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Intellectual Capital Measurement in IT industry

Master thesis

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Introduction

Intellectual capital have become the primary resource for creating wealth and value in most industries, surpassing the contributions of traditional resources. It is no surprise, then, that the business and valuation and measurement services in highest demand within today's corporations involve intellectual property and other intangibles for a variety of purposes including business transactions, strategic management, accounting, tax regulation etc. However nowadays with emergence and intensive growth of technological and capital intensive industries (especially IT) the topic is becoming one the most important issues for researchers to resolve.

There are different research traditions of intellectual capital measurement or valuation of intangible assets. For financial accountants the topic has been debated since at least 1950`s. Lately the topic has rendered renewed interest in financial accounting through a large number of so called value relevance studies, but there are also other aspects to it. Also related to the management aspect of intangibles there are studies that are built on the „resource-based view" on the firm mainly found in general management journals. A combination of internal management and external information purposes of measuring and reporting intellectual capital can be found in respectively labeled literature. A lot of researches and academic works has been carried out describing different methods of the intellectual capital measurement or valuation of intangible assets.

However, classic theories do not always hold their relevance in the face of new emerging technologies, organizational structures and relevant resources, hence there is a gap that ongoing research plans to fill. This brings us to the **goal** of this research – which is to critically analyze current theories and methods of intangible assets evaluation and potentially develop and test new methodology based on the practical example(s) in the IT industry. Having this goal in mind the main **research questions** in this paper will be: What are advantages and disadvantages of the current practices of measurement intellectual capital or valuation of intangible assets? How to properly measure intellectual capital in IT?

Subsequently, the **object** of this research is intellectual capital of IT companies. Respectively designated parts of this paper research address primary constraints of the intellectual capital phenomenon and selected industry cluster. The **subject** of this research is the measurement of intellectual capital of IT companies: research aims to analyze existing methods of measurement and bring out a new model that would fit within theoretical framework and would provide practical relevance in alignment with original research goal. The **method** used in this research is composed of two stages: model-building process followed by multiple case study to test developed model in practical environment.

Literature Review

Distinctions & Definitions

Defining Intellectual Capital

The first question we have to address in this topic is to understand the nature of intellectual capital and give certain definition. In the literature, Intellectual Capital is often associated with the intangible assets. There is a discussion among the researcher whether or not terms intangible assets and intellectual capital are in fact interchangeable and equal. For the purpose of this research, I would consider them so. The reason behind this assumption is that in relevant literature both terms usually refer to the same phenomenon while exercising different approaches of valuation and measurement. So what is intellectual capital is exactly? This question finds many answers in the related literature. One of the most notable compilations of definitions is presented in the Martin-de-Castro work "Towards 'An Intellectual Capital-Based View of the Firm': Origins and Nature". (Martin-de-Castro et al., 2011) The adopted version is listed in the Table 1.

Intellectual capital / Intangible assets definitions	**Author(s)**
The difference of an organization's market value and book value	Galbraith (1969)
The difference between the market value of the company and the replacement cost of assets	Bontis (1996)
The combination of market assets, human-centred assets, intellectual property assets, and infrastructure assets	Brooking (1996)
The gap between market and book value of the firm	Sveiby (1997)
The gap between a firm's market value and its financial capital (book value of a firm's equity)	Edvinsson and Malone (1997)
Knowledge, information, intellectual property, expertise which can be used for create wealth	Stewart (1997)
Knowledge and knowing capability of a social collectivity	Nahapiet and Ghoshal (1998)
Essentially comprises all immaterial resources that could be considered as assets, being possible to acquire, combine, transform and exploit, and to which it is possible to assign, in principle, a capitalized value	Granstrand (1999)
Intellectual assets, knowledge assets, total stock of knowledge-based equity possessed by a firm	Dzinkowski (2000)

Includes knowledge, competence and intellectual property. Also includes other intangibles such as brands, reputations, and customer relationships	Teece (2000)
Represents the stock of knowledge that exists in an organization at a particular point in time	Bontis et al. (2002)
The sum of all knowledge firms utilize for competitive advantage	Subramaniam and Youndt (2005)
Includes those intangible assets of an organization that are not recorded in financial statements but which may constitute 80% of the market value of the organization	Martı´nez-Torres (2006)
Basic competences of intangible character that allow creating and maintaining competitive advantage	Reed et al. (2006)
Set of intangible resources and capabilities possessed or controlled by a firm	Alama (2008)
The knowledge assets that can be converted into value. Is a matter of creating and supporting connectivity between of sets of expertise, experience and competences inside and outside organization	Cabrita and Bontis (2008)
Represents knowledge-related intangible assets embedded in an organization	Chang et al. (2008)
The total capabilities, knowledge, culture, strategy, process, intellectual property, and relational networks of a company that create value or competitive advantages and help a company achieve its goals	Hsu and Fang (2009)
All nonmonetary and nonphysical resources that are fully or partially controlled by the organization and contribute to the organization`s value creation	Roos et al. (2007)

Table 1. Intellectual capital concepts; adopted from (Martin-de-Castro et al., 2011)

No doubt, different definitions provide certain specific perspective on the subject of intangible assets an intellectual capital. For example, some focus on the idea of intellectual capital as resource that is used for value creation or generating competitive advantage whereas some discuss the subject in more market-oriented terms (The gap between market and book value of the firm).

In order to generalize it is tempting to assert intellectual capital as the coalescence of human assets, organizational structures and specific technological resources that organization can utilize to create value. However, in this particular case using some common denominator is barely acceptable, since all the different definitions and concepts have underlying theories that in turn define valuation methods, analysis of which is going to be the focus of this paper.

Despite that, we are yet to define and understand what characteristics intangible asset has. In classic literature, (Reilly, Robert, Schweihs, Robert 1999) authors pinpoint the following main characteristics of an intangible asset:

- The asset should be subject to specific identification and recognizable description
- The asset should be subject to legal existence and protection
- The asset should be subject to the right of private ownership, and the private ownership should be legally transferable
- There should be tangible evidence or manifestation of the existence of the asset (contract or license, a registration document etc.)
- It should have been created or come into existence at an identifiable time or as the result of an identifiable event
- It should be subject to being destroyed or to termination of existence at an identifiable time or as a result of identifiable event

It is a subject to speculation whether those constraints have changed in the recent years, however it is absolutely clear that the volume of what qualifies as an intangible asset has increased by a large margin. Nowadays there is a large variety of property classified as intangibles; brands, trademarks, patents, copyright, software, databases, registered designs, domain names, brands, customer contacts, goodwill, management excellence, trade secrets, exclusive rights… and list goes on.

Classification of intellectual capital

The classification of intangible assets / intellectual capital is also a big topic among researchers. First, the purpose of classification should be identified that would later dictate classification criteria. To put this into perspective total assets classification into current and non-current assets had a purpose of facilitating calculation of such measures as solvency and liquidity. Another illustration of this phenomenon is appliance of measurement solutions for different categories of assets, like fair-value concept for financial items and historical-cost approach for non-current assets. So what is the purpose for classifying intangibles? Managerial implication of the classification of intangibles are usually the most feasible explanation behind the most classification performed by various authors. To effectively manage and operate certain resources one must put certain labels and able to distinct between them; in other way to put resources into different categories. There are many proposals in the literature for such classification. In the table 2, there is a list of proposals of classification of intellectual capital partially adopted from (Martin-de-Castro et al., 2011)

Authors	**Intellectual capital blocks**		
	Individual perspective	Collective or organizational perspective	
		Internal organizational perspective	External organizational perspective
Kaplan & Norton (1992)	Learning and growth	Internal processes	Customers
Sveiby (1997)	Competences	Internal structure	External structure
Bontis (2001)	Human capital	Structural capital	Customer capital
Lev (2001)	Human-resource	Discovery/learning Organization capital	Customer-related
Kaufmann & Schneider (2004)	Human capital	Organizational capital	Relational capital
Wyatt (2008)	Human resources	Technology resources	Production resources
Roos et al. (2007)	Human capital	Organizational capital	Relational capital

Table 2. Intellectual capital typology; partially adopted from (Martin-de-Castro et al., 2011)

In addition to this short review, there are many classification models in the literature that distinguish intellectual capital into more distinct and numerous categories, however ultimately all those classifications converge into three main categories: human capital, structural/organizational capital and customer/relationship capital.

Human capital refers to specific knowledge, competences, skills, personal networks of the company`s employees, their ability to generate and utilize it in the process of value creation. Human Capital is indispensable part of Intellectual capital and provides input to both organizational and relational capital .The second commonly identified component of intellectual capital is organizational capital (or structural capital).

Organizational capital usually refers to resources of the organization such as brands, patents and other intellectual property, systems, organizational structures, valuable information etc. Organizational capital also includes such informal resources as corporate, structure and organizational learning – implicit and explicit, formal and informal renewal knowledge processes.

Relational capital includes relationships which it maintains with the main agents connected with its basic business processes – customers, consumers, intermediaries, representatives suppliers, partners, etc., as well as the value to the organization of the relationships which it maintains with other social agents and its surroundings. (Martin-de-Castro et al., 2011)

Motivation for measurement/valuation

Before discussing methods and techniques for evaluation or measurement of intellectual capital another important question one has to answer is what is motivation for performing measurement and as a result - what is ultimate purpose of measurement.

It is common trend nowadays that the nature of capital and investment is shifting from tangible to intangible. In fact many researchers and analyst reports suggest that respective value of intangibles have surpassed that of tangible assets by a large margin. Bookstaber R. suggests that by some estimates, intangible assets now make up to 80 percent of the value of the S&P 500. (Bookstaber, 2007) With this trend of modern economy becoming more and more intellectual capital intensive, there has been an emergence of relevant contributions in the academic field considering this particular topic.

The foremost and most discussed reason for conducting research in this field and coming up with new methodologies to measure and value intellectual capital – is managerial control purpose. “You can only manage what you can measure” – is the most popular justification given in large number of works on this topic. There is a big discussion whether this statement is in fact false or meaningless, since throughout the history companies always measured things – people, morale, strategy – which are essentially unmeasured. (Andriessen, 2004) Apart from that managerial control purpose also has many other implications that explain why the measurement is necessary:

- To give all relevant stakeholders of the company understanding of the true or real value of the company
- To encourage efficient management of intangible resources, allowing management to focus on the areas that need improvement and capitalize upon already established competences

- To reduces information asymmetries among the stakeholders which can perhaps would help company seek out financial recourses on better conditions since clearly identified intangibles would be able to provide guarantees when seeking financial resources
- To facilitate decision making process in case of merger and acquisition
- To help making assumption about relevance of company's stock valuation, i.e. to understand to what extent stock value describes real value of the company in order to make financial decisions

The purpose defines outcomes and that is why so many different methods of valuation exist to a date. Another classification of purposes is presented in Sveiby's work:

- Control purpose (monitoring performance)
- Valuation purpose (mergers & acquisitions processes)
- Justification and Public Relations (reporting to relevant stakeholders)
- Investment decisions purpose
- Learning purpose (uncovering hidden value, categorizing, prioritizing activities and resources in value-creation process)

It is not so difficult to reflect what types of outcomes and what scales different methods tailored to a specific purposes usually coming out with. Valuation and investment oriented methods most likely are trying to come up with a number that would reflect the value of intangibles in financial statements and, therefore, use absolute scale. On the contrary there is a wide variety of methods that are centered on learning or control purpose that lean towards use of indicators and relational comparisons to measure intangibles.

Concept of Value and Measurement Systems

In order to discuss, analyze or compare methods of valuing something as complex as intellectual capital, one need to have concrete framework that would define all necessary constraints of the system where valuation is going to happen. Sometimes researchers while aspiring to create lean and simple measurement tools forget about underlying assumptions that has to be met while building a measurement system. In the article by C. Ittner and D. Larcker "Coming up short on nonfinancial performance measurement" (Ittner, Larcker, 2003) authors present an excellent set of guides for the development of useful measurement systems for nonfinancial resource measurement and list most common mistakes in those systems:

- Not connecting measurements to strategy (or what really needs to be measured)

- Not ensuring there are causal links between the measure and the phenomena to be measured
- Not setting the right performance metrics and targets
- Measuring incorrectly (Ittner, Larcker, 2003)

In the “Managing Intellectual Capital in Practice” by (Roos et al., 2007) authors take a step further and discuss three more common mistakes that occur while building business measurement systems:

- Not dealing with redundant or unwieldy measurement systems
- Are not auditable (by an independent third party) and consequently unreliable
- Don’t generate the information needed by shareholders, investors, or other relevant stakeholders (Roos et al., 2007)

Concept of Value

Consequently, in order to avoid those mistakes the first thing that has to be explained – is the concept of value. Concept value defines significant assumptions that are made regarding asset in the valuation analysis. Different parties in a negotiation of value may represent different perspectives of value in assessing an asset. Another aspect to the value is the purpose of the valuation. There are several examples used in practice: one might consider fair market value, open market value for tax purposes, fair value, owner value and investment value. Each concept has its own set of rules, often derived from a combination of experience, case law, statute and/or regulatory practice, which need to be understood before carrying out a valuation. (Centre For Business Research, Manchester Business School, 2003)

From the scientific point of view, these questions can be viewed form the point of axiology, the study of value. (Rescher, 1969) When employing axiology in practice one must take certain precautions to make sure that selected approach remains acceptable:

- The object to be measured or valued is precisely defined.
- The definition is inclusive of all opinions and requirements from all stakeholders.
- All participants (stakeholders) have equal dignity or importance.
- All participants are accountable for the veracity of their position. (Roos et al., 2007)

As have been mentioned above stakeholders and their identification have a profound effect on the outcome of value analysis. A stakeholder is anyone who can affect an outcome that is valued by the organization. (Roos et al., 2007) There are multiple frameworks developed by different researches that attempt to categorize stakeholders by importance and other characteristics. It is important to note though that attaching importance to stakeholders essentially infringes the third and possibly the second condition of axiology thus is not applicable in the process of value calculation. In practice however, there is always a choice of the stakeholders whose views are taken into consideration when building a measurement system.

Basics of Measurement Theory

Before going into the process of measuring something as complex as business and intellectual capital we have to answer mischievously simple question – what are we really doing when we take measurement? Roos et al. In the "Managing Intellectual Capital in Practice" provides a very definitive insight:

"Whether we want to measure the size of a room, weigh ingredients for a recipe, count money in the bank, or evaluate the value of a business, the process is the same. What we are trying to do is to measure the value of something, which may be tangible or be made up of tangible and intangible elements. In all these cases, we are using a tool of some kind to transfer the characteristics of something in the real world into a numerical system that we can record, report, or use for some other purpose. In the preceding examples, a tape measure is used to measure the room, sprung scales measure the weights of ingredients, and money is already in a numerical system. The instrument used to measure the value of a business or components of it fulfills the same function and is bound by the same rules, but just happens to be a little more complex in form." (Roos et al., 2007)

All proper measurements are underpinned by the same theory and that theory is, of course, measurement theory, which is a branch of applied mathematics. The formalization of measurement theory is a surprisingly recent event. The primary motivation for the formalization of measurement theory was the need to understand what it means to measure things in the social sciences—things like preference, value, loudness, and so on. These attributes were obviously hard to measure, much as intangible resources would appear to be today. (Roos et al., 2007) Having introduced the theory, in this paper, I am not going to discuss all the details, however the most important implication are vital for the purpose of this research in order to form criteria to compare and distinguish between multiple methods of intangible assets evaluation.

Measurement primarily is concerned about two things: representation and ordering. Representation concerns itself with operations in which an attribute is represented by a measure; for example, 10 cm could be a numerical representation of a dimensional attribute of an object noting that a full description of the object requires that many other attributes are represented. Ordering is simple and concerns the amount of something an entity possesses and ensures—for example, that a 10 cm length object is always longer than a different object whose length measurement is 9 cm. (Roos et al., 2007) Thus, in business practice process of measurement is concluded in two-stages: in first step entity is described and identified and then a numerical system to describe it in numbers is created in the second step. This approach is known as relational measurement theory.

