ORIGINAL SCIENTIFIC ARTICLE
UDK: 005.94
005.336.4:334.71(497.11)
Date of Receipt: December 15, 2014

Stevo Janošević
University of Kragujevac
Faculty of Economics
Department of Management and Business Economics

Vladimir Dženopoljac
University of Kragujevac
Faculty of Economics
Department of Management and Business Economics

THE RELEVANCE OF INTELLECTUAL CAPITAL IN SERBIAN ICT INDUSTRY*

Značaj intelektualnog kapitala u IKT industriji u Srbiji

Abstract

Knowledge economy is mainly based on intellectual capital (IC), which plays a key role in contemporary enterprise's value creation. The basic components of IC are human, structural, and relational capital. The substance of IC is made of intangible resources of an enterprise. There is empirical evidence of increased investments in IC that reveals the true nature of relationship between IC and financial performance. Knowledge-intensive industries are given special treatment in this field of research. This is why the objective of this study is to find out whether Serbian enterprises in the information and communication technology (ICT) industry rely more on tangible or intangible resources in their quest for improving financial performance. The paper analyzed financial performance of 594 enterprises that operate within the ICT industry in Serbia in the period of five years (2009-2013) and their dependence on IC efficiency. Three main hypotheses were tested in the paper regarding the relationship between human, structural, and physical capital, on one side, and financial performance (measured by net profit, operating profit, return on equity, return on assets, profitability, and return on invested capital), on the other. The results indicated that human capital and physical capital partially affect financial performance, which is consistent with empirical findings from other developing countries. When compared to other industries in Serbia, ICT industry demonstrated more significant impact of human capital.

Key words: *intellectual capital, financial performance, ICT industry, Value Added Intellectual Coefficient*

Sažetak

Osnovu ekonomije zasnovane na znanju čini prevashodno intelektualni kapital (IK) koji ima ključnu ulogu u procesu stvaranja vrednosti savremenog preduzeća. Glavne komponente IK-a su ljudski, strukturni i relacioni kapital. Supstancu IK čine nematerijalni resursi preduzeća. Brojni su empirijski dokazi koji potvrđuju značajan rast investicija u IK i koji ukazuju na prirodu odnosa između IK i finansijskih performansi. Privredne grane koje se posmatraju kao grane intenzivne znanjem zauzimaju posebno mesto u ovoj oblasti istraživanja. Ovo je i razlog zbog čega je osnovni cilj istraživanja utvrđivanje međuzavisnosti između komponenti IK i finansijskih performansi preduzeća iz industrije informaciono-komunikacionih tehnologija (IKT). Predmet istraživanja su 594 preduzeća iz IKT industrije Srbije u vremenskom periodu od pet godina (2009-2013). U radu su testirane tri osnovne hipoteze u vezi sa uticajem ljudskog, strukturnog i fizičkog kapitala na finansijske performanse (izražene neto dobitkom, poslovnim dobitkom, prinosom na sopstveni kapital, prinosom na ukupnu aktivu, profitabilnošću i prinosom na investirani kapital). Rezultati ukazuju na to da ljudski i fizički kapital delimično opredeljuju finansijske performanse, što je u saglasnosti sa rezultatima empirijskih istraživanja u drugim zemljama u razvoju. Kada se IKT industrija uporedi sa drugim industrijama u Srbiji, ona pokazuje veće oslanjanje na ljudski kapital u procesu stvaranja vrednosti.

Ključne reči: *intelektualni kapital, finansijske performanse, IKT industrija, koeficijent dodate vrednosti intelektualnog kapitala*

* This paper is part of the research on the project financed by the Ministry of Education, Science and Technological Development entitled "Strategic and tactical measures to overcome real sector competitiveness crisis in Serbia" (No. 179050, period 2011-2014)

Introduction

The global economic horizon has experienced paradigm shift in the last couple of decades. The main determinants of these changes are decreased cost of information flow, increases in the number of markets, liberalization of product and labor markets in many parts of the world, and the deregulation of international financial flows. These factors introduced new fundamental core of wealth creation in contemporary enterprises. That new source of wealth creation constitutes of development, deployment, and utilization of enterprises' intangible assets (IA) or intellectual capital (IC). The corner stones of IC that drive enterprise performance are knowledge, competence, intellectual property, brands, reputation, customer relationships, and the like. While there are many ways in which enterprises may increase revenues, there is only a diminishing set of strategies increasing profit margins. Therefore, in the world of heightened competition, the focus should be on developing and owning intangibles that are difficult to imitate, as well as on orchestrating these assets appropriately. The capability of using intangibles adequately is often labeled as dynamic competence of an enterprise [49, p. 3]. In the era of information and knowledge, IC has been the main driving force of corporate performance, value creation, and sustainable competitive advantage. In 1836, *Senior* was the first who emphasized the concept of IC. The essence of IC in that time was made solely of human capital. American scholar *Galbraith* considered that IC was not the static form of capital, like pure knowledge, but also a dynamic process of effective use of that knowledge with the objective of improving enterprise performance [14].

The most significant growth in value of IC, as well as the growth of its impact on corporate performance became evident during the eighties of the XX century, when a number of knowledge-intensive industries emerged. These industries included software, biotechnology, and internet-based industries. The growth and importance of intangibles has been increasing ever since [36]. Investments in intangibles have become the main indicator of enterprises' vitality and a key indicator of future returns. Research studies show that IC has significant positive impact on productivity growth. In USA, in the period from 1973 to 1995, IC contributed in average 0.4% to annual human labor productivity increase. This contribution grew even more from 1995 to 2003 and IC's contribution to productivity rose to 0.8%. In France, from 1995 to 2003, IC's contribution to productivity growth was 0.9%; In Germany, IC contributed by 0.6%, in Italy 0.4%, and in Spain the contribution was 0.2% [9]. In Great Britain, from 1979 to 1995, IC positively affected productivity growth by 0.4% on average, annually, while between 1995 and 2003 this impact increased to 0.6% [32]. In Finland, the growth in IC's contribution to productivity was 0.6% on average in the period from 1995 to 2000, while in the 2000-2005 period this contribution steadily grew to 0.9% on average [22].

The undisputed importance of IC for an enterprise and for an economy was the main driving force for undertaking the research in order to understand the essence of competitive advantage in the information age. Therefore, the main *objective* of this paper is to reveal whether Serbian enterprises in the ICT manufacturing industry rely on tangible or intangible resources in their quest for better financial performance. The defined research objective will be carried out through in-depth analysis of financial performance of 594 enterprises that operate within the ICT industry in Serbia. According to this, the paper is divided into an introduction and the following five parts. *The first part* presents a theoretical and methodological framework for understanding the concept of IC and its importance for creating value in the enterprises of information era. In addition, this segment of the paper deals with the main elements and dimensions of IC. Finally, the first part ends with brief insight into the main categories of IC measurement approaches. *The second part* relates to the importance and role of IC in the value-creation process of enterprises in ICT industry. In *the third part* of the paper, the focus shifts towards explaining the research methodology, which includes sample definition, development of research hypotheses, and identification of variables used in the empirical study. *The fourth and crucial part* of the work deals with the analysis of the results of applied research study in Serbia, which is intended to demonstrate the impact of IC on financial performance of enterprises in the ICT manufacturing industry in Serbia. *The final part* contains concluding remarks and directions for future research.

Definitions, dimensions, and measurement of IC

There is no generally accepted definition of IC, as well as there is no universal term that entails all of the IC's dimensions and characteristics. In practice the terms like intellectual capital, knowledge capital, intellectual assets, or intangible assets are often used interchangeably as they all represent the property of an enterprise that has no physical form but possesses the significant potential for future value creation. In addition, these intangible assets cannot deliver tangible outcomes without being related to tangible assets. The economists note them as knowledge capital, management experts refer to them as IC, and accountants explain them as intangible assets or intellectual assets. Intangible assets represent generic term used to describe the invisible capital of an enterprise that is likely to generate future value. Intangible assets commonly refer to IC or knowledge capital or intellectual assets. If IC is considered as an input then, intellectual assets is referred to as output, in an intangible form. When intellectual assets are legally protected, they become intellectual property [28]. However, the terms most commonly used by researchers and practitioners are intellectual capital, intangible resources, immaterial capital, immaterial resources, intellectual property, invisible assets, immaterial values, intellectual knowledge.

