b) efficiency of four partial elements of visible IC in the balance sheet, such as (1) eficiency Goodwill (*Eg)*, (2) eficiency of use of the intagible assets contained in customer relationships (*Ecr)*, (3) eficiency of use of internally generated intangible assets (*Eiia*) and (4) efficiency of use of other intangible assets (*Eoia*),

(c) efficiency of non-disclosed IC on the assets side of the balance sheet ($E_{\Delta IC}$), and

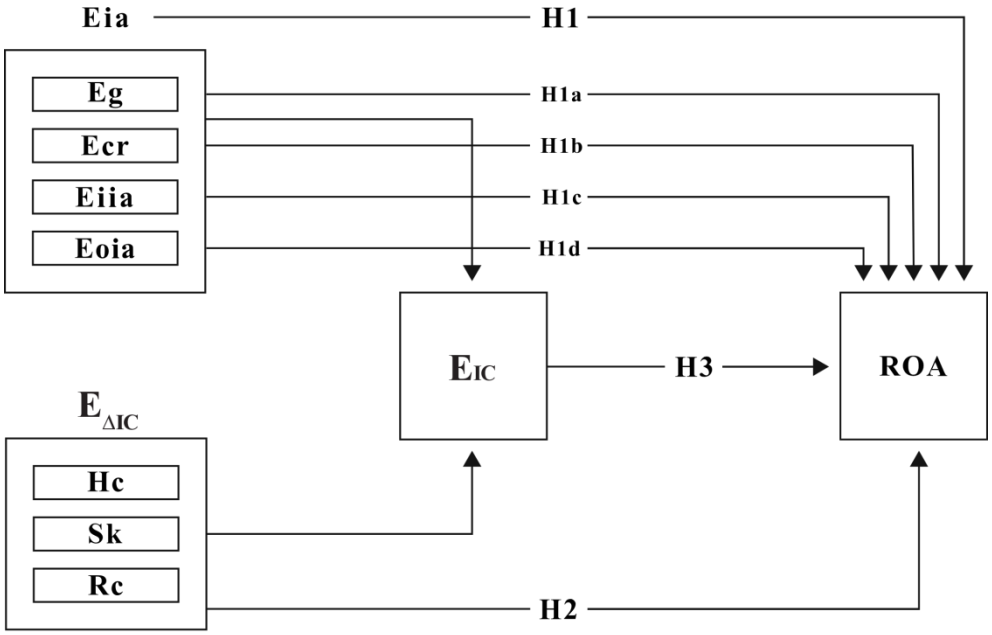
(d) efficiency of total IC (E_{IC}).

The efficiency of visible IC in the balance sheet i.e. the efficiency of elements of intangible assets in line of ASC incorporates four following partial efficiency indicators:

1. *Eg* - efficiency of goodwill (in line with ASC 350-20);
2. *Ecr* - efficiency of use of intagible assets contained in customer relationships - contracts with customers (in harmony with ASC 340-40) and capitalizated advertising costs (in the line with ASC 340-20);
3. *Eiia* - efficiency of use of internally generated intangible assets in software (in line with ASC 350-40), website development costs (in line with ASC 350-50) and blokchain technology i.e. crypto assets (in line with ASC 350-60);
4. *Eoia* - efficiency of use of other externally acquired intangible assets, such as acquired softwares, patents or brend (in line with ASC 350-30 and ASC 985-20).

In order to realize the defined goal of the research, the concept of empirical research was created and presented in Figure 1.

Figure 1. Concept of empirical research



Source: Authors

In order to achieve the defined goal of the research, the following hypotheses were formulated:

H1: Efficiency of intangible assets (*Eia*) has a positive impact on profitability.

H1a: Efficiency of goodwill (*Eg*) has a positive impact on profitability.

H1b: Efficiency of use of intagible assets contained in customer relationships (*Ecr)* has a positive impact on profitability.

H1c: Efficiency of use of internally generated intangible assets (*Eiia*) has a positive impact on profitability.

H1d: Efficiency of use of other intangible assets (*Eoia*) has a positive impact on profitability.