There is a rigor set of rules and principles that define the process of building a relational measurement system. However, there is still one last link to be discussed before going in to the description of this process. Since our ultimate goal is to build a measurement system to value something as complicated as intellectual capital and which would take viewpoints of different stakeholders the final theoretical concept comes into play multi-attribute value theory (MAVT) introduced in "Decisions with Multiple Objectives: Preferences and Value Trade-Offs" by (Keeney, Raiffa, Meyer, 1993). MAVT allows for the representation of the value of complex entities using a hierarchical structure, which can be made operational by the incorporation of mathematics to represent the subjective judgments made by stakeholders. (Roos et al., 2007)

The basic steps in building a relational measurement system

1. The first and most important step in building a system is to define very precisely the scope of the object or business to be measured and to determine what the results are to be used for. This cannot be stressed strongly enough. Failures in measurement systems almost always have their origins here.
2. The second step is to determine who the stakeholders are.
3. With the problem scoped, work can begin on building an empirical relational system. In this third step, the basic axiological framework, MAVT, and measurement theory are used to build an empirical measurement system (i.e., a system containing all the attributes that, taken together, completely define the overall scope). There are two key tests at this stage and these are completeness and distinctness. The system is hierarchical and the statement about completeness applies at every level. Furthermore, at every level, the attributes must also be distinct from one another in terms of meaning. In this way the object or business to be measured is completely defined by attributes that are different from one another. The danger of double counting is therefore avoided. This process also requires that definitions of attribute meanings are rigorously recorded.
4. The empirical measurement system is a system showing what should be measured, and its development continues only until it is felt that there is a reasonable chance of the attributes actually being measurable in practice. When this point is reached, then a real working image of this empirical structure is built. This is the fourth step and it results in an

isomorphic numerical measurement system: the ruler that we will use for measuring our object. Unfortunately, the process may require that proxies be found for some of the empirical attributes since it is usual that what one wants to measure often cannot be measured directly in practice. For example, we measure the gas temperature in the shockwave of a detonation by secondary observation of its effects rather than by direct measurements because the measuring equipment rarely survives the process. Proxy measures are subjected to a third test: agreeability. The key issue is that the meaning of the attribute on the next level up in the numerical system is not changed by the substitution of the proxy.

5. Step five is to make the numerical relational structure active by inserting value and aggregation functions at the nodes of the structure. This is a simple step in that generic algorithms can be used over and over. However, when selecting algorithms for aggregation for the first time, a fourth condition must be satisfied, which is that the algorithms are preference independent. The test for preference independence requires that the operations used to aggregate value comply with the normal requirements of commutativity, associativity, monotonicity, positivity, and with the Archimedean condition.
6. The sixth step is to customize the settings of the numerical system to meet the preferences of the stakeholders. It is vital that no averaging is undertaken to get some mean stakeholder view. This is counter to the intent of axiology and mostly leads to a set of views that represent no stakeholder. The wealth of information that could come from stakeholders, especially if their views differ significantly, will be lost through averaging and will severely diminish the value of rigorous measurement. This customization process is best done in face-to-face discussions using techniques that assure unbiased weightings such as pair-wise comparisons. Other techniques may be acceptable as long as ratio-scale results are obtained. Step 7 explains ratio scaling.
7. The last step is to find the data needed to run the measurement system and actually do some measurement. Here the fifth and final requirement has to be met. Performance data must be commensurable, that is, normalized on a well-defined scale ranging from 0 to 1 and collected on a ratio scale. The definitions of 0 and 1 for each attribute must be recorded with the same rigor as the meanings of the attributes. Zero is usually taken to be the threshold of uselessness. This is the threshold where performance just starts to have some value. The meaning of 1 depends on the nature of the problem and the use to which the results are to be put. In most circumstances, 1 can either represent the strategic targets of the company if the results are to be used for internal measurement or management, the best

in class if the results are to be used for external release or external comparison or the best imaginable if the results are to be used for strategic reframing. (Roos et al., 2007)

Another important step towards comprehension of measurement is the definition of the scales. Different data types have to be measured in different scales, which entitles use of certain methods for its analysis and transformation. Table 3, adopted from (Roos et al., 2007) shows those categories.

Name of Scale	Typical Description	Transformations	Allowed Statistics
Nominal	A classification of the objects	Only those that preserve the fact are different	(Descriptive) Frequencies, mode, information content; (Associative) Chi-square.
Ordinal	A ranking of the objects	Any monotonic increasing, transformation, although a transformation that is not strictly increasing loses information	(Descriptive) Median, quantiles and quartiles; (Associative) Spearman’s rank-order correlation coefficient, Kendall’s tau, rho.
Interval	Differences between values are meaningful, but not the values of the measure itself	Any affine transformation t(m) = c * m + d, where c and d are constants; the origin and unit of measurement are arbitrary	As above plus arithmetic mean, standard deviation
Ratio	There is a meaningful “zero” value and the ratios between values are meaningful	Any linear (similarity) transformation t(m) = c* m, where c is a constant; the unit of measurement is arbitrary.	As above plus geometric mean

Absolute	All properties reflect the attribute	Only 1-to-1 transformations	All

Table 3. Description of Scales adopted from (Roos et al., 2007)

Simplification of Measurement Systems and Indicators

When discussing a measurement system, there is always a tradeoff between detail and utility against the cost and effort in collecting the data. As was discussed in (Ittner, Larcker, 2003) existing systems rarely follow all the rules and principles of measurement theory, and the reason behind this is an aspiration to make a system simple and easy to use. In order to find balance between precise and reliable measurement system that takes into account all the details and attributes and a system that would allow making quick and effective decisions, represent information relevant to the stakeholders at reasonable cost – level of detalization and acceptable proxies have to be identified.

In the development of this idea (Roos et al., 2007) further distinguish measurement systems and other systems that are referred to as indicators.

- Measures: A measure is a numerical representation of an object in which all the attributes of the object are included in the representation in a manner compliant with measurement theory and all measures and manipulations are also compliant with measurement theory. Measure are used when there is need for reliable information that would be used as basement to make decisions about the future
- Indicators: An indicator is a roughly estimated representation of an object, which may suffice for local needs but is prone to errors. Indicators are used in cases one needs to monitor progress toward targets with moderate trust in the results (that may, in practice, occasionally be compensated for by access to relevant and valid experience)

Methods and techniques for measurement of intellectual capital

The goal in this chapter is to provide description and discuss different systems and methods developed in the previous studies. Over the last 15 years, there has been a great number of systems devised to help managers to measure business performance. According to different researchers there are about 20-30 different methodologies proposed that in one way or another deal with the task of measuring intellectual capital / intangible assets.

Discussing each method in detail is a daunting task and for the sake of simplicity and for the purpose of this research I would bundle all the available methods into certain categories, give general description of every method and then discuss most important characteristics of each group outlying and highlighting most interesting and worthwhile methodologies within each category.

The classification of methods for valuation of intangibles is also a large topic in relevant literature. Some authors (Lev et al., 2003) (Sveiby, 2010) suggest classification according to the valued objects and thus break all methods into two categories: Holistic (general valuation of the intellectual capital of a company) and Atomistic (valuation of the certain components or elements of intellectual capital). Another grouping is compiled according to the use of a monetary unit in the process of valuation and thus researchers distinguish monetary and non-monetary types of methods. Yet another classification of methods is based on valuation results: Andriessen (Andriessen, 2004) distinguish four different groups of methods based on the "results" criteria:

- Financial valuation
- Value measurement
- Value assessment
- Measurement

The last but not the least and probably the most common among researchers classification originally developed by Luthy (1998) and Williams (2000) is a classification according to general principles of valuation. As noted above this methodology earned a lot of attention from other researchers and was extensively referenced in the works of (Sveiby, 2010) (Roos et al., 2007). The main benefit of using such classification is that it allows to understand how the method was developed by focusing on the core underlying principles of the methodology. That is why for the purpose of this research I am going to focus mainly on this particular classification to describe and analyze methods for intellectual capital valuation. Original classification implies that valuation methods can be categorized into four groups. These are:

1. Direct Intellectual Capital Methods (DICM) estimate the dollar value of intangible assets by identifying its various components. Once these components are identified, they can be directly evaluated, either individually or as an aggregated coefficient.
2. Market Capitalization Methods (MCM) calculate the difference between a company's market capitalization and its stockholders' equity as the value of its intellectual capital or intangible assets.
3. Return on Assets Methods (ROA) average pre-tax earnings of a company and divide them by the average tangible assets of the company. The result is a company ROA that is then compared with its industry average. The difference is multiplied by the company's average tangible assets to calculate an average annual earning from intangibles. By dividing the above-average earnings by the company's weighted average cost of capital or an interest rate, one can derive an estimate of the value of its intangible assets or intellectual capital.
4. Scorecard Methods (SC) identify various components of intangible assets or intellectual capital and indicators and indices are generated and reported in scorecards or as graphs. SC methods are similar to DIC methods, except that no estimate is made of the dollar value of intangible assets. A composite index may or may not be produced. (Sveiby, 2010)

In the "Managing Intellectual Capital in Practice" (Roos et al.,2007) authors argue that fifth category should be added:

5. Proper Measurement Systems (MS) take everything of value in or about the company and break them down into attributes that can be measured. These are built into a measurement system, usually a conjoint hierarchy, and real data are used to produce reliable calculations of value. These can be combined with financial data to provide value for money and related outputs. (Roos et al., 2007)

When discussing MS as an approach Roos emphasizes the goal of completeness and reliability with an explicit treatment of all aspects of value. According to authors, MS methodologies, if done correctly, offer the possibility of not only reliable measurement but also of the proper combination of intellectual capital resources with financial resources. They do this by using dispassionate measurement as the starting point with the intention of applying it to company resources rather than making assumptions about the principle resources followed by an attempt to quantify them in some way. (Roos et al., 2007)

If we were to discuss generally others methods, it is possible to note that the MCM and ROA approaches are more rigid in a sense that they rely on financial figures (for both incomes and outcomes), and despite disadvantages associated with those methods, are auditable. ROA and

MCM methods follow long-established accounting rules and thus are more popular within accountant community. Even though the valuation provided by those methods might not be accurate or precise, the results might be particularly helpful in M&A situations since they can give crude comparisons between companies within the same industry. Despite that, for a detailed due diligence activity, the amount of details provided is far insufficient for adequate analysis. Apart from a lack of detail to help managers, ROA methods in particular are extremely sensitive to interest rate assumptions. Some of them are not suitable for nonprofit organizations, government agencies, business units; same problems applies to MCM methods. DICM, and to a lesser extent SC methods, can sometimes provide more comprehensive and explaining picture of an organization's health than methods that solely rely on financial metrics. Another feature of DICM and SC methods – is the fact that they are more flexible in a sense of appliance to different organizational levels. Methods from these categories estimate intellectual capital resources from the bottom up and thus can potentially be faster and more accurate than ROA and MCM measures when it comes to resources measurement. Their disadvantages are that the indicators are contextual and the meanings of the resource definitions can vary between each organization and each purpose, which makes comparisons very difficult. Another problem might be that these methods sometimes are not easily connected to financial results, which impairs their use for certain purposes.

The following tables (4-7) contain brief description of the most significant methodologies classified according to general principles of valuation followed by a more specific discussion of the advantages and disadvantages of proposed methods.

Direct Intellectual Capital Methods (DICM)

Title	Author	Description
Technology Broker	Brooking (1996)	Assesses the value of the intellectual capital of a firm based on a diagnostic analysis of a firm's response to 20 questions covering four major components of intellectual capital.
Citation-Weighted Patents	Bontis (2001) Hall et al. (2005)	Calculates a technology factor based on the patents developed by a firm. Intellectual capital and its performance is measured based on the impact of research development efforts on a series of indices, such as

		number of patents and cost of patents to sales turnover, that describe the firm's patents.
Inclusive Valuation Methodology (IVM)	McPherson (1998)	Uses hierarchies of weighted indicators that are combined, and focuses on relative rather than absolute values. Combined Value Added = Monetary Value Added combined with Intangible Value Added.
The Value Explorer™	Andriessen and Tiessen (2000)	Calculates and allocates value to five types of intangibles: (1) Assets and endowments, (2) Skills and tacit knowledge, (3) Collective values and norms, (4) Technology and explicit knowledge, (5) Primary and management processes.
Intellectual Asset Valuation	Sullivan (2000)	Methodology for assessing the value of Intellectual Property.
Total Value Creation, TVC™	Anderson and McLean (2000)	A project initiated by the Canadian Institute of Chartered Accountants. Uses discounted projected cash flows to re-examine how events affect planned activities.
Accounting for the Future (AFTF)	Nash (1998)	A system of projected discounted cash flows. The difference between AFTF value at the end and the beginning of the period is the value added during the period.
Valuation Approaches	Reilly, Robert, Schweihs (1999)	Methodology that suggest use of three fundamental methods of financial valuation for intangible assets valuation: cost approach, market approach, income approach.

Table 4. Direct Intellectual Capital Methods; partially adopted from (Sveiby, 2010)

Most methods listed under Direct Intellectual Capital category share a certain set of attributes. Some methods (for example Citation-weighted Patents method) usually focus on particular areas of business (intellectual property for example), while not really providing a good estimation of a big picture. On the other hand, others (Intellectual Asset Valuation by Sullivan (2000); Total Value Creation, TVC™ by Anderson and McLean (2000)) try to include into equation as many resources as possible – thus ignoring resource individual instrumental value. The reason behind both of these issues is that definitions of resources used by researchers are rather fragmented. Another feature of methods in DIC category that most rely on financial valuation: i.e. most methodologies (Accounting for the Future by Nash (1998), Intellectual Asset Valuation by Sullivan (2000), The Value Explorer™ by Andriessen and Tiessen (2000)) just classify intellectual capital typology and then use certain established financial methods of valuation: expected cash flow method for example. Those financial methods of valuation were described in detail in the work of Reilly, Robert, Schweihs (1999) where authors identify three approaches for valuation. Despite the fact that this methodology was not originally included in the DIC category by some authors (Sveiby, 2010), it probably suits this classification the most since most DIC methods refer to that particular type of valuation. While not particularly problematic as a standalone process, financial valuation, however, creates certain issues when used for intellectual capital assessment. Since most methods that utilize this underlying methodology are using specific set of proxies to create certain indicators (Citation-weighted Patents) or dashboards (Value Explorer™), they have plenty of input and outcome data not collected on ratio scale, which violates measurement theory.

To get better understanding of how exactly methods in this category perform assessment of intellectual capital (or its certain parts) I would like to discuss a couple of examples in detail. Citation-weighted Patents method provides a good example for use of proxies and building specific indicator: in this methodology patents are used as proxy for company`s inventive output and patent citations are proxy for knowledge flows or knowledge impact. The citation of particular patent in other patent provides information about size of the technological "footprint" of the cited patent. Taking those assumptions together result in the construction of the citation weighted patent index, in which patents of the firm are weighted by the number of citations. (Hall et al., 2005) Citation-weighted Patents method carries most traits of the DIC category – it displays use of proxies, concentrating on specific form of intellectual capital and uses indicators as an outcomes. The problems with this approach are also not very different from the rest of DIC category: it doesn't measure all intangible assets of the company, it relies on long term historic data (it usually takes many years for a patent to be cited) and therefore indicator possesses considerable time lag. Another problem is that incomes of the method are heavily dependent on the company and sometimes can be manipulated (even unintentionally) – by increasing/decreasing number of selfcitations within a firm for legal or whatever other reasons. Taking this into consideration and the assumption that indicator is supposed to use ration scale there can be certain incompliance with measurement theory.

Special reference should be made about Inclusive Valuation Methodology by McPherson (1998). Even though this method was formally allocated to DIC category by some authors (Sveiby, 2010), others (Roos et al., 2007) believe that since it is actually one of the few methodologies that are fully compliant with measurement theory, it should has the classification of its own. This method implies building multidimensional mathematical model of the business of the company to simulate various alternative management actions and assign particular measurable attributes in accordance with perspective of relevant stakeholders using a "criterion hierarchy". The method is rather complex and sometimes is deemed not practical, since obviously requirements for proper measurement are hard to meet in practice. However Inclusive Valuation Methodology also suggest that there always a very important trade-off between rigor and relevance and it is in fact possible to build if not a measurement system but relevant and independent set of indicators that would be compliant with measurement theory and would serve their purpose without committing extensive costs.

