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Using Fuzzy AHP to manage Intellectual Capital assets: An application to the ICT service industry

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ABSTRACT

In today's competitive business environment, Intellectual Capital (IC) management is ever more recognized as a fundamental factor in gaining competitive advantage. Actually, most firms have only a vague idea of how to manage investments in IC and what they should obtain from these investments. As a result, many companies overlook to balance IC investments, overinvesting in some IC components and neglecting other ones. Following this lead, the aim of the paper is to assess the relative importance of IC components, with respect to their contribution to the company value creation, in order to obtain guidelines for IC management and investments.

We propose a model for IC evaluation by integrating Fuzzy Logic and Analytic Hierarchy Process (AHP). This Fuzzy AHP approach allows to capture and foster IC dynamics: experts and managers are greatly supported by the use of linguistic variables in the evaluation process of the company intangible assets. Finally, the application of the Fuzzy AHP methodology to a group of ICT service companies is presented.

1. Introduction

In order to obtain and maintain competitiveness companies must understand how to manage their intangibles by effectively increasing, spreading and exploiting them in the organization (Stewart, 1997). Indeed, business performance depends in great measure on an efficient management of Intellectual Capital (IC) and, consequently, IC evaluation is a critical obstacle to gain and maintain competitiveness. For this reason, the general attention for Knowledge Management approaches to understanding the nature of the firm and the possible basis for sustained competitive advantage, has been nurturing the interest for developing IC assessment methodologies (Spender & Marr, 2006).

Scientific literature on IC regards accounting rules as generally inadequate to completely appraise the economic value of intangible assets (Hand & Lev, 2003; Lev, 2003; Lev & Zambon, 2003), even after the adoption of IAS 38 (Morricone, Oriani, & Sobrero, 2010). The lack of an exhaustive response to company accounting needs regarding intangibles, caused the rise of alternative IC oriented forms of corporate reporting and the creation of new assessment methods. The new methods of measurement are often founded on different or even conflicting perspectives (e.g. monetary or non-monetary), but they all take into account the essential role that the IC plays in the knowledge-economy (Sveiby, 2001–2010).

Actually, most firms have only a vague idea of how to manage investments in IC and what they should obtain from these investments. As a result, many companies overlook to balance IC investments, because they overinvest in some IC components neglecting other ones (Zambon, 2003). Nevertheless, evaluating the importance of IC components is essential for any company that understands the new rules of survival in the knowledge-economy. More specifically, for a company it is important to understand how to manage IC creating and maintaining the right equilibrium among IC components (Lev, 2003). For example, if a service company invest too much in Human Capital neglecting its Structural Capital, tacit knowledge could overgrowth explicit knowledge, exposing the company to a high risk associated with personnel turnover.

In a real business scenario, many IC components are intangible in nature, therefore they are difficult or impossible to measure quantitatively. Actually, when measuring what are considered as intangible benefits, most experts provide linguistic assessments rather than exact numerical values to express their opinions (Costa & Evangelista, 2008). Following this lead, in this paper IC evaluation is realized by means of Fuzzy AHP, assessing the contribute of each IC component to the company value creation process. The methodology allows the comparison among companies of the same industry in the perspective of IC management improvement through benchmarking. Indeed, the aim of the analysis is to give guidelines to decision makers in order to create and preserve

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a valuable balance among IC components. Finally, the presented model is applied to the IC evaluation of a group of ICT service companies.

2. Measuring Intellectual Capital

In this paper we refer to IC utilizing the definitions by Roos, Roos, Dragonetti, and Edvinsson (1997), that describe the IC as complementary to the Financial Capital in the value creation process of a company. In their "Value Description Tree", IC is determined as the combination of two main categories of intangibles:

- Human Capital that embodies the intangibles that are embedded in the company Human Resources. It is subdivided in three sub-components: "Competence" (competencies, skills and knowhow), "Attitude" (motivation and leadership) and "Intellectual Agility"(creativity, innovativeness, mental flexibility and problem solving).
- Structural Capital that defines the intangibles that are embedded in the organization. It is subdivided in three sub-components: "Relationship" (the company relational network with its stakeholders), "Organization" (structure, culture, routines and processes) and "Renewal and Development" (R&D, new projects, product and process innovations).