In terms of various definitions, notions, and elements of IC, Table 1 depicts terms, definitions, and corresponding categorization that generally made the most significant impact on the literature in this scientific field.

The dimensions of IC are its main components. As described in Table 1, different forms of IC are most commonly categorized as human, structural, and relational capital. *Human capital* entails employee knowledge, skills, expertise, and innovative capabilities. In addition, human capital consists of their talents, motivation, creativity, demonstrated enthusiasm, ability to learn, and teamwork. *Structural capital* is made of management systems, corporate culture, information-communications technology (ICT), internal databases, and different forms of intellectual property through which intangible assets are being exploited. *Relational capital* includes numerous relationships with different stakeholders, such as customers, suppliers, creditors, investors, and partners. In addition, relational capital takes into account stakeholders' perception of the enterprise. Examples of relational capital are brand, reputation, customer and supplier relations, various agreements, licenses, supply chains, negotiation capacity, and external networking.

Measurement of IC and its contribution to value creation presents an extremely important task since it is an input for strategy formulation and implementation, decision-making process regarding diversification and growth in general, applying appropriate compensation schemes, and communication with external stakeholders [31]. During the last three decades, a number of IC measurement methods have been developed with the aim of quantifying its absolute value, as well as for measuring IC's relative contribution to value creation in an enterprise. The four broad categories of measurement methods exist and they entail direct intellectual capital methods (DICM), market capitalization methods (MCM), return-on-assets methods (ROA methods), and scorecard methods [42]. The mentioned categories and their methods are presented in Table 2.

The first three groups of measurement methods produce financial value of IC, while the scorecard methods point to nonfinancial value of IC and propose certain nonfinancial measures of IC. The methods that belong to DICM aim at delivering the money value of separate elements of IC in an enterprise. In case of MCM, the starting premise is the fact that successful companies tend to have their market value significantly above their book value of assets, and that this positive difference can be appended to the effect of IC. ROA methods use financial statements of enterprises as the starting point for estimating absolute value or relative contribution of IC to corporate performance. The last category of measurement methods seeks data regarding certain components of IC in an enterprise and forms the indicators as the scorecard. The objective is to create graphical presentation of IC and to monitor investment in this type of assets. These methods are similar to the

Table 1: The terms and definitions of IC

Author(s)	Term/concept	Definition	Categorization
Brooking [5]	Intellectual capital	Intellectual capital constitutes of market capital, assets related to human capital, intellectual property, and infrastructure.	- Market assets - Human capital related assets - Intellectual property - Infrastructure assets
Sveiby [49]	Intangibles	Intellectual capital possesses three dimensions: employee competence, internal structure, and external structure.	- Employee competence - Internal structure - External structure
Stewart [46]	Intellectual capital	Intellectual capital represents intellectual material – knowledge, information, intellectual property, experience – that can be used for wealth creation. In other words, it represents the collective brainpower.	- Human capital - Customer capital - Structural capital
Bontis et al. [2]	Intangible resources, intellectual capital as a subcategory	Intellectual capital is simply the sum of intangible resources and their flows; intangible resources are any factor that contributes to the enterprises' value creation process.	- Human capital - Structural capital
Petty & Guthrie [39]	Intellectual capital	Intellectual capital is an indicator of economic value of two IC's components in an enterprise: organization and human capital.	- Organizational capital - Human capital
Sullivan [47]	Intellectual capital	Intellectual capital represents knowledge that can be converted into profit.	Human capital is the essence of intellectual property, which includes intellectual assets
Lev [30]	Immaterial assets	Immaterial assets represent the claim for future benefits, which has no physical or financial form.	- Discovery - Organizational practices - Human resources
FASB (Financial Accounting Standards Board) [15]	Intangible assets	Intangible assets represent non-financial expectations from future benefits, which have no physical or financial form.	- Technology - Customers - Market - Employees - Contracts - Statutory assets
MERITUM [33]	Intangibles, intellectual capital, intangible resources, intangible activities	Intangibles (intangible assets) refer to intangible resources that represent sources of future benefits for an enterprise, which could (but not necessarily) appear in the financial statements.	- Human capital - Structural capital - Relation capital
Pablos [38]		The broader definition of intellectual capital states that it is the difference between market and book value of an enterprise. It includes the knowledge-based resources that contribute to realization of competitive advantage.	- Human capital - Structural capital - Relation capital
Mouritsen et al. [35]	Intellectual capital	Intellectual capital mobilizes employees, clients, information technology, managerial work, and knowledge. Intellectual capital cannot operate independently since it represents a mechanism that enables connections between different resources in an enterprise's production process.	- Human capital - Organizational capital - Customer capital
IASB (International Accounting Standards Board) [20]	Intangible assets	Intangible assets that can be identified as non-monetary asset without physical substance that is used for production process and purchase of goods and services, for rent or for administrative purposes.	- Marketing - Distribution - Human resources trainings - Start-up - Research and development - Brands - Copy rights - Cooperation agreements - Franchise - Licenses - Operating rights - Patents - Original recordings - Secret processes - Trade marks

Table 2: Categorization of IC measurement methods

Category	Output	Level of analysis	Methods	Author
Direct Intellectual Capital Methods	Financial value	Enterprise	Technology Broker	*Brooking, A.*
		Business units	Citation-Weighted Patents	*Petrash, G., Dow Chemical*
		Functional units	Value Explorer	*KPMG, Knowledge Advisory Services*
			Intellectual Asset Valuation	*Sullivan, P. H.*
			Total Value Creation	*Anderson, R., & McLean R., Canadian Institute of Chartered Accountants*
Market Capitalization Methods	Financial value	Enterprise	Tobin's q	*Stewart, T.*
			Investor Assigned Market Value	*Standfield, K.*
			Market-to-Book Value	*Stewart, T.*
ROA Methods	Financial value	Industry	Economic Value Added	*Stern Stewart & Co.*
		Enterprise	Human Resource Accounting	*Flamholtz, E. G.*
			Calculated Intangible Value	*Stewart, T.*
			Knowledge Capital Earnings	*Lev, B.*
			Value Added Intellectual Coefficient	*Pulic, A.*
Scorecard Methods	Nonfinancial value	Enterprise	Skandia Navigator	*Edvisson, L.*
		Business units	Value Chain Scoreboard	*Lev, B.*
		Functional units	Intangible Assets Monitor	*Sveiby, K. E.*
			Balanced Scorecard	*Kaplan, R., & Norton, D.*

Source: Adapted according to [11]

methods from DICM group since both groups aim at gathering information about individual components of IC. However, the difference is that scorecard methods do not estimate money value of intangibles but at best can produce certain composite index of IC.

Literature review

There is a lot of empirical evidence regarding the research about impact of IC on financial performance [29], [34], [50], [54], [55]. In a research covering different industries, which was conducted in *Finland*, it was found that relative value of IC is fairly high in the electronics industry, whereas the results of both efficiency measures are near average. By contrast, in the electricity, gas and water supply the relative value of IC is quite low and, in addition, the total efficiency and efficiency of IC are among the highest. Moreover, in business services the relative value of IC as well the total efficiency of IC are fairly high, but the efficiency of IC is low [29]. When investigating the relationship between IC and corporate performance, *Moeller* [34] applied structural equation modelling to test a large-scale empirical study of more than 100 *German* business networks. Quantitative data were collected from the heads of the management accounting departments by means of a written questionnaire. The results revealed an interrelation between intangible and tangible/financial performance that is mainly influenced by strategic relevance and participation. In contrast to other studies, trust is not found to have significant effects on tangible or intangible performance. In a study by *Tan et al.* [50] which used the data from 150 publicly listed companies on the *Singapore* Stock Exchange, the findings showed that IC and company performance were positively related, that IC was correlated to future company performance, that the rate of growth of a company's IC was positively related to the company's performance, and that the contribution of IC to company performance differs by industry. Research undertaken in *Taiwan*, aimed to provide insights into the relationship between IC and market value and the financial performance of listed companies [6]. Another interesting study [18] presented the level of IC in domestic and foreign banks in *Malaysian* territory. *Goh*'s research found that domestic banks were generally less efficient at IC exploitation. Another study from *Malaysia* involved entire financial sector [53], with the aim of determining the impact of IC on financial performance in this sector from 1999 to 2007. *Ting* and *Lean* chose to analyze the financial sector after assuming its heavy dependency on IC performance [22, p. 248].

