

PRIORITIZATION STRUCTURAL CAPITAL INDICATORS IN IRANIAN E-BUSINESS

Mohammad Reza Gholamian, Iran University of Science and Technology, Iran

Peyman Akhavan, Iran University of Science and Technology, Iran
peyman_akv@yahoo.com

Faezeh Mohammadipour, Iran University of Science and Technology, Iran

Morteza Namvar, Iran University of Science and Technology, Iran
namvar@ind.iust.ac.ir

ABSTRACT

Structural capital has been described as more hidden part of intellectual capital and organizational knowledge. In spite of more clarity regarding the indicators of human capital, the first dimension of intellectual capital, structural capital sub-dimensions and indicators have been a challenging subject in intellectual capital literature. Clarifying structural capital indicators in e-business as more knowledge-based arena is also a missing topic of research in the literature. Despite the highly importance of intellectual capital in e-business success, few applicable research has been conducted in recent years. This research contributes to the literature and practices in using a two-step survey in order to discover the most influencing indicators in the success of e-business. The application of the analytic hierarchy process (AHP) is utilized to extract weights for setting the priority among criteria.

Keywords: intellectual capital, structural capital, prioritization, e-business, analytic hierarchy process

INTRODUCTION

E-business is defined as commercial or administrative transaction or information exchange made available over internet (Moodley, 2003; Wang and Cheung, 2004). In order to implement e-business successfully, organizations need to assess their knowledge. Knowledge shapes the foundation of firm performance, and this is a topic of fundamental importance, practically for e-business that often have few physical assets (Leadbeater, C., 2000). The rise of the knowledge-based economy has been attributed to the increasing importance of intellectual capital (IC), a main resource for companies as they seek to sustain competitive advantage (Moon and Kym, 2006; Sonnier *et al.* 2007; Tan *et al.* 2007). For traditional brick

and mortal business models development, managers consider financial issues more. On contrary, in order to implement click and mortal business models or innovative pure e-business models, managers and stakeholders evaluate their intellectual capital requirement more than their financial capital aspects before any investment.

Unfortunately, current literature on both intellectual capital measurement and the development of e-business models does not adequately address the many complexities facing today's e-business initiatives and there is a great need for considering these two disciplines in the researches. Besides, the selection of intellectual capital measurement indicator is a multi-criteria decision problem which requires resolutions involved with various stakeholders' interests [Han, and Han, 2004].

Despite the significant efforts and research into IC management, most companies do not identify core intellectual indicators in some areas that directly influence business value (Ittner and Larcker, 2003). A number of companies also tend to weigh a long list of awkward, complex, and unnecessary indicators equally with intellectual capital (Bontis, 2001; Reisinger et al., 2003). According to Kim and Kumar (2009) the inefficient use of indicators, therefore, frequently results in increasing a manager's confusion, unnecessarily complicating decision making; and damaging business performance by incurring significant costs of opportunities missed.

In order to assist management decision making in selecting intellectual capital indicators for measurement and disclosure, this paper suggests a model that identifies the criteria reflecting decision usefulness and expected risk factors. Analytic hierarchy process (AHP) is utilized in order to prioritize intellectual capital indicators in the Iranian e-business has been delineated. Based on the criteria and their weights, this study identified each indicator's weights through an evaluation of two-steps expert's surveys of Iranian e-business managers and academics.

The aim of this paper is to evaluate the role of IC in success of e-business and proposing a framework for prioritizing intellectual capital indicators and for suggesting key improvement areas. To increase the reliability of results at first a survey is conducted to rank the existing intellectual capital indices and the second survey utilized AHP – that have been widely proven as among the best tools to weigh indicators (Pike et al., 2005a, b; Reisinger et al., 2003).

This paper is organized as follows. In Section 2, the concept of intellectual capital and its prioritization is discussed. Section 3 presents a research methodology. Section 4 demonstrates the results of two-steps survey and the proposed strategy map. Finally, the authors provide a conclusion of their findings in Section 5.