Market Capitalization Methods (MCM)

Title	Author	Description
Tobin's q	Stewart (1997)	The q is the ratio of the stock market value of the firm divided by the replacement cost of its assets. Changes in q provide a proxy for measuring effective performance or not of a firm's intellectual capital.
Investor assigned market value (IAMV™)	Standfield (1998)	Takes the company's true value to be its stock market value and divides it into tangible capital + (realised IC + IC erosion + SCA (Sustainable Competitive Advantage)
Market-to-Book Value	Edvinsson, Malone (1997) Stewart (1997) Luthy (1998)	Considers the value of intellectual capital to be the difference between the firm's stock market value and the company's book value.

Table 5. Market Capitalization Methods; partially adopted from (Sveiby, 2010)

This group of methods is probably one of the oldest and the most criticized one. Originally proposed by multiple researchers, idea that Value of intangibles equals to Market value minus

Book value caused significant reverberation in this field of study. While being one of easiest and simple ways to measure intangibles this method is exposed to an extensive criticism from multiple standpoints. First of all, the underlying idea of identifying value of intangible by subtracting book value from the market value is flawed simply because book value usually refers to the reported stockholder` equity, which represents the difference between assets and liabilities, both of which are valued at historical costs, whereas market value references to the perceived value of the future cash flow of the company. Therefore, such an operation as subtracting book value from the market value is like comparing apples and oranges (Andriessen, 2004) and, therefore, absolutely violates measurement theory. Another argument is that all the resources of the organization are interdependent and interact with each other, which essentially means that in a process of value creation tangible and intangible resources are not separable since one part does not mean or worth anything without the other. Yet another problem in this approach stems from the fact that the market value of a company depends on so many factors, so it is simply naive to attribute all of stock price changes to the movement of the intellectual capital.

Methods like Tobin's q were not even originally designed to measure intangibles and yet some researchers (Stewart, 1997) decided to employ this technique for IC valuation. Even-though methods like Tobin's q try to address certain inconsistencies by using special asset replacement cost instead of book value, pretty much all of the above-mentioned issues are equally attributable to all methods in MCM category.

Return on Assets Methods (ROA)

Title	Author	Description
Economic Value Added (EVA™)	Stewart (1997)	Calculated by adjusting the firm's disclosed profit with charges related to intangibles. Changes in EVA provide an indication of whether the firm's intellectual capital is productive or not.
Human Resource Costing and Accounting (HRCA)	Johansson (1996)	Calculates the hidden impact of HR related costs, which reduce a firm's profits. Intellectual capital is measured by calculation of the contribution of human assets held by the company divided by capitalized salary expenditures.

Calculated Intangible Value	Stewart (1997) Luthy (1998)	Calculates the excess return on hard assets, then uses this figure as a basis for determining the proportion of return attributable to intangible assets.
Knowledge Capital Earnings	Lev (1999)	Calculates knowledge capital earnings as the portion of normalized earnings over and above expected earnings attributable to book assets.
Value Added Intellectual Coefficient (VAIC™)	Pulic (1997)	Measures how much and how efficiently intellectual capital and capital employed create value based on the relationship to three major components: (1) capital employed; (2) human capital; and (3) structural capital. VAIC™i = CEEi + HCEi + SCEi

Table 6. Return on Assets Methods (ROA); partially adopted from (Sveiby, 2010)

Methods under Return on Assets Methods are not really intellectual capital methodologies, but rather methods that were originally used for general value measurement adopted to the valuation of intangibles. In fact most of them do not particularly measure intangibles but rather attribute changes / differences in certain financial features to the efficiency of intellectual capital. For that reason, all these methodologies usually struggle with identifying the exact contribution of intangible assets and/or do not provide an adequate explanation of how this process should be conducted. Unlike MCM category authors of ROA methods avoid direct linkages with market values, however they still usually rely on certain financial figures and market factors that definitely bear a significant bias and make the choice of scales rather questionable. To give a better picture I will briefly discuss most common and significant methods under this category.

Calculated intangibles value method is based on the assumption that the premium (premium return on assets) on company`s value is a result of its intangible assets. Premium is identified by comparing company`s ROA with industry average and after that it calculates present value of premium earnings. Method is rather elegant, uses publicly available accounting information and produces a benchmark that displays whether or not value of the company is reflected in the balance sheet. However, it certainly does not display the value of intangible resources in any adequate way. Like the rest of the methods in the ROA category, it only attributes some value difference (in this case – premium return on assets) to the intangible resources. It also runs into such common problems as difficulty in selecting benchmarks, since sometimes asset structure of different companies may differ even within same industry so standard classification and generalization are not applicable.

Economic value added is usually also considered as a method for measuring intangibles by certain authors (Sveiby, 2010) (Bontis, 2001) even though it was not originally designed to serve this purpose. Method aims at finding shareholder wealth by figuring the difference between the firm`s total value and the total capital investor have committed to it. Since method operates with a flow rather than stock indicators, it does not measure value of intangible resources or even any resources at all. At most it indicates the added value of a resource (intangible or not). There many arguments for and against the fact EVA can measure added value of intangibles, and whereas the answer to this discussion is far from being certain – what is certain - is that it is almost impossible to attribute certain part of EVA to exactly intangibles resources if this is even possible at all.

Value Added Intellectual Coefficient is an interesting method that provides a very good instance of building an intellectual capital indicator utilizing financial statements data. Pulic (1997) in fact makes a very solid attempt to find suitable proxies to separate contribution of intellectual capital in added value. However, this method also faces many problems and has questionable assumption in its core: assets are not properly separated from the expenses, stock and flows indicators are used together in one model, indicator does not ultimately accounts for synergies between different types of IC and some others. With all that in mind, method is definitely not compliant with measurement theory and produces rather questionable results. (Andriessen, 2004) Despite that, the advancement that was made by Pulic (1997) is in fact commendable and some authors (Roos et al., 2007) do believe that Value Added Intellectual Coefficient is best out of ROA methodologies.

Scorecard Methods (SC)

Title	Author	Description
Human Capital Intelligence	Jac Fitz-Enz (1994)	Collects and benchmarks sets of human capital indicators against a database. Similar to HRCA.
Skandia Navigator™	Edvinsson and Malone (1997)	Measures intellectual capital through the analysis of up to 164 metric measures (91 intellectually based and 73 traditional metrics) that cover five components: (1) financial; (2) customer; (3) process; (4) renewal and development; and (5) human.
Value Creation Index (VCI)	Ittner et al. (2000)	Drivers of value are derived from an extensive literature survey and advanced statistics. Metrics are weighted and combined to give a Value Creation Index. The index is compared and combined with financial data.

IC-Index™	Roos, Dragonetti and Edvinsson (1997)	Consolidates all individual indicators representing intellectual properties and components into a single index. Changes in the index are then related to changes in the firm's market valuation.
Intangible Asset Monitor	Sveiby (1997)	Management selects indicators, based on the strategic objectives of the firm, to measure four major components of intangible assets: (1) growth (2) renewal; (3) efficiency; and (4) stability.
Value Chain Scoreboard™	Lev (2002)	Arranges a matrix of non-financial indicators in three categories according to the cycle of development: Discovery/Learning, Implementation, Commercialization.
Balanced Scorecard	Kaplan & Norton (1992)	Measures a company's performance through indicators covering four major focus perspectives: (1) financial perspective; (2) customer perspective; (3) internal process perspective; and (4) learning perspective. The indicators are based on the strategic objectives of the firm.

Table 7. Scorecard Methods; partially adopted from (Sveiby, 2010)

On the general note, Scorecard methods are quite similar to the Direct Intellectual Capital Methods. The defining feature of SC methodologies is the specific way of presenting results – namely the scorecard. Other than that, all the comments regarding advantages and disadvantages that was made about DIC methods are still relevant for methods from SC category. Unlike ROA and MCM methodologies results produced by SC methods are not easily connected to the financial results and are rather ambiguous, which certainly impairs the use of those methods for certain purposes (like investments evaluation and like). However, scorecard methods usually give a better understanding of the hidden value of intangible resources.

One of the oldest methods in this category is Balanced Scorecard by Kaplan & Norton (1992). The proposed solution involves a two-stage process. On the first stage, a strategy map is created that describes casual assumptions underlying the strategy. Than the scorecard consisting of 20-25 measures grouped by 4 perspectives (financial, customer, internal process, learning) is created. However it is important to note that this method does not directly measure intangible resources, but rather measures level of goal achievement in specific improvement areas. Value

Chain Scoreboard™ by Lev (2002) shares same ideas about representing the results and building the scorecard, however Lev uses different underlying assumptions and definitions: he mainly focuses on constituents of value-chain of organization, which he identifies as discovery and learning, implementation and commercialization. Despite use of different set of indicators this method faces same issues as Balanced scorecard and other SC methods: data is usually fragmented, sometimes very subjective and collected on different scales which significantly undermine the validity of the results from the basis of measurement theory.

Another significant contribution to SC methods and to the valuation of intangibles in general was performed by Sveiby (1997). Introducing Intangible Asset Monitor Sveiby explicitly stated that monetary evaluation is not an obligatory common denominator that should be used when measuring intangibles, but rather new set of proxies should be introduced for that purpose. The proposed scorecard contains indicators grouped by perspectives of growth and renewal, efficiency and stability.

As have already been described in cases of previous methods the structure and philosophy of the SC methodologies are rather homogeneous. All methods select set of indicators, group them by certain criteria and form a scorecard. The main difference lies within selection of indicators and grouping criteria. The discussion about how good a SC method is coming down to discussion about how sound and robust is justification for selecting certain indicators. In IC-Index™ for example authors specifically emphasize critical selection of indicators, rooted in company`s strategy and provide justifications of combining indicators into one single index. IC-Index™ in fact comes very close to satisfy all functional requirements of measurement theory, even though it still falls short on certain aspects of it. In the further development of IC-Index™ Holistic Value Approach (HVA) was created. HVA is proclaimed by authors as the third generation of the measurement methods and it is probably unfair to group this method with the rest of SC category. The method is created with all the assumptions of measurement theory and axiology taken into consideration. Despite that it is worth noting that a sophisticated measurement system like HVA is best suitable only for internal reporting and facilitating decision making process and even then it is rather complicated and requires significant recourse commitment and data collection which may ultimately rule out this method for certain purposes.

Defining IT Industry

When discussing questions about valuing or measuring certain aspect of a business (in our case – intangible assets) it is important to identify and understand key features, characteristics and industry specific factors where the methodology is going to be applied. Thus in this chapter the goal is to understand what exactly is understood by IT industry, what is so special about companies conducting business in this sphere and what industry specific features should be taken into consideration for the purpose of valuation of intangible assets in IT.

IT (information technologies) or ICT (Information and Communications Technology) industry is in fact a very broad term that encompass multiple subcategories. As technology progress steps further, setting the bounds of the IT Industry becomes ever more difficult. The definitions that were relevant yesterday might not be so relevant today. For instance, proposal produced by OECD in 1998 defined the ICT sector is a "it is a compromise, limited to those industries which facilitate, by electronic means, the processing, transmission and display of information, and it excludes the industries which create the information, the so-called 'content' industries". (OECD, 2011) However, in 2006 OECD already came up with a revised definition that included ICT services and ICT trade industries that are directly involved in information creation process.

Another take on what is IT industry and what subcategories it encompasses is provided by consultancy agencies and market research groups like MarketLine and CompTIA. For instance in MarketLine`s industry selector IT sector is listed under Technology and Services category that consists of multiple elements, namely: Software, IT Services and IT Hardware.

Software subcategory consists of systems and application software. Systems software comprises operating systems, network and database management and other systems software. Application software comprises general business productivity and home use applications, cross-industry and vertical market applications, and other application software. (MarketLine, 2014)

The IT services industry sector represents the combination of the data processing and outsourced services market, and the IT consulting & other services market. The data processing & outsourcing market consists of commercial electronic data processing (EDP), Information Technology outsourcing (ITO), or other business process outsourcing (BPO).

IT Hardware subcategory comprises of Semiconductors and Processors, Servers, Storage, Mainframes, Peripherals, Networks and Communications industries profiles. (MarketLine, 2014)

From the IT Industry Outlook by (CompTIA, 2014) the following list of examples and key elements of IT definition can be retrieved:

- Hardware – computers, servers, storage, tablets, mobile phones, printers, network equipment
- Software – productivity and business applications, network applications, security Applications
- Services – deployment, integration, custom development, break/fix, managed services
- Infrastructure – Internet backbone, telecommunication networks, cloud data centers
- Information – data, documents, voice, video and images
- Business Objectives – commerce, production, communication, collaboration, sales etc. (CompTIA, 2014)

Yet another way to segment IT industry is to divide industry by grouping of hardware, software and services and a grouping of telecommunications, which includes broadband services. (CompTIA, 2014)

Nowadays if we try to define IT industry in a more down-to-earth and less scientific terms it appears that IT industry is description of multiple fields of business involving computer-based software and hardware, networking, telecommunication, a wide range of IT services that directly or indirectly enable information transfer, storage, usage etc. There are, no doubt, more comprehensive and extensive frameworks identifying and classifying IT industry, however, for the purpose of this research provided definitions should suffice the question of identification of an industry scope.

Industry Specific Features

Once identified what is meant by IT industry the next question to address is what so special about it, what industry specific factors affect the competition and value creation process within the industry.

Since IT industry is essentially an aggregative term for different industries that are involved into information technology sector, in order to highlight common specifics of different branches of IT there need to be an attribute that is shared by all companies from all the branches of IT. For instance, usually IT industry companies are regarded as high-tech companies. Even though term “high-tech” is not inclusive, meaning that not every high-tech company belongs in the IT sector, the reversed statement is valid since almost all the companies classified as IT related can be regarded as high-tech as well. This particular view finds support in the literature: in the paper called “Competitive advantage and the information technology industry” (Koski Timo, 1998) author discusses the definition of high technology industry and its relevance to the IT. The following characteristics of high technology industry are outlined in the article:

- High technology and IT industries are typically ones with higher than average growth and higher than average earnings potential.
- High technology and IT industries are more technology and innovation intensive in R&D effort and its exploitation of global technology base than other industries. Because of the global technology base and emerging demand homogeneity the innovation capability is not only limited to products but also covers innovation in production, distribution, marketing, finance.
- Human resources in high technology industries and especially in IT related companies are highly educated, financially independent, critical and demanding towards the employer. Many companies, especially ones leaning towards software and IT services part of IT sector value their human capital as the most important asset in their value-creation process.
- High technology industry and IT are dependent on the global development of technology. Emerging technologies have made product life cycles shorter and shorter. This, in turn, has resulted in the fast outdating of knowledge, which, for the individual, involves several changes of career during one's working life. Education intensity, which is typical of high technology industry, has made companies more like universities with their life-long educational programs. The most talented and skilled people are attracted to companies who support the individual's continuous growth through education.
- In IT, the concept of product has been extended from traditional equipment to a solution in which, in addition to the physical component itself, value-added is created by the know-how and service components.
- High technology industry and IT are dependent on global capital markets because of their technology intensiveness and its fast business cycles and product life cycles. The industry is facing increasing homogeneity of capital markets, which means that corporations operating on those markets are under constant international evaluation. (Koski Timo, 1998)

Another take on Information technology and high-tech industries characteristics is presented in the paper by Zakrzewska–Bielawska "High Technology Company – Concept, Nature, Characteristics". (Zakrzewska–Bielawska, 2010) In the article author highlights the following features of IT and high-tech industries and companies:

- High demand for scientific research and intensity of R&D expenditure
- High level of innovativeness
- Fast diffusion of technological innovations
- Fast process of obsolescence of the prepared products and technologies
- High level of employment of scientific and technical personnel

- High capital expenditure and high rotation level of technical equipment replaced by more modern and innovative devices
- High flexibility of organization structures
- High investment risk and fast process of the investment devaluation
- Intense strategic domestic and international cooperation with other high technology enterprises and scientific and research centers
- Implication of technical knowledge in the form of numerous patents and licenses
- Increasing competition in international trade (Zakrzewska–Bielawska, 2010)

The set of presented characteristics is derived through a process of comparing and combining features of innovative enterprise, knowledge-based company and company using modern information technology.