It has been already argued that positive difference between enterprise's market value and its book value of assets can be attributed to the adequate use of IC. According to [4; 28] it is estimated that the market-to-book ratio of the Standard & Poor's 500 companies reaches 6.0, compared to just over 1.0 in the early eighties. While some of this difference is attributable to the current value of physical and financial assets exceeding their historical cost, a large proportion is still the result of adequate IC management. Intangibles have, therefore, become the major value driver for many companies. These assets are generated through innovation, organizational practices, human resources or a combination of these sources and may be embedded in physical assets and employees. These conclusions especially apply for knowledge-intensive industries, like software industry, telecommunications, biotechnology, or professional consulting.

In recent literature, numerous empirical studies were implemented in order to analyze the effect of IC on corporate performance within industries that heavily rely on intangibles. One such industry is ICT manufacturing industry, which is the object of the analysis in this paper. *Firer* and *Williams* [16] examined the IC's impact on corporate performance of 75 *South Africa* IC-intensive enterprises that operated within banking, electrical, information technology, and services industries. The empirical findings suggested that physical capital remained the most significant underlying resource of corporate performance in South Africa at the time of the research, despite the efforts to increase the nation's IC base. In a research conducted by *Shiu* [44], Value Added Intellectual Coefficient (VAIC) was applied in order to measure the contribution of IC to corporate performance of 80 listed technological firms in *Taiwan* in 2003. The research concluded that VAIC had significant positive correlation with profitability and market value, while there was negative correlation with productivity. The study also revealed that Taiwanese technological firms possess the ability of transforming intangible resources into tangible outcomes, but with certain time lag. A similar study was conducted on Egyptian software companies to analyze how human capital, as a part of IC, affected the organizational performance of selected companies [43]. *Gan* and *Saleh* [17] investigated the relationship between IC (measured by VAIC) and corporate performance of technology-intensive companies in *Malaysia* and found that in the time of the study, these Malaysian companies were primarily dependent on physical capital. The results also indicated that physical capital efficiency is the most significant variable related to profitability while human capital efficiency is of great importance in enhancing the productivity of the company. This study concluded that VAIC can explain profitability and productivity but failed to explain market valuation of these companies. *Erickson* and *Rothberg* [12] carried out a longitudinal assessment of three *USA* hi-tech industries in the period of eight years, in two separate data sets (1993-1996 and 2003-2006). One of the conclusions of the research was that these industries seriously lack effective knowledge sharing because of high risk of competitive intelligence. However, the IC and effective knowledge management (KM) can contribute to market performance of these industries, measured by Tobin's q. Another research was conducted within *Irish* ICT sector [7] and aimed at discovering the relationship between management accounting and structural capital of enterprises. The research did not confirm the premise that management accounting systems positively influence firms' structural capital, whereas the results did indicate a positive relationship between management accounting information and structural capital. However, the findings strongly supported positive impact of human, structural, and relational dimensions on IC and business performance.

Kavida and *Sivakoumar* [28] evaluated the role of IC in the performance of the *Indian* IT industry, with an objective to enlighten the relevance of IC in the Indian IT industry. The results showed that IC was relevant to the corporate performance of the Indian IT industry. In a study carried out among telecommunication enterprises in *Nigeria* [48], which belong to the broader definition of ICT sector, results revealed that Nigerian telecommunications companies had mostly emphasized the use of customer capital, exemplified by market research and customer relationship management to boost their business performance. On the other hand, putting too much focus on customer capital to the detriment of other intellectual capital components is found to be undermining the productivity of Nigerian telecommunications companies. *Fan et al.* [13] investigated the relationship between IC and company performance in *China's* IC-intensive manufacturing industry, information technology industry, and banking and insurance industry. The study covered the period between 2007 and 2009, using Value Added Intellectual Coefficient (VAIC) as the indicator of IC performance. The paper identified three empirical research models based on economic performance, financial performance, and stock market performance. The results showed that there existed significant difference between the efficiency of IC among different industries. The efficiency of IC in finance and insurance industry was the highest, while the efficiency of IC in information and technology industry was not quite clear because this industry was still at an early stage of development in China, at the time of the study. Another conclusion was drawn and this was that the driving force of value creation lied in human capital and structural capital, while the effect of physical capital was relatively low. The latest research on IC's impact on corporate performance was performed by *Osman* [36] and the research investigated the issue on a sample of ICT small and medium enterprises (SMEs) in *Malaysia*. The study revealed that IC had significant and positive direct impact on both innovation capability and firm performance in Malaysian ICT SMEs. As intellectual capital significantly affects firm performance, a complementary mediation or partial mediation effect of innovation capability was also established for the relationship between IC and performance.

While ICT sector was extensively investigated by the researchers in various national economies, the performance of ICT sector in Serbia in relation to IC has not been analyzed so far. In terms of relationship between IC and corporate performance among Serbian companies, several research studies were implemented. The most important of these research studies were conducted in the real sector of Serbia in 2010 [22], among enterprises that constituted BELEX15 index [23], within the 300 of top Serbian exporting enterprises [24], among 100 top performing enterprises in terms of net profit in 2011 [26], and in the Serbian banking sector [3]. The research studies carried out in mentioned industries in Serbia, so far revealed that enterprises in Serbia in majority cases rely on physical capital, except in the cases of employee productivity, which is often significantly affected by human capital of an enterprise.

Research methodology

In terms of information and communications technology sector (ICT sector), the basic classification used in this paper relies on International Standard Industrial Classification of All Economic Activities (Revision 4) from 2008, issued by The Department of Economic and Social Affairs of the United Nations Secretariat, Statistics Division [51]. There were several revisions of this industry classification so far. By following the logic of Revision 4, the research was primarily oriented on broader scope of ICT sector that incorporates three major segments: ICT manufacturing industries, ICT trade industries, and ICT services industries. In Serbia, the European Classification of Economic Activities (EU – NACE Rev. 2) was accepted without any changes on January 1, 2008 [13].

In the process of identifying the ICT economic activities (industries), the following general principle is used: "The production (goods and services) of a candidate industry must primarily be intended to fulfill or enable the function of information processing and communication by electronic means, including transmission and display" [52, p. 278]. According to this, the *ICT manufacturing* industries entail manufacturing of electronic components and boards, manufacturing of computers and peripheral equipment, manufacturing of communication equipment, manufacturing of consumer electronics, and manufacturing of magnetic and optical media. The industries that belong to the *ICT trade* industries are wholesale of computers, computer peripheral equipment and software, and wholesale of electronic and telecommunications equipment and parts. Lastly, the *ICT services* industry consists of businesses in the field of software publishing (publishing of computer games and other software); telecommunications (wired telecommunications activities, wireless telecommunications activities, satellite telecommunications activities, and other telecommunications activities); computer programming, consultancy and related activities (computer programming activities, computer consultancy and computer facilities management activities, and other information technology and computer service activities); information service activities (data processing, hosting and related activities; web portals); and repair of computers and communication equipment (repair of computers and peripheral equipment and repair of communication equipment).

The total number of enterprises operating in the ICT sector of Serbia is 13,989 according to the official data published by the Serbian Agency for Business Registers. The 12,207 enterprises operate within the ICT services sector (87%), 1,583 belong to ICT manufacturing industry, and 199 enterprises are in the ICT trade segment. Figure 1 illustrates the structure of whole ICT sector in Serbia.

Sample description

Serbia is in the state of structural, rather than cyclical, crisis, which can be illustrated by the data that in 2012 Serbian economy experienced immense difficulties due to irreversible trends in both real and financial sectors. After GDP growth of 2% in 2011, a drop of 1.5% recorded in 2012 must be observed as a serious warning sign. Industrial production fell by 3.5%, while agricultural production declined by 8% [10]. If we analyze key macroeconomic indicators of national economy in 2013 and 2014, it can be seen that the situation has not improved; the industry growth is insufficient, with realistic risks of industry activity decrease in 2015. This data shows the reality in Serbian real sector and necessity for focusing on manufacturing industries with higher added value. This is one of the main reasons why we conducted a research on a sector that is both IC-intensive and production-oriented.

