Prioritization of intellectual capital indicators in knowledge-based industries: Evidence from pharmaceutical industry

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A B S T R A C T

During the last decade, intellectual capital (IC) and intangible assets have been widely considered as critical tool to deliver successful business in an intensive-knowledge environment. Accordingly, the main goal of this paper is to design and prioritize the most important indicators of intellectual capital in knowledge-based industries. Based on an extensive literature review, a valid and reliable questionnaire was designed. In order to data gathering, it was sent out to participants from both academic and university who qualified well in pharmaceutical practice. In order to exact prioritization of indicators, fuzzy TOPSIS technique as a MADM model was used. The fuzzy TOPSIS results revealed participants remark high concerns especially about knowledge and skills of managers and employees regarding to human capital, high concerns particularly about positive climate, ratio of investment in R&D and numbers of R&D projects according to structural capital, while considering the relational capital, more attention was paid to customers and strategic cooperation such as alliances and licensing.

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1. Introduction

In the current economy, the industrial development model has become knowledge based and innovation intensive (Selemi, Ashour, & Bontis, 2007). Accordingly, company valuation is beyond the ability of conventional accounting methods. The intangible assets and intellectual capital (IC) are increasingly overcoming traditional valuating tools, such as land, property and capital assets, and are becoming the determinants and foremost sources of company success (Drucker, 1993). The concept of intellectual capital has expanded in two phases. The first phase started in the 1990s and concentrated on increasing awareness, defining concepts, reviewing case studies and developing primary definitions (Edvinsson & Malone, 1997; Stewart, 1997; Sveiby, 1997; Ross et al., 1997). The second phase, which started in the year 2000, considered measurement, modeling, international cases and various levels of analysis (Selemi et al., 2007). Finally, IC accepted as encompassing: human capital, structural capital and relational capital (Bontis, 1998).

It is often discussed that companies in today’s new economy do not initially invest in fixed assets, but in intangibles, since these are today’s value drivers. Among these intangible assets, IC plays an important role, and due to the huge investments in IC, its measurement becomes an important issue given the direct and indirect advantages. Some of these advantages may consist of the added value of the knowledge that is processed, the learning process included in the measurement of IC (Roos & Roos, 1997), its strategic power (Bontis, 2001), the optimal exploitation of limited resources and its usage as a motivational factor (Edvinsson & Malone, 1997). However, despite the difficulties connected to IC evaluation, there are several logical reasons for companies to disclose information on IC (Bruggen, Vergauwen, & Dao, 2009).

In spite of agreement on the importance of IC reporting and managing, there is no consensus on measurement indicators in order to satisfy stakeholders’ interests and provide an open policy for IC reporting (Han & Han, 2004). The selection of IC measurement indicator is a multi-criteria decision problem which needs resolutions involved with different stakeholders’ interests. Ultimately, the purpose of this study therefore is to develop and prioritize the most important indicators of IC through the adaptation of fuzzy TOPSIS in knowledge-based industries. As pharmaceutical companies have all the features of knowledge-based environments (Boekestein, 2006), accordingly this industry as the best example to manifest knowledge based environment was selected, moreover Bollen, Vergauwen, and Schnieders (2005) asserted that the pharmaceutical industry combined all relevant four components of IC, HC, SC and RC, the latter not always being present in other knowledge-intensive industries. The organization of this paper is as follows. Remaining of paper consist of 4 sections. In section 2, literature review on intellectual capital and its components are discussed, followed by section 3 which presents research
methodology. Section 4 describes the data analysis, and section 5 contains discussion. Finally, in section 6 conclusion, limitations and implications are presented.

2. Intellectual capital concept

IC is generally recognized as an intangible asset of a company that is difficult to evaluate by conventional financial report. Although it normally cannot be identified from traditional financial statements, relevant parties have usually taken such expanding investments. To date, researchers have proposed a wide scope of definitions and perspectives on intellectual capital. Edvinsson and Malone (1997) assert IC as the value of intangible assets accumulated by the company. This value was equal to the difference between corporate market and book value (Bonitis, 2001; Edvinsson & Malone, 1997). Stewart (1997) explained IC as the intellectual material composed of knowledge, information, intellectual property and experience by which wealth could be created.