H2: Efficiency of use of non-disclosed IC on the assets side of the balance sheet ($E_{\Delta IC}$) has a positive impact on profitability.

H3: Efficiency of total intellectual capital (E_{IC}) has a positive impact on profitability.

Secondary data gathered from balance sheets reports, income statements, cash flow reports, notes and annual reports were used for testing the mentioned hypothesis. At the beginning of the research, the sample consisted of 75 IT

companies on the NYSE selected according to S&P 500 Information Technology index in the period from 2011 to 2022. However, due to unavailability of data from the reports of some companies, the toal company number in the sample came down to 63. Table 1 shows the review of companies in the research sample.

Table 1. The review of enterprises listed on the stock market by S&P 500 IT

No	Enterprise	Country	No	Enterprise	Country
1.	Accenture Plc	Ireland	33.	Keysight Technologies Inc.	California
2.	Adobe Systems Inc	California	34.	KLA-Tencor Corp	California
3.	Analog Devices	Massachusetts	35.	Lam Research Corp	California
4.	Automatic Data Procs	New Jersey	36.	Mastercard Inc.	New York
5.	Akamai Technologies	Cambridgen	37.	Microchip Technology	Arizona
6.	Applied Materials	California	38.	Monolithic Power Systems	Washington
7.	Advanced Micro Devices	California	39.	Microsoft Corp	Washington
8.	Ansys Inc.	Pennsylvania	40.	Motorola Solutions	Illinois
9.	Amphenol Corporation	Connecticut	41.	Micron Technology	Idaho
10.	Broadcom Ltd	California	42.	Servicenow Inc.	California
11.	Broadridge Financial Solutions	New York	43.	Netapp Inc.	California
12.	Cadence Design System	California	44.	Nvidia Corp.	California
13.	CDW Corp	Illinios	45.	Nxp Semiconductors	Netherlands
14.	Salesforce Inc.	California	46.	On Semiconductor	Arizona
15.	Cisco Systems Inc.	California	47.	Oracle Corp	California
16.	Cognizant Tech Solutions	New Jersey	48.	Paycom Software Inc.	Oklahoma
17.	Epam Systems Inc.	Pennsylvania	49.	Paychex Inc.	New York
18.	F5 Inc.	Wasshington	50.	Ptc Inc.	Massachusetts
19.	Fidelity National Information Services	Florida	51.	Qualcomm Inc.	California
20.	Fiserv Inc.	Wisconsin	52.	Roper Industries	Florida
21.	Fleetcor Technologies	Georgia	53.	Synopsys Inc	California
22.	Fortinet Inc.	California	54.	Seagate Technology Holdings	California
23.	Corning Inc.	New York	55.	Skyworks Solutions	California
24.	Global Payments Inc.	Georgia	56.	Teledyne Technologies Inc.	California
25.	Hewlett Packard Enterprise	Texas	57.	TE Connectivity Ltd.	Pennsylvania
26.	Hp Inc	California	58.	Teradyne Inc.	Massachusetts
27.	International Business Machines	New York	59.	Trimble Navigation	Colorado
28.	Intel Corp	California	60.	Tyler Technologies	Texas
29.	Intuit Inc.	California	61.	Visa Inc.	California
30.	Gartner Inc.	Connecticut	62.	Western Digital	California
31.	Jack Henry & Assoc	Missouri	63.	Zebra Technologies	Illinois
32.	Juniper Networks	California			

Source: Authors' presentation

With the aim of examining the existing hypothesis, the following independent variables were used *Eia* and $E_{\Delta IC}$ *:* $E_{\Delta IC}$ is calculated as a sum of human, structural and relational capital. In literature $E_{\Delta IC}$ is shown by the following formula (Andriessen, 2004, p. 340; Krstić & Bonić, 2016):

$$\Delta IC = Mc - E \quad (1)$$

where

$$E = As - L - Nci \quad (2)$$

where: *Mc* – market capitalisation, *E* - equity, *As* – total assets, *L* – longterm liabilities and *Nci* – non-controling interests. Total intellectual capital (*IC*) is the sum of visible IC i.e. IC invested in intangible assets (*Ia*) and non-disclosed IC on the assets side of the balance sheet (Δ*IC*):

$$IC = Ia + \Delta IC, \quad (3)$$

respectively

$$IC = Ia + Hc + Sc + Rc \quad (4)$$

where: *Ia* – Intangible assets, *Hc* - human capital i *Sc* – structural capital, *Rc* – relational capital, where the efficiency is calculated in accordance with *EIC methodology,* stated in Table 2.