The sample consists of 1,583 enterprises that operate within ICT manufacturing sector in Serbia. The data was gathered from the official financial statements of these enterprises for the period of five years (2009-2013). The structure of the ICT manufacturing industry is given in Figure 2.

However, after a thorough analysis of available data, we found that 594 enterprises (37.52%) have complete data

Figure 1: The structure of ICT sector in Serbia

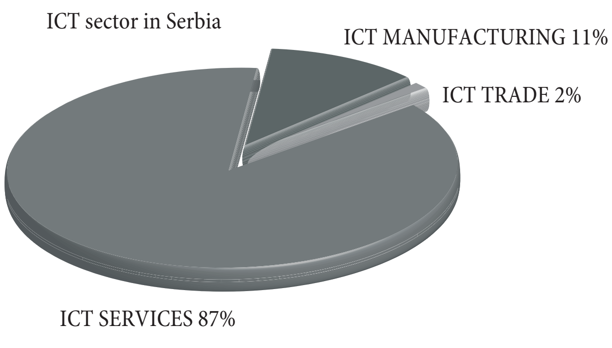


Figure 2: The structure of ICT manufacturing industry in Serbia

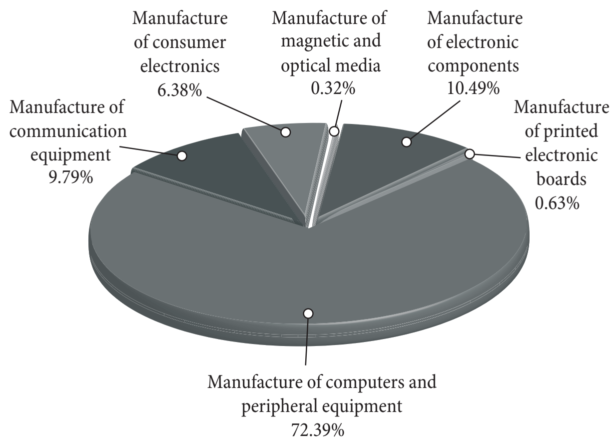
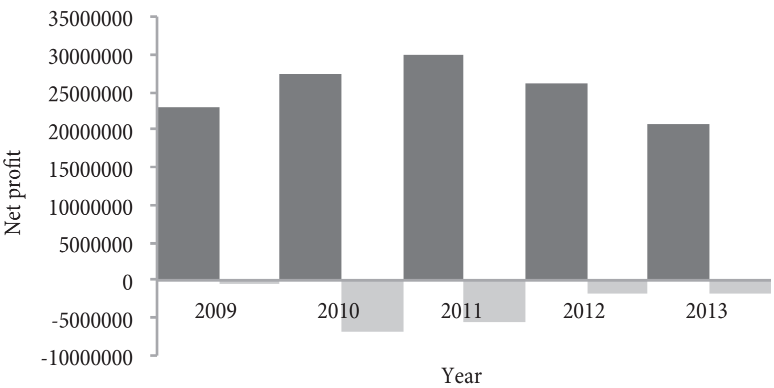


Figure 3: Aggregate net profit in ICT manufacturing industry



for the observed five-year period. In order to have sample that is homogenous and comparable among subjects the analysis included these 594 enterprises for the period from 2009 to 2013. The 552 enterprises are limited liability firms (92.93%), 28 are entrepreneurial entities (4.71%), 7 of them are corporations (1.18%), there are 3 partnerships (0.51%), 2 limited liability partnerships (0.34%), one state-owned enterprise (0.17%), and one cooperative (0.17%). During the observed period, the net effect in terms of profit was positive since in average 524 enterprises realized net profit. This net effect of the ICT industry is presented in Figure 3.

The share of realized loss in total net profit of the ICT manufacturing sector in Serbia varied over five-year period. In 2009, only 2.17% of realized net profits were realized losses by enterprises in this industry. However, this percentage drastically grew in 2010 to 25.35%. In 2011 and 2012, the share of losses in total net profits decreased to 18.21% and 6.77% respectively. In 2013 this percentage slightly rose to 8.92%. These indicators reveal the overall profit generation by the enterprises in the ICT manufacturing sector. In order to investigate the driving forces behind this performance, this paper will examine thoroughly the main value drivers in ICT manufacturing industry in Serbia. The study used data drawn from the publicly available financial statements of each of these enterprises. Software SPSS 21.0 was used to analyze the data statistically.

Development of hypotheses

The main advantages of VAIC model for measuring IC performance in enterprises are its simplicity and ability to determine relative contribution of tangible and intangible resources to the creation of value added. In order to determine this contribution VAIC is divided into two separate elements. The first element is intellectual capital efficiency (ICE), which is calculated by simply adding together values of human capital efficiency (HCE) and structural capital efficiency (SCE). The second part represents capital employed efficiency (CEE), which is a proxy for efficient use of physical and financial capital of an enterprise. In accordance to the identified objective of this research, which is examining whether Serbian enterprises in the ICT manufacturing industry rely more on tangible or intangible resources in their quest for better financial performance, and bearing in mind this duality of VAIC measure, the following research hypotheses are proposed:

H1. *Human capital efficiency (HCE) has direct positive impact on financial performance of enterprises in ICT manufacturing industry*

a. Enterprises with higher values for HCE tend to have higher net profit
b. Enterprises with higher values for HCE tend to have higher operating profit
c. Enterprises with higher values for HCE tend to have higher ROE
d. Enterprises with higher values for HCE tend to have higher ROA
e. Enterprises with higher values for HCE tend to have higher profitability
f. Enterprises with higher values for HCE tend to have higher ROIC

H2. *Structural capital efficiency (SCE) has direct positive impact on financial performance of enterprises in ICT manufacturing industry*

a. Enterprises with higher values for SCE tend to have higher net profit
b. Enterprises with higher values for SCE tend to have higher operating profit
c. Enterprises with higher values for SCE tend to have higher ROE
d. Enterprises with higher values for SCE tend to have higher ROA
e. Enterprises with higher values for SCE tend to have higher profitability
f. Enterprises with higher values for SCE tend to have higher ROIC

H3. *Capital employed efficiency (CEE) has no significant impact on financial performance of enterprises in ICT manufacturing industry*

a. CEE has no significant impact on net profit
b. CEE has no significant impact on operating profit
c. CEE has no significant impact on ROE
d. CEE has no significant impact on ROA
e. CEE has no significant impact on profitability
f. CEE has no significant impact on ROIC

The defined research objective and identified research hypotheses will be tested through correlation and multiple linear regression analysis regarding the relationship between intellectual capital and physical capital efficiency and financial performance of 594 enterprises that operate within the ICT industry in Serbia.

Variables used in the research

The starting point in terms of variables identification is presenting the rationale behind model of measuring IC's contribution to value creation, which was introduced by *Pulic* [40], [41]. The model relies on achieved value added (VA) from business as an indicator of efficient exploitation of IC. The basic premise of the model is to measure the contribution of a company's total resources (human, structural, physical, and financial) to the creation of VA, which can be calculated as:

$$VA = OUT - IN$$

Here, outputs (OUT) are the company's total sales or sales income. Inputs (IN) comprise all management costs, excluding those related to human resources, which in this model are treated as investment. IC is made up of human capital (HC) and structural capital (SC). Thus, IC efficiency consists of human capital efficiency (HCE) and structural capital efficiency (SCE). The calculation starts from salaries and wages, which, as mentioned previously, are not regarded here as inputs. The formula for HCE calculation is therefore constructed as the contribution of human resources to VA creation:

$$HCE = VA/HC$$

Human capital consists of total employee salaries and wages in one fiscal year. The next IC component, structural capital, represents everything that remains in the company when employees go home at the end of the working day. SC includes hardware, software, organizational structure, patents, and trademarks [1]. SCE can now be calculated as:

$$SCE = SC/VA$$

This rationale for SCE calculation can be explained by the fact that SC is the second component of IC and is obtained by subtracting HC from VA. Therefore, SCE is a measure inversely proportionate to HCE (VA = HCE + SCE = VA/HC + SC/VA). Finally, the value for capital employed efficiency (CEE) is obtained through dividing VA by the net book value of assets. In the following equation capital employed (CE) represents the capital invested in the company:

$$CEE = VA/CE$$

Despite its critics, VAIC methodology is gaining increasing acceptance among researchers as a good indicator of a company's efficient use of IC. The main critics lie in the fact that VAIC is calculated using the financial statements of companies, which imply that, the coefficient is a measure of value created in the past and not that of value-creation potential. In addition, the model does not incorporate synergy realized through interactions between different components of IC. The VAIC methodology clearly depicts the contribution of each component of IC to value creation. However, in practice, elements of IC interact, and therefore it is not possible to calculate accurately the contribution of each component to the creation of VA. In addition, the model fails to offer adequate analysis of VA creation for those companies that have negative equity in terms of operating profit [26].

