Intellectual capital transformation evaluating model

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Abstract

Purpose – The purpose of this paper is to present a framework that is developed for analysis of intellectual capital transformation into companies' value, including an identification of the key factors of this process.

Design/methodology/approach – The paper employs intellectual capital on the intersection of value-based management (VBM) and the resource-based view (RBV). Starting from a review of the results provided in the literature regarding intellectual capital (IC) evaluation and its link with firm performance, a system of proxy indicators related to IC transformation in both concepts has been designed. The evaluation ability of the developed model was justified using regression analyses.

Findings – A detailed algorithm for intellectual capital evaluation in terms of input-outcome transformation. The intellectual capital transformation evaluating model (ICTEM) provides a holistic view of intellectual resources as companies' strategic investments.

Research limitations/implications – The paper emphasizes that the ICTEM framework could be mostly applied for the analysis of a firm as a typical representative of the industry or the country. In that sense it is not applicable for specific feature analysis of a company.

Practical implications – The paper highlights the ICTEM as a tool of investment decisions, mostly taking into account common trends, the prospects of industries, and economies' development.

Originality/value – The ICTEM provides the ostensive framework of intellectual capital transformation analysis using a statistical approach.

Keywords Intellectual capital, Evaluation, Model, Value drivers, Transformation process, Business performance

Paper type Research paper

1. Introduction

Intellectual capital (IC) evaluation seems to be one of the most important and relevant topics in the new strategic management (Roos *et al.*, 2005).

When defining the strategy of the company, managers and owners always have a shortage of information about the potential effectiveness of different investments. This problem is even more acute if companies' intangibles are considered. It seems to be important due to their heterogeneity, as well as non-physical and non-financial nature (Pike *et al.*, 2005). This is why many IC evaluating methods have appeared in recent years (Sveiby, 2010). Despite a strong empirical background this issue has not been fundamentally well studied. Most of the research has been devoted to the IC impact analysis, but has provided contradictory results (Firer and Williams, 2003; Tseng and Goo, 2005; Shiu, 2006).

This paper aims to develop a tool for the evaluation of IC transformation. Authors believe that this issue is very important and should have strong theoretical support.

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Starting with the development of a framework of IC analysis authors try to identify relevant questions.

It should be noted that most of the empirical studies mentioned above seek to answer the question: "What does happen with companies' intellectual resources?" While only a few provide the answer to the question: "Why?" However, the second problem is even more important than the first one in some cases. Solving that issue the factors, which support or obstruct IC transformation in companies' performance, should be revealed. Among these impact factors are the industry to which the companies belong (Clarke *et al.*, 2010), the companies' sizes and ages (Al-Twaijry, 2009), and socio-political and economic environment (Tovstiga and Tulugurova, 2007). The final, yet equally important, question of IC transformation is: "How much does IC contribute to companies' performance?" The model introduced in this paper provides the tools to allow answering all the questions mentioned above.

Authors seek to integrate significant approaches within this research field: resource- and value-based views. The first one underlines the quality of input resources: they need to be appropriable, valuable, rare, durable, imperfectly imitable and non-transferable (Grant, 1991). The value-based view explores how much the company benefits from investments, including IC accumulation. This approach provides a wide range of tools that simultaneously reflect companies' performance and IC outcomes: the economic profit concept.

The proposed framework is based on a statistical analysis of data collected from companies' annual reports and other publicly available information.

This model is expected to be useful for both academic research and company managers. Academics could apply the suggested framework in this paper to solve empirical problems encountered in their own research projects. The key advantages of the approach designed in this study are connected with its ability to systematize core intellectual resource features, as well as provide a modern view of companies' performance in terms of value creation. Additionally, this decision-making tool can support managers if they use benchmark designing of the company strategy.

In attempting to solve the problems stated in this research authors investigate the process of IC transformation in companies' performance, identifying the factors that influence this transformation. That is why this technique is called in this research an "Intellectual Capital Transformation Evaluating Model" (ICTEM).

The paper is organized as follows: the next section gives a brief overview of the theoretical issues of IC in both resource- and value-based approaches, and introduces the framework of the ICTEM tool at the intersection of these concepts. In the next part of the paper the methodology of the ICTEM is described. Then the model suggested in this research is empirically tested. The last section concludes the paper by briefly summarizing the main findings obtained.

2. IC: entity, features and transformation

In analysing the evolution of the IC concept, it is concluded that in relevant studies an interpretation of IC is diversified. That could be easily explained by the multiple purposes of its analysis.