LITERATURE REVIEW

Intellectual capital and structural capital

Botins (2001) believes that intellectual capital is the collection of intangible resources and the flows. Brooking (1997) states that intellectual capital is the differences between the book value and the market value. Although a large number of intellectual capital methods and models have been developed, only a few of them are approved in any specific industries or organizations (Bontis, 2001 and Moczydlowska, 2007), but according to Namvar *et al.* (2010) in spite of different categorization for intellectual capital, most of them have considered same indices for intellectual capital. The important point in all the taxonomies is that, all of them considered intellectual capital as a summation of human capital and some other intangible resources (Brooking, 1996; Edvinsoon and Malone, 1997; Roos *et al.*, 1997; Stewart, 1997; Sullivan, 1998; Bounfour, 2003; Edvinsoon, 2004; Moon and Kym, 2006; Bozbura and Beskese, 2007; and Namvar *et al.*, 2010).

Although all of the mentioned authors considered human capital as an independent part of intellectual capital, there are some different approaches for classifying its other parts. Mostly, the role of structural capital and its sub-components is a challenging phenomenon. Some authors clarified it clearly and named it “structural capital” (Edvinsoon and Malone, 1997, Roos *et al.*, 1997, Stewart, 1997, Bounfour, 2003, Moon and Kym, 2006, and Namvar *et al.*, 2010); however some other others mentioned it indirectly and named it with variety of expressions such as “infrastructure asset” (Brooking, 1997), “internal structure” (Sveiby, 1997), “intellectual asset” (Sullivan, 1998), “organizational structural asset” (Edvinsoon, 2004), and “organizational capital” (Bozbura and Beskese, 2007). Choong also in 2008 provides an extensive analysis of the literature for the identification and classification of intangible assets and suggests a categorization of intellectual capital into three categories; (1) human capital (i.e. knowledge, the experiences, the competencies, and the creativity the staff); (2) organizational or structural capital (include assets from organizational structure, management and information systems, etc.); and

(3) Relational capital (relationships an organization deploys with its external environment).

Intellectual capital indices prioritization

The intellectual capital models which are mentioned in the previous part proposed the structure and candidate indicators of intellectual capital (Brooking, 1996; Edvinsson, 1997; Stewart, 1997; Sullivan, 2000; Sveiby, 1997). The relevant list of indicators and several classification dimensions such as customer, process, innovation, and human capital have been identified as a basis for explaining the intellectual capital [Han and Han, 2004]. Therefore these models can't identify what indicators are efficient, and risk of disclosure for a specific industry or company circumstance because they don't include the weights of each indicator which assist the measurement decision processing. According to Mouritsen (2002) managers and researchers have experienced difficulties in conducting intellectual measurement due to the absence of a model which includes measurement priority among candidate intellectual capital indicators.

Recently some authors have conducted researched in order to prioritize intellectual capital in different in industries. In 2004, Han and Han conducted one of the first researches for Prioritization and selection of intellectual capital measurement indicators using AHP for the mobile telecommunications industry in South Korea. They considered five selection criteria for intellectual capital indicators e.g. relevance, reliability, comparability, representational quality and risk.

Bozbura and Beskese in 2007 published a paper aiming at prioritization of organizational capital measurement indicators using fuzzy AHP. Their study defines a methodology to improve the quality of prioritization of organizational capital measurement indicators under uncertain conditions. Within their model, three main attributes; deployment of the strategic values, investment to the technology and flexibility of the structure; their sub-attributes and 10 indicators are defined. The results of their study showed that “deployment of the strategic values” is the most important attribute of the organizational capital.

Liu and Chen in 2009 tackled at digital capital prioritization in recruiting web sites. They considered three dimensions for digital capital – internet relational capital, internet customer capital and internet service capital - and utilized Fuzzy AHP to prioritize in recruiting websites. Lee in 2009 continued their work in Taiwanese universities using fuzzy AHP to

develop intellectual capital evaluation model for assessing their performance contribution in a university

Kim and Kumar in 2009 stated that using AHP lonely for prioritizing intellectual capital could be risky and presented a framework for prioritizing intellectual capital indicators by using the Delphi approach and AHP. They evaluated they proposed framework in R&D sectors of South Korea.

Wu *et al.* in 2009 used a hybrid Fuzzy AHP to prioritize innovation capital within Taiwanese universities. In their research intellectual capital consists of Intellectual property (IP) and tangible assets (TA). IP itself consists of innovative preference, innovative culture and number of new ideas. Tangible assets regarding innovation capital include number of publications, financial support and research performance.

