



Intellectual capital evaluation using fuzzy cognitive maps: A scenario-based development planning



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ABSTRACT

Evaluation of Intellectual Capital (IC) is a vital phenomenon for various organizations in order to determine the value of the organization, to improve the control system and to assist strategic planning and decision-making. This study presents a new model in which the interactions between the IC components are considered in the evaluation and development planning process. This, in turn, would enhance the accuracy in evaluating IC and would aid managers in establishing a development plan for IC. In other words, this study tackles the common problem of the inner correlation between IC components by using fuzzy logic, which bears concrete results. The procedure starts with studying numerous criteria proposed for measuring IC drawn from the literature and selecting the most frequently used ones. Then, the selected criteria are refined through a questionnaire based on their relevance to the organization in which we want to evaluate IC. Interactions among IC criteria are captured with the help of Fuzzy Cognitive Maps (FCMs). The present study is the first that uses FCMs method for evaluating IC. After the influence of each criterion over the others is identified, several scenarios are developed and analyzed in order to realize their efficiency and effectiveness for IC development. The results reveal that improving IC criteria with maximum influence over others, does not necessarily lead to the development of IC and investigations are required to establish the development plan.

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1. Introduction

From the early practices of industrialization to the early 1950s, it had been assumed that the main reason of underdevelopment in the developing countries is the lack of financial and physical capital. In order to eliminate this plight many societies have squandered a considerable amount of financial capital. However, it is now accepted that injecting a large amount of budget does not necessarily lead to development and progress. In fact, in the societies where specialized human resources are available, physical capital and budgets are consumed more efficiently, consequently noticeable development could be observed. In addition, in the knowledge-based economy, knowledge has gained salient attention compared to other assets such as land, budget, and machines (Darabi, Rad, & Heidaribali, 2012). Economy knowledge is the most important factor in production and the main strength of an

organization in a competitive market (Bontis, Dragonetti, Jacobsen, & Roos, 1999; Cricelli & Grimaldi, 2008; Kujansivu & Lönnqvist, 2007; Seetharaman, Sooria, & Saravanan, 2002). Therefore, the survival of an organization in a market has a direct relationship with non-financial subjects (Stewart & Ruckdeschel, 1998).

On the other hand, with the evolution of technology and Information Technology (IT) since the 1990s, the formation of global economics has drastically changed. The rapid changes of IT during the last two decades has fundamentally affected all aspects of human lives and their activities leading to the emergence of a new era entitled 'knowledge era and farewell to the industrial epoch' (Uhl-Bien, Marion, & McKelvey, 2007). During industrialization (i.e., 1890s) firms demanded mass production and distribution; nonetheless, in the knowledge epoch, knowledge is the key to success in business and industry. Therefore, knowledge is the indispensable component of intangible assets, which needs to be managed deliberately.

In general, the assets of an organization can be divided into two categories (Feiwel, 1975):

1. Tangible and concrete assets: which function under the principles of 'economy of scarcity'. In other words, the more they are utilized, the more they depreciate.

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2. Intangible assets: these assets could be further divided into two sub-categories:
 - a. Those that are subjected to legal and juristic support and, in fact, are assumed as intellectual properties. Examples of these assets are copyrights, franchise, logos, and trademarks.
 - b. Those that are categorized as intellectual capital and function under the principles of 'economy of abundance'. To put it differently, no matter how much they are used, no depreciation and diminution in the worth of the assets occurs. Human and workforce in a company belong to this category.

This study focuses on the latter. The term 'Intellectual Capital' (IC) first was referred by John Kenneth Galbraith at 1969 (Galbraith, 2007). Before that, Drucker (1995) had used the term 'knowledge workers'. By selecting the term 'Intellectual Capital' instead of all the synonyms, researchers mainly refer to all intellectual and intangible assets which have the potential to create economic value for the organizations (e.g., knowledge, merit, brand, and so forth).

Several definitions have been proposed for IC (Ross, Ross, Edvinsson, & Dragonetti, 1997; Seetharaman et al., 2002; Stewart & Ruckdeschel, 1998). This term could be defined as the difference between the market value of an organization and the replacement costs of the assets in the same organization (Edvinsson & Malone, 1997). This capital contains knowledge, copyright, experience, and other intellectual assets. In another definition, IC is known as all processes, procedures, and capitals that do not usually appear on the balance sheet (Bontis, 1998). In this study, Bontis model is selected for the evaluation phase (Bontis, Chua Chong Keow, & Richardson, 2000). In this model, IC is divided into three major components, namely structural capital, human capital and relational capital (Bontis et al., 2000).