In this study IC is considered according to the resource-based approach. The resource-based view concentrates on the dominant role of internal resources and understands firms as heterogeneous entities characterized by their unique resource base (Pike *et al.*, 2005). It does not emphasize physical or intangible resources. The resource-based view generally states that a firm is able to secure sustainable abnormal returns from their resources when they are (Barney, 1991; Grant, 1991; Kristandl and Bontis, 2007):

- Valuable: firm resources need to be able to create sustainable value for a company.
- Appropriable: they should be able to earn rents exceeding the cost of the resources.
- Durable: the useful lifespan of the resources should be long in comparison with those of competitors. The rate at which resources depreciate and become obsolete influences the sustainability of benefit creation.
- Rare: the resources need to be heterogeneously distributed across firms, not easily accessible to competitors, and in possession by a low number of firms.
- Imperfectly or slightly imitable: the complex nature of the resources should protect them from being copied by competitors.
- Non-transferable: competitors should be unable to acquire (on equal terms) the equivalent resources on factor markets in order to substitute an otherwise inimitable resource.

These features required from resources show that the resource-based view explores the nature as well as the quantity and quality of resources deployed in the value creation process (Tseng and Goo, 2005). In recent years, evidence has been presented that intangible resources are more suited to these characteristics than tangible one (Roos *et al.*, 2005). That is why the investigation of the transformation of intangible resources into a firm's value and attention to them as an enhancer of tangible resources appears to be an important research problem.

In this study a slightly modified definition of IC is presented. Initially that is proposed by Kristandl and Bontis and is strongly corresponds to the resource-based view:

> Intellectual capital is a portfolio of strategic firm resources that enable an organization to create sustainable value (2007).

It should be noted that IC is a heterogeneous resource; therefore, it is important to split it into components and analyse each of them separately. These three components are now the most commonly accepted: human capital (HC), relational capital (RC) and structural capital (SC). Each of the three IC components can be defined (InCaS: Intellectual Capital Statement, 2009), can be measured through indicators (Pedersen, 1999) and cover separate management areas (InCaS: Intellectual Capital Statement 2009). In Table I some examples of possible IC component indicators using so-called Ramboll model are shown (Pedersen, 1999), because it gives numerical IC indicators that are essential to our model.

Despite an obvious relation – "the more and better resources are used the more and better performance is achieved" – in the reality this logic is sometimes broken. It is supposed that resources could be either utilized or over-utilized; meanwhile a number of internal and external factors could be influencing the transformation of IC into companies' performance. Considering this relation authors move to the IC transformation analysis. The logical scheme of this analysis is related to the assumption that IC inputs convert into the outputs and they in turn transfer to outcomes (Figure 1).

Components	Definition	Examples of indicators	Management focus
Human capital	What the single employee brings into the value-adding processes	Revenue generated per employee, number of senior positions filled by junior staff, training spent per employee, average length of service of staff, staff turnover, educational level of staff, new ideas generated by staff, value added per employee	Employee's professional and social competence management, leadership, incentive system
Structural capital	What happens between people, how people are connected within the company and what remains when the employee leaves the company	Income per R&D expense, individual computer links to database, number of times database has been consulted, upgrades of database, contributions to database, number of patents, number of new product introductions	Process engineering, organizational culture, innovation and technology, organizational knowledge creation and transfer
Relationship capital	The relations of the company to external stakeholders	Growth in sales volume, revenues per customer, brand loyalty, customer satisfaction, customer complaints, reputation of company	Communication and cooperation with customers, suppliers, investors, partners and competitors

Table I. Intellectual capital (IC) components: definition, indicators and management focus

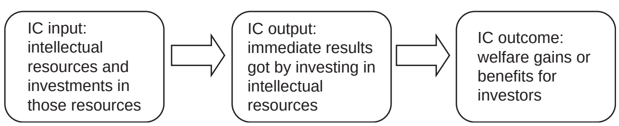


Figure 1. Intellectual capital transformation scheme

To reveal IC outcomes from the investment point of view the value-based approach should be applied.

3. IC: outcome evaluation

As it has been already noted that both tangible and intellectual resources of the companies are strongly interrelated. Thereby the companies' performance indicators that mostly reflect intangible outcomes have to be chosen. Turning to the main stages of value-based view evolution many links to the IC concept likely to appear. As mentioned above, the VBM approach considers a company from an investment point of view and provides the whole set of tools for intangibles' effectiveness evaluation. Most of them are related to the economic profit concept. Economic profit expresses the residual income – "profit above a normal rate of return" (Zaratiegui, 2002). That means that if IC outcomes are considered it is important to analyse not only returns of a particular firm, but also opportunity costs expressed in the normal (average) rate of return in the economy or the industry.

