

Measurement of intellectual capital in the academic research and development units

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Abstract: This paper titled as "measurement of intellectual capital in the academic research and development units", studies the rate of intellectual capital in the academic research and development units. The main objective of this paper is to measure different dimensions of intellectual capital. Other objectives of this paper include helping managers in deciding about value created by knowledge creation, filling the gap caused by lack of research into intellectual capital, showing the importance of knowledge and converting it into value. To measure intellectual capital, three main questions have been raised. 1) Is the rate of human capital appropriate in the research and development units? 2) Is the rate of social capital appropriate in the research and development units? 3) Is the rate of structural capital appropriate in the research and development units? This paper is an applied research in terms of objective since it is carried out in a dynamic organization and it is aimed at measuring the intellectual capital. It is a descriptive survey in terms of data collection method. To collect data for testing the model, a questionnaire has been used. To test normality of the research variables, frequency distribution was drawn and then hypotheses of data normality were studied and approved by using Kolmogrove- Smirnov test. After this test, all hypotheses were approved at the significance level 0.00.

Key words: *Intellectual capital; Human capital; Social capital; Structural capital*

1. Introduction

During several last decades, the relative importance of knowledge compared to land, labor force, and capital has increased so that mind power governs in the organization instead of arm power, and physical assets like machinery have lower importance. Intellectual capital has been recognized as a strategic asset for the organizational performance and management of this valuable asset is vital for the organizations competition.

In fact, traditional accounting indices were mainly used in preparing reports of organization performance in the past. Such indices had some problems including being retrospective, lack of required flexibility for adapting to the modern conditions and inherent limitations like lack of attention to the intellectual capitals. Low attention to the accounting of intellectual capital and its growing role in the value creation process shows that financial reports have lost their value for many beneficiaries and users.

In the modern methods of management, strategic tools like balanced score card (BSC) are used to measure organization performance which include financial aspects as well as non-financial aspects that are usually qualitative and non-measurable. One of the non-financial aspects of this strategic tool is attention to the learning, creativity, and innovation of the staff in the organization. In fact, when the

organization adapts itself to the environmental changes constantly, this dimension is converted into the main competency and creates value, and management of intellectual capitals with the purpose of strategic identification, measurement, guidance, and development of this intangible resource becomes more vital. The main objective of this paper is to provide a model for measuring intellectual capitals in the academic research and development units to operate this important concept.

We encounter some difficulties in this regard including problems of measurement and inefficiency of traditional accounting in measuring some intangible assets like creativity and innovation and unpredictability of them and also dependency of intellectual capital upon thoughts and attitudes to the extent that what is valuable for an organization may be valueless for another one and so comparison of organizations becomes difficult. Moreover there is no system for measuring efficiency of tacit knowledge transfer process.

2. Theoretical literature review

The first empirical research for measuring the intellectual capital was carried out in the mid-1980s by a Swedish association and then many studies were carried out for determining the status of companies intellectual capital inside the countries (Olsson, 2001; Abeysekera, 2005; Brennan, 2001) and among countries (Subbarao, 1997). Rudez (2007) studied the effect of intellectual capital

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components on the financial performance in hotel industry in Slovenia. The results of this research revealed that first there is a positive significant relation between intellectual capital components and financial performance in this industry and second, the effect of relational capital on the company financial performance is more than other intellectual capital components. Chang and Hsieh (2011) studied the relation between intellectual capital components and three operational, financial, and market performance in Taiwan Stock in the electronics industry. To measure intellectual capital, adjusted value added intellectual coefficient model has been used. The results show that the operational performance has a positive relation with the applied capital and has no relation with structural and human capitals. Also intellectual capital components have a negative relation with market and financial performance. Maditinos and colleagues (2011) studied the relation of intellectual capital components with financial and market performance in the Greece Stock. To calculate intellectual capital, value added intellectual coefficient method was used. The results indicated that there is no significant relation among intellectual capital and financial and market performance, and only the relation of human capital with return on equity has been confirmed. Zéghal, and Maaloul (2010) measured intellectual capital with value added index and studied its results on financial and economic performance and market value in 300 English companies. To measure intellectual capital, value added intellectual coefficient model has been used. The results show that efficiency of intellectual capital has a positive significant relation with economic performance and financial performance; but as regards market value performance, the relation is only important in technology industry and also applied (physical and financial) capital has a negative relation with economic performance and a positive significant relation with market value performance and financial performance.

2.1. Definition of intellectual capital

Researchers have presented different definitions for intellectual capital including:

- Stewart defines intellectual capital in terms of organizational resources as wealth creation through investment in knowledge, information, intellectual properties, and experience (Stewart, 1997).
- Bontis believes that intellectual capital is a volatile resource; but when it is explored and used, it makes the organization able to compete in the environment by using a new resource. Bontis has found out this point in his studies that intellectual capital is to search and pursue effective use of knowledge (manufactured product) compared to information (raw materials) (Bontis, 2004, p. 13).
- Seetharaman and colleagues maintain that intellectual capital refers to the difference between

market value of a company and replacement cost of its assets (Seetharaman, Sooria, Saravanan, 2002).