Both academics and practitioners regard IC as the keystone to obtain and maintain competitive advantage in today's ever-competitive market (Cricelli & Grimaldi, 2008; Lev & Zambon, 2003), because they believe that an effective IC management has positive effects on company performance (Cheung, Lee, Wang, Chu, & To, 2003; Nakamura, 2003). Several studies deal with the issue of how IC management improves business performance generating value in the organization and there is evidence that investments in IC (i.e. R&D and innovation capital expenditure) have positive effects on a firm value and competitiveness (Huang & Liu, 2005; Tan, Plowman, & Hancock, 2007). Hand and Lev (2003) point out that IC has a positive impact on market value and business performance, being an indicator for future financial performance. Some authors also observe that different stakeholders may attribute a different financial value to different IC components (Chen, Cheng, & Hwang, 2005; Costa & Menichini, 2013). Generally, the greater efforts a company devotes to IC management, the greater performance and competitive advantage it receives in return (Lu, Wang, Tung, & Lin, 2010).

For these reasons, business performance nowadays depends in greater measure on an efficient management of intangibles, making the evaluation of IC components a critical obstacle to turning those investments into sources of competitive advantage (Campisi & Costa, 2012). Indeed, intangibles are the business aspect more difficult "to manage" because of the difficulty to correctly report in a financial statement their economic value and to identify the effect of each IC component on the enterprise performance (Lev & Zambon, 2003). Nevertheless, assessing the effectiveness of IC management is an important issue and the measures that are available are generally unsatisfactory: they do not allow the comparison of IC components among companies of the same industry (Wen, 2009), preventing the use of benchmarking, as a management tool, to create and preserve a valuable balance among IC components. For this reason, there is a necessity for a method that can compare companies of the same industrial sector with respect to the value of their IC components.

In this paper, we want to highlight the importance of measuring IC components in order to assess and to validate the effectiveness of IC strategies and to identify the most critical knowledge assets for achieving competitiveness. Following this lead, we propose a Fuzzy AHP method to assess the comparative importance of IC components, allowing a comparison between different firms of the same industry in the perspective of IC management improvement through benchmarking.

3. Using Fuzzy AHP to assess Intellectual Capital

Most IC components are intangible in nature, therefore they are difficult or impossible to measure quantitatively (Lev 2003; Sveiby, 2001–2010). For this reason, practitioners and managers are greatly supported by the use of multi-criteria method and fuzzy linguistic variables in the IC evaluation process. Indeed, AHP is suitable to assess the relative importance of IC components, allowing to consider both quantitative and qualitative criteria. Moreover, Fuzzy AHP, as an extension of the classic AHP method, enables to deal with the fuzziness and vagueness of linguistic judgments, establishing an effective priorization of IC components.

3.1. The analytic hierarchy process

The AHP is a decision approach created to solve complex multiple criteria problems involving qualitative decisions (Saaty, 1980). Basically, decision makers have to decompose the goal of the decision process into its constituent parts, progressing, from the general to the specific perspective. In its simplest form, this structure must include a goal, criteria and alternative levels, ordered into a hierarchy. Each item (criterion, sub-criterion or alternative) would then be further divided into an appropriate level of detail. Once the hierarchy has been structured, decision makers judge the importance of each criterion in pair-wise comparisons, structured in matrices. The judgement is performed from the perspective of the direct upper level criterion.

The final scoring is on a relative basis, comparing the importance of one decision alternative to another. AHP captures both subjective and objective evaluations, also providing an useful mechanism for checking the consistency of the decision maker evaluations (Saaty, 1980). It can be used to analyze intangibles, because of the possibility to evaluate quantitative and qualitative criteria and alternatives on the same preference scale, namely a verbal one. In fact, IC components are attributes that have no scale of measurement, but can be quantified through relative measurement (priorities) (Grimaldi & Rippa, 2011; Saaty, Vargas, & Dellmann 2003; Schiuma & Carlucci, 2007). In addition, AHP is a subjective methodology where information and priority weights of elements can be obtained from decision makers using direct questioning or a questionnaire method.

3.2. The fuzzy analytic hierarchy process

Saaty's AHP is often used to evaluate intangibles, but it does not completely capture the importance of qualitative aspects because its discrete scale cannot reflect the human thinking style (Özdağoğlu & Özdağoğlu, 2007). Indeed, when expert preferences are affected by uncertainty and imprecision, it is not very reasonable to use definite and precise numbers to represent linguistic judgments (Kwong & Bai, 2003). In order to deal with ambiguity, Triangular Fuzzy Numbers (TFNs) and AHP are integrated in the Fuzzy AHP approach to solve decision making problems concerning subjective evaluations. Fuzzy AHP converts linguistic judgments in TFNs organized in fuzzy pair-wise comparison matrices. These matrices are then processed to obtain the relative weights of items and the ranking of alternatives. A large number of methods are introduced to handle comparison matrices (Buckley, 1985; Chang, 1996; Custora & Buckley, 2001; Wang & Chin, 2006; Lee, 2010) and, among them, Chang's method (1996) is widely used, due to its implementation simplicity to calculate relative weights. At the