Numerous stakeholder theory researchers agree that economic profit, as well as possible, describes the efficiency of IC employment (Donaldson and Preston, 1995; Riahi-Belkaoui, 2003). This concept implies that the company succeeds when returns on invested capital exceed the industry average level. In a situation where much of the technology and financial resources are generally available to all companies around the world, they should look for another source of growth. This is the only way to achieve better results on the market. That could be provided by IC employment and its effective management. This reasoning underlies the assumption that a positive economic profit reveals an IC.

Obviously economic profit could be expressed in different performance indicators: shareholders' value added (Rappaport, 1986), economic value added (EVA) (Stern, 2001), cash value added (Ottoson and Weissenrieder, 1996) and many others. They can be considered as indicators of the IC outcomes.

The EVA model is very widespread and could be used to estimate on the data introduced in companies' financial statements. According to the Stern and Stewart concept, "EVA is calculated as the difference between the Net Operating Profit After Tax (NOPAT) and the opportunity cost of Capital Employed (CE*WACC)" (Stern, 2001).

EVA provides an evaluation of a company as reflected in an increase in enterprise value over a certain period.

Market value added (MVA) is related to the long-term indicators of the IC outcomes. MVA estimates a spread between an enterprise value and a book value of assets.

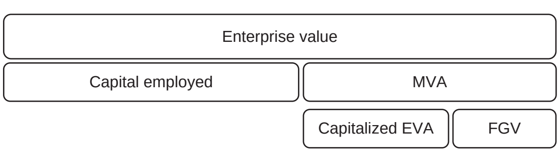
Another indicator which is closely connected with economic profit is the future growth value (FGV). FGV assesses a share of market value attributed to EVA growth. According to Stern and Stewart, "FGV can be driven by market expectations of productivity improvements, organic growth and value-creating acquisitions. Companies can calibrate their incentive plan to performance targets tied to the annual EVA growth implied by FGV. Furthermore, the FGV component can be a useful tool in benchmarking against the 'growth plan' of competitors and evaluating investors' assessments of the wealth creation potential of new strategies and opportunities" (Stern Stewart & Co, 2012). Several studies have shown that a share of the FGV in several companies' value grows every year, and in some industries is associated with innovative product implementation (Burgman and Roos, 2004). This approach suggests that innovative behaviour and investment policy focused on IC accumulation have a higher potential of future growth.

In conclusion it is stated that three value-added indicators are the most widespread and applicable for the IC outcomes analysis: EVA, MVA and FGV.

Figure 2 shows the links between those indicators.

The EVA indicator is related to the immediate return on the IC investments. The MVA indicator, as well as FGV, is associated with the long term; however, they are different. MVA reflects the intrinsic value of the IC, while FGV is associated with potential value growth indicated by the market.

Figure 2.
Intellectual capital outcomes' interconnection



4. IC: from inputs to outcomes

Since the IC becomes the key driver in providing improved performance (Roos *et al.*, 2005) there have been many attempts to develop common guidelines for measuring IC itself and also its ability to enhance business performance. The most famous models are Sveiby's Intangible Asset Monitor (Sveiby, 1997), Norton and Kaplan's balanced score card and strategy maps (Kaplan and Norton, 2004) and the Skandia Navigator (Edvinsson and Malone, 1997). These models consider intellectual resources as inputs and seek to ascertain their impact on companies' outcomes.

Recent development of the IC management area is concentrated on standardizing the process of creating an Intellectual Capital Statement. Practical guidelines from Europe, Australia, Denmark, France, Sweden and others allow each company according to its strategy to implement an IC measurement system (European Communities, 2006). This system supports IC management and reporting through the input-output-outcomes value creation indicators. The main disadvantage of such an "individual" approach is the difficulties of benchmarking and comparison with close competitors.

Another body of literature investigates the impact of IC on companies' performance by turning to econometric tools. One of the main conclusions provided by the econometric-based studies is the evidence that the key feature of IC is its ability to enhance the effectiveness of other resources, including tangible assets. The existing studies have mixed results across different countries, industries and years, and provide contradictory results.