In this study, for calculating the efficiency of IC instead of original component in EIC methodology (Krstić & Bonić, 2016) – category of the intellectual capital value added (ICVA) is replaced with *EBITDA* (Earnings before interest and tax, depreciation and amortization) (Krstić, 2022, 214-216).

Table 2. Steps of EIC methodology implemented in the research

Steps	Indicator	Formula
Step 1 – IC in combination with other resources generate the category of economic result i.e. earnings	*EBITDA*	$EBITDA = EBIT + D_{fa} + Am_{ia}$
Step 2 – Computation of efficency of elements of visible IC i.e. Intangible assets in assets side of the balance sheet	*Eia* *Eg* *Ecr* *Eiia* *Eoia*	*Eia = EBITDA : Ia* *Eg = EBITDA : Value of Goodwill* *Ecr = EBITDA : Value of assets contained in customer relationships* *Eiia = EBITDA : Value of* internally generated intangible assets *Eoia = EBITDA : Value of other intangible assets*

Step 3 – Efficacy of non-disclosed IC on the assets side of the balance sheet	$E_{\Delta IC}$	$E_{\Delta IC} = EBITDA : E_{\Delta IC}$
Step 4 – Efficiency of the use of total IC	E_{IC}	$E_{IC} = EBITDA : IC$

Source: Adjusted to Krstić & Bonić, 2016.

A *dependent variable* represents *ROA* based on the accounting concept result – the accounting profit, which is calculated monthly, quarterly, annualy. *ROA* could be calculated in different ways (Shapiro & Balbirer, 2020; Krstić & Bonić, 2016, Sardo & Serrasqueiro, 2017), that's why the authors of this study have chosen 2 methods of calcullation. In the first method of calculation, the statement rate of the return on assets (ROA_1) is in the numerator *EBIT*, while in the second method (ROA_2) it is in the numerator *EBITDA*. The advantage should be given to *EBITDA* because, as an analytical indicator, it enables the parallel analysis of companies from different countries with different tax systems, finance and different accounting policies for the depriciation of intangible assets (Krstić & Bonić, 2016; Sardo & Serrasqueiro, 2017). Calculating formulas are shown in Table 3.

Table 3. Calculating formulas for ROA indicators

ROA Indicators	Formula
ROA_1	$ROA_1 = EBIT: As$
ROA_2	$ROA_2 = EBITDA : As$

Izvor: Krstić, 2022, 214-216

In order to determine how an independent variable affects a dependent variable, the regression analysis of the panel data is used (Waisanen et al., 2007). Firstly, descriptive statistics for the chosen dependent and independent variables was shown. The existence of interdependence between the variables was estimated by the correlation analysis. There are two correlation coefficents - Pearson's and Spearman's rho. Spearman's rho correlation coefficient is implemented in case that there is no normal distribution of data (Wiasanen et al., 2007). The value of correlation coefficient determines the level of interdependence (Kujansivu & Lonnqvist, 2007).

According to preliminary tests, it was confirmed that there are panel effects, by checking F-test, a dilemma was solved whether it's better to estimate the fixed or random effects. Breush-Pagan LM test and Hausman's test were performed for the selected models.

The results and discussion

In Table 4 – the descriptive statistics of the sample is shown. The measures for the descriptive statistics were used: minimum value (min), maximum value (max), arithmetic mean (mean), standard deviation (SD), skewness and kurtosis. The gathered data on the efficiency of intangible assets (*Eia*) show that their mean value is 1.4513 million USD (SD=4.98543). The value of variable *Eia* shifts between 0.02 million USD and 86.48 million USD. The value $E_{\Delta IC}$ goes from 0.00 to 94.70 million USD. The value E_{IC} shifts from 0.00 and 14.27 million USD with the mean value of 0.1269, while the standard deviation is 0.58811.