In addition, researchers have decomposed and conceptualized IC in order to obtain a better description of it. Brookings (1996) addressed four components of IC including marketplace-related, mind-related, organization-related and human-capital related. Other researchers describe IC from the perspectives of human capital and structural capital (Bonitis et al., 1999; Edvinsson & Malone, 1997; Sveiby, 1997). Edvinsson and Malone (1997) defined IC as the sum of knowledge and capabilities of employees in a company. Finally, IC is considered as the portion of a firm's competitive strength obtained from its components consists of human capital, structural capital, and customer capital (Bonitis, 1998).

2.1. Human capital concept

The human capital can be considered the key element of Intellectual assets and one of the most important sources of firm's sustainable competitive advantages (Cabrita & Bonitis, 2008). Edvinsson and Malone (1997) described that human capital includes knowledge, skills, innovativeness and the ability to meet the task at hand, and also human capital cannot be owned by the company. The extant literature on human capital suggest that organizations need to recruit, nurture and retain talents so that the knowledge base can be expanded, which has the capacity to improve an firm's overall productivity (Boxall, 2003). More recently, some empirical studies have found a positive relationship between human capital and organizational performance. For example, in a study of public listed firms in diverse industries, Youndt and Snell (2004) have found that human capital has significant impact on performance measures such as return on assets and return on equity. As a result of increasing attention paid to human capital, there are intensive interests in developing reliable indicators for measuring human capital.

Considering the lack of consistent measure of human capital, there is an intriguing opportunity for researchers and practitioners to develop a more robust system of measuring and reporting human capital information. The development of a robust human capital indicator is likely to present value for a firm and its stockholders as well as encourage greater private investment (Olsson, 1999). This observation is not surprising due to human capital is an important component in IC, and the effective management of human capital often creates and sustains a firm's wealth and competitive advantage.

In order to advance in the understanding of the nature of human capital, it is necessary to determine its internal structure. To do, and based on the literature review, Martin-de-Castro, Delgado-Verde, and López-Saez (2011) asserted three major dimensions in developing human capital: Knowledge; Makes reference to the knowledge which employees have about things, to successfully carry out their tasks. Includes the following variables: (i) formal education, (ii) specific training, (iii) experience and (iv) personal development. Abilities; Refer to the kind of knowledge associated to ‘the way of doing things’ (know-how). Specifically, it collects all the utilities, agility and talent which a person develops basically as a result of his/her experience and practice. Includes the following variables: (i) individual learning, (ii) collaboration-team work, (iii) communication (exchange of individual knowledge and know-how) and (iv) leadership. Behaviors; manifest knowledge about the primary sources which encourage individuals to do their tasks. Includes mental models, paradigms, beliefs, etc. and refers to: (i) feeling of belonging and commitment, (ii) self-motivation; (iii) job satisfaction, (iv) friendship, (v) flexibility and (vi) creativity.

2.2. Structural capital

Structural capital (SC) comprises mechanisms and structures which support employees. In reality, they are the companies routines and convert individual human assets into group assets. Edvinsson and Malone (1997) explained SC as everything that “supports employees’ productivity” or “everything that gets left behind at the office when employees go home”. Bonitis (1998) stated that SC comprises mechanisms and structures of the organization that support employees in their performance in order to achieve overall business performance. Unlike human capital, SC is an intangible asset that can be traded, reproduced and shared within the firm. In fact, specific structural capital elements can be legally protected in the form of patents and trademarks as a result of investment in research and development (Roos & Roos, 1997). Finally, in this manner, SC can be considered as the skeleton of a firm because it provides the tools and architecture for retaining, packaging, reinforcing and transferring knowledge along the business activities (Cabrita & Bonitis, 2008).