These studies consider IC inputs as explanatory factors, while IC outputs and outcomes are explained as variables. The frameworks used for most IC evaluation models have similar features; however, they do serve different purposes or use different approaches. For IC measurement the following tools are applied:

- Scorecard methods (Tseng and Goo, 2005; Bollen *et al.*, 2005; Tovstiga and Tulugurova, 2007; Cricelli *et al.*, 2011). The IC indicators in the scorecard are obtained through questionnaires or from available information.
- Integrated IC indexes as value added intellectual coefficient (Pulic, 2000), calculated intangible value (Garanina and Pavlova, 2011) and EVA (Huang and Wang, 2008).

The companies' performance in the empirical studies is identified through:

- accounting indicators such as return on assets (Shiu, 2006; Zéghal and Maaloul, 2010; Bollen *et al.*, 2005), profit after tax (Cohen and Kaimeakis, 2007), employee productivity (Clarke *et al.*, 2010); and
- value-based indicators such as market to book value (Tseng and Goo, 2005), MVA (Pulic, 2000), Tobin's *Q* (Shiu, 2006; Liang *et al.*, 2011).

Turning to the questions that led to the idea of this study: "What?", "Why?" and "How much?", it is found out that against a large number of studies solving the first of these issues, only a few consider the transformation factors of IC. Even fewer researchers focus on evaluating the contribution of intellectual resources.

The ICTE model introduced in the next section provides a multipurpose technique that allows answering all the questions mentioned above.

5. Developing the transformation evaluating tool

The elements of the chain "inputs-transformation-outcomes" are identified in terms of the most efficient way of IC employment. The quality and quantity of intellectual resources are introduced as IC inputs. Those inputs transform into the benefits companies obtain from investing in IC. In this research value creation is considered as a checkpoint for efficient investment decisions. Thus, the framework for ICTEM is presented in Figure 3.

The model introduced in this study implies econometric analysis. The core specification of the ICTEM is as follows:

$$\begin{aligned}\mathrm{Perf}_{it} = \alpha + (\beta_1, \ldots, \beta_n)\mathrm{HC}_{it} + (\delta_1, \ldots, \delta_n)\mathrm{SC}_{it} \\ + (\varphi_1, \ldots, \varphi_n)\mathrm{RC}_{it} + (\lambda_1, \ldots, \lambda_n)\mathrm{TF}_{it} + \varepsilon_{it}\end{aligned}$$

where Perf is an indicator of IC outcomes (e.g. EVA, MVA or FGV); HC is a vector of variables responsible for HC component; SC is a vector of variables responsible for SC component; RC is a vector of variables responsible for RC component; TF is a vector of transformational factors; ε is a vector of errors; t is a time period (from panel data); β_i, δ_i, φ_i, λ_i are regression coefficients.

In accordance of the framework for ICTEM (Figure 3) the indicator's system for each element based on the previous theoretical and empirical studies is developed. Despite the rich body of literature devoted to the measurement of IC transformation, the problem of its evaluation remains a challenge. The direct estimation of IC inputs, outcomes and transformational factors is difficult due to their nature and features. Proxy indicators are used to solve that problem. For instance, "board of directors' qualification" reflects the quality of HC related to top management; "commercial expenses share" approximates investments in RC; and "number of patents, licenses and trademarks" indirectly shows the amount of companies' SC. Value-added indicators are proxies for IC outcomes as well because they reflect an integrated return on capital employed. It is also supposed that according to economic profit concept those indicators are mostly related to intellectual resources. The indicators' system implemented in this study fits the following requirements:

- proxies describe (as well as possible) the phenomenon they estimate;
- system of indicators is comprehensive and balanced; and
- information is publically available: companies' annual reports, companies' web sites, different rankings, search engines and many others sources.

Our system of "inputs-transformation-outcomes" indicators, as well as its digitizing method, is introduced in Tables II-IV.

This paper presents the difficulties of finding out direct indicators of IC components. Further testing and applications of the developed ICTE model will offer the opportunity to refine and validate it.