The average value of dependent variable ROA_1 0.1215, and ROA_2 is 1.4513 (SD_{ROA1}=0.07191, SD_{ROA2}=4.98543), while the value ROA_1 shifts from 0.00 to 0.61 million USD, and the value ROA_2 from 0.02 to 86.48 million USD. The standard deviation in the observed variables is higher compared to arithmetic mean, which implicates the existence of high asymmetry. The value of skewness and kurtosis the measures for efficiency indicators (*Eia*, E_g, E_{cr}, E_{iia}, E_{oia}, $E_{\Delta IC}$, E_{IC}, ROA_1, ROA_2), point to the conclusion that their distribution significantly deviates from the normal distribution.

Table 4. Descriptive statistics

Variable	Min	Max	Mean	SD	Skewness		Kurtosis	
					Value	Std. Error	Value	Std. Error
Eia	0.02	86.48	1.4513	4.98543	11.462	0.090	159.239	0.180
E_g	0	86	0.66	5.051	10.216	0.093	138.098	0.185
E_{cr}	0	3722	46.85	204.476	12.057	0.098	185.039	0.195
E_{iia}	0	1861	30.10	119.118	11.406	0.107	152.959	0.214
E_{oia}	0	5665	125.80	446.972	7.674	0.096	71.992	0.191
$E_{\Delta IC}$	0.00	94.70	0.2954	3.57657	25.868	0.091	682.613	0.183
E_{IC}	0.00	14.27	0.1269	0.58811	20.339	0.091	470.144	0.181
ROA_1	0.00	0.61	0.1215	0.07191	1.039	0.091	2.858	0.182
ROA_2	0.02	86.48	1.4513	4.98543	11.462	0.090	159.239	0.180

Source: Authors'calculations

Before implementing the regression analysis, it is necessary to determine the interdependence level between ROA_1, ROA_2, *Eia*, *Eg*, *Ecr*, *Eiia*, *Eoia*, $E_{\Delta IC}$ and E_{IC}. Firstly, in order to test the normality of data, Kolmogorov-Simirnov test was performed (the sample was higher than 50). According to the test results, normality was not confirmed (sig ROA_1, ROA_2 0.000), so the use of Spearman's rho correlation was justified (Table 5).

The confirmed correlation between the independent and the dependent variable has a middle strength. *Eia* is positively and statistically siginificantly correlated

with ROA_1 and ROA_2 (r_1=0.574 i r_2=0.241, p<0.05). The relationship between E_{IC} and profitability (ROA_1 and ROA_2) is weak (r_1=0.119, r_2=0.241). The relationship between the efficiency in the use of unrepresented IC and ROA_2 indicates the correlation of the middle level with the statistical significance of 1% (r=0.010).

Table 5. Results of correlation analysis for companies profitability

Variable	ROA_1	ROA_2
	Spearman's rho	Spearman's rho
E_{ia}	0.574*	0.241*
	(0.000)	(0.000)
E_g	0.566*	0.974*
	(0.000)	(0.000)
E_{cr}	0.466*	0.681*
	(0.000)	(0.000)
E_{iia}	0.626*	0.623*
	(0.000)	(0.000)
E_{oia}	0.235*	0.405*
	(0.000)	(0.000)
$E_{\Delta IC}$	-0.050*	0.010*
	(0.190)	(0.790)
E_{IC}	0.119*	0.241*
	(0.01)	(0.000)

**Correlation is significant at the 0.01 level*
Source: Authors'calculations

As the correlation analysis showed the existence of interdependence between the analysed variables, in Table 6 – the test results for the selection of an adequate model results for the adequate regression source were shown, while the results of the regression analysis were shown at Table 7. The testing of models was conducted by applying Breush-Pagan LM test and Hausman's test. The test results for the selected regression models show that the model of the fixed effects should be selected.