2.3. Relational capital

Until now, relational capital remains underexplored relative to the way and depth of the other two previous types of IC. This may be due to the fact that relational capital has probably the most complex and divers nature due to all the kinds of intangible assets. According to Acedo, Barroso, and Galán (2006) one of the most effective developments of the resource-based view (RBV) will be the ‘relational one’. From the knowledge-based perspective of the firm (Kogut & Zander, 1993), it has been highlighted that firms are social entities that retain internal and external knowledge which lies at the core of firm survival and success. Now, when describing relational capital, we have to focus on how firms can absorb, exploit and explore new knowledge from its environment to obtain and sustain competitive advantage positions. Besides other classifications related to relational capital, Bonitis (1996) expands the concept of ‘client or customer capital’ to include all the external relationships of the firm (e.g. suppliers, allies, trade unions, etc.).

2.4. Intellectual capital evaluation

There is no globally accepted IC evaluation method among the 34 methods recognized in the relevant literature (Sveiby, 2010). Nevertheless, several substantial studies have been done by researchers (Bollen et al., 2005; Bonitis, 1998; Grasenick & Low, 2004; Huang, 2011; Kim & Kumar, 2009; Sharbaty, Jawad, & Bonitis, 2010) in order to develop IC indicators and its impact on firm’s outcomes. So, despite the difficulties connected to IC evaluation, there are several logical reasons for companies to disclose information on intellectual capital: (i) the reduction of information asymmetry between a company and external users of information is one main
reason for voluntary IC disclosure. According to Andriessen (2004), information asymmetry may make misallocation of capital; (ii) the weak of traditional financial accounting, therefore IC disclosure can help to enhance the value relevance of financial reports. Undoubtedly, investors have difficulties in appropriately assessing firm value for resource allocation through financial statements that do not disclose IC. Furthermore, managers may find it difficult to assign relevant intangible investments needed for the company’s operations. As a result, the providing of relevant information to managers and other users of financial statements can become pivotal; (iii) companies are also interested in evaluating IC information to establish trustworthiness with employees and other stakeholders (Bruggen et al., 2009). The dissemination of trust is one of the most important factors in the company’s long-term growth strategies because it creates stakeholders’ higher commitment to the future of company, especially in turbulent times (Prusak & Cohen, 2001); (iv) the disclosure of IC may support the investor and government relationship by producing clear information; (v) finally, manifesting the company’s market value, Edvinsson and Malone, 1997 addressed that in a major proportion of well established companies such as Intel and Microsoft, there are remarkable differences between market values and book values, and in addition, a cross-sectional study determined that the discrepancy between market value and book value reached 30-times in pharmaceutical companies, in which intellectual capital plays an key role in company valuation (Liao, Huang, & Hsu, 2010).

As, IC includes many intangible factors and items, it is difficult to evaluate IC using traditional value directly. Accordingly, linguistic variables are suitable applied by experts to evaluate the ratings of IC. Herrera-Viedma, Herrera, Martínez, Herrera, and López (2004) pointed out that Fuzzy linguistic approach uses linguistic variable to manifest the difference of degree and carry out processes of computing with words easier and without loss information. In other words, decision-makers and experts can apply linguistic variable to evaluate indicators in order to obtain the final evaluation result with appropriate linguistic variable. Therefore, it is an effective method to mitigate the time and mistakes of information translation and avoid information loss by computing with words.

2.5. The important role of IC and intangible assets in the pharmaceutical industry

Considering all the features of knowledge-based companies, pharmaceutical companies are widely accepted as such companies. Knowledge is developed mainly in their own research departments or is bought from other companies, and it also is considerably protected by intellectual property rights (IPR). Knowledge is sold to other companies and – most important – there is a continual and critical need to develop new knowledge in order to have successful products in time to the market (Alpkan, Bulut, Gunday, Ulusoy, & Klice, 2010). Furthermore, pharmaceutical companies are dependent extensively to capital and they also intend to invest large amounts of money, while the returns will only come after years of research and development. Inevitably, investors are looking for indicators of “good-knowledge-handling” in order to guaranty their investment (Boekestein, 2006).