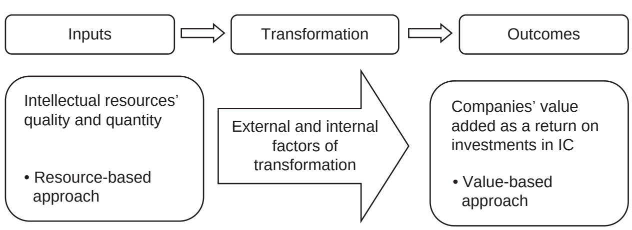


Figure 3.
Framework for ICTEM

Components	ICTEM input indicators	Information source and estimation algorithm
Human capital	Share of wages in costs	Company's Annual Report,[a] section "Financial data" Employee costs divided to total costs
	Cost of employee	Company's Annual Report,[a] section "Financial data" Employee costs divided to total costs
	Earnings per employee	Company's Annual Report, sections "Common information" and "Financial data" EBIT divided to number of employees
	Board of directors' qualification	Company's Annual Report, section "Directors' information" If more than one-third of directors have postgraduate level qualifications and more than five years experience – 2 points If more than one-third of directors have postgraduate level qualifications or more than five years experience – 1 point Otherwise – 0 points
	Corporate university	Search on company's web site using the words as "corporate university" If company has information about the above – 1 point, otherwise – 0 points
Structure capital	R&D investments	Company's Annual Report, section "Financial data"
	Intangible assets	Company's Annual Report, section "Financial data"
	Patents, licenses, trade marks	Search on company's name and number of patents on the web site QPAT: http://library.hse.ru/e-resources/e-resources.htm
	ERP systems implementation	Search on company's location on their web site using the following words as "ERP", "Oracle", "NAVISION", "NAV", "SQL", "SAP" If company has news about these as listed above – 1 point, otherwise – 0 points Important to put "1" or "0" in the year of implementation
	Strategy implementation	Search on company's location on their web site using the following words as "strategy", "strategy implementation" If company has news about these as listed above – 1 point, otherwise – 0 points Important to put "1" or "0" in the year of implementation
	Stable turnover growth	Company's Annual Report, section "Financial data" Standard deviation of the total revenue sum from previous and current divided to average of this sum
	Presence of subsidiaries	Company's Annual Report, section "Subsidiary name" If company has <100 subsidiaries put the total number, otherwise use the following vector "First 100 out of Y subsidiaries"
Relational capital	Well-known brand	Search on company's name on the web site: www.justmeans.com/top-global-1000-companies If it has a rank – 1 point, otherwise – 0 points
	Commercial expenses share	Company's Annual Report, section "Financial data" Commercial expenditures divided to difference between total revenue and EBIT
	Foreign capital employed	Company's Annual Report, section "Shareholder name", vertical vector "country" If company has foreign investors it gains 1 point and otherwise 0 points

(*continued*)

Table II.
Proxy indicators for IC inputs

Components	ICTEM input indicators	Information source and estimation algorithm
	Citations in search engines	Search on company's name and its score on the web site: www.prchecker.info/check_page_rank.php
	The integral index of the web site quality	Search on company's web site and estimate site quality according to the following criteria: availability of information for investors (special section or page); multi-lingual information (with English language); amount of information (more than ten pages); and design (using flash animation) For each criterion company gains 1 point. The integral index is the sum of points
	Participation in business associations	Company's Annual Report, section "Common information" For those who involved in business associations it is given 1 point and otherwise 0 points
	Owner/director ratio	Company's Annual Report,[a] sections "Shareholder name" and "Directors' information"

Notes: [a]All information which we take from a company's profile, balance sheet or profit and loss account is called "A Company's Annual Report". For our study we used the annual reports from the AMADEUS database provided by Bureau Van Dijk (www.bvdep.com/be-nl/AMADEUS.html)

Table II.

It is important to note that the authors suggest only one method of ICTEM framework implementation. The empirical results are presented in the next section.

6. ICTEM justification study

The purpose of this section is to justify the ability of ICTEM to analyse the IC transformation process. In assessing the ICTEM specification introduced in the previous section on the database of European companies a significant model with high explanatory power expected to be discovered.

In this research companies from a number of European countries (Germany, Finland, Denmark, Spain and some others) are studied. These countries are chosen according to their positions in the Knowledge Economy Index (KEI) ranking – the first, second and third quartiles (The World Bank, 2009).

In addition companies from industries with a predominance of varied IC components and, therefore, different IC configuration are analysed. Thus following industries are selected: financial services, wholesale and retail trade (with HC power), machinery and equipment manufacturing, the chemical industry (with the important role of SC), and transport and communications (with RC predominance). These particular industries are relevant to this study since they represent a wide range of knowledge-intensive manufacturing and service sectors. Firm selection is carried out through a "one-step stratified sample design".