The proposed research model employs several variables. The first group of variables relate to the calculation of VAIC, defined above. These are HCE, SCE, and CEE. The second group of variables represents chosen measures of financial performance of enterprises in Serbian ICT manufacturing industry. The measures selected for the purpose of the present paper are net profit (NP), operating profit (OP), return on equity (ROE), return on assets (ROA), profitability (P), and return on invested capital (ROIC).

Most of the previous empirical studies that interlinked IC and business performance used firm size, leverage, firm age, growth ability, industry as control variables [16], [44], [14]. However, because the enterprises in our present study belong to the same industry (ICT manufacturing industry), since the period is limited to five years, our research model includes two controlling variables: firm size (using total assets, TA, as a proxy) and financial leverage (*Lev*) of enterprises in the ICT manufacturing sector.

Research results

Descriptive statistics

Table 3 presents the results of descriptive statistics analysis. The data presented consists of minimum and

Table 3: Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
NP	2970	-3703939.9	5062446.56	37305.1024	264324.72197	8.654	.045	175.841	.090
OP	2970	-1758911.5	5535421.46	34130.847	311168.14364	10.786	.045	154.546	.090
ROE	2367	-26.5652	67.0000	.259382	2.2560274	22.049	.050	663.855	.101
ROA	2957	-26.5652	17.0000	.032310	.6944697	-11.914	.045	890.885	.090
P	2755	-1098.9350	507.9730	-1.322422	36.7212713	-18.456	.047	584.627	.093
ROIC	2291	.0001	2047.4000	14.099570	76.9493612	18.894	.051	411.816	.102
Valid N	2291								

maximum values, means, standard deviation, skewness, and kurtosis statistics.

The data for skewness suggests that majority of research variables (except for ROA and profitability) tend to be placed left of the average values, which means that these values are relatively smaller ones. On the other hand, the values for kurtosis suggest that all of the variable's values are concentrated close to the average values in the research sample.

Correlation analysis

In order to test the existence of relation between dependent and independent variables, a correlation analysis was used in the case of enterprises within Serbia's ICT manufacturing sector. Table 4 illustrates the results of conducted correlation analysis. The *Spearman*'s correlation coefficient was used because it is suitable for nonparametric tests.

Interpretation of correlation analysis results will be performed according to the scale proposed by *Cohen* [8]. *Cohen*'s scale considers correlation from -0.29 to -0.10, or from 0.10 to 0.29 to be low; from -0.49 to -0.30, or from 0.30 to 0.49 to be mediate; from -1 to -0.5 and from 0.5 to 1 to be high correlation. As illustrated in Table 4, the results of correlation analysis are as follows:

High, positive, and significant correlation

- HCE with net profit, operating profit, ROA, and profitability
- CEE with ROIC

Medium, positive, and significant correlation

- HCE with ROE
- SCE with profitability

Low, positive, and significant correlation

- SCE with net profit, operating profit, ROE, and ROA
- CEE with net profit, operating profit, and ROA

Low, negative, and significant correlation

- SCE with ROIC

In case of human capital efficiency, the highest positive correlation exists with profitability, operating profit, ROA, net profit, and ROE, respectively. When we observe structural capital component, the highest correlation is with profitability, operating profit, ROE, ROA, and net profit. As far as ROIC is concerned, the correlation is negative and low. Finally, physical capital possesses strongest correlation with ROIC, ROE, ROA, operating profit, and net profit respectively.

Table 4: Correlation analysis

		NP	OP	ROE	ROA	P	ROIC
HCE	Correlation Coefficient	.565**	.730**	.448**	.566**	.878**	-.009
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.671
	N	2635	2635	2181	2635	2554	2156
SCE	Correlation Coefficient	.113**	.218**	.218**	.131**	.391**	-.088**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
	N	2909	2909	2350	2900	2745	2286
CEE	Correlation Coefficient	.068**	.260**	.442**	.280**	.314**	.646**
	Sig. (2-tailed)	.001	.000	.000	.000	.000	.000
	N	2367	2367	2367	2367	2291	2291

Regression analysis

After completing correlation analysis, we proceed to examine the nature and direction of relationships between elements of VAIC and chosen indicators of financial performance. Therefore, we used multiple linear regression analysis to assess these relationships and to determine the value drivers in ICT manufacturing enterprises in Serbia. Since there are six dependent variables in the research, we identified six regression models, which can explain whether financial performance is more dependent on the tangible or intangible resources. Formally, the model for multiple linear regression, given n observations, is

$$Y_i=\beta_0+\beta_1 x_{i1}+\beta_2 x_{i2}+ \dots +\beta_p x_{ip}+\varepsilon_i$$
$$\text{for } i=1, 2, 3 \dots n$$

In the presented model of multiple regression, Y_i is dependent variable, β_0, β_1, β_2 … β_p are regression coefficients, x_{i1}, x_{i2}… x_{ip} are independent variables, and ε_i represents the notation for the model deviations. In order to determine the characteristics of the relationships between IC, physical capital, on one side, and basic indicators of financial performance, on the other, the regression models were developed accordingly.

Table 5 depicts the results of the first regression model where net profit acted as dependent variable. The results of ANOVA analysis confirm that the regression model is valid (Sig. = 0.000). This regression model leads to the conclusion that, after controlling for firm size and financial leverage, there is only significant positive impact of human capital efficiency on the size of realized net profit in the observed period. Also, the quality of the regression model is satisfactory because the changes in VAIC components can explain 35.2% of the alterations in

Table 5: Regression model 1(Net profit)

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.592[a]	.350	.350	229226.75647	
2	.593[b]	.352	.351	229051.79895	2.147

a. Predictors: (Constant), Lev, TA
b. Predictors: (Constant), Lev, TA, SCE, HCE, CEE
c. Dependent Variable: NP

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	61296867688467.910	2	30648433844233.953	583.281	.000[b]
	Residual	113707176323290.500	2164	52544905879.524		
	Total	175004044011758.400	2166			
2	Regression	61627769827108.766	5	12325553965421.754	234.930	.000[c]
	Residual	113376274184649.640	2161	52464726600.948		
	Total	175004044011758.400	2166			

a. Dependent Variable: NP
b. Predictors: (Constant), Lev, TA
c. Predictors: (Constant), Lev, TA, SCE, HCE, CEE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	17862.054	5107,590		3.497	.000		
	TA	.046	.001	.591	34.136	.000	1.000	1.000
	Lev	-134.203	120.419	-.019	-1.114	.265	1.000	1.000
2	(Constant)	16401.434	5139.975		3.191	.001		
	TA	.046	.001	.591	34.128	.000	1.000	1.000
	Lev	-143.310	131.148	-.021	-1.093	.275	.842	1.188
	HCE	763.016	319.246	.041	2.390	.017	.999	1.001
	SCE	646.252	897.213	.012	.720	.471	1.000	1.000
	CEE	28.423	141.000	.004	.202	.840	.841	1.189

a. Dependent Variable: NP

net profit. According to the results of the first regression model, the equation has the following elements:

*Net profit = 17,862.05 + 763.02*HCE + 0.046*TA*

In Table 6, we present the results for the second regression model where operating profit stands as dependent variable. The model fit is also satisfactory because this regression model can describe 33.9% of operating profit variations. ANOVA table defines the second regression model as adequate, too (Sig. = 0.000).