Summary, Daum (2005) concluded that pharma industry is research-intensive, highly innovative and well-balanced environment in its use of IC and technological knowledge (Hermans & Kauranen, 2005; Liljeroth & Hansen, 2011). Pharma industry is extensively dependent on its intangible assets as key sources for innovation (Huang, 2011). Pharmaceutical industry, therefore, can be considered as an ideal candidate for analyzing IC and intangible assets (Bollen et al., 2005; Huang, 2011). Moreover, intellectual capital was proposed to measure future value and tacit value of a firm (De Pablos, 2002), particularly is important for firms in knowledge-based environment such as the pharmaceutical industry.

3. Research methodology

This study used a developmental process that employs a set of procedures similar to perceptual mapping. This process involves several phases of data collection and sequenced data analysis. The four phases of the development process include:

1. generation of critical elements;
2. expert review and questionnaire development;
3. data collection; and
4. data analysis.

Phase 1. In this phase, this study developed an initial questionnaire with detailed indicators of intellectual capital. In accordance with intellectual capital theory in pharmaceutical environment (Sharabati et al., 2010), main factors in human capital were categorized into (i) learning and education, (ii) experience and expertise and (iii) innovation and creation, in structural capital were divided into (i) systems and programs, (ii) research and development and (iii) intellectual property rights, meanwhile relational capital consists of (i) strategic alliances, licensing and agreements and (ii) relation and knowledge about partners, suppliers and customers.

The items of this study were summarized from both previous literatures (Bollen et al., 2005; Bontis, 1998; De Pablos, 2002; Edvinsson & Malone, 1997; Liao et al., 2010; Lynn, Christopher, & Chan, 2009; Selemi et al., 2007; Sharabati et al., 2010) and expert’s opinions.

Phase 2. In the second phase, the initial questionnaire was further refined by experts. The validity of a measure refers to the extent to which it measures what is intended to be measured. Face validity is not evaluated numerically, it is subjectively judged by the researchers (Kaplan, 1987). Eight experts who qualified in field of pharmaceutical practice, from both industry and university were participated in this phase. The participants suggested adding and omitting some parts of questionnaire, so that, all the pretest participants expressed strong agreement with the validity of the questionnaire. Finally, the expert-refined questionnaire includes 17 indicators related to human capital, 11 indicators related to SC and 14 indicators measure relational capital.

Besides the face validity, using principal components method for extraction, factors with eigenvalues greater than 1 were retained. The Factor analysis (i.e. Pearson’s principal component analysis) was tested with and without rotation (i.e. Varimax rotation with Kaiser normalization). The conservative factor loadings of greater than 0.4 were considered at 95% level of confidence (Hair, Anderson, Tatham, & Black, 1998). The internal consistency of a set of measure items refers to the degree to which items in the set are homogeneous. Internal consistency can be estimated using a reliability coefficient such as cronbach’s alpha (Hair et al., 1998). In this research, it was calculated around 0.88. Ultimately, the questionnaire was finalized, then ready to be delivered.

Phase 3. During this phase, the questionnaire is scored on a scale ranging from 1 (least important) to 5 (most important). In order to participate in this study, our inclusion criterion was being as a manager in pharmaceutical practice for at least 5 years. The questionnaire was delivered to 148 participants from both industry and university, finally 108 questionnaires were returned, resulting in a valid response rate of 73 per cent.

4. Data analysis and results (phase 4)

Data for this study were collected using a self-administered questionnaire that was distributed to both industry and university
experts. Questions also included demographics such as educational level, work place and experience which are shown in Table 1. The majority of the respondents have at least 15 years of experiences in the pharmaceutical practice, and above ninety percent of participants have higher education. In order to prioritize IC indicators, fuzzy TOPSIS technique as an algorithm of Multiple Attribute Decision Making (MADM) was used.