The validity of country and industry choice test (ANOVA) and the distribution of the data test (Kolmogorov-Smirnov test) show that the data for further analysis can be used with some restrictions. This means that the differences between countries and industries are statistically significant and the distribution is non-normal.

According to the ICTEM (Figure 3) and indicators for each component (Tables II-IV) the dataset is compiled for the European traded companies, including information on 332 companies over the years 2005-2009. Each categorical variable is transformed into a dummy variable for the linear regression analysis.

Transformational factors	ICTEM indicators	Information source and estimation algorithm
Internal factors	Company age	Company's Annual Report, section "Common information", foundation year
	Company size	Company's Annual Report, section "Common information", number of employees
	Global market orientation	Company's Annual Report, section "Financial data" If company has earnings from export – 1 point, otherwise – 0 points.
External factors	Industry	Company's Annual Report, section "Common information" Location of the company's headquarters
	Country	Company's Annual Report, section "Common information", Location of the company's headquarters
	Developed market	Company's Annual Report, section "Common information", foundation year If company is located in developed countries – 1 point, otherwise – 0 points
	Sub-indexes (or pillars) of Knowledge Economy Index (KEI)	Search on company's location on the web site: http://data.worldbank.org/data-catalog/KEI Put the score in the following pillars: vEconomic Incentive and Institutional Regime (EIR); veducation; vinnovation; and vinformation and communications technologies (ICT)
	Location in the state (or region) capital	Search on company's location on their web site, see the status of the city location in Wikipedia If it is the capital of the state (or region) – 1 point, otherwise – 0 points
	Location in a megalopolis	Search on company's location on their web site, see the population of the city location in Wikipedia If the number of inhabitants is more than one million people – 1 point, otherwise – 0 points

Table III.
Transformational factors' proxies

The datasets in this study derive from the detailed longitudinal database "Amadeus" provided by Bureau Van Dijk which is based on the companies' annual statistical and financial reports.

The sample in each stratum was selected with equal probability and without remission. The following criteria are applied when deciding on the inclusion of companies into the sample:

- Number of employees should be no less than 500 and no more than 20,000 people. For small and giant companies there are other factors affecting the company's success (tangible or non-market drivers consequently) and IC plays a minor role.
- A company should refer to the public and traded company. It is needed for IC outcomes' estimation (data for EVA estimation).

IC outcomes	ICTEM indicators	Information source and estimation algorithm
Immediate (short term) return on IC	Economic value added (EVA)	$EVA_t = CE_{t-1} \times (ROIC_t - WACC_t)$, $CE_{t-1} = D_t + E_t$: capital employed D_t: book value of debt E_t: book value of equity $ROIC_t = NOPAT_t/CE_{t-1}$: return on invested capital $NOPAT_t = EBIT_t(1-T)$: net operation profit after taxes $WACC_t = D_t/(D_t + E_t) \times kd(1-T) + E_t/(D_t + E_t) \times ke$: weighted average cost of capital $kd = krf +$ default spread of the company + default spread of the country: cost of debt $ke = krf + \beta \times (km - krf)$: cost of equity krf: risk-free rate – return on the treasury bonds of US Government β: bottom-up build beta (adjusted by Hamada's equation) km: historical return on the market portfolio (market index) T: effective tax rate
Potential (long term) return on IC	Market value added (MVA)	$MVA_t =$ Market capitalization$_t$ + Long-term debts$_t - CE_t$
	Future growth value (FGV)	$FGV_t = MVA_t -$ Capitalized EVA_t

Table IV.
Proxy indicators for IC outcomes

Table V helps to characterize types of companies that were analysed in our research. It presents several descriptive statistics of the sample, where the mean, median and the standard deviation of the variables are detailed.

The correlation coefficients between explanatory variables are not high. They range from a low of 0.003 to a high of 0.33. Presumably the absence of any multicollinearity problems is observed.

On the further stage the following issues are examined:

- What IC inputs transform into companies value in the short- and long-term periods? (EVA and FGV indicators of IC outcomes are applied for this purpose.)
- What internal and external factors have an impact on the IC transformation?

We assume that the variables, reflecting IC inputs as well as transformational factors, are statistically significant and are "explained by the sign".

When looking for the key drivers of IC transformation for European countries the relationship between them and IC outcomes tried to be revealed. Obviously, the variables that will be statistically significant in the equations can be considered as such drivers.

Table VI exhibits the results of the regression coefficients for all explanatory variables, using short- and long-run IC outcomes as the dependent variables. Panel A presents the results for EVA while Panel B presents the results for FGV, respectively.