When analyzing coefficients within Table 6, we can confirm that human capital efficiency has significant positive impact on operating profit. Other components of VAIC have no impact on operating profit in the case of ICT manufacturing enterprises in Serbia. As a consequence, we construct the second regression model as follows:

*Operating profit = 5,719.42 + 872.72*HCE + 0.056*TA*

When observing third regression model (Table 7), we can see that it is a valid regression model (according to the ANOVA table), but it can explain only 12.7% of all changes in ROE values.

After the analysis of third model's regression coefficients, the conclusion is that only physical capital (capital employed efficiency) has significant, positive, and low impact on this measure of financial performance of enterprises. Therefore, after controlling for firm size and leverage, the regression formula in case of ROE is:

*ROE = 0.235 + 0.021*CEE –0.008*Lev*

The fourth regression model (see Table 8), where ROA is dependent variable, suffers from borderline validity (Sig. close to 0.05) and very poor explaining power, with the ability to describe the ROA variations only in 0.6% of cases.

Table 6: Regression model 2 (Operating profit)

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.581[a]	.337	.336	288767.56365	
2	.582[b]	.339	.337	288623.49886	2.093

a. Predictors: (Constant), Lev, TA
b. Predictors: (Constant), Lev, TA, SCE, HCE, CEE
c. Dependent Variable: OP

ANOVA[a]

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	91740951704374.440	2	45870475852187.220	550.093	.000[b]
	Residual	180448831389362.300	2164	83386705817.635		
	Total	272189783093736.750	2166			
2	Regression	92170867529375.720	5	18434173505875.145	221.289	.000[c]
	Residual	180018915564361.030	2161	83303524092.717		
	Total	272189783093736.750	2166			

a. Dependent Variable: NP
b. Predictors: (Constant), Lev, TA
c. Predictors: (Constant), Lev, TA, SCE, HCE, CEE

Coefficients[a]

	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	5719.419	6434.268		.889	.374		
	TA	.056	.002	.580	33.161	.000	1.000	1.000
	Lev	-106.700	151.697	-.012	-.703	.482	1.000	1.000
2	(Constant)	4050.161	6476.778		.625	.532		
	TA	.056	.002	.580	33.147	.000	1.000	1.000
	Lev	-121.028	165.257	-.014	-.732	.464	.842	1.188
	HCE	872.724	402.275	.038	2.169	.030	.999	1.001
	SCE	679.134	1130.559	.011	.601	.548	1.000	1.000
	CEE	42.955	177.671	.005	.242	.809	.841	1.189

a. Dependent Variable: OP

Table 7: Regression model 3 (ROE)

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.149[a]	.022	.021	2.2029903	
2	.356[b]	.127	.125	2.0833630	1.997

a. Predictors: (Constant), Lev, TA
b. Predictors: (Constant), Lev, TA, SCE, HCE, CEE
c. Dependent Variable: ROE

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	239.150	2	119.575	24.639	.000[b]
	Residual	10502.251	2164	4.853		
	Total	10741.402	2166			
2	Regression	1361.795	5	272.359	62.750	.000[c]
	Residual	9379.607	2161	4.340		
	Total	10741.402	2166			

a. Dependent Variable: ROE
b. Predictors: (Constant), Leverage, Total assets
c. Predictors: (Constant), Leverage, Total assets, SCE, HCE, CEE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.235	.049		4.789	.000		
	TA	-6.34E-009	.000	-.010	-.494	.621	1.000	1.000
	Lev	.008	.001	.149	7.002	.000	1.000	1.000
2	(Constant)	.204	.047		4.374	.000		
	TA	-2.94E-009	.000	-.005	-.242	.809	1.000	1.000
	Lev	.000	.001	.009	.402	.688	.842	1.188
	HCE	-.001	.003	-.007	-.356	.722	.999	1.001
	SCE	.003	.008	.008	.412	.680	1.000	1.000
	CEE	.021	.001	.352	16.076	.000	.841	1.189

a. Dependent Variable: ROE

Table 8: Regression model 4 (ROA)

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.055[a]	.003	.002	.2020420	
2	.076[b]	.006	.003	.2019014	2.035

a. Predictors: (Constant), Lev, TA
b. Predictors: (Constant), Lev, TA, SCE, HCE, CEE
c. Dependent Variable: ROA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.263	2	.132	3.225	.040[b]
	Residual	88.337	2164	.041		
	Total	88.600	2166			
2	Regression	.508	5	.102	2.495	.029[c]
	Residual	88.091	2161	.041		
	Total	88.600	2166			

a. Dependent Variable: ROE
b. Predictors: (Constant), Leverage, Total assets
c. Predictors: (Constant), Leverage, Total assets, SCE, HCE, CEE

In addition, there are no independent variables in this model that has significant impact on return on assets. This is why the regression model cannot be constructed. Just in the case of structural capital efficiency, we can find borderline impact, but due to the model quality this is disregarded.

Table 9 gives detailed description on fifth regression model that uses profitability as a dependent variable. Like

Table 8 (continued): Regression model 4 (ROA)

Coefficients[a]

	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.076	.005		16.990	.000		
	TA	-8.546E-01	.000	-.016	-.726	.468	1.000	1.000
	Lev	.000	.000	-.052	-2.434	.015	1.000	1.000
2	(Constant)	.076	.005		16.877	.000		
	TA	-8.100E-01	.000	-.015	-.688	.491	1.000	1.000
	Lev	.000	.000	-.063	-2.688	.007	.842	1.188
	HCE	.000	.000	-.028	-1.304	.192	.999	1.001
	SCE	.001	.001	.037	1.747	.081	1.000	1.000
	CEE	.000	.000	.027	1.155	.248	.841	1.189

a. Dependent Variable: ROA

Table 9: Regression model 5 (Profitability)

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.003[a]	.000	-.001	7.6257387	
2	.125[b]	.016	.013	7.5716336	1.985

a. Predictors: (Constant), Lev, TA
b. Predictors: (Constant), Lev, TA, HCE, SCE, CEE
c. Dependent Variable: Profitability

ANOVA[a]

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.203	2	.602	.010	.990[b]
	Residual	124386.895	2139	58.152		
	Total	124388.098	2141			
2	Regression	1931.996	5	386.399	6.740	.000[c]
	Residual	122456.102	2136	57.330		
	Total	124388.098	2141			

a. Dependent Variable: Profitability
b. Predictors: (Constant), Lev, TA
c. Predictors: (Constant), Lev, TA, HCE, SCE, CEE

Coefficients[a]

	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.088	.171		.513	.608		
	TA	-5.84E-009	.000	-.003	-.131	.895	1.000	1.000
	Lev	.000	.005	-.001	-.059	.953	1.000	1.000
2	(Constant)	-.013	.171		-.075	.941		
	TA	-7.85E-009	.000	-.004	-.178	.859	.999	1.001
	Lev	-.007	.007	-.030	-.945	.345	.462	2.164
	HCE	.059	.011	.121	5.610	.000	.999	1.001
	SCE	.014	.035	.009	.397	.692	1.000	1.000
	CEE	.012	.010	.039	1.237	.216	.462	2.166

a. Dependent Variable: Profitability

in the previous case, the model has very low explanatory power ($R^2 = 0.016$).

Yet, if we observe regression coefficients, there is only significant impact of human capital efficiency on profitability. This does not mean a lot because only 1.6% of variations in profitability values is attributable to the changes in VAIC components, or in this case, the human capital element. Still, there is theoretical possibility to construct regression equation:

*Profitability = 0.088 + 0.059*HCE*

The next regression model analyzes the relationship between intellectual and physical capital on one side, and return on invested capital on the other. The model is presented in Table 10.

The results of sixth regression model point to the several conclusions. Firstly, this model has the highest explanatory power so far. Secondly, it is obvious that only capital employed efficiency has significant impact on ROIC values, after controlling for firm size and leverage. Finally, the adequate regression equation that explains this relationship can be constructed as follows:

*ROIC = 3.872 + 1.243*CEE + 1.99*Lev*

The results of the multiple linear regression analysis lead us to the conclusions about hypotheses confirmation or rejection. According to this analysis, we can conclude that human capital efficiency and capital employed efficiency partially affect financial performance of enterprises in ICT manufacturing industry in Serbia. Therefore, the first and the third hypothesis are partially confirmed. Structural capital efficiency does not determine the financial performance when analyzing all of the financial performance indicators, which rejects the second research hypothesis.