- Marr believes that intellectual capital is regarded as among knowledge assets and among features of the related organizations and it improves competitive situation of the organization by increasing the level of value added for the key beneficiaries of the organization (Marr, 2005).

Other definitions have also been offered by the researchers besides the above mentioned ones. Table 1 presents the most important definitions of intellectual capital.

Based on the definitions of most researchers, one can conclude that intellectual capital is a non-monetary asset without physical presence but it has value and generates advantage and profit in the future.

2.2. Dimensions of intellectual capital

Conceptualization of different dimensions of intellectual capital provides a tool for combining different approaches through which knowledge is used in the organizations. This combination differentiates three dimensions of intellectual capital specified in the research literature, i.e. human capital, structural capital, and social capital which are explained more in this section.

2.2.1. Human capital

Human capital is a set of tacit knowledge and explicit knowledge of the organization staff and is regarded as value for the organization (Shirani and Abbasi, 2009). In the other words, human capital is defined as a combination of knowledge, skill, innovation, and ability of the organization staff for doing their tasks (Bontis, 2001). It also includes values, culture, and atmosphere of the organization. A company cannot own the human capital. Stewart states that although the staff is regarded as the most important asset in a learner organization, they are not owned by the organization because this is still a heated debate that whether the knowledge created by the staff belongs to the organization or not. Human capital has made organizations rely upon the staff knowledge and skills for creating revenue, growth, and also improvement of efficiency and profitability to a high extent (Westphalen, 1992).

2.2.2. Structural capital

Structural capital refers to the tacit knowledge related to the internal processes of the organization for distribution, communications, and management of scientific and technical knowledge (Shirani and Abbasi, 2009). This capital includes hardware, software, databases, organizational structure, patents, trademarks, and other organizational capabilities to support profitability.

Table 1: Definition of intellectual capital through the lens of different researchers

Definition	Reference	Year
Intellectual capital can be classified as the assets (like trade mark) or skills (like technical knowledge of personnel, organizational culture).	Hall	1992
Companies invest in customers, suppliers, work flows, technology, and innovation to increase the future value. These collective values are called intellectual capital.	Koplon and Norton	1996
A knowledge that may be converted into profit.	Edvinsson and Salivan	1996
It includes three classes of intangible assets: internal structure, external structure, and staff competency.	Sieby	1997
It refers to the hidden assets of the company that are not mentioned in the balance sheet completely and so it includes those things existing in the mind of organization staff and what remains if they leave the organization.	Ross and colleagues	1997
Knowledge asset, practical experience, organizational technology, customer relationship, and professional skills that create high competitive advantage for the organization.	Edvinsson and Malone	1997
Intellectual capital means total knowledge- based ownership right or asset that the company owns.	Zinkovskiy	2000
It refers to the resources of future profits (value) generated by innovation, unique designs of the organization, or experiences of the human force.	Lou	2001
It is a group of knowledge assets by which an organization is characterized and its main usage is to help improvement of the organization competitive situation by increasing value for its key beneficiaries.	Marr and Schiuma	2001
It includes all intangible assets, whether they are owned and used by the organization officially or developed non-officially. Besides human, structural, and communicative resources of the organization, intellectual capital includes its usage for value creation.	Meritum	2002
Intellectual capital includes such things as staff, customers, information technology, managerial endeavor, and knowledge. Intellectual capital is nothing by itself; rather it merely creates a mechanism for joining different assets to each other in a profitable process for the organization.	Moristen and colleagues	2004
Intellectual capital includes study of innovation, knowledge management, new technology, intangible assets, human capital, organizational learning, and knowledge workers.	McMaster World Congress	2006
Intellectual capital is either the final product of knowledge conversion process or the organizational knowledge.	Navasivayam and Denisi	2006
It is defined as a combination of human, structural, and social capitals.	Dalkir	2007

In the other words, structural capital includes the institutionalized knowledge and encoded experience used inside the databases, structures, systems, and processes of the organization (Yundet et al., 2004). Structural capital refers to anything that remains in the company when the employees go home. Structural capital also provides customer capital and communications developed with the key customers. Contrary to human capital, the company can own the structural capital and buy and sell it. The structural capital is a function of human capital. So interacting with each other, structural capital and human capital help the organizations to form, develop, and use customer capital.

2.2.3. Social capital

Third dimension, social capital, includes the knowledge used in the interactions between people and network (Nahapiet and Ghoshal, 1998). Social capital shows the importance of strong networks and relations based on trust and cooperation in the societies. From the organizational perspective, Ghoshal and Nahapiet (1998) define social capital as the sum of actual and potential resources accessible through relation network of a person or a social unit.

According to them, social capital is one of the important organizational assets and capabilities that may help the organization to create and share knowledge and create a sustainable organizational advantage for them compared to other organizations.