In the article "Competition, Regulation and Strategy: Information Technology Industry" (Morris, 2003) author provides yet another insight of the industry specific features of IT, this time the focus is on the supply and demand characteristics of IT industry. Author argues that the IT industry (both software and hardware) is characterized by vast consumer side scale and scope economies, which are incomparably larger than in other industries with supply side network economies like pipelines or electricity distribution. In IT the supply side, economies are also incomparably larger because the marginal cost of an additional unit of the software or hardware, especially the former, is very small. (Morris, 2003) Another point that author conveys is that IT industry is characterized with high degree of uncertainty due to heightened technological dynamism. Coupled with extreme economies of scale in the industry it promotes and facilitates path dependency in the developments and capital concentration in the industry. Which in turn explains the existence of such giants as Microsoft, CISCO, Google etc. Despite the fact that those companies extract significant part of the scale economies in the form of large profits, such firms are competitive in the more relevant dynamic sense. (Morris, 2003)

Value Creation Process

Last but not the least aspect of IT industry is the peculiarities of the value creation process. For the purpose of this analysis, one might use an advanced scale introduced by Stabell, Fjeldstad (Stabell, Fjeldstad, 1998) that stems from Porter's original value chain framework. Authors offer two additional alternative value configuration in addition to the traditional value chain represented in a table below:

	Chain	Shop	Network
Value creation logic	Transformation of inputs into products	(Re)solving customer problems	Linking customers
Primary technology	Long-linked	Intensive	Mediating
Primary activity categories	• Inbound logistics • Operations • Outbound logistics • Marketing • Service	• Problem-finding and acquisition • Problem-solving • Choice • Execution • Control/evaluation	• Network promotion and contract management • Service provisioning • Infrastructure operation
Main interactivity relationship logic	Sequential	Cyclical, spiralling	Simultaneous, parallel
Primary activity interdependence	• Pooled • Sequential	• Pooled • Sequential • Reciprocal	• Pooled • Reciprocal
Key cost drivers	• Scale • Capacity utilization		• Scale • Capacity utilization
Key value drivers		• Reputation	• Scale • Capacity utilization
Business value system structure	• Interlinked chains	• Referred shops	• Layered and interconnected networks

Table 8. Overview of alternative value configurations adopted from (Stabell, Fjeldstad, 1998)

As different companies fall into specific categories that determines properties of their value creation process, which in turn defines the relative significance of resources and assets that companies operate. This is the exact reason why this framework appears in this research, since it is essential to identify different assets significance in the value creation process of the company in order to be able to derive their value. Unfortunately, no relevant studies illustrated application of this framework in the IT industry; however, it is possible to assemble certain classifications from the available information. As authors mention: most firms are not pure instances of a single distinct value configuration. A single firm may employ more than one technology and hence have more than one configuration. (Stabell, Fjeldstad, 1998) However, since IT industry in particular encompasses different business segments, it is rather simple to find examples well fit for every value creation framework. For instance, a company focused on the hardware production is probably closest to traditional value chain framework since its key activities and value creation are most likely revolve around logistics-operations-sales. Despite that, it is important not to downplay the significance of the structural or organizational aspect of intellectual capital that company possesses since, as we already know, technological advancement, R&D and patents are key components in IT and especially in the hardware manufacturing. Another example: a company that produces business specific software or provides maintenance or networking support fits the definition of value shop framework, which in turn outlines focus on human resources and relations with customers (so-called relational capital) for the purposes of value creation. Telecommunication company or any social network brilliantly corresponds to the value net concept since its key activities revolve around setting up a network, providing linkages and infrastructure using mediating technology. Strong network effects alongside with volume scaling dictate indisputable significance of relational capital as well as emphasis on the organizational capital for the infrastructure support.

On the one hand, examples outline highly fragmented nature of the IT sector in a sense of different IT branches having different set of priorities for different types of intellectual capital in their value creation process. However, examples also highlight the overall significance of the intellectual capital in IT in general, which also corresponds with the whole framework of this research.

To conclude this chapter I would like once again to revisit the core concepts that further will be used for the purpose of this research and outline the most important features of IT industry. As the relevant literature and different industry reports suggest IT industry – a coalescence of business segments involving software and hardware, networking and telecommunication, a wide range of IT services that directly or indirectly enable information transfer, storage, usage etc.

The main features of IT industry:

- Fast paced technological advancement and high growth rates
- Technology, innovation and R&D intensity
- Emphasis on the human resources
- Short product lifecycles
- High degree of uncertainty
- Large economies of scale
- Capital concentration

- Intellectual capital significance in the value creation process
- High level of conceptual fragmentation between different IT clusters

The term IT industry is in fact very broad and encompasses multiple industry segments that might not share exact same characteristics. No doubt, that industry specific factors and features in software and hardware industries for example might differ and require closer examination, however for the purpose of this research certain generalization has to made.

Summary

Theoretical part in general addresses the first research question: main focus here is to understand core definitions and discuss current practices for measuring intellectual capital as well as understanding underlying aspects of measurement theory for proper assessment of those methods. Yet another focus of this part is on features and peculiarities of IT industry that would affect intangible valuation for that particular area of business. Therefore, theoretical part is virtually divided into four parts or major chapters.

In the first part, I provide all necessary distinctions, definitions and classifications regarding intangible assets including motivation for valuation.

Second part focuses on concept of value and measurement systems. In this chapter, the goal was to establish a proper framework that would allow adequately discussing and analyzing intangible assets valuation methods. First theoretical concept reviewed is axiology (value theory), which main assumptions are proper identification of an object of valuation and identification of relevant stakeholders. Next step is to establish rigorous set of rules that are used when building a relational measurement system that is compliant with the measurement theory. The process of building such a system includes identification of purpose and perspectives of valuation, identification of attributes and acceptable proxies, creating corresponding numerical systems tailored for the purpose of valuation and choosing relevant scale. Another question is finding balance between costs of obtaining information that are associated with building a proper measurement system and benefits gained from more detailed inspection of certain attributes of a system. Regarding this issue there is an important distinction between measures and indicators. Measures are the results of rigorous measurement and are suitable when the output needs to be completely reliable. Indicators are more subjective assessments, which are suitable for internal performance tracking locally.

In the third part, I attempted to classify and briefly describe features, advantages and disadvantages of the existing methods of intangible assets valuation with the underlying assumptions of measurement theory. There are multiple classification of those methods present nowadays; however, I choose to focus on classification according to general principles of valuation. This classification includes Direct Intellectual Capital methods (DIC), Market Capitalization Methods (MCM), Return on Assets methods (ROA) and Scorecard Methods (SC). Closer inspection of methods revealed the fact that most of them fail one or more implications of measurement theory and sometimes even the principle of least astonishment. MCM and ROA methodologies usually do not even attempt to measure the intangible assets / intellectual capital but rather try to explain and attribute certain differences in financial figures to the changes in intangibles / IC. DIC and SC methods attempt to measure intellectual capital from the bottom-up and thus come with results that can potentially satisfy learning purpose and uncover hidden value of intangible resources. Despite that justification of use of indicators and underlying assumptions that rule out selection criteria are usually very debatable and subjective. On top of that, most authors do not pay enough attention to the scales that they use for different data, which results in sometimes confusing results. Nevertheless, there are interesting and well-designed methods in almost every category that despite certain shortcomings can provide useful results for the defined narrow purpose.

The last part focuses on identifying and understanding key features, characteristics and industry specific factors where the methodology is going to be applied. In the case of my research this refers to the IT industry. Thus in this chapter the goal is to understand what exactly is understood by IT industry, what is so special about companies conducting business in this sphere and what industry specific features should be taken into consideration for the purpose of valuation of intangible assets in IT. The term IT industry is in fact very broad and encompasses multiple industry segments that might not share exact same characteristics. No doubt, that industry specific factors and features in software and hardware industries for example might differ and require closer examination, however for the purpose of this research certain generalization has to made.

In theoretical part, I try to underline strengths, weaknesses and areas for improvement of current practices with regards to the area of research (IT) and create link to the second part, where I try to answer the second research question: how to properly measure and value intangible assets in IT.

Empirical Research

Purpose & motivation / philosophy

In the literature review, I covered the majority of existing methods of valuation of intangible assets / measuring intellectual capital. As I already have mentioned in the conclusion remarks for the first chapter, many of those techniques have shortcomings and disadvantages: some violate underlying theories, some produce rather impractical results. By saying this, I am not trying to discredit work of others but rather to point to the fact that this particular field of research has not yet reached the point when certain methods are considered best and accepted in all situations. Thus, I believe that I would make a decent contribution to the field by developing my own method.

When trying to develop a methodology to measure or evaluate something, one absolutely need to have a clear understanding of the purpose of his task. In order to clarify this purpose I would like to revisit concepts of measuring intellectual capital / valuation of intangible assets. Most researchers (myself included) consider them equal when speaking in terms of theoretical definition. However, when it comes to the practical implication there comes a difference. I would describe it rather more philosophical than actual difference. And this difference is usually directly associated with the purpose of the research. When the goal is to find monetary value – researchers usually operate with the terms “intangible assets” and “evaluation”; when the idea is to estimate intrinsic value of the matter – “intellectual capital” and “measurement” terms are usually mentioned. There is no better version: both branches are suitable and favorable in certain specific situations. Since I have already discussed those situations in the first chapter I would not go into further details about them right now. However, here I would like to answer very important question about the purpose of my method.

The ultimate purpose of this research would be to create a specific indicator that can be effectively used as a benchmarking tool for measuring intellectual capital in IT industry. Benchmarking in this case relates to the tool that would allow to compare certain specific company and its intellectual capital against industry standards. The indicator is based upon theoretical background that was discussed in theoretical part and aims at improving current practices of measuring intellectual capital using a case of IT industry. Therefore, with previous implications in mind, I am going with “Intellectual capital measurement” philosophy in my empirical research.

This was the description of the practical purpose of the research, and now I would like to talk about academic or scientific purpose. The first and the foremost goal in constructing the method is to avoid those common mistakes that I discussed in the overview of existing methodologies. Within this method, the model is to be compliant with measurement theory, using proper scales, analyzing comparable clusters of data and using consistent logic in identifying and building indicators.

It is important to mention that building a measurement model of any kind is a multi-iteration process. Thus, considering the format of this research paper, I acknowledge the fact that the method in one of its first iterations cannot be considered perfect and will have multiple limitation, which I would cover in the later chapters.

Structure of the model

Keeping in mind all remarks about purpose and philosophy I would like to proceed to describe model structure. Within the model, I operate the following structure of intellectual capital: Relational capital, Human capital, and Organizational capital. Since my goal is to create a benchmarking tool, within each category, I seek out a certain number of proxies or metrics that would allow creating certain index that would reflect level of respective part of intellectual capital in company. Those categories are rather abstract and thus there are no established metrics to describe them. Hence, the use of proxies.

Within each category, certain number of proxies is selected (2-3 proxies per category, mostly depending on the availability of the data). Once all proxies are established, the data relevant to certain industry cluster is extracted, filtered and weighted average values are found for each of the respective proxies. As a result, we have an n-dimensional radar diagram where each ray represent certain proxy. Next step is to integrate all proxies into the aggregated radar with just three rays, representing Relational capital, Human capital, and Organizational capital.

Thus, final benchmarking tool consist of two radar diagrams that can be utilized to compare metrics of certain company against industry average statistics. Every metric adheres to strictly ratio scale in order to provide model scaling and comparability.

Data description

In this part, I would like to describe in detail what kind of data was used to build the indicator, selection criteria for proxies, methods for data aggregation and filtering and end set of proxies.

Since one of my goals was to make sure that indicator would serve as an adequate comparative benchmark for companies within certain cluster, the first step of data selection process was to choose said cluster. Considering the type of information I needed for this model I used Thomson Reuters Datastream database that contains corporate financial data for over 100,000 equities in nearly 200 countries around the world.

Sample

For the purpose of this research, I focused my attention on sector of **Software & Internet services** in the United States. Defining criteria for such selection was the fact that US holds largest and the most developed market within this IT sector and as a result provides the largest pool of companies to draw data from. Total number of companies within this sector is 796, however the actual number companies within each different metric category varies significantly because the data is very fragmented and not every company provides all possible metrics.

Selection of proxies

This is one of the most important and sensitive moments in the research. The ultimate goal was to select metrics that would most adequately represent respective share of intellectual capital.

Coming from theoretical background I have generated a list of "elements" that are associated with respective share of intellectual capital. This list is by no means claims to cover all of the aspects attributed to IC; however, it goes through ones that have the highest chance of having some sort of sensible measurement tool on the scale that would actually allow them to be used as a proxy.

Human capital	**Organizational capital**	**Relational capital**
Salary/per employee Human capital ROI Training investment factor Employee`s level of education	Patents and copyrights Research and development costs / investments Trade marks Design rights Trade secrets Know-how Service marks Information technology systems Networking systems	Brand value Goodwill Marketing costs User base Customer relations Customer satisfaction

Table 9. List Possible Intellectual Capital Metrics

In a perfect world, I would like to use as many available proxies as possible to maximize accuracy of the IC measurement; however, situation with data availability applied its correction to the plans. After proper evaluation of different ideas and close up data inspection, the ultimate set of proxies was identified. The results are represented within table 10.

IC Category	Proxy
Human capital	• Workforce /Training and Development (coeff.) • Workforce /Employment Quality (coeff.) • Score - Performance/Employee Cost
Organizational capital	• Research & Development Costs / Total Assets • Brand + Patents Gross / Total Assets • Other Intangibles Gross / Total Assets
Relational capital	• Goodwill / Total Assets • Operating Income / Total employees

Table 10. Final set of Intellectual capital proxies

Human capital

Unfortunately, some of the "traditional" or originally desired human capital proxies like salaries, training costs etc. were not available within researched industry cluster / time-frame or were presented by insufficient number of entries for model building purposes. For these reasons, I had to choose certain unconventional set of proxies, which are essentially indicators themselves composed by external agencies.

Workforce /Training and Development - this category measures a company's management commitment and effectiveness towards providing training and development (education) for its workforce. It reflects a company's capacity to increase its intellectual capital, workforce loyalty and productivity by developing the workforce's skills, competences, employability and careers in an entrepreneurial environment.

Workforce /Employment Quality - this category measures a company's management commitment and effectiveness towards providing high-quality employment benefits and job conditions. It reflects a company's capacity to increase its workforce loyalty and productivity by distributing rewarding and fair employment benefits, and by focusing on long-term employment growth and stability by promoting from within, avoiding lay-offs and maintaining relations with trade unions.

Score - Performance/Employee Cost – this category represents a ratio of total salaries and benefit expenses (staff cost) divided by net sales or revenue.

Organizational capital

Proxies within this category reflected original concept of organizational capital the most. However, there was still some problems with these categories as well. Namely, **Brand + Patents** proxy was meant to be separated into its respective parts (and Brand part going to the Relation capital), however since these metrics were not available in individual entries I had to make a compromise and put them together under organizational capital category. This does not violate theory though since those categories are not set in stone and Brand can be justifiably attributed to both categories.

Research & Development Costs / Total Assets – this ratio represents all direct and indirect costs related to the creation and development of new processes, techniques, applications and products with commercial possibilities divided by company`s total assets.

Brand + Patents Gross / Total Assets - this ratio represents the gross value of brands, patents and trademarks divided by company`s total assets.

Other Intangibles Gross / Total Assets - this ratio represent the gross value of intangible fixed assets which are either not included in goodwill, development costs, brands and patents, or licenses or which may represent a combination of some or all or these assets divided by company`s total assets.

Relational capital

This category of intellectual capital has proven to be the most problematic to fill up since market and customers related data sufficient enough for a proper sample is extremely difficult to come by. Hence, there are only two proxies within this category.

Goodwill / Total Assets – this ratio represents the excess cost over the fair market value of the net assets purchased as reported by company divided by company`s total assets.

Operating Income / Total employees – this ratio represents the difference between sales and total operating expenses divided by company`s total number of employees.

Weighted average / data filters used

Within the selected metrics range, I performed time series request that covered 5 years period from 2009 to 2013. Since I operated with yearly values for the data, 2014 was out of scope due to very limited data.

In order to avoid irrelevant and warped results I used a certain set of filters within each category of selected metrics. First of all, all missing and zero values were excluded from further processing (exception for zero values is metric of Operating Income / Total employees since in this particular case zero and even negative values make practical sense). For categories representing organizational capital (Research & Development Costs / Total Assets; Brand + Patents Gross / Total Assets; Other Intangibles Gross / Total Assets) I filtered all the values exceeding (0.5) coefficient. For category Goodwill / Total Assets the same threshold was set at (0.8) mark. The rationale behind those filters was that in most cases those values came from incorrect data rather than statistical anomaly (which in turn is also a solid reason to consider removing those values).