Table 10: Regression model 6 (ROIC)

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.861[a]	.742	.742	40.1534155	
2	.902[b]	.814	.814	34.0949929	1.954

a. Predictors: (Constant), Lev, TA
b. Predictors: (Constant), Lev, TA, HCE, SCE, CEE
c. Dependent Variable: ROIC

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9914122.010	2	4957061.005	3074.534	.000[b]
	Residual	3448702.798	2139	1612.297		
	Total	13362824.808	2141			
2	Regression	10879792.010	5	2175958.402	1871.843	.000[c]
	Residual	2483032.798	2136	1162.469		
	Total	13362824.808	2141			

a. Dependent Variable: ROIC
b. Predictors: (Constant), Lev, TA
c. Predictors: (Constant), Lev, TA, HCE, SCE, CEE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	3.872	.902		4.294	.000		
	TA	-2.09E-007	.000	-.010	-.892	.372	1.000	1.000
	Lev	1.999	.025	.861	78.405	.000	1.000	1.000
2	(Constant)	3.873	.772		5.020	.000		
	TA	-8.51E-008	.000	-.004	-.428	.669	.999	1.001
	Lev	1.326	.032	.571	41.635	.000	.462	2.164
	HCE	-.058	.048	-.011	-1.222	.222	.999	1.001
	SCE	-.028	.157	-.002	-.176	.860	1.000	1.000
	CEE	1.243	.043	.396	28.821	.000	.462	2.166

a. Dependent Variable: ROIC

Conclusion and directions for future research

In the last couple of decades, significant number of research studies has been implemented with the objective of determining the relationship between intellectual capital and corporate performance. In addition, these studies examined various industries and reached various conclusions. The majority of empirical studies confirmed positive impact of intellectual capital on corporate performance. However, these conclusions were often made for the developed economies, which already rely significantly on intangible resources as the major driver of value creation. On the other hand, conclusions from developing economies vary. For example, as stated by *Firer* and *Williams* [16], physical capital remained the most significant underlying resource of corporate performance in South Africa among enterprises in the knowledge-intensive sectors (banking, electrical, information technology, and services industries). Similarly, *Gan* and *Saleh* [17] when investigated the relationship between components of intellectual capital and corporate performance of technology-intensive companies in Malaysia found that in the time of the study, these Malaysian companies were primarily dependent on physical capital. The results also indicated that physical capital efficiency is the most significant variable related to profitability while human capital efficiency is of great importance in enhancing the productivity of the company.

The research conducted in Serbian ICT manufacturing industry, where relationship between intellectual capital and financial performance of 594 enterprises were analyzed for the period of five consecutive years (2009-2013), produced results that were expected to a certain extent. The starting premise was that intellectual capital components (human and structural capital efficiencies) were primary drivers of financial performance, while physical capital had no significant influence on value creation. The research hypotheses were identified accordingly. The results of multiple regression analysis showed that only human capital efficiency affects financial performance (in cases of net profit, operating profit, and profitability), while capital employed efficiency had significant impact on ROE and ROIC. Structural capital had no impact on any indicator of financial performance. Overall, we can say that ICT manufacturing industry might be moving into the right direction when discussing employing IC in achieving positive financial results. When compared to other industries in Serbia, ICT manufacturing industry demonstrated increasing significant impact of human capital, thus confirming that this industry is knowledge-intensive even in developing country like Serbia. On the other hand, the research that analyzed IC and financial performance of another presumably knowledge-intensive sector in Serbia (banking sector) pointed out that human capital component was undervalued and not exploited effectively. In addition, physical capital still played a significant role in achieving exceptional levels of profitability and ROE in banking sector [3]. In a study conducted on 100 enterprises with the highest net profits in 2011 [27] there was no statistically significant impact of either of IC components on financial performance. In particular, the results of regression analysis showed that ROE was mainly influenced by physical capital and to a small extent by structural capital. ROA was affected solely by physical capital, while employee productivity was not influenced by any component of IC. Profitability was determined by physical and structural capital, and not by human capital.

The results of our empirical study undertaken in Serbia in ICT manufacturing sector serves as a good basis for further research to improve understanding of the impact of IC on financial performance in knowledge-intensive industries. One direction can be towards including more variables in the study, such as different nonfinancial measures of performance. By doing this, the scope and validity of the research could be increased. Another route would be to conduct the research on a larger sample and include the whole ICT sector, and not only manufacturing segment. This broader study would increase the validity of the results and could help in understanding the IC flows in knowledge-intensive industries in developing economies.

References

1. Bontis, N. (2001). Assessing knowledge assets: A review of the models used to measure intellectual capital. *International Journal of Management Reviews*, *3*(1), 41-60.
2. Bontis, N., Dragonetti, N. C., Jacobsen, K., & Roos, G. (1999). The knowledge toolbox: A review of the tools available to

measure and manage intangible resources, *European Journal of Management, 17*(4), 391-402.