### 4.1. Result of fuzzy TOPSIS

Natural language to express perception or judgment is always subjective, uncertain or vague. Such uncertainty and subjectivity have long been handled with probability and statistics (Wang & Chang, 2007). Since words are less precise than numbers, the concept of a linguistic variable approximately characterizes phenomena that are too complicated or poorly defined to be described with conventional quantitative terms (Herrera & Herrera-Viedma, 2002). To resolve the ambiguity and subjectivity of human judgment, fuzzy sets theory was introduced to present the linguistic terms in decision making process. The TOPSIS method was firstly proposed in 1981. The basic concept of this method is that the chosen alternative should have the shortest distance from the positive ideal solution and the farthest distance from a negative ideal solution. A positive ideal solution is a solution that maximizes the benefit criteria and minimizes cost criteria (Karimi, Mehrdadi, Hashemian, Nabi-Bidhendi, & Tavakkoli-Moghadam, 2011); whereas, a negative ideal solution maximizes the cost criteria and minimizes the benefit criteria. Therefore, the fuzzy TOPSIS method is proposed, in which the weights of criteria and ratings of alternatives are evaluated by linguistic variables represented by fuzzy numbers to deal with the deficiency in the traditional TOPSIS. This paper presents an extension of the TOPSIS method proposed by Chen, Lin, and Huang (2006). The related algorithm can be described as follows:

**Step 1:** A committee of the decision-makers is formed fuzzy rating of each decision maker. \( D_k = (k = 1, 2, \ldots, k) \) can be represented as triangular fuzzy number \( \tilde{R}_k = (k = 1, 2, \ldots, k) \) with membership function \( \mu_{R_k}(x) \)

**Step 2:** Criteria evaluation is determined.

**Step 3:** After that, appropriate linguistic variables are chosen for evaluating criteria and alternatives.

**Step 4:** Then the weight of criteria are aggregated. The aggregated fuzzy rating can be determined by:

\[
\tilde{R} = (a, b, c), \quad k = 1, 2, \ldots, k.
\]  

where

\[
a = \min(d_{ijk}), \quad b = \frac{1}{k} \sum_{k=1}^{k} b_{ijk}, \quad \text{and} \quad c = \max(c_{ijk})
\]

**Step 5:** Then the fuzzy decision matrix is constructed.

**Step 6:** The above matrix is normalized.

**Step 7:** Considering the different weight of each criterion, the weighted normalized decision matrix is computed by multiplying the importance weights of evaluation criteria and the values in the normalized fuzzy decision matrix.

**Step 8:** The fuzzy positive ideal solution (FPIS, \( A^+ \)) and fuzzy negative ideal solution (FNIS, \( A^- \)) are determined by:

\[
A^+ = (\tilde{V}_1^+, \tilde{V}_2^+, \ldots, \tilde{V}_n^+),
\]

\[
A^- = (\tilde{V}_1^-, \tilde{V}_2^-, \ldots, \tilde{V}_n^-)
\]

where \( \tilde{V}_j^+ = \max_i \{V_{ij}\} \) and \( \tilde{V}_j^- = \min_i \{V_{ij}\} \) for \( i = 1, 2, \ldots, m; \ j = 1, 2, \ldots, n \)

**Step 9:** Then, the distance of each alternative from FPIS and FNIS are calculated by:

\[
d_i^+ = \sum_{j=1}^{n} d_{ij}(\tilde{V}_j^+, \tilde{V}_j^+) \quad i = 1, 2, \ldots, m
\]

\[
d_i^- = \sum_{j=1}^{n} d_{ij}(\tilde{V}_j^-, \tilde{V}_j^-) \quad i = 1, 2, \ldots, m
\]

where \( d_{ij}(\ldots) \) is the distance measurement between two fuzzy numbers.