Next step was to estimate industry average indicators across all selected metrics. In order to perform this operation I used weighted average method where total assets were used as a driver for the weight coefficient. I calculated average values for each year separately. The general equation for the weighted average for the any given metric reads following

$$\sum_{i=1}^{n} = m_i \ (\frac{TA_i}{TA_n})$$

Where ***m*** is face value of certain metric of ***i*** company (for example value of Research & Development Costs / Total Assets).

n – Total numbers of companies that have data for the particular ***m*** metric. This one is exceptionally important since actual sample size varies significantly within different categories (for example for category Research & Development Costs / Total Assets there is a total number of 268 data entries after application of all filters whereas for category Score - Performance/Employee Cost there are only 31 entries). Thus, each metric category has its own weight coefficients for companies actually participating in this particular sample.

TA_i – stands for total assets of company ***i***.

TA_n – stands for total assets of ***n*** companies that have data under ***m*** metric.

Final model

Results for data processing are displayed in the following table n.:

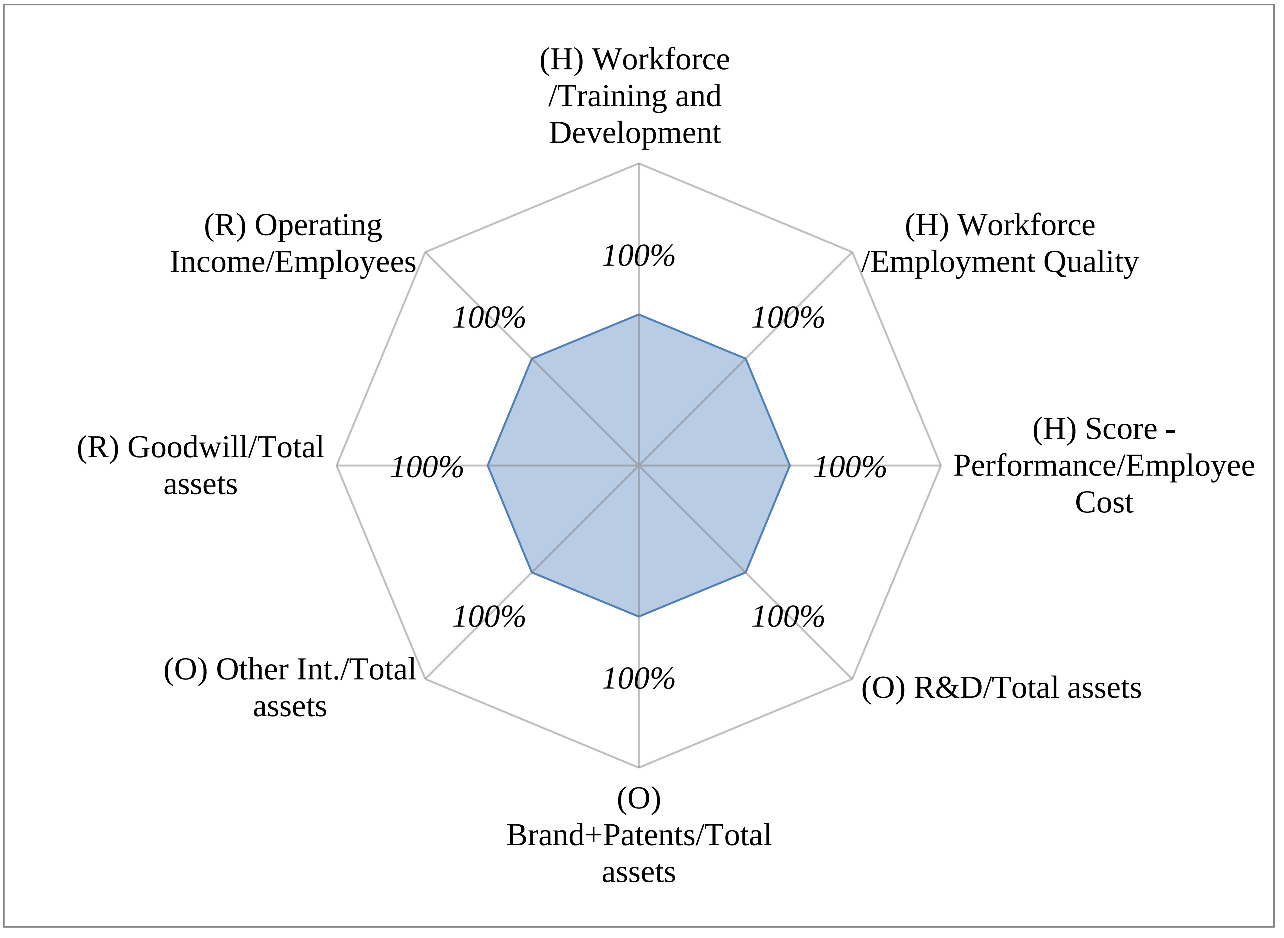
		Weighted average values (yearly)					Sample size (2013)
		2009	2010	2011	2012	2013	
HC	Workforce /Training and Development	62,13	65,68	67,78	62,22	61,63	46
	Workforce /Employment Quality	53,32	55,62	52,95	50,28	46,63	45
	Score - Performance/Employee Cost	51,83	52,16	51,62	53,12	54,98	31
OC	R&D/Total assets	0,075	0,070	0,070	0,071	0,069	268
	Brand + Patents/Total assets	0,013	0,013	0,015	0,026	0,025	155
	Other Int./Total assets	0,052	0,060	0,059	0,063	0,068	216
RC	Goodwill/Total assets	0,24	0,23	0,22	0,21	0,20	255
	Operating Income/Employees	159,44	199,48	271,46	296,63	355,54	310

Table 11. Weighted average values for selected proxies

As one can see, sample sizes vary significantly among categories of proxies and especially the data for the human capital proxies is very limited and fragmented. In fact sample sizes for those categories before 2013 are pretty much non-existent, which makes weighted average values for pre-2013 years non-representable. Also because of this, number of possible companies that can be measured in all eight dimensions is reduced, especially if attempting a time-series analysis. This is a primary reason to focus on the latest retrievable values (for 2013) when measuring Intellectual capital for a given company.

For the reasons of unification and possibility of further data integration industry weighted average values are considered to be 100%, thus each individual value put up against those industry benchmarks would receive % score.

The very general model of the radar diagram that would serve as a part of ultimate benchmark for measuring intellectual capital looks the following way:



Picture 1. Graphical representation of the IC model (8-dimensional)

Next step is to transition from 8-dimensional model where each dimension represents one of the selected proxies, to 3-dimensional model that would provide benchmark for Human Capital, Organizational Capital and Relational Capital. In order to make that transition I developed secondary set of conversion coefficients that would distribute the share of every original metric into respective intellectual capital category. Selected coefficients are displayed in the table below:

IC Category	Proxy	Coefficient
HC	Workforce /Training and Development Workforce /Employment Quality Score - Performance/Employee Cost	0,3(3) 0,3(3) 0,3(3)
OC	Research & Development Costs / Total Assets Brand + Patents Gross / Total Assets Other Intangibles Gross / Total Assets	0,35 0,45 0,2
RC	Goodwill / Total Assets Operating Income / Total employees	0,5 0,5

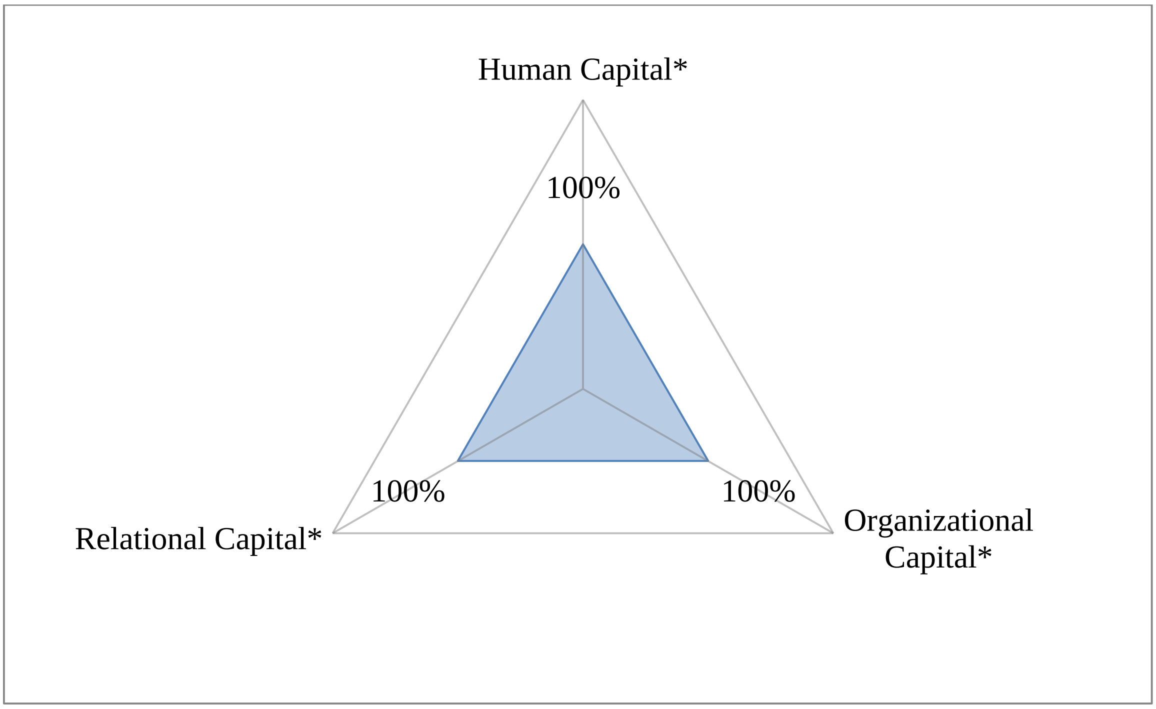
Table 12. Coefficients for the IC category distribution

For human capital, I decided to go with even distribution of shares among different metrics, mainly since enlisted categories provide general assessment of certain aspect of human capital. It is of course up for debates whether training, job conditions or staff performance is the most important (or most “valuable”) characteristic of human capital of IT companies, however for the purpose of this research I decided not to distinguish these roles in further detain, hence equal weight coefficients.

For organizational capital, I considered different distribution of weights. Proxies used in this category represent straight up parts of the balance sheet of sampled companies and thus certain weighted distribution had to be applied to those proxies. For software & internet services companies and for IT in general, the importance of patents cannot really be overestimated and considering that in this model, patents are part of brands & patents metric it is logical that this proxy gets highest weight coefficient. Second highest coefficient in this category goes to R&D cost since once again industry specifics dictate the importance of this metric for IT firms.

In relation capital I decided to once again go with equal distribution of weights, since I believe that factors of company`s public image (reflected by Goodwill) and market sales effectiveness (which tries to approximate market strength and therefore customer relations) are rather equal in terms of weigh for the purpose of approximation of relation capital.

With application of secondary weight coefficients, 3-dimensional model can be finally put together. This model represents the same data as an 8-dimensional one, however potentially provides a larger scale picture of the company`s intellectual capital. The general outlook of 3-dimensional model graphically represented in a following way.



Picture 2. Graphical representation of the IC model (3-dimensional)

I would like to point out an important detail about graphs on pictures 1 and 2: both represent general format of the models and their respective axes. Blue circuit on both pictures actually just highlights 100/100 within respective categories due to the fact there is no values to compare. Both models operate exclusively on the ratio scale, thus, any meaningful data representation within given format can only be achieved when comparing an actual data (from ***i*** company) with the industry weighted average values. That is exactly what the next part of this chapter is all about.

Real case examples (industry leading companies on the radars) + implications

In this part, I would like to provide real cases of application of my methodology to companies from selected cluster of IT. For this purpose, I decided to focus my attention on the industry leading companies within this cluster mainly because of wide exposure they are getting in the media that would allow to link implications of the analysis with facts and secondly - data accessibility.

The structure of the model allows taking and analyzing any company that has data available for the designated proxies and belongs to the studied cluster, however due to some proxy metrics (especially HC-related) having rather limited sample size, the total number of companies having complete (all-dimensional) models is limited to the mentioned bottleneck sample. However, that does not mean that the model is useless in case when some data is missing within a particular category: through the adjustments to secondary set of conversion coefficients, it is still possible to measure IC within framework of this model. In fact, such case is specifically presented further in this chapter to display the model flexibility.

Google

Google Inc. (Google or "the company") is a global technology company that offers search, advertising, operating systems and platforms, enterprise, and hardware products. The company operates in the US, the UK and in several other countries across the world. Google is headquartered in Mountain View, California and employed 47,756 people as of December 31, 2013.

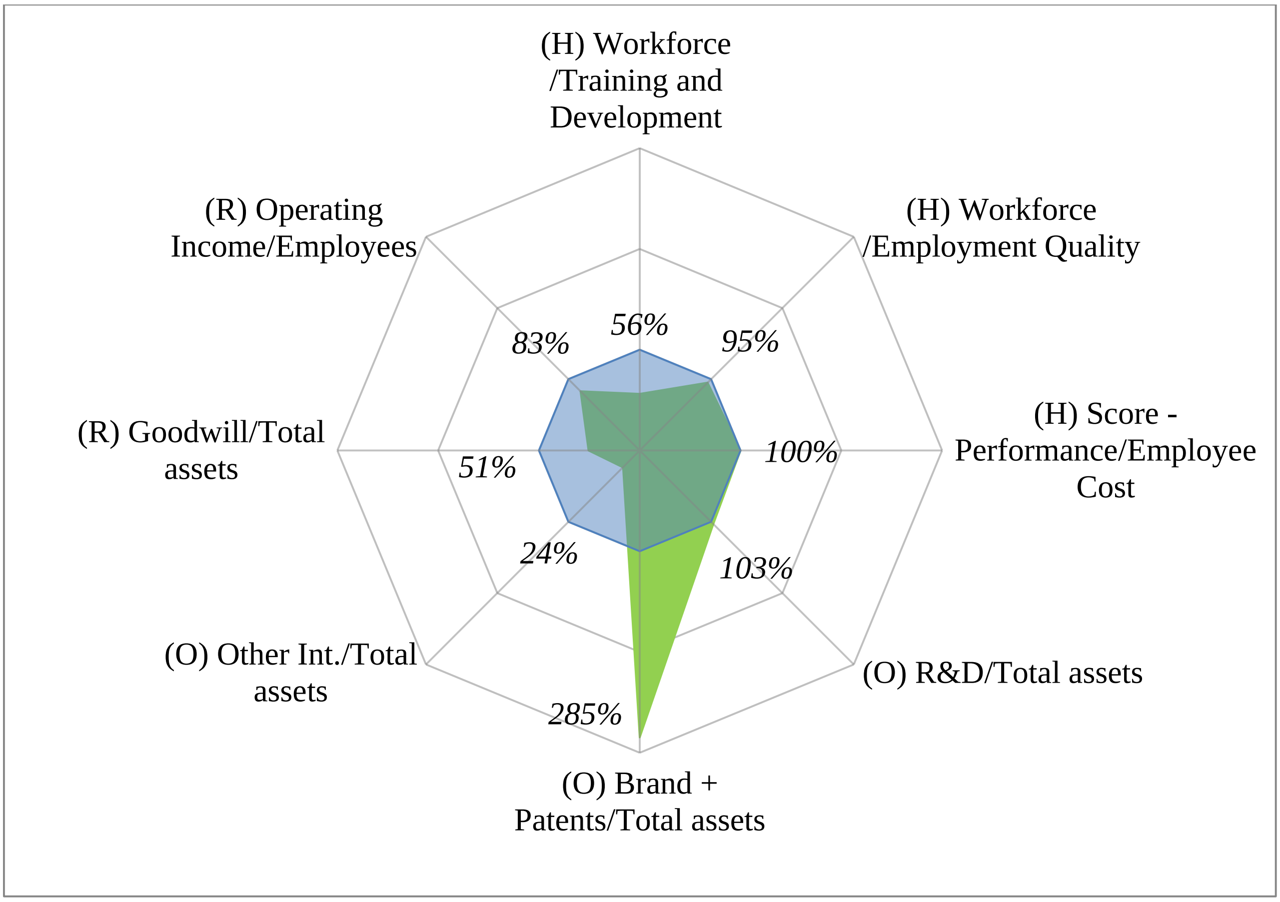
The company recorded revenues of $59,825 million during the financial year ended December 2013 (FY2013), an increase of 19.2% over FY2012. The revenues increased primarily due to an increase in advertising revenues generated by Google websites and Google Network Members' websites. The operating profit of the company was $13,966 million in FY2013, an increase of 9.5% over FY2012. Its net profit was $12,920 million in FY2013, an increase of 20.3% over FY2012. (MarketLine, 2014)