In the first regression model, where ROA_1 is dependent variable, the obtained results indicate that the increase of efficiency of intangible assets for 1% will lead to increase of ROA_1 for 0.61%. The adjusted R-squared indicates that the variations in *Eia* explain 47% variability in ROA_1. The increase of total intellectual capital for 1% increases ROA_1 for 0.14%, and ROA_2 for 0.29%. We should also point out that the invisibe part of the intellectual capital has a positive impact on ROA_2. The influence of variable *Eia* to ROA_2 isn't confirmed, because the selected model doesn't fulfill the assumptions of the regression analysis. In the second regression model, the influence of $E_{\Delta IC}$ to ROA_1 isn't confirmed, because there is no statistically relevant influence.

Table 6. The test results for selected adequate model

Independent variable	**The first regression model (ROA_1)**		**The second regression model (ROA_2)**	
	Breusch-Pagan LM	Hausman	Breusch-Pagan LM	Hausman
	H0: Polled H1: REM	H0: REM, H1: FEM	H0: Polled H1: REM	H0: REM, H1: FEM
lnE_{ia}	846.20 (0.000)	29.84 (0.000)	1737.84 (0.000)	0 (0.000)
lnE_{g}	705.47 (0.000)	24.55 (0.000)	582.78 (0.000)	0.40 (0.5277)
lnE_{cr}	608.47 (0.000)	4.36 (0.0368)	1478.16 (0.000)	0.81 (0.3670)
lnE_{iia}	309.21 (0.000)	0.11 (0.7399)	1466.03 (0.000)	0.01 (0.9098)
lnE_{oia}	608.67 (0.000)	9.71 (0.0018)	1360.84 (0.000)	0.00 (0.9872)
$lnE_{\Delta IC}$	518.95 (0.000)	0.93 (0.3340)	1648.40 (0.000)	3.74 (0.0532)
lnE_{IC}	557.32 (0.000)	0.00 (0.9984)	1635.72 (0.000)	0.28 (0.5951)

Note: *p* value in ( )

Source: Authors'calculations

Table 7. Results of the regression analysis

Dependent variable	**Independent Variable**						
	lnEia	*lnEg*	*lnEcr*	*lnEiia*	*lnEoia*	$lnE_{\Delta IC}$	lnE_{IC}
Constant	-1.98666	-2.15942	-2.90148	-3.03141	-2.89577	-2.20840	-1.98605
$lnROA_1$	0.614333 (0.000)	0.580333 (0.000)	0.260359 (0.000)	0.309413 (0.000)	0.188939 (0.000)	0.0598401 (0.527)	0.141329 (0.097)
R-squared	0.4771	0.4229	0.77421	0.2975	0.1412	0.0000	0.0149
Constant	-	-0.29713	-1.55118	-1.54011	-1.35119	-0.17477	0.22274
$lnROA_2$	-	0.961799 (0.000)	0.378313 (0.000)	0.433973 (0.000)	0.244194 (0.000)	0.152089 (0.024)	0.290567 (0.000)
R-squared	-	0.9528	0.4613	0.3630	0.1510	0.0004	0.0463

Source: Authors'calculations

Based on the mentioned results, the tested hypothesis was shown in Figure 2. From 3 basic hypotheses, the influence of efficiency of total intellectual capital oncompanies' profitability (H3) is confirmed completely, whereas the rest of 2 were partially confirmed.

Figure 2. Results of regression analysis

Hypothesis 1 (H1 - *Eia*)	**Impact on ROA_1** Confirmed	**Impact on ROA_2** Unconfirmed
H1a	Confirmed (Eg)	Confirmed (Eg)
H1b	Confirmed (Ecr)	Confirmed (Ecr)
H1c	Confirmed (Eiia)	Confirmed (Eiia)
H1d	Confirmed (Eoia)	Confirmed (Eoia)

Hypothesis 2 (H2 - $E_{\Delta IC}$)	**Impact on ROA_1**	**Impact on ROA_2**
H2	Unconfirmed ($E_{\Delta IC}$)	Confirmed ($E_{\Delta IC}$)

Hypothesis 3 (H3 - E_{IC})	**Impact on ROA_1**	**Impact on ROA_2**
H3	Confirmed (E_{IC})	Confirmed (E_{IC})