In this paper, first, the most suitable criteria for IC evaluation in the under studied organization are determined by using Questionnaire No. 1. Following the precise selection of the criteria, Questionnaire No. 2 is used to measure the value of the criteria and examine their correlations. Subsequently, by the aid of FCMs, the influence of the IC criteria over each other is determined. Then, a number of scenarios for developing IC in the studied organization are designed based on the results from Questionnaire No. 2. Finally, these scenarios are analyzed and examined in order to select the best plan for developing IC.

The presented model is applied to a real case in order to examine and prove its applicability. The studied enterprise is a holding organization with more than half a century experience in macro and micro economic activities in Iran. The activities of this organization encompass managing several production plants in the fields of husbandry, textile, olive oil, detergents, sugar, meat products, as well as financial and commercial activities. This company has established a retail chain of Fast-Moving Consumer Goods (FMCG) products using self-owned chain stores. This organization is regarded as one the largest and most reliable trading organizations in Iran. The organization owns and manages more than 500 physical stores nationwide, in addition to an online shopping platform. More than 140 staff including top managers, market analysts and IT professionals work in the headquarter building, where is under the analysis in this study.

The rest of the paper is organized as follows: At first the literature related to IC and the methodology used are reviewed. Afterwards, in Section 3, the methodology used in the paper is investigated in details in which the chosen IC components are discussed and the data collection process, and FCMs methodology are explained. Then, Section 4 deals with the results of implementing the model on the holding organization. Section 5 provides managerial insights as well as a discussion regarding the results of the

study. Finally, the paper is concluded in the sixth section presenting a number of directions for future research.

2. Literature review

The most recent literature reviews on IC have been conducted by El Tawy and Tollington (2012), and Aisenberg Ferenhof, Durst, Zaniboni Bialecki, and Selig (2015). Earlier, Petty and Guthrie (2000) provided an extensive overview of IC. The first theoretical work in the field of intangible assets was published in the early 1990s by Itami and Roehl (1991). Following the discussions of knowledge assets, Bontis (1998) suggested a comprehensive framework, as well as a pilot study that investigated components of IC from both theoretic and practical perspectives. In this research and subsequent studies, IC was divided into three components including human capital, structural capital and customer capital. Later, customer capital was replaced by relational capital because of its more general definition.

It has already proven that IC has a positive effect on business performance (Bontis et al., 2000; Sharabati, Jawad, & Bontis, 2010). It also has a considerable influence over the financial performance of an industry (Rudez & Mihalic, 2007). In addition, Marr, Gupta, Pike, and Roos (2003) identified five reasons to shed light on the significance of measuring IC: (1) it helps organizations to plan their strategy; (2) acts as an aid for implementing their strategies; (3) facilitates development decisions; (4) IC measurement results can be used as a base for supporting services; (5) it can inform stakeholders about the status of the organization. Considering all the arguments, the importance of IC development can be justified.

The interaction and correlation of IC components have already been proven in several studies regardless of the type of industry (Alizadeh, Jafari, & Hooshmand, 2008; Bollen, 2005; Bontis, 1998; Bontis et al., 2000; Edvinsson & Malone, 1997). Bontis (1998), in a research carried out in Canada, noted that there are direct relationships among the IC components. Bontis et al. (2000) investigated the interrelationships among IC components and concluded that regardless of the industry sector, customer capital has a significant influence over structural capital. Another research conducted in Taiwan confirmed the results and arguments provided by previous studies (Bollen, 2005).

Most of IC factors and items are particularly intangible; therefore, it is difficult, and in some cases impossible, to quantify them by using traditional crisp values (Lev, 2003; Sveiby, 2001–2010; Tai & Chen, 2009). For this reason, practitioners and managers are mostly inclined to use multi-criteria methods and fuzzy linguistic variables in the IC evaluation process (Calabrese, Costa, & Menichini, 2013; Bozbura, Beskese, & Kahraman, 2007; Lee, 2010). Furthermore, a large number of studies that have used Likert scale in their questionnaires for measuring IC assumed that the distance between two levels of a Likert scale are approximately equally divided (Cummins & Gullone, 2000; Davey, Barratt, Butow, & Deeks, 2007). This assumption interferes with the reflection of respondents' opinion in answering the questions while they do not have any choice in between two scales, for instance if the respondents are asked to select among integer values ranging from 1 to 5, they would not be able to select non-integer values. Considering these arguments, and in order to boost the accuracy and efficiency in measuring IC and to take the correlations and the effects of each IC component and criterion on the other ones into consideration, Fuzzy Cognitive Maps (FCMs) method is utilized in this study. Using FCMs, which is a mixture of qualitative and quantitative approaches, mitigates the limitations of transforming implicit assumptions (or mental models) from experts to explicit ones and has the potential to tackle the issue discussed earlier in this paragraph (Jetter & Kok, 2014).

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