Google	2013

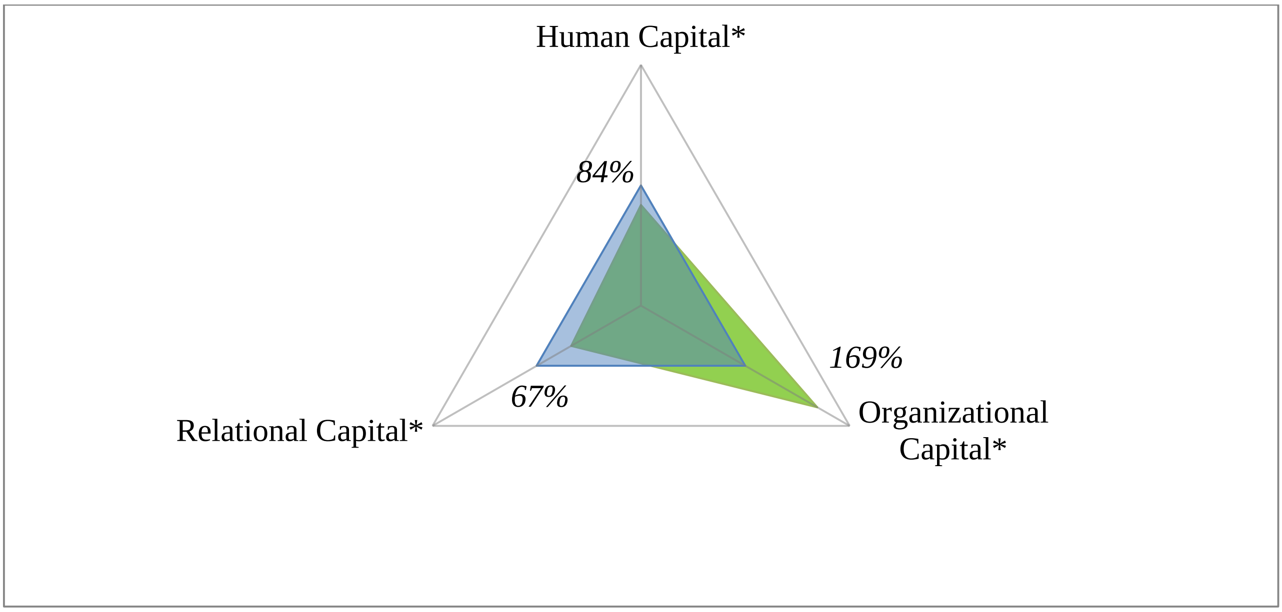
Conversion coefficient	Proxy metric	Company`s data	Industry weighted Average	Benchmark Ratio
0,3(3)	(H) Workforce /Training and Development	34,74	61,626	56%
0,3(3)	(H) Workforce /Employment Quality	44,34	46,629	95%
0,3(3)	(H) Score - Performance/Employee Cost	54,99	54,980	100%
0,35	(O) R&D/Total assets	0,07	0,069	103%
0,45	(O) Brand + Patents/Total assets	0,07	0,025	285%
0,2	(O) Other Int./Total assets	0,02	0,068	24%
0,5	(R) Goodwill/Total assets	0,10	0,203	51%
0,5	(R) Operating Income/Employees	295,02	355,535	83%

IC capital category	Benchmark Ratio
Human Capital*	84%
Organizational Capital*	169%
Relational Capital*	67%

Table 13. Model data for Google (2013)



Picture 3. Graphical representation of the IC model (8-dimensional) for Google (2013)



Picture 4. Graphical representation of the IC model (3-dimensional) for Google (2013)

As one of the largest company within Software & Internet services sector Google understandably reaches a very high score (169%) within organizational capital category. Other categories of IC are not so impressive, however I would like to stop here and take an opportunity to point out extremely important feature of the model that I developed: with the way industry weighted average (benchmark) value is calculated even 1% over 100% means that company has a significant edge within respective IC category. In addition, I do not try to combine, sum or interconnect numbers for different IC categories into one aggregate IC indicator for methodological reasons. The idea behind these two assumptions, is that score over 100% in one category does not make up for other categories and vice versa, however even one above average usually becomes a source of a competitive advantage.

How exactly does this lead translates into firm`s competitive advantage is unique case for every company; like in this particular case, Google strength comes from all the wide range of technological innovations, numerous patents, R&D developments and variety of products it provides to the market.

The fact that human capital score is slightly below the benchmark (at 84%) does not necessarily indicates low level of human capital development within company, but rather states the fact that firm doesn't have competitive advantage based on this IC component.

Score for relationship capital in Google`s case might actually be an indication of imperfect scaling of consisting categories (more detailed description about this – in the "Limitations and assessment of the method" chapter). However, apart from that note, the score of 67% might indicate a field for potential improvement, even though such score is still in the psychological "green zone".

Oracle

Oracle Corporation (Oracle or "the company") is a provider of enterprise software, computer hardware products and services. The company operates in more than 145 countries across the world. Oracle is headquartered in Redwood Shores, California and employed 120,000 people as of May 31, 2013.

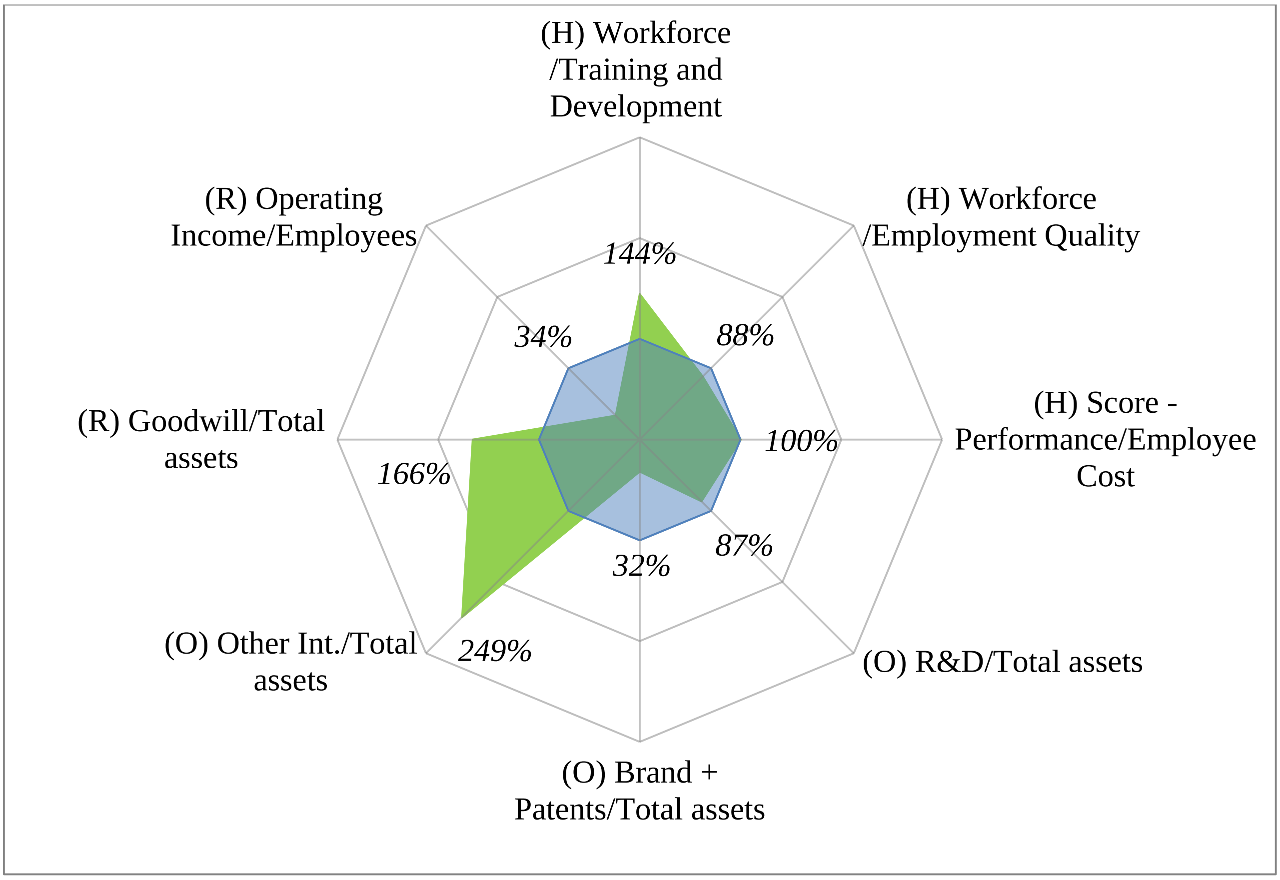
The company recorded revenues of $37,180 million during the financial year ended May 2013 (FY2013), an increase of 0.2% over FY2012. The increase in revenues was due to an increase in Oracle's software business revenues. The operating profit of the company was $14,684 million in FY2013, an increase of 7.1% over FY2012. The net profit was $10,925 million in FY2013, an increase of 9.5% over FY2012. (MarketLine, 2014)

Oracle	2013

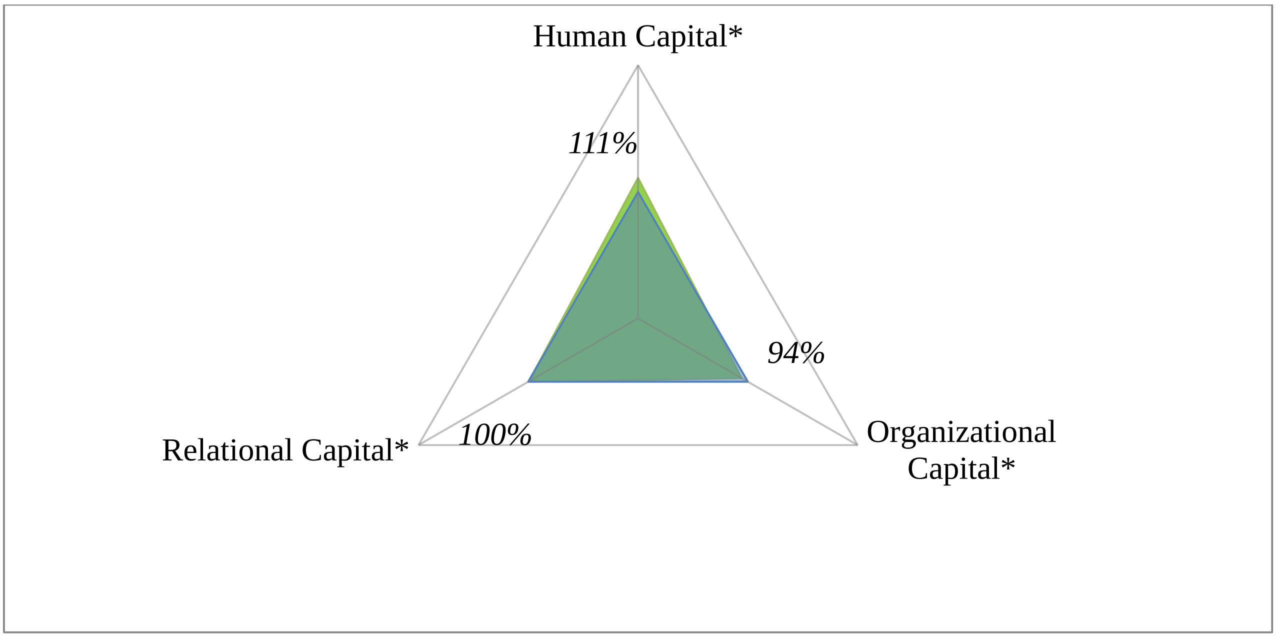
Conversion coefficient	Proxy metric	Company`s data	Industry weighted Average	Benchmark Ratio
0,3(3)	(H) Workforce /Training and Development	88,90	61,626	144%
0,3(3)	(H) Workforce /Employment Quality	41,23	46,629	88%
0,3(3)	(H) Score - Performance/Employee Cost	55,15	54,980	100%
0,35	(O) R&D/Total assets	0,06	0,069	87%
0,45	(O) Brand + Patents/Total assets	0,01	0,025	32%
0,2	(O) Other Int./Total assets	0,17	0,068	249%
0,5	(R) Goodwill/Total assets	0,34	0,203	166%
0,5	(R) Operating Income/Employees	120,27	355,535	34%

IC capital category	Benchmark Ratio
Human Capital*	111%
Organizational Capital*	94%
Relational Capital*	100%

Table 14. Model data for Oracle (2013)



Picture 5. Graphical representation of the IC model (8-dimensional) for Oracle (2013)



Picture 6. Graphical representation of the IC model (3-dimensional) for Oracle (2013)

This software company poses an interesting example of having rather polarizing results among metrics within same IC category. Notably Other Int./Total assets proxy has an impressive score of 249% vs relatively low score for Brand + Patents/Total assets – 32%; the same picture can be observed in relational capital. In the final 3-dimensional model, however, those outliers compensate each other to the point of having scores for all three IC categories to fluctuate really close to the industry average level. This particular case conveniently showcases the usefulness of both stages of the model: 3-dimensional IC model identifies Oracle as a well-rounded company without significant outliers in any category, whereas 8-dimensional model provides an insight on the company`s unique IC structure.

Adobe

Adobe Systems Incorporated (Adobe or "the company") offers a range of software products and services for creating, managing, delivering, measuring, optimizing and engaging with content across multiple operating systems, devices and media. Adobe operates in the Americas; Europe, Middle East and Africa (EMEA); and Asia-Pacific (APAC) regions. It is headquartered in San Jose, California and employed 11,847 people as of November 29, 2013.