The adjusted R^2 equals 0.14-0.33 for different specifications. These numbers indicate that the regression is able to explain about 20 per cent on average of the variance in the dependent variable for the sample. All equations are statistically significant in terms of the F-statistic.

ICTEM groups of indicators	Indicators	Objects observation numbers	Mean	Median	SD
Human capital	Share of wages in costs (%)	904	0.23	0.21	0.12
	Earnings per employee (th. euros/people)	904	0.03	0.01	0.13
	R&D investments (th. euros)	904	5.16	0.00	18.09
	Intangible assets (th. euros)	904	223.01	53.56	501.53
Relational capital	Commercial expenses share (%)	904	0.13	0.06	0.18
	The integral index of the web site quality	904	2.99	3.00	0.92
Transformational factors	Age (years)	904	39.93	25.50	35.24
	Number of employees (th. people)	904	4,406.74	2,620.50	4,554.34
	KEI: EIR	904	7.98	9.06	2.07
	KEI: education	904	8.25	8.94	1.42
	KEI: innovation	904	8.16	8.36	1.14
	KEI: ICT	904	8.38	9.45	1.45
IC outcomes	EVA (th. euros)	904	−51.07	−11.38	349.24
	FGV (th. euros)	904	1,379.47	375.82	6,622.22

Table V. The sample descriptive statistics

Independent variables	Dependent variables and specifications EVA (Panel A)	FGV (Panel B)
Human capital inputs		
Cost of employees	0.09	5.20**
	(1.18)	(2.51)
Owner-director ratio	−22.11	−132.47
	(−0.44)	(−0.14)
Board's qualification	−14.10	871.32*
	(−0.56)	(1.77)
Structural capital inputs		
Commerce expense	107.43	−271.76
	(1.41)	(−0.19)
Intangible assets	−0.28***	7.79***
	(−10.56)	(16.35)
ERP systems	51.91*	−955.00*
	(1.82)	(−1.86)
Patents, licenses and trade marks	−0.22	2.93
	(−1.44)	(1.08)
Strategy implementation	35.51	−661.80
	(1.26)	(−1.22)
Citation index	−19.00	400.03
	(−0.74)	(0.88)
Subsidiaries	−0.12	−2.06
	(−0.96)	(−0.88)

(*continued*)

Table VI. EVA and FGV regressions

Independent variables	Dependent variables and specifications EVA (Panel A)	FGV (Panel B)
Relational capital inputs		
Foreign capital employed	6.72	199.19
	(0.21)	(0.30)
Brand	162.60***	−1,632.42**
	(4.12)	(−2.26)
Web site quality	−77.33**	985.75*
	(−2.68)	(1.82)
Internal transformational factors		
Age	−0.25	0.93
	(−0.70)	(0.15)
Belonging to large enterprises (more than 1,000 employees)	−10.08	−0.35***
	(−0.36)	(−4.10)
External transformational factors		
Knowledge sub-index (economic incentive regime)	36.88*	238,547.90
	(1.69)	(0.96)
Knowledge sub-index (innovation)	157.51**	−170,491.20
	(1.97)	(−0.98)
Knowledge sub-index (education)	−92.81**	54,713.01
	(−2.54)	(1.00)
Knowledge sub-index (ICT)	−179.13***	18,730.40
	(−3.37)	(1.12)
Belonging to industry (manufacturing)	56.77**	−1,315.90**
	(2.03)	(−2.43)
Belonging to country (Germany)	63.74*	−264.63
	(1.72)	(−0.24)
Location in capital	46.88*	−361.89
	(1.89)	(−0.77)
Location in megalopolis	−7.34	−1,094.88*
	(−0.24)	(−1.80)
Constant	639.35	−1,270,112.00
	(3.39)	(−0.97)
Adjusted R^2	0.14	0.33
F-statistic	7.387753	18.41570
Probability (F-statistic)	0.000000	0.000000
Number of observations	930	829

Table VI.

Notes: *, **, ***Significance for 10, 5, and 1 per cent respectively

A number of statistically significant factors of IC outcomes are revealed. Moreover, they are consistent across specifications. The results seem to be robust because all coefficients have the expected sign, high significance ($p < 0.1$ or better) and remain unchanged.

We also found that supportive and obstructive external and internal transformational factors exist, such as company's size, industry, country and location. The unexpected finding implies that age does not appreciate the importance of the IC transformational process. The results remain similar and not significant at conventional levels in all equations.