**Step 10:** A closeness coefficient index (CCI) is defined to rank all possible alternative. The closeness coefficient represents the distance to the fuzzy positive ideal solution (\( A^+ \)) and fuzzy negative ideal solution (\( A^- \)) simultaneously. The closeness coefficient of each alternative is calculated by:

\[
CCI_i = \frac{d_i^-}{d_i^+ + d_i^-}, \quad i = 1, 2, \ldots, m
\]

### Table 1
Demographics of the respondents.

<table>
<thead>
<tr>
<th>Workplace</th>
<th>Experience</th>
<th>Frequency</th>
<th>Educational level</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>Between 6 years and 10 years</td>
<td>31</td>
<td>BS</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Between 11 years and 15 years</td>
<td>25</td>
<td>MS</td>
<td>23</td>
</tr>
<tr>
<td>Industry</td>
<td>Between 16 years and 20 years</td>
<td>26</td>
<td>PharmD</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>More than 20 years</td>
<td>26</td>
<td>PhD</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>108</td>
<td></td>
<td>108</td>
</tr>
</tbody>
</table>
Step 11: According to the closeness coefficient, the ranking of the alternative can be determined.

In order applying fuzzy TOPSIS, We have converted the language terms to fuzzy numbers according Table 2, and its results are shown in Tables 3–5.

As depicted in Table 3, several factors could get high priorities according to fuzzy TOPSIS’s result namely: seniority of chief executive officer’s (CEO) management experience, extent of CEO’s management knowledge, extent of employee’s skills, team working culture, commitment to organizational goals, extent of employee’s knowledge and on-job training days per employees. In opposite, factors such as percentage of R&D personnel to total employees, number of full-time employees, average age of employees, and finally percentage of employees with higher education to total employees were placed in the least ranking.

According to Table 4, open and positive climate shows the high priority followed by ratio of investment in R&D and numbers of R&D projects, in opposite the numbers of scientific publications manifest the least priority based on fuzzy TOPSIS technique. This may result from low interest of practitioners to publish scientific documents without applicability for them. Moreover, related to high rank of R&D structure, it is important to note that it is an important component of technological capital in knowledge-based environments.

As depicted in Table 5, customer’s perspectives are placed in higher rank according to fuzzy TOPSIS result. Furthermore, pay attention to public institution’s needs and commitment to strategic cooperation like alliances, licensing and agreements could show the high priority among relational capital indicators.

5. Discussion

Present study has developed a valid tool for measuring and evaluating of intellectual capital especially for the knowledge-intensive environments like pharmaceutical and bio pharmaceutical industry. From a primary questionnaire, experts confirmed 42 important and relevant items to this issue. In order to have precise discussion, it will be presented separately according to each component of IC:

5.1. The human capital

Human capital continues to be a key character of innovation, organizational competitiveness and economic performance particularly for knowledge-based environments. This also could be important for financial and information management, business planning and corporate governance (Lynn et al., 2009). Fuzzy TOPSIS as a powerful technique has been used to prioritize IC indicators in this study. It also can strongly differentiate among indicators using numerical scale. Considering human asset as a fundamental component of both IC and intangible assets (Bollen et al., 2005; Mehralian, Rajabzadeh, Sadeh, & Rasekh, 2012), the weight of both CEOs and employee’s experience and seniority in the present study reflect the need for professional managers and skilled employees in the emerging pharmaceutical industry like Iran. This goal would be unreachable, if there is no commitment in the firm according to on-job training, since Katsanis (2006) pointed out that continuous training program is a key tool for employees and managers performance. According to employee’s satisfaction, fuzzy TOPSIS determines the importance of this indicator and also its compatibility with recent study which conducted by and Lynn et al. (2009). In addition, Burke, Graham, and Smith (2005) signified due to connection between employee’s satisfaction with productivity of firms, employee’s satisfaction plays a crucial role in supporting achievements of a firm. Regarding to other items which ranked with low priority, some reasons can be proposed. For instance, related to percentage of R&D personnel to total employees in a firm, it is proposed to recruit talent and creative persons who can effectively promote the performance of firms instead of large number of non qualified employees (Edvinsson & Malone, 1997). Furthermore, considering the number of full-time employees in a firm, Edvinsson and Malone (1997) addressed the value of this indicator may point out if just the company is carrying too much overhead, and also pay attention to aforementioned indicator will be much concern for the firms, when they feel weak psychological link between internal human assets and the firm’s goals (George, 2003). Although, according to Roberts and Amit (2003), a firm’s ability to introduce new innovative products and services depends on its employee’s experience, result of this study shows that just relying on employees seniority cannot meet definitely the employee’s experience in the firm, so an artful mix of expertise and seniority of staff is key factor for a firm. The educational level of human assets indicates the basic organizational knowledge of the firm, but result of this study determined that there is no interest from participants’