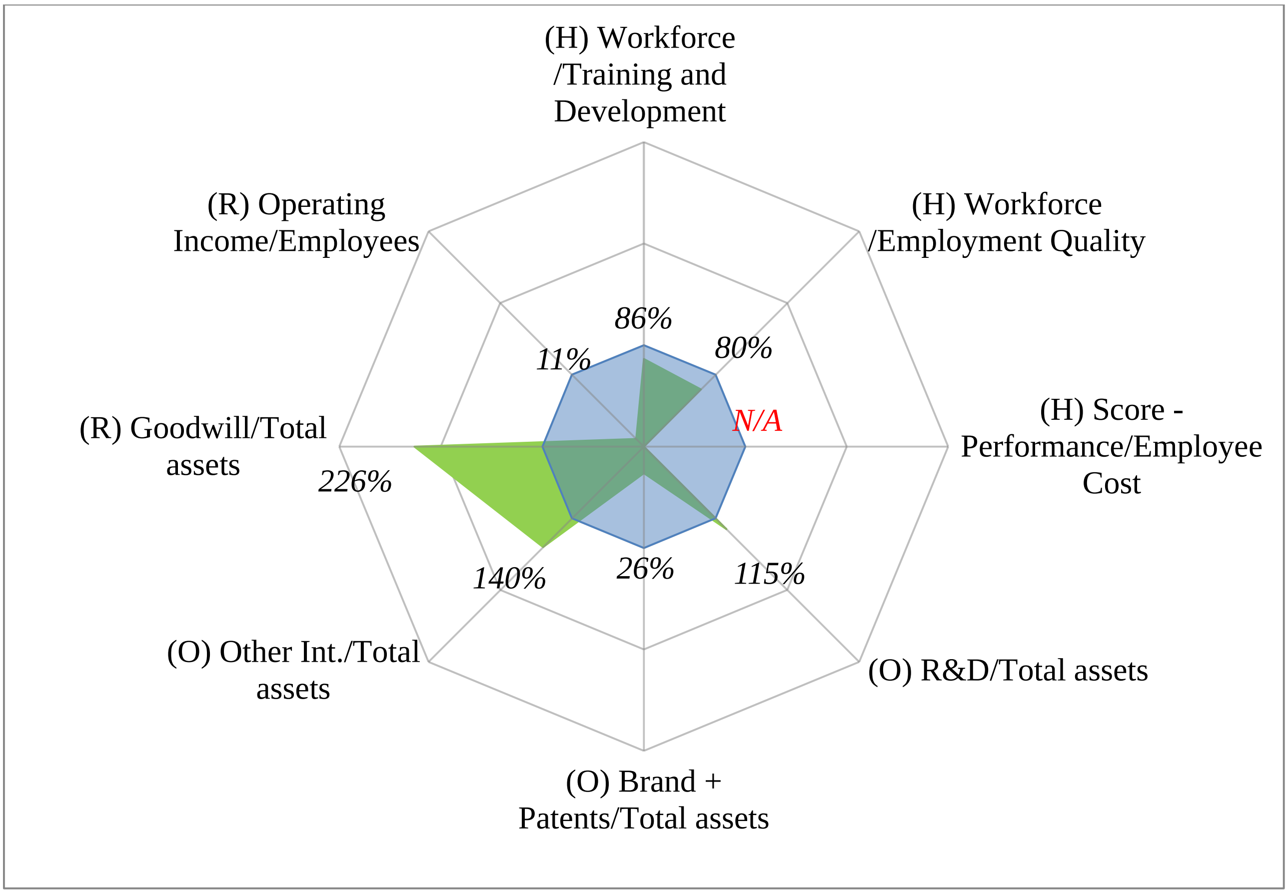
The company recorded revenues of $4,055.2 million during the financial year ended November 2013 (FY2013), a decrease of 7.9% compared to FY2012. The operating profit of the company was $422.7 million in FY2013, a decrease of 64.2% compared to FY2012. The net profit of the company was $290 million in FY2013, a decrease of 65.2% compared to FY2012. (MarketLine, 2014)

Adobe	2013

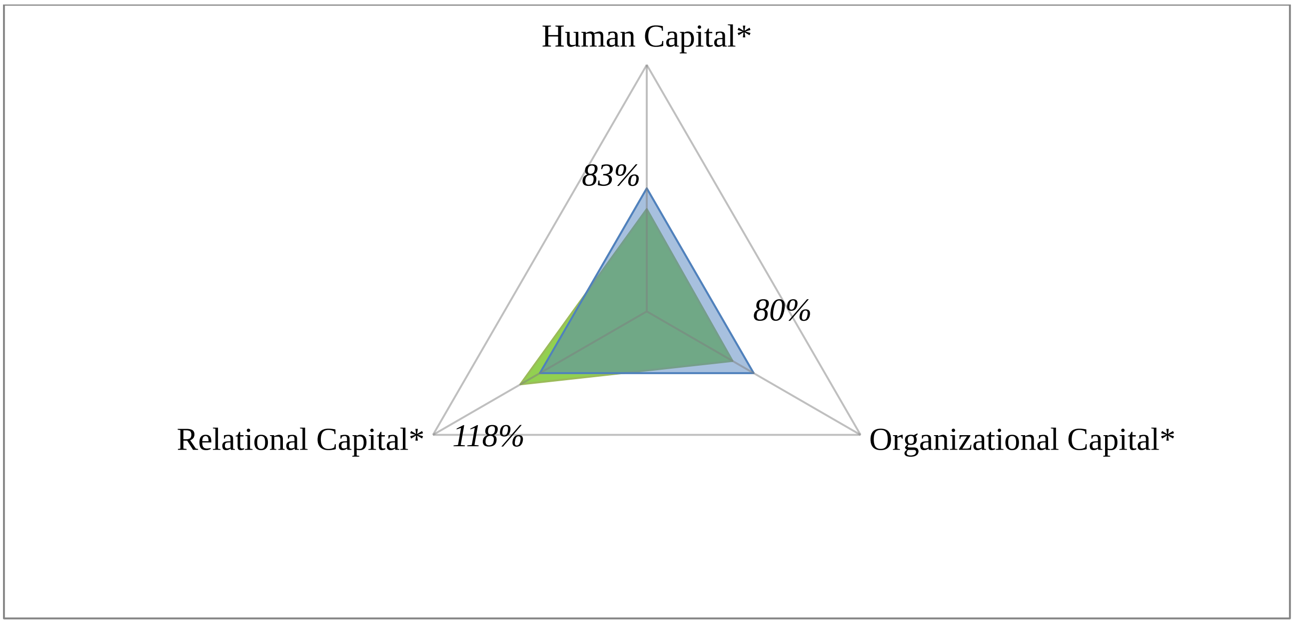
Conversion coefficient	Proxy metric	Company`s data	Industry weighted Average	Benchmark Ratio
0,5	(H) Workforce /Training and Development	53,20	61,626	86%
0,5	(H) Workforce /Employment Quality	37,13	46,629	80%
0	(H) Score - Performance/Employee Cost	0,00	54,980	0%
0,35	(O) R&D/Total assets	0,08	0,069	115%
0,45	(O) Brand + Patents/Total assets	0,01	0,025	26%
0,2	(O) Other Int./Total assets	0,10	0,068	140%
0,5	(R) Goodwill/Total assets	0,46	0,203	226%
0,5	(R) Operating Income/Employees	37,92	355,535	11%

IC capital category	Benchmark Ratio
Human Capital*	83%
Organizational Capital*	80%
Relational Capital*	118%

Table 15. Model data for Adobe (2013)



Picture 7. Graphical representation of the IC model (8-dimensional) for Adobe (2013)



Picture 8. Graphical representation of the IC model (3-dimensional) for Adobe (2013)

Adobe is another case that features polarizing results among metrics of specific category of IC and once again, those categories cover organizational and relational capital. Subsequently, aggregate results of IC categories show slight ahead of the curve result of 118% for relational capital and slightly below average results (around 80%) for other IC categories. In case of human capital score results can be straight up interpreted and acted upon accordingly, whereas score for organizational capital should be examined more carefully with additional attention for actual inner structure. High Other Int./Total assets and low Brand + Patents/Total assets might in fact mean that calculation process for those metrics for this particular company might had certain important peculiarities that were not accounted for. Another idea that this case might inspire is that maybe the approach of having same secondary weight coefficients for all companies, may not be an ideal solution since different companies may have different emphasis on the components of IC in value creation process. Counter argument to that is obviously the fact that those coefficients should be kept same to insure the integrity of scales and maintain comparable values. Despite that, this topic is still worth considering for further research.

Another interesting “feature” in this particular case is that the model actually lacks input (there was no information on Score - Performance/Employee Cost proxy), that I handled by redistributing weight confidents to the residual proxies in human capital category. This gets to show that model still remains operational even with some missing data inputs, at the expense of accuracy of measurement. Even though such cases are not desirable, however it is not always possible to get all the data for the particular company thus having extra flexibility makes method much more applicable in different situations. The question of redistributing weight of the “missing” part is open for debate though: I redistributed weight equally among remaining proxies to maintain the proper scale in this model. In this iteration of method such manipulations are rather painless within categories of human and relational capital since their respective parts are equally weighted in the first place, however, if this operation has to be applied to organizational capital section remaining proxies should remain in the same proportions they were before redistribution. For example if Other Int./Total assets proxy value is missing coefficient for remaining proxies R&D/Total assets and Brand + Patents/Total assets should be set to 0,4375 and 0,5625 respectively in order to maintain their original ratio: 0,35/0.45 = 0,4375/0,5625 = 0,7(7). This is particularly important for any potential further iteration of model to make sure this particular element will not become another potential pitfall.

Symantec

Symantec Corporation (Symantec or "the company") is one of the leading providers of security, storage and systems management solutions to businesses and consumers. It provides customers with software and services that protect manage and control information risks related to security, backup and recovery, storage, compliance, and systems management. The company primarily operates in the US. It is headquartered in Mountain View, California and employed about 20,800 people as of March 28, 2014.

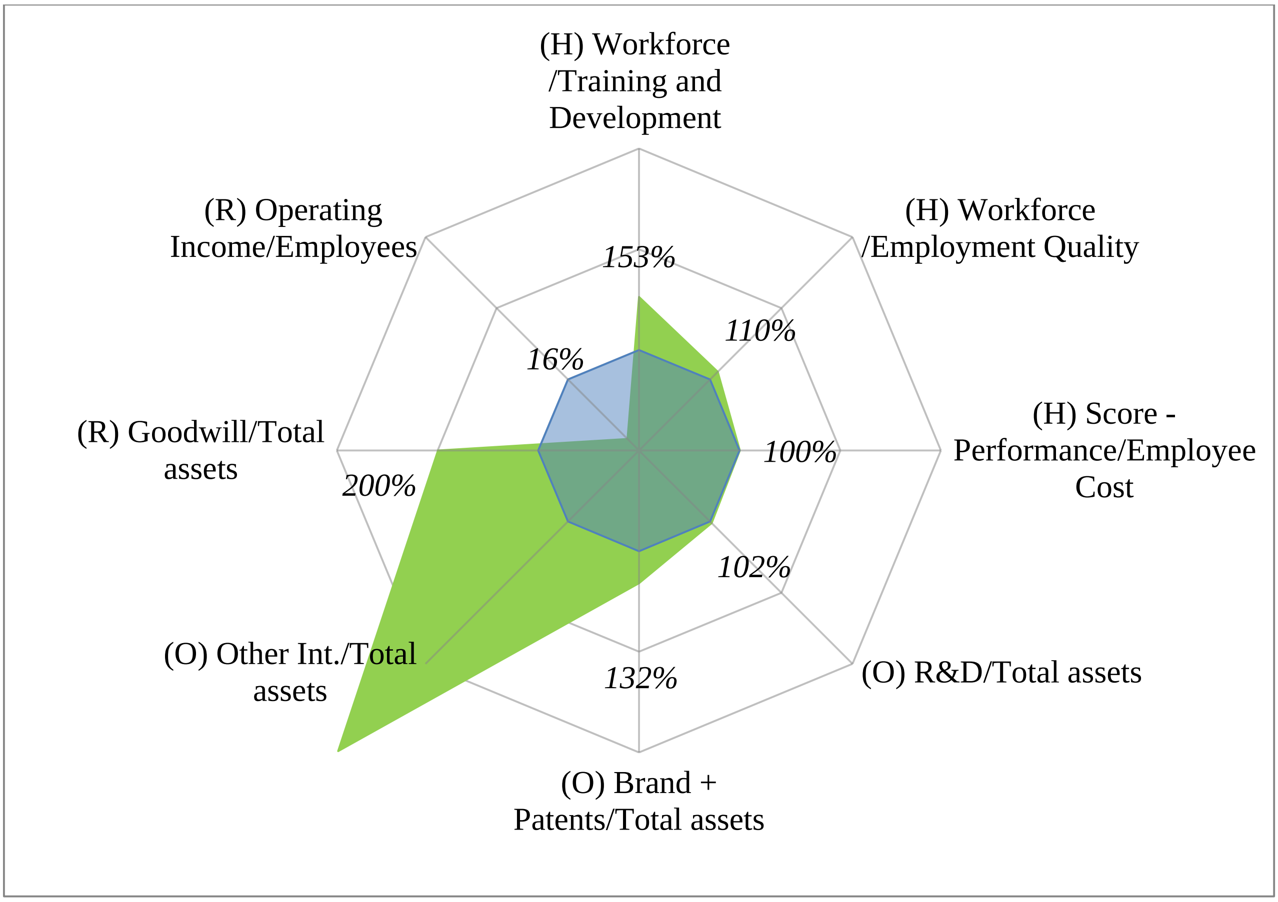
The company recorded revenues of $6,676 million during the financial year ended March 2014 (FY2014), a decrease of 3.3% compared to FY2013. The operating profit of the company was $1,183 million in FY2014, an increase of 7% over FY2013. Its net profit was $765 million in FY2014, a decrease of 34.7% compared to FY2013. (MarketLine, 2014)

SYMANTEC	2013

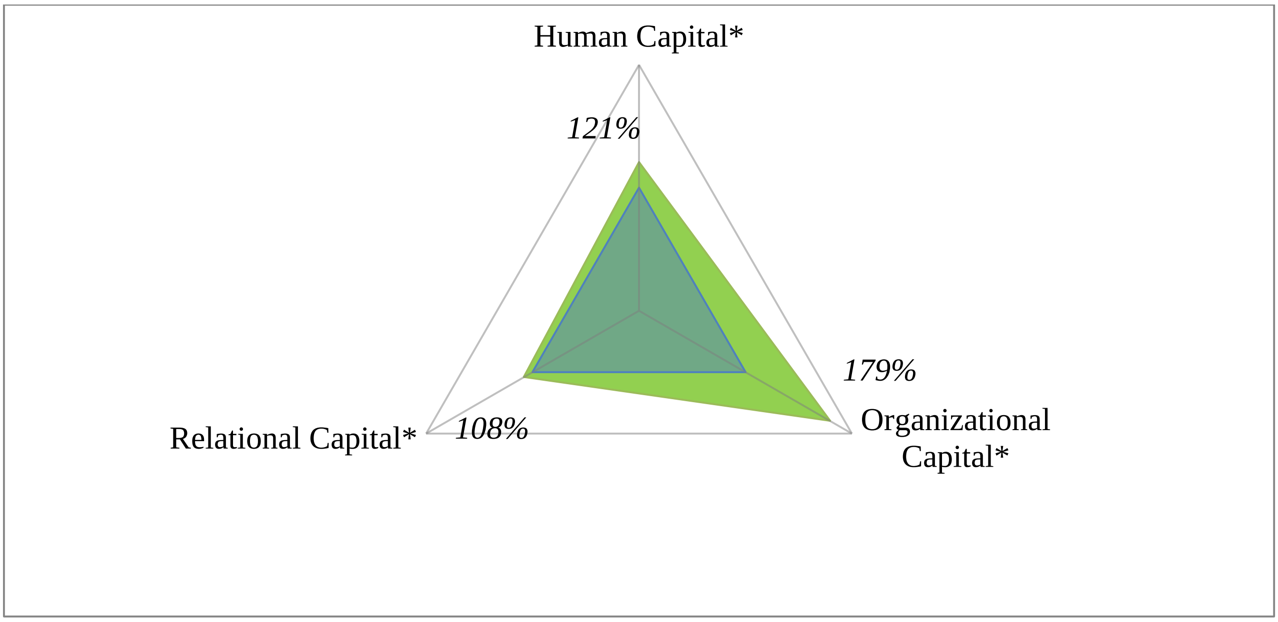
Conversion coefficient	Proxy metric	Company`s data	Industry weighted Average	Benchmark Ratio
0,3(3)	(H) Workforce /Training and Development	94,00	61,626	153%
0,3(3)	(H) Workforce /Employment Quality	51,52	46,629	110%
0,3(3)	(H) Score - Performance/Employee Cost	55,05	54,980	100%
0,35	(O) R&D/Total assets	0,07	0,069	102%
0,45	(O) Brand + Patents/Total assets	0,03	0,025	132%
0,2	(O) Other Int./Total assets	0,29	0,068	423%
0,5	(R) Goodwill/Total assets	0,41	0,203	200%
0,5	(R) Operating Income/Employees	58,05	355,535	16%

IC capital category	Benchmark Ratio
Human Capital*	121%
Organizational Capital*	179%
Relational Capital*	108%

Table 16. Model data for Symantec (2013)



Picture 9. Graphical representation of the IC model (8-dimensional) for Symantec (2013)



Picture 10. Graphical representation of the IC model (3-dimensional) for Symantec (2013)

Symantec is in fact the only company in this case description section that show positive scores in all three categories of intellectual capital, having particularly high score in organizational category. This no doubt describes company`s intellectual capital in a very positive light within all of its aspects, however this case illustrates a perfect example of the fact that IC is not the only component of company`s success as despite good IC scores in 2013 company`s financial performance decreased significantly in 2014. That gets to show that even for IT-software companies IC capital is not the end of it all in a process of value creation, thus the important lesson learned from this case is that, measurement of IC does not really allow jumping to concussion of the overall company performance even in such IC-heavy industry as software and internet services. Another possible option obviously implies that model simply does not manage to catch those crucial metrics that would reveal company`s shortcomings in this case. That is of course gets us back to the discussion of the limitations regarding proxy selection and accuracy of selected metric, which is discussed in further detail in the latter part of this chapter.