Source: Authors

The obtained results from the sample of 63 IT companies on the NYSE confirm the defined hypotheses. The first regression model showed that there was a positive relationship between the observed variables, i.e. that *Eia* (efficiency of intangible assets) has a positive influence on companies' profitability which is measured by an income rate towards the assets. Liu (2017) concluded that there is a positive relationship between the intangible assets and the business performance of companies. In Iran, Rahmani & Ismaieli (2013) analyzed the relationship between the intangible assets and earnings (profit). The results showed that the intangible assets positively affected earnings (profit) and that they were very important in assessing the market value of companies. Arianpoor (2021) confirmed the starting hypothesis – intangible assets have a positive influence on *ROA*, in his study. His research examined the role of intangible assets in the functioning of the companies in Teheran Exchange. This researcher formed the sample of 1350 companies from 2008 to 2018. Gamainuni (2015) conducted the analysis in the period between 2007-2009 in Indonesia and the research results confirmed that intangible assets had a positive and statistial relevant influence on *ROA*.

In the second regression mode,l the influence between $E_{\Delta IC}$ (the efficiency of IC which isn't shown in balance) and profitablity was tested. The hypothesis is confirmed by looking at ROA_2. The third regression model shows that when E_{IC} is increased, the companies profitability also increases. E_{IC} proved itself as significant indicator that influences companies' profitability. The results are in accordance with previously conducted researches considering the literature review (Ranani & Bijani, 2014; Arianpoor, 2021; Radonić et al., 2021; Corrado et al., 2006; Yuan & Riziki, 2020, Jovanović et al., 2020;).

Haji and Ghazali (2018) suggested it should be invested in intangible assets and human capital, because it would influence the profitability. Their research, in its sample, observed large Malesian companies during six-year period. As a limitation

in their research, they state using only one measure of intangible assets. Radonić et al. (2021) confirmed a positive impact of invisible IC on companies' profitability.

By analysing IT companies, and its specifics, it can be concluded that all segments of IC have to be aligned, working together, so it's not reccomended to isolate only one segment. Showing the implication efficiency of the chosen variables on the companies profitability, the authors indicated the efficiency significance of total IC, with pointing out the relevance of efficiency significance which wasn't shown in the balance, but which also contributed greatly to creating companies' value.

Conclusion

In this study, the influence of efficiency of IC and the efficiency of their elements (visible and invisible) on the profitability of IT companies is examined in the research sample. The study points out that visible and invisible elements of total IC are relevant for top management of contemporary companies, as well as for their commitment to more efficient and effective management of visible and invisible IC. The main reason for that is in the fact that the elements of IC contribute to the generation of benefits for companies in realising the competitive advantages, increasing the value of economic results, economic efficiency and the value of companies.

The study points out the usefulness of EIC methodology for the measurement of the efficiency of total IC. It is a very valid methodology for quantifying the efficiency of total IC. Its implementation is possible in all knowledge companies in different industries by using the public available information form of financial reporting of companies. In this paper, the authors have improved the initial formula (Krstić & Bonić, 2016) in numerator for calculating the efficiency indicators of IC and its elements, and *ICVA* category is replaced with *EBITDA*, and economic results category which provide comparative analysis of enterprises from different countries with different fiscal systems, financing policy and different accounting policies in the field of calculation of the amortization of intangible assets and depreciation of fixed assets.

The conducted research has some limitations. The obtained results in this study can't be generalized for all economic sectors and all companies. The reason for that reflects in the fact that such companies have different structure of value of visible and invisible IC, or they have a little participation of visible and invisible IC or they don't have these elements at all, so the results of this research can't be applied to such companies.

Besides, the EIC methodology is suitable for measuring the efficiency of IC in the companies that have high participation of visible and invisible elements of IC, like IT companies. Furthermore, the research is focused on the perception of

efficiency influence of IC and its elements to profitability, while the influence of IC efficiency of certain elements of IC to profitability has been considered in details. However, this research hasn't considered the influence of certain components on the efficiency of the invisible part of IC in the balance sheet at profitability and that was due to difficulties in its quantifying and identifying, because the selected companies in the research sample report and in different forms of financial annual reports, offer different information.