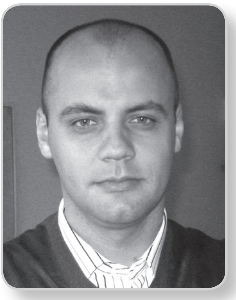
3. Bontis, N., Janošević, S., & Dženopoljac, V. (2013). Intellectual capital and the corporate performance of Serbian banks. *Actual Problems of Economics*, *4*, 287-299.
4. Brennan, C., & Connell, B. (2000). Intellectual capital: Current issues and policy implications. *Journal of Intellectual Capital*, 1(3), 206-240.
5. Brooking, A. (1997). *Intellectual capital: Core asset for the third millennium enterprise*. London: Thomson Business Press.
6. Chen, M., Cheng, S., & Hwang, Y. (2005). An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance. *Journal of Intellectual Capital, 6*(2), 159-176.
7. Cleary, P. (2009). Exploring the relationship between management accounting and structural capital in a knowledge-intensive sector. *Journal of Intellectual Capital, 10*(1), 37-52.
8. Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates.
9. Corrado, C., Hulten, C., & Sichel, D. (2006). *Intangible capital and economic growth (*Finance and Economics Discussion Series No. 24). Washington, DC: The Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board.
10. Đuričin, D., & Vuksanović, I. (2013). Reindustrialization strategy of Serbia: How to get it and how to use it. *Ekonomika preduzeća, 61*(5-6), 289-308.
11. Dženopoljac, V. (2013). *Uticaj nematerijalne aktive preduzeća na proces stvaranja vrednosti* (doktorska disertacija). Kragujevac: Ekonomski fakultet. Retrieved from https://fedorakg.kg.ac.rs/fedora/get/o:269/bdef:Content/get
12. Erickson, S., & Rothberg, H. (2009). Intellectual capital in tech industries: A longitudinal study. *Electronic Journal of Knowledge Management, 7*(5), 559-566.
13. Eurostat European Commission. (2008), *NACE Rev. 2: Statistical classification of economic activities in the European Community*. Retrieved from http://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF/dd5443f5-b886-40e4-920d-9df03590ff91?version=1.0
14. Fan, L., Yuan, X., & Wang, S. (2011). Research on the relationship between intellectual capital and company performance: An empirical analysis based on panel data. In *M&D Forum, Proceedings of the Sixth International Symposium of Corporate Governance*. Retrieved from http://www.seiofbluemountain.com/upload/product/201108/2011gszlhy04a8.pdf
15. Financial Accounting Standard Board. (2001). *Statement No. 142: Goodwill and other intangible assets*. Retrieved from http://www.fasb.org/summary/stsum142.shtml
16. Firer, S., & Williams, S. M. (2003). Intellectual capital and traditional measures of corporate performance. *Journal of Intellectual Capital, 4*(3), 348-360.
17. Gan, K., & Saleh, Z. (2008). Intellectual capital and corporate performance of technology-intensive companies: Malaysia evidence. *Asian Journal of Business and Accounting*, *1*(1), 113-130.
18. Goh, P. C. (2005). Intellectual capital performance of commercial banks in Malaysia. *Journal of Intellectual Capital*, *6*(3), 385-396.
19. Hall, R. (1992). The strategic analysis of intangible resources. *Strategic management journal*, *13*(2), 135-144.
20. IASB. (2004). *Intangible Assets: International Accounting Standard (IAS) No. 38*. London: International Accounting Standards Board – IASB.
21. Itami, H. (1991). *Mobilizing invisible assets*. Cambridge: Harvard University Press.
22. Jalava, J., Aulin-Ahmavaara, P., & Alanen, A. (2007*). Intangible capital in the Finnish business sector, 1975-2005* (ETLA discussion paper no. 1103). Retrieved from http://www.etla.fi/files/1866_Dp1103.pdf
23. Janošević, S., & Dženopoljac, V. (2011). Intellectual capital and financial performance of Serbian companies in the real sector. *Ekonomika preduzeća, 59*(7-8), 352-366.
24. Janošević, S., & Dženopoljac, V. (2012a). Impact of intellectual capital on financial performance of Serbian companies. *Actual Problems of Economics*, *7*, 554-564.
25. Janošević, S., & Dženopoljac, V. (2012b). An investigation of intellectual capital influence on financial performance of top Serbian exporters. *Ekonomika preduzeća, 60*(7-8), 329-342.
26. Janošević, S., Dženopoljac, V., & Dimitrijević, S. (2013). Analysis of intellectual capital practices in Serbia. *Actual Problems of Economics*, *6*, 548-562.
27. Janošević, S., Dženopoljac, V., & Tepavac, R. (2012). Corporate performance driven by intellectual capital: An empirical analysis. In D. Tipurić, & M. Dabić (Eds.), *Management, governance, and entrepreneurship: New perspectives and challenges* (pp. 136-153). Darwen: Access Press UK.
28. Kavida, V., & Sivakoumar, N. (2010).The relevance of intellectual capital in the Indian information technology industry. *The IUP Journal of Knowledge Management*, *8*(4), 25-38.
29. Kujansivu, P., & Lonnqvist, A. (2005). *The value and efficiency of intellectual capital in Finnish companies*. Tampere University of Technology. Paper presented in the First Workshop on Visualizing, Measuring, and Managing Intangibles and Intellectual Capital (pp.1-14). Ferrara Italy.
30. Lev, B. (2001), *Intangibles: Management and reporting*. Washington, DC: Brookings Institution Press.
31. Marr, B., Gray, D., & Neely, A. (2003). Why do firms measure their intellectual capital? *Journal of Intellectual Capital, 4*(4), 441-464.
32. Marrano, M. G., Haskel, J., & Wallis, G. (2007). *What happened to the knowledge economy? ICT, intangible investment and Britain's productivity record revisited* (Working paper no. 603). Retrieved from http://www.econ.qmul.ac.uk/papers/doc/wp603.pdf
33. MERITUM. (2002). *Guidelines for managing and reporting on intangible measuring intangibles to understand and improve innovation management*. Madrid: MERITUM.
34. Moeller, K. (2009). Intangible and financial performance: Causes and effects. *Journal of Intellectual Capital*, *10*(2), 224-245.
35. Mouritsen, J., Bukh, P. N., & Marr, B. (2004). Reporting on intellectual capital: Why, what and how? *Measuring Business Excellence*, *8*(1), 46-54.
36. Nakamura, L. (2000). Economics and the new economy: The invisible hand meets creative destruction. *Federal Reserve Bank of Philadelphia Business Review*, July/August, 15-28.
37. Osman, J. Z. A. (2014). *An empirical investigation into the significance of intellectual capital and strategic orientations on innovation capability and firm performance in Malaysian*

information and communications technology (ICT) small-to-medium enterprises (SMEs) (Doctoral thesis). School of Management, RMIT University. Retrieved from https://researchbank.rmit.edu.au/eserv/rmit:160964/OsmanZainalAbidin.pdf

38. Pablos, P. (2003). Knowledge management projects: State of the art in the Spanish manufacturing industry. *International Journal of Manufacturing Technology and Management*, *14*(4), 297-310.
39. Petty, R., & Guthrie, J. (2000). Intellectual capital literature review: Measurement, reporting and management. *Journal of Intellectual Capital, 1*(2), 155-176.
40. Pulic, A. (1998). *Measuring the performance of intellectual potential in knowledge economy.* Paper presented at 2nd World Congress on Managing and Measuring Intellectual Capital, McMaster University, Hamilton.
41. Pulic, A. (2004). Intellectual capital: Does it create or destroy value? *Measuring Business Excellence*, *8*(1), 62-68.
42. Roos, G., Pike, S., & Fernström, L. (2005). *Managing intellectual capital in practice*. Oxford: Butterworth-Heinemann.
43. Seleim, A., Ashour, A., & Bontis, N. (2007). Human capital and organizational performance: A study of Egyptian software companies. *Management Decision*, *45*(4), 789-801.
44. Shiu, H. J. (2006). The application of the value added intellectual coefficient to measure corporate performance: Evidence from technological firms. *International Journal of Management, 23*(2), 356-365.
45. Smith, G. V. (1994). *The new role of intellectual property in commercial transactions*. New York: Wiley.
46. Stewart, T. A. (1998). *Intellectual capital: The new wealth of organizations*. London: Nicolas Brealey Publishing.
47. Sullivan, P. H. (2000). *Value-driven intellectual capital: How to convert intangible corporate assets into market value*. New York: Wiley.
48. Suraj, O. A., & Bontis, N. (2012). Managing intellectual capital in Nigerian telecommunications companies. *Journal of Intellectual Capital, 13*(2), 262-282.
49. Sveiby, K. E. (1997). *The new organizational wealth: Managing and measuring knowledge-based assets*. San Francisco: Barrett – Kohler.
50. Tan, H. P., Plowman, D., & Hancock, P. (2007). Intellectual capital and financial returns of companies. *Journal of Intellectual Capital*, *8*(1), 76-95.
51. Teece, D. J. (2000). *Managing intellectual capital: Organizational, strategic, and policy dimensions*. New York: Oxford University Press.
52. The Department of Economic and Social Affairs of the United Nations Secretariat. (2008). *International Standard Industrial Classification (ISIC) of All Economic Activities, Revision 4.* Retrieved from http://unstats.un.org/unsd/cr/registry/regdntransfer.asp?f=135
53. Ting, I. W. K., & Lean, H. H. (2009). Intellectual capital performance of financial institutions in Malaysia. *Journal of Intellectual Capital*, *10*(4), 588-599.
54. Tovstiga, G., & Tulugurova, E. (2007). Intellectual capital practices and performance in Russian enterprises. *Journal of Intellectual Capital*, *8*(4), 695-707.
55. Zéghal, D., & Maaloul, A. (2010). Analyzing value added as an indicator of intellectual capital and its consequences on company performance. *Journal of Intellectual Capital*, *11*(1), 39-60.

Stevo Janošević

is a Full Professor at the Faculty of Economics, University of Kragujevac. He teaches courses in Strategic Management (graduate studies) Business Strategy and Intellectual Capital Management (master's degree studies), and Change Management and Competitive Advantage (PhD studies). So far he has published several books as author or co-author, such as Strategic Planning of Research and Development, Innovations and Technology Strategy of a Firm, Strategic Management (4 editions), Total Quality Management, and Management and Strategy (8 editions). He led and participated in over 60 studies for the needs of companies in Serbia. Now, he is Chairman of the Board of Directors at "Metalac-Proleter". Current areas of professional interest are change management and competitive advantage, enterprise restructuring, strategic financial management, and measurement and management of intellectual capital.



Vladimir Dženopoljac

is an Assistant Professor at the Faculty of Economics, University of Kragujevac, for the courses of Strategic Management and Business Planning and Policy, at the bachelor's level studies. At the master's degree studies, he is engaged as Assistant Professor of Business Strategy and Intellectual Capital Management. Within the doctoral degree studies, he teaches Change Management and Competitive Advantage. Until now, he has published a number of papers in his field of professional expertise, and has been involved in implementation of several projects for Serbian companies. Current areas of professional interest are intellectual capital management and strategic financial management.