Yahoo!

Yahoo! Inc. (Yahoo or "the company") is a global technology company offering personalized products and services including search, content, and communications tools. The company primarily operates in Americas, Asia Pacific and Europe, Middle East and Africa (EMEA). It is headquartered in Sunnyvale, California and employed 12,200 people as of December 31, 2013.

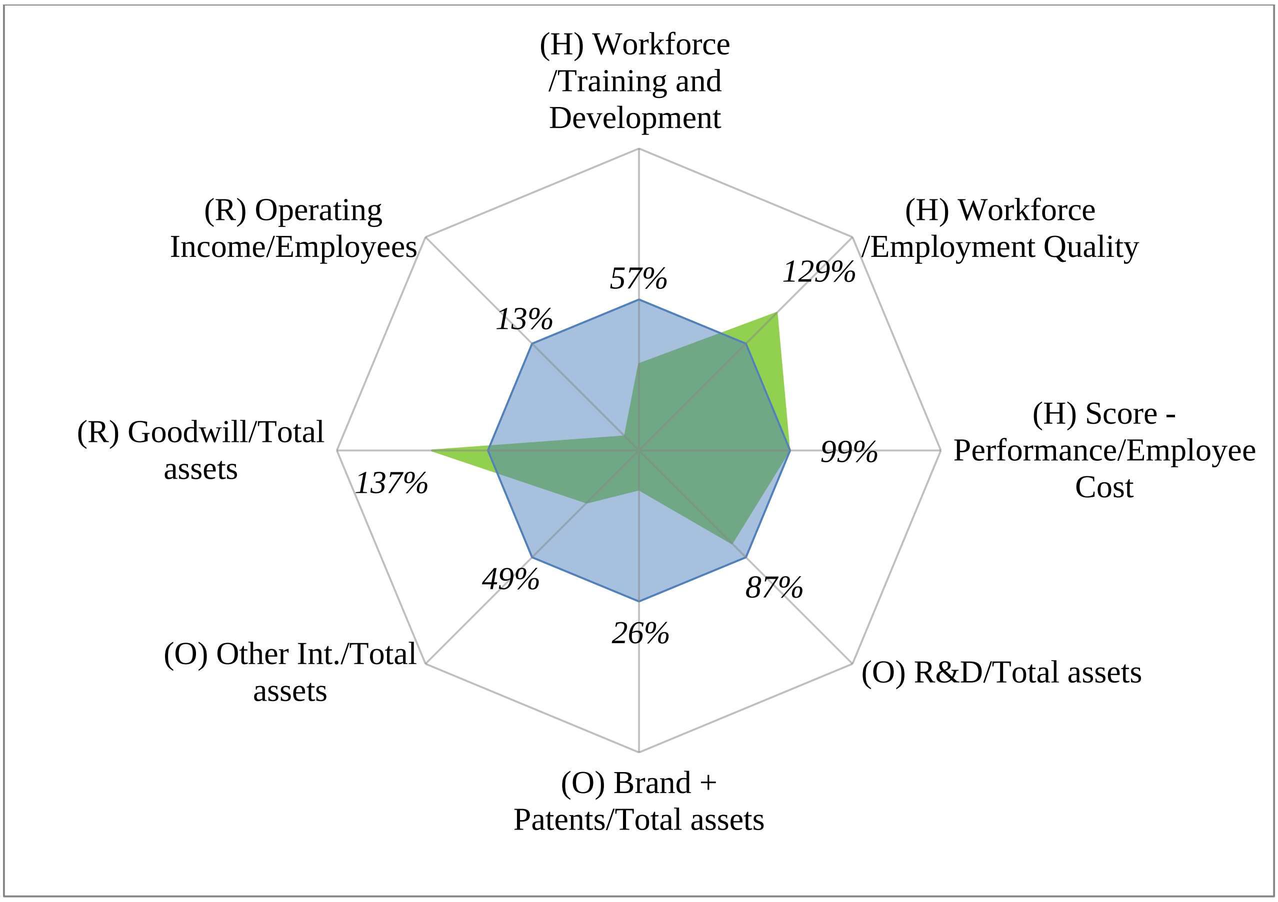
The company recorded revenues of $4,680.4 million during the financial year ended December 2013 (FY2013), a decrease of 6.1% compared to FY2012. The operating profit of the company was $589.9 million in FY2013, an increase of 4.2% over FY2012. Its net profit was $1,366.3 million in FY2013, a decrease of 65.4% compared to FY2012. (MarketLine, 2014)

Yahoo!	2013

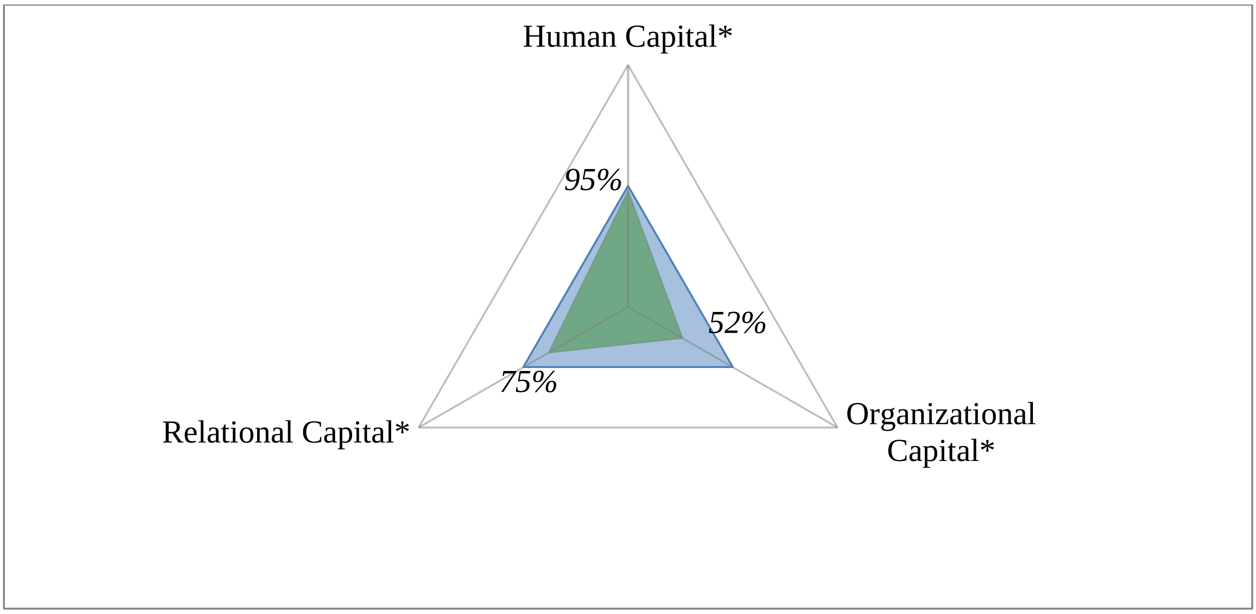
Conversion coefficient	Proxy metric	Company`s data	Industry weighted Average	Benchmark Ratio
0,3(3)	(H) Workforce /Training and Development	35,22	61,626	57%
0,3(3)	(H) Workforce /Employment Quality	60,12	46,629	129%
0,3(3)	(H) Score - Performance/Employee Cost	54,66	54,980	99%
0,35	(O) R&D/Total assets	0,06	0,069	87%
0,45	(O) Brand + Patents/Total assets	0,01	0,025	26%
0,2	(O) Other Int./Total assets	0,03	0,068	49%
0,5	(R) Goodwill/Total assets	0,28	0,203	137%
0,5	(R) Operating Income/Employees	47,32	355,535	13%

IC capital category	Benchmark Ratio
Human Capital*	95%
Organizational Capital*	52%
Relational Capital*	75%

Table 17. Model data for Yahoo (2013)



Picture 11. Graphical representation of the IC model (8-dimensional) for Yahoo (2013)



Picture 12. Graphical representation of the IC model (3-dimensional) for Yahoo (2013)

Yahoo is yet another company that faces certain difficulties with its current situation, however unlike previously reviewed Symantec its radar in fact shows below average indication as well. Organizational capital, one the best performing category for other companies reviewed in this paper, scores relatively low 52% for Yahoo. Relational capital is also somewhat on the low side (75%), while human capital scores in rather safe zone of 95%.

One interesting thing that I would like to point out is a reoccurring situation in the last four cases, regarding the fact that proxy Operating Income/Employees is usually very low (10-20%) whereas Goodwill/Total assets I usually rather high (100% range). This is probably caused by the fact that the reviewed companies despite certain temporarily difficulties are rather large and well established corporations (hence higher than average Goodwill), however due to mentioned problems Operating Income/Employees ratio is on the low side. Another explanation is that once again there is a problem of proper scaling of the benchmark used for this particular proxy.

To summarize information gathered from those cases I would like to point out that all results, implication and ensuing recommendation should be taken as is, bearing in mind all the limitations that I discussed along the way in cases and in further part of this chapter. Detailed analysis of each individual case that would connect all the results to the actual company's internal processes would require resources to study each company from the inside, however since this paper is not a consulting project, my implications do not go into deep details.

I primarily used those cases as a mean to test my method on the actual companies. In other words – proof of concept. The results gathered from those cases have helped to acquire necessary knowledge to polish and improve method to the point of its current iteration. Despite the fact that I still mention multiple limitations when discussing those cases, their number was much greater in the initial iteration of the method.

Thus many features that model now has, like weighted average, data filters, time and industry cluster selection, were originally missing in the initial iteration of the model, however exactly the analysis of real companies helped to figure out what are model`s weak links and eventually find ways to fix them. There is no doubt still a room for improvement and it will always be – so is the process of measurement method creation.

Limitations and assessment of the method

In this part, I would like to focus on limitations of the developed method. My ultimate goal in this research was to create a specific indicator that can be effectively used as a benchmarking tool for measuring intellectual capital in IT industry. I believe that I was in fact able to achieve this ambitious goal; however, there are several positions about method that are rather debatable or leave room for improvement.

First, I would like to address the applicability of results that are generated by the method. Since from its inception method was designed as a benchmark tool that operates exclusively on the ratio scale, results are mostly suitable for internal managerial use or external ratings and are not so applicable for other purposes (for example financial evaluation).

Another vulnerable element in the model, are proxies used to assess different shares of intellectual capital. As I have discussed in the first chapter of this paper, questionable selection of the proxies is a problem for all Scorecard methods of IC measurement. This method is no exception. Having completed my research, I understood how difficult it is too find adequate proxies for IC and in the end the final set still would remain biased and imperfect in many ways. Main reason for this is lack data, time and resources. In order to build this model I had to make a compromise: it is rather simple to find all necessary information for the short list of well-known companies, however if you want to build a model that would leverage metrics against industry average standards, the number of accessible categories of metrics shrinks significantly. In other words, in this method I had to make a trade-off between "better" (more reflecting/relevant) set of proxies for almost a single-digit number of companies within certain cluster, and more general (thus potentially less reflecting) set of proxies that allow to capture large enough amount of firms to create industry average benchmark.

Scales are another debatable element of the model. Scales are used to make sure that all the elements of equation at all stages of calculation remain comparable: in order for individual values of a given company to be compared to the benchmark the benchmark and for individual value alike have to represent a ratio (or be normalized). For cases of proxies for human capital input data were already represented as comparable coefficients / scores, for almost all other proxies (except - Operating Income/Employees – though in this case same logic applies) I used company`s assets as a common denominator to create a comparable categories. This idea accomplishes initial purpose perfectly; however, it might create some problems with reliability of the results. This idea is essentially based on ambitious assumption that there is linear positive correlation between certain proxies (Brand + Patents, R&D cost, Goodwill – initially taken on absolute scale) and total assets of company. While this idea is not without common sense, this assumption obviously may fail, especially at extreme ends of spectrum. For example, ratios with total assets for the largest companies in the industry might be not so comparable with benchmark since the unequal or non-linear scaling of the equation may significantly warp the data. In other words ratio Goodwill/TA of a company with 1*x* TA is not fully comparable to the same ratio of a company with 100*x*. On a positive note, these flaws are somewhat smoothened by the weighted average methodology used to calculate the benchmark, so model retains its legitimacy. This limitation however is still very important to consider if any further development has to be made within this field of a research.

Next point of potential concerns is model structure, especially the methodology of calculating industry weighted average. This particular step of the method went through multiple iterations before locking into its current form. In the method I used total assets as a driver for the weight coefficient, thus assuming that total assets – is the defining criteria of the firm`s respective share in certain cluster. While this idea seems logical and sound it is rather debatable that other metrics (like net income for example) or maybe even combination of metrics should be used for this particular purpose.

Another important limitation that I would like to discuss is the span of application for the particular version of the model. When building a proper measurement system or indicator one of the most important task is to make sure, your inputs are comparable in all aspects. It is not only about scales but about practical relevance (time-frame, industry cluster) as well. In this particular version of the method, I studied Software & Internet services in the US in 2009-2013, which makes it applicable to the companies that belong to this cluster within the given time-frame. In this iteration of the method, I considered benchmark based on the US sample eligible for the rest of the world, since US is a world leading market within given industry. This however, is also a debatable statement and ideally, it would probably be better to use data from multiple countries to form a benchmark. Counterargument to this is that some counties or markets have certain local specifics even within same industry cluster that it is incorrect to mix them up with the rest. In other words, “one fits all” strategy is not applicable in measuring IC in the slightest and tailored approach is required for whatever different categories had to be measured. This on the first glance disadvantage leads to an actual strength of the method - flexibility.

The flexibility of the model means that as long as you keep the logic with necessary adjustments this method can be applied for any company from any industry. This would of course require proper selection of industry cluster and time-frame, respective set of proxies relevant for this particular industry, respective calibration of the secondary set of conversion coefficients and other potential changes to the model structure. Theoretically, this method can even be used to measure entities other than intellectual capital and provide unique comparative results.

Previous points about specifics of model structure and variations comes to remind that building a measurement system or indicator is an iterative process, which means that almost any variation of it cannot be considered perfect or final. Building a benchmark for an industry cluster requires a lot of time and research, in this paper I have presented working indicator in Software & Internet services cluster. I believe that method`s current iteration is good enough to fulfill its original purpose – to serve as benchmarking tool for the IT or more precisely Software & Internet services industry cluster. The indicator may have its shortcomings and limitations however, the true value of it is that it displays the idea of a model built by the rules of measurement theory that provides a unique and new approach to measure intellectual capital and possibly even beyond.

Conclusion

In conclusion, I would like to once again revisit and highlight research structure and draw parallels between original goals and achieved results. Research questions stated in the introduction were: What are advantages and disadvantages of the current practices of measurement intellectual capital or valuation of intangible assets? How to properly measure intellectual capital in IT? First part (Literature review) of this paper addresses first research question, where I give all necessary definitions, establish the framework (measurement theory) for assessment of existing methodologies of intellectual capital measurement and perform this assessment. The main conclusion that I came up with from the assessment of different methods: there are methods in every classified category that are suitable and legit for their designated purposes. However, most of the assessed methods are not compliant with measurement theory or have other significant faults that disallows me to answer to answer my second research question (How to properly measure intellectual capital in IT?) at this step. Hence, this signals the next part of this paper to be devoted to building a new method that would actually would allow to properly measure intellectual capital in IT. Last chapter of first part of the paper establishes constrains of the research focusing further advancements in the boundaries of IT industry. In second part of the paper (Empirical research), I describe the process of building a new method for measuring intellectual capital in IT and then testing it on five leading companies within selected industry cluster. Resulting method exhibits a new unique approach to the IC measurement and potentially even larger field of application. Despite the fact that in this particular research, I focused my attention on IT (Software and Internet services cluster – to be exact), the logic behind the method is applicable within any industry since the method is designed to be fully compliant with measurement theory and thus can be properly scaled for any application. Building a new method is a difficult and iterative process: in the current iteration the method stands out as rather a theoretical concept rather than a business tool, however even current concept totally fulfills its purpose as a benchmarking tool for measuring intellectual capital in IT industry.

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