<p>| Table 2 |</p>
<table>
<thead>
<tr>
<th>Language terms.</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low</td>
<td>1</td>
<td>(0.0,0.1,0.2)</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>2</td>
<td>(0.1,0.25,0.4)</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>3</td>
<td>(0.25,0.5,0.7)</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>4</td>
<td>(0.5,0.75,0.9)</td>
<td></td>
</tr>
<tr>
<td>Very high</td>
<td>5</td>
<td>(0.8,0.9,1)</td>
<td></td>
</tr>
</tbody>
</table>

<p>| Table 3 |</p>
<table>
<thead>
<tr>
<th>Rank of fuzzy TOPSIS for human capital.</th>
<th>Important level</th>
<th>Distance from positive ideal</th>
<th>Distance from negative ideal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seniority of CEO’s management experience</td>
<td>0.75</td>
<td>0.006</td>
<td>0.018</td>
</tr>
<tr>
<td>Extent of CEO’s management knowledge</td>
<td>0.72</td>
<td>0.007</td>
<td>0.017</td>
</tr>
<tr>
<td>Extent of employees’ skills</td>
<td>0.66</td>
<td>0.008</td>
<td>0.016</td>
</tr>
<tr>
<td>Team working culture</td>
<td>0.66</td>
<td>0.000</td>
<td>0.016</td>
</tr>
<tr>
<td>Commitment to organizational goals</td>
<td>0.65</td>
<td>0.002</td>
<td>0.016</td>
</tr>
<tr>
<td>Extent of employees’ knowledge</td>
<td>0.62</td>
<td>0.009</td>
<td>0.015</td>
</tr>
<tr>
<td>On-job training days per employees</td>
<td>0.60</td>
<td>0.009</td>
<td>0.014</td>
</tr>
<tr>
<td>Extent of employees’ problem solving ability</td>
<td>0.59</td>
<td>0.0011</td>
<td>0.015</td>
</tr>
<tr>
<td>Employees’ satisfaction</td>
<td>0.58</td>
<td>0.001</td>
<td>0.014</td>
</tr>
<tr>
<td>Extent of CEO’s international experience</td>
<td>0.55</td>
<td>0.011</td>
<td>0.014</td>
</tr>
<tr>
<td>Rate of managers’ turn-over</td>
<td>0.54</td>
<td>0.011</td>
<td>0.013</td>
</tr>
<tr>
<td>The average of employee’s seniority</td>
<td>0.54</td>
<td>0.012</td>
<td>0.014</td>
</tr>
<tr>
<td>Non financial incentives for employees</td>
<td>0.50</td>
<td>0.012</td>
<td>0.012</td>
</tr>
<tr>
<td>Percentage of R&amp;D personnel to total employees</td>
<td>0.43</td>
<td>0.015</td>
<td>0.011</td>
</tr>
<tr>
<td>Number of full-time employees</td>
<td>0.41</td>
<td>0.014</td>
<td>0.01</td>
</tr>
<tr>
<td>Average age of employees</td>
<td>0.38</td>
<td>0.015</td>
<td>0.009</td>
</tr>
<tr>
<td>Percentage of employees with higher education to total employees</td>
<td>0.35</td>
<td>0.016</td>
<td>0.009</td>
</tr>
</tbody>
</table>
5.2. The structural capital and relational capital