For measuring profitability, it has been used *ROA* indicator, calculated in two ways. Considering that, there are no insights what happens when profitability indicators based on cash flow performance are used (such as Cash return on assets – *CRA*, Cash flow return on equity – *CFRE*, Cash flow return on investment – *CFROI*, Total business return – *TBR*), which are especially important in conditions of economic instability. Previously mentioned performance indicators were usually used for internal analysis and internal reporting for top management in companies. Also, these indicators aren't usually published in official financial reports.

In this study, a step forward was made, compared to previous studies, in formulae for the calculation of IC efficiency (Krstić & Bonić, 2016) and its elements based on EIC methodology (the change is made using *EBITDA* instead of *ICVA* in formulas). Also, the influence of efficiency of certain elements of IC on profitability is considered in details, and what is especially highlighted is the relevance of the efficiency of the total value of invisible IC for the increase of profitability of IT companies.

Directions for further research are the examinations of the influence of efficiency of certain elements of invisible IC in the balance sheet on profitability. This kind of research could make possible the benchmarking performances of the best knowledge companies operating on developed financial markets in the world. The aim of such analysis is benchmarking the influence of certain elements of IC and their efficiency on profitability of knowledge companies in various industries or sectors. In addition to this, directions for further research could be the use of cash flow performance for profitability measurement in the conditions of economic crisis which induces the problem of insolvency.

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UTICAJ EFIKASNOSTI INTELEKTUALNOG KAPITALA NA PROFITABILNOST: STUDIJA SLUČAJA KOMPANIJA U OBLASTI INFORMACIONIH TEHNOLOGIJA NA NYSE

Apstrakt: Intelektualni kapital (IK) doprinosi stvaranju koristi za preduzeća u generisanju konkurentskih prednosti, kao i povećanju ekonomskih rezultata (prihoda i zarada), ekonomske efikasnosti (produktivnosti rada i profitabilnosti) i vrednosti preduzeća. Ukupni IK se sastoji od dva glavna segmenta: a) vidljivog IK, priznatog i prikazanog na strani imovine bilansa stanja – nematerijalna ulaganja, i b) nevidljivog IK, neotkrivenog na strani imovine bilansa stanja jer ne ispunjava definisane uslove za računovodstveno priznavanjae i obelodanjivanje. Kao kategorija u teoriji računovodstva, prvi segment ukupne IK je IK uložen u nematerijalnu imovinu. Drugi segment ukupne IK je zapravo sama IK koja je u teoriji intelektualnog kapitala označena kao skup ljudskog, strukturnog i relacionog kapitala. Polazeći od strukture ukupne IK, cilj ove studije je ispitivanje uticaja efikasnosti ukupne IK i njenih elemenata (vidljivih i nevidljivih) na profitabilnost kompanija na Njujorškoj berzi (NYSE). Istraživanje je zasnovano na uzorku od 63 IT kompanije koje su odabrane prema S&P 500 listi informacionih tehnologija. Analiza obuhvata period od 2010. do 2022. godine i iz ovih razloga se koristi

regresiona analiza. Nezavisne varijable su sledeće: efikasnost ukupnog IK (EIC), efikasnost IK koja nije obelodanjena u bilansu stanja (EΔIC) i efikasnost u korišćenju nematerijalne imovine (Eia), kao i njeni elementi (efikasnost goodvill-a (npr.), efikasnost korišćenja nematerijalne imovine sadržane u odnosima sa kupcima i efikasnosti interne upotrebe imovine (Ecr generisane interne imovine), efikasnost u korišćenju drugih nematerijalnih sredstava (Eoia) je profitabilnost IT kompanija, koja se meri prinosom na sredstva (ROA) kao pokazateljem profitabilnosti ostvarivanje ciljane profitabilnosti IT kompanija, i, istovremeno, potvrđuje korisnost i validnost primene EIC metodologije (Krstić & Bonić, 2016) u IT kompanijama za merenje efikasnosti ukupne IK, kao i njenih elemenata.

Ključne reči: ukupni IK, vidljivi IK, nevidljivi ili nematerijalni IK, EIC metodologija, profitabilnost, IT kompanije.

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