The regression analysis ascertains different important input indicators of IC transformation. Some coefficients have positive signs with EVA and negative with

FGV, and are strongly significant ($p < 0.001$) meanwhile. This fact indicates that brand and ERP-system implementation play a crucial role for IC outcomes over short-term periods. However those factors are not reflected in the companies' value for strategic investors.

The negative sign on intangible assets and web site quality in the EVA model may be due to the fact that their improvement may generate additional expenses for companies. It is concluded that investments in intangibles assets, as well as web site development and promotion are not covered in the short-term period but provide the potential value growth.

All the evidences obtained in this study confirm that the ICTEM can be used as a tool for evaluation of the IC transformational process.

The results obtained from empirical analysis are shown in Figure 4.

7. Conclusions

The analysis of the relevant researches shows that they do not meet all of the challenges of IC management. Moreover, some empirical studies introduce contradictory results. It is concluded that this problem is mostly related to the difficulties of IC identification and measurement. It seems that a holistic framework for IC analysis is the next step of development in this field. That is why the theoretical background in the intersection of resource- and value-based views was proposed. This allows extending the knowledge of the IC transformation process, helping to deepen our understanding of its features and outcomes' evaluation.

The ICTEM introduced in this paper presents a multipurpose technique that allows answering the relevant questions related to IC benchmarking. The ICTEM provides the ostensive framework of IC analysis using a statistical approach. This tool is expected to be useful for further empirical studies as well as for practical accomplishment.

The empirical results mainly are in line with the previous studies that found a positive effect of IC on company performance, stating that IC plays a major role in creating value for shareholders as well as for other stakeholders. Our findings extend the understanding of transformation processes:

- The companies' efforts on IC management are enhanced in developed markets and in knowledge-driven economies. Although the level of education in the country and the information technology development complicate the obtaining abnormal profits from IC employment.
- HC appears to be relevant only for long-term return. Cost of employee and board's qualification are established as positive value drivers on our sample.

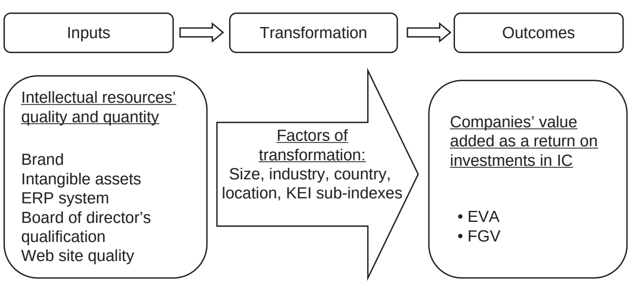


Figure 4. Framework for ICTEM: empirical evidence

- SC investigation provides unforeseen results in our research. The factors like as strategy, innovation behaviour, companies' network expected to be not important for company by creating value. At the same time, intangible assets are relevant as negative driver in the short-term performance and positive one in the potential future growth. ERP system on the contrary seems to lose its significance for companies' value.
- The effect of relation capital differs in depending on particular asset. In a short-term period brand of the company creates the value while the investment in web site quality destroy it. This influence changes in the long-term period.

This paper presents only a small part of the empirical results provided by ICTEM's application. Nevertheless, authors conclude that the model can be used for IC transformation evaluation because the statistical results are significant in terms of regression assessing.

Despite the logical reasoning of the ICTEM framework, it has shortcomings and limitations. The key restriction of the model is related to the assumption that the process of IC transformation could be investigated on the system of proxy indicators. This assumption should be tested on a particular database before drawing further conclusions. The second limitation of the presented approach is those difficulties faced by researchers mainly associated with data collection. If it has been decided to apply ICTEM, the costs of this solution should be checked. Are they covered by the benefits of applying this framework? The last matter that should be emphasized is linked to the ICTEM idea. According to this approach a particular company is investigated as a typical representative of the industry. It means that individual features of a specific company cannot be discovered. ICTEM would be only the first, but important, step of the investigation.

Further development of the model is connected with improvement of the proxy indicator system, as well as the implementation of more sophisticated econometric tools. Panel regression and instrumental variables application should be useful to avoid strong endogeneity problem related to the corporate data analysis. The variety of research questions can be investigated by applying ICTEM such as:

- hedonic pricing to identify IC contribution to value creation;
- complementary effects of the IC components and others; and
- impact of exogenous factors on IC transformation (financial and economic crisis seems to be one of the most relevant now).

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