These two researchers in a study carried out into the effect of social capital on the intellectual capital creation, identified three structural, relational, and cognitive dimensions. The major work of Nahapiet and Ghoshal has been conducted based on the analysis of prior works. In spite of differentiating these three dimensions, they believe that many features identified in the components of their model are highly dependent upon each other. Although these two researchers focused on the function of social capital in combination and exchange of knowledge to create intellectual capital, foundation of social capital use in the knowledge scope was managed by the dimensions presented by them in practice.

3. Research method

This paper is an applied research in terms of objective since it is conducted in a dynamic

organization and is aimed at measuring the intellectual capital. It is also a descriptive survey in terms of data collection method.

3.1. Research hypotheses

The main question in this research is the rate of intellectual capital in the academic research and development units. With regard to the carried out studies, below hypotheses can be raised:

Main hypothesis: Intellectual capital of academic research and development units has an appropriate situation.

Subordinate hypotheses: Human capital of academic research and development units has an appropriate situation. Social capital of academic research and development units has an appropriate situation. Structural capital of academic research and development units has an appropriate situation.

3.2. Research statistical universe

The statistical universe of the present paper is comprised of the faculty members, researchers, and experts in the research subject that are working in the academic research and development units and

the number of them is 85. With regard to Morgan table, 70 persons were selected as the sample.

3.2.1. Sampling method

The present paper uses cluster sampling method (In cluster sampling, the measurement unit is not a person; rather it is a group of persons formed naturally. Cluster sampling is used when selection of a group of persons is easier than selection of persons in a defined universe). So, each research and development unit of the research statistical universe is considered as a cluster and 30 units (clusters) are selected randomly from among them. And then with regard to the feature of the statistical universe, all qualified persons are considered as the research sample.

3.2.2. Design of measurement tool (questionnaire)

To test the research model, the questionnaire has been used. The primary questionnaire was derived through credible scientific references (Table 2) and accredited by the experts.

Table 2: The primary questionnaire was derived through credible scientific

Scientific reference	Questions
Bontis, N, 1998, Intellectual capital: an exploratory study that develops measures and models.	Human capital, social capital, and structural capital

3.3. The questionnaire reliability

To calculate reliability, Cronbach's alpha method has been used in this paper. Accordingly, a primary sample including 30 persons were selected randomly from among the statistical universe members. Then the research final questionnaire was distributed among them and finally Cronbach's alpha was calculated for the questions of each part of the questionnaire and the results are presented in the following table.

The Cronbach's alpha shows that the questions have a relatively proper correlation with each other. Another concept of Cronbach's alpha indicates that if we measure the feature studied in this paper by using this questionnaire and the same respondents

under similar conditions, no remarkable difference will be seen in the responses. The rate of reported alpha approves this state for the questionnaire.

Table 3: Cronbach's alpha

Index	Cronbach's alpha
Human capital	0.80
Customer capital	0.94
Structural capital	0.87
Intellectual capital	0.95

4. Analysis of the research data

With regard to the research data normality, t test was used for analyzing hypotheses. The results of these analyses are as following:

Table 4: Analysis of the research data

Test Value = 3						
	T statistic	Degree of freedom	Sig.	Mean difference	95% confidence interval	
					lower limit	Lower limit
Human capital	2.095	69	.040	.1227	.0058	.2396
Test Value = 3						
	T statistic	Degree of freedom	Sig.	Mean difference	95% confidence interval	
					Lower limit	Lower limit
Customer capital	-.393	69	.695	-.0300	-.1823	.1223
Test Value = 3						
	T statistic	Degree of freedom	Sig.	Mean difference	95% confidence interval	
					Lower limit	Lower limit
Structural capital	2.072	69	.042	.1629	.0061	.3197

The results of the above table and significance level obtained for each dimension of the intellectual capital show that human capital and structural capital have a proper situation and only significance level obtained for customer capital (0.695) is more than 0.05 and this indicates that this type of capital does not have a proper situation in the academic research and development units.

Since structural capital does not have a proper situation in the university, below suggestions are offered to preserve and develop these capitals:

1. Supporting innovation and creativity of the staff by the value system governing the organization and providing job security for the employees that have more creativity and innovation in their work,
2. Increasing the organization flexibility by reducing rules and regulations and creating coordination between policies and measures of the organizations,
3. Creating non-official places in the organization for solving the problems creatively,
4. Designing the reward system and improvement criteria in a way that encourages the staff for having innovation and creativity in the organization,
5. Designing measurement indices based on performance, fairness of staff salary, and their improvement in the organization,
6. Implementing new ideas offered by the organization staff,
7. Designing the organizational structure in a way that facilitates learning, innovation and knowledge flow in the organization,
8. Designing the organizational structure in a way that supports strategic goals of the organization,
9. Creating an organizational culture that supports and facilitates innovation in the organization,
10. Designing the organization strategy with an emphasis on the continuous learning and considering staff mistakes as a part of learning, Designing, implementing, and updating information systems of the organization.

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