Considering the structural and relational capital as two major components of IC (Wu, Chang, & Chen, 2008) and knowledge productivity (Huang & Wu, 2010), the competitive position of companies is heavily dependent on systems and programs which provide positive climate for the scientists in order to be creative and innovative (Sharabati et al., 2010). Regarding to structural capital, fuzzy TOPSIS’s result show that much concern is paid to positive climate, ratio of investment in R&D and numbers of R&D projects which reflect the meaningful position of systems and programs beside the technological capital in such environment. According to Subbarasimha and Ahmad (2003), among the resources which a firm uses, technological knowledge (R&D activities) is an imperative one as it can help firms both attain, and sustain their competitive advantage. Furthermore, Cabrita and Bontis (2008) pointed out that if a company has good systems, database, patents, trademarks, routines and procedures (as parts of the structural capital) it would be promising of efficient running of the company performance.

Though the relational capital dimension is divers and including suppliers, competitors, investors, and collaborators, the primary attention in this study is customers and strategic cooperation such as alliances and licensing. Considering the key role of customer’s satisfaction, Seleim, Ashour, and Bontis (2004) addressed it as a critical component of relational capital. In addition, Kennedy (1998) proposed that customer’s loyalty gives an indication of how stable the customer base is, also maintainable customer relationship with company is an important competitive advantage. According to numbers of R&D contracts for product development, our result was consistent with the findings of Maurer and Ebers (2006) that states pharma companies are interested in collaborating with parties enabling their R&D particularly scientific centers. Related to the number of strategic cooperation (alliances, licensing and agreements) as an indicator which refers to the acquisition of new knowledge from other firms, some studies indicate that considering aforementioned strategy in R&D industries, knowledge can be transmitted (Cristina & Carlos, 2011). The high interest related to extent of relationship with public institution in order to be aware about their needs and priorities in this study is in turn with recent literatures which have addressed the influence of corporate social responsibility on IC components (Aras, Aybars, & Ozlem, 2011; Passetti, Andrea, Lino, & Marco, 2009).

6. Conclusion, limitations and implications

From a strategic point of view, IC is becoming a critical factor for a firm’s long-term productivity and performance in the knowledge-based environment, and it is widely accepted that knowledge make capabilities for firm to innovate, as well as its performance. Furthermore, firm performance is clearly connected to its IC ability to utilize knowledge resources in an effective manner (Subramaniam & Youndt, 2005). Therefore, in order to measure and report the IC, firms would require a number of indicators which able to evaluate the intellectual resources of the firm. Considering the human capital, it can be concluded that seniority and extent knowledge of CEOs, knowledge and skill of employees and their ability to team working and solving problems were accepted as important factors in order to prioritize human capitals indicators in this study. Finally, regarding to structural and relational capital, it can be summarized that customers and collaborators play a key role in relational capital, since the concentration on aforementioned issues show the willingness of such firms to accelerate their own research through external collaborations.

There are some limitations in our study. One limitation refers to specific industry which can be developed by researchers to others knowledge-based environment, and in those environments should
be delivered with care as some modifications may be required because of industry-specific characteristics and market differences. Next, although we believe that our sample is representative for Iranian managers who involved in pharmaceutical firms, a larger sample could help to improve the generalizability of this study. In spite of some existing limitations, the tool for measuring and evaluating of intellectual capital constructed in this study has a number of new contributions and applications. First, the measurement is not only suitable for evaluation of a company’s development but also present a basis for further academic research. Second, the development of this tool can support the inadequacy of tangible asset evaluation of companies in emerging industry or with primary activities in R&D. Third, investors can apply this measurement for evaluation of the future value of such companies; also it is able to give venture capitalists a set of relatively objective indicators of the stature of firms and their future trends in different development stages in an emerging industry. Finally, in light of this distinction, IC measurement can also be used as a quality management tool for corporate performance using concepts adopted from existing quality management technologies, such as ISOs, capability maturity model (CMM), and total quality management (TQM), in organizational or process improvements. Appropriate application of this tool in quality management can significantly help organizations in improving efficiency and achieving goals (Lee & Chang, 2006).

References

cited references...