Finally, Asonitis and Kostagiolas in 2010 presented a methodological framework for the identification of a hierarchy among the three categories of intellectual capital, i.e. human capital, organizational/structural capital and relational capital, with respect to their contribution to the objective of improving a library's performance. They also provide a case study of Greek central public libraries.

RESEARCH DESIGN

This study is developed in three stages; intellectual capital indices extraction from the literature (stage one), ranking intellectual capital indicators using Freidman test (stage two), and giving weight to each indices of structural capital using AHP method (stage three). (See figure 1)



Figure 1 research framework

First stage

The objective of this stage is to determine a set of important intellectual capital indicators using literature review on intellectual capital. The output of this stage is a list of indicators that are weighted equally which will be used as for the next stage. As a result, 30 more referenced indices regarding two dimensions (human capital, structural capital) of intellectual capital are extracted from the literature.

Second Stage

The previous researches depended on only a single methodology, namely AHP analysis, without considering multiple methodologies. According to Kim and Kumar (2009) the single methodology might be risky. Parung and Bititci (2006) believe that AHP analysis even draws a few criticisms because of a limited theoretical background. So, before the AHP analysis in this stage we aimed at selecting the most influencing indicators for main analysis with AHP. As a result, during this stage a survey is conducted from 42 e-business experts. A questionnaire was designed which contained a list of 30 indicators of intellectual capital from previous stage. And the respondents were asked to evaluate the importance of each index in 5 point Likert-type from 1-not effective- to 5-strongly effective.

The results of this survey is analyzed using Freidman Test. Prior researches recommends that a manageable number of indicators should be 20-25 (Kaplan and Norton, 1996; Reisinger et al., 2003), so 20 high-ranked indices of intellectual capital were selected using this test. It is because the aim of this research is to prioritize structural capital indicators, 14 indicators of 20

indicators which are related to structural capital were chosen for the next stage. 6 high-ranked indicators after Freidman Test which belonged to human capital are omitted from the analysis.

Third Stage

Analytical Hierarchy Process (AHP) is a technique used for setting priority in a complex, un-anticipated, multi-criteria problematic situation which been developed by Thomas L.Saaty in 1970s. In addition, AHP is used in applied science and various managerial and decision-making related assignments (Saaty, 1982).

“Elements in each hierarchy are paired compared with respect to their importance to the decision-making. AHP uses a verbal scale, which enables the experts to incorporate subjectivity, experience and intuition in a natural way .A major strength of AHP is the pair-wise comparison and the influence of the elements of a particular level over those of a lower level is measured. The comparison is based on an expert’s opinion and the experience gained from the observation and continuous learning of the system behavior “(Saaty, 1982,P.167).

In this stage 14 high-ranked indices from the previous stage are taken into account for AHP analysis. 12 experts participated in this survey. The AHP analysis is conducted in two levels. At first, three dimensions of structural capital (customer capital, innovational capital and process capital) were compared pare wise using three questions. Then indices of each dimension of structural capital are compared together. Therefore, in the questionnaire 10 questions for comparing 5 indicators of customer capital, 10 questions for comparing 5 indicators of process capital and 6 questions for comparing 4 indicators of innovational capital were designed.

RESULTS

As mentioned in the previous part in this study two expert’s survey was conducted which would be explained more in the following.

First expert’s survey

In the first survey a questionnaire was conducted from 42 academic and industrial experts in the field of e-business. The questionnaire includes 30 questions which measures the importance of each of 30 intellectual capital indicators on the success of e-business. The respondents were asked to evaluate their importance in the five-point Likert scale from 1-not effective to 5-strongly effective. 25 of respondents were surveyed directly and the remaining

ones were asked to fill in questionnaire by e-mail. Of the 42 respondents, 28% have PhD, 59% have Msc, and the remaining have Bsc. Also, %42 of them is top-level or middle-level managers.

Regarding the validity of analysis, 30 indicators which were embedded in the questionnaire are chosen from the literature, and then confirmed from three e-commerce professors. The research used Cronbach's α to investigate the reliability of each construct (see table 1). All of the coefficients were at least 0.707. In addition, the overall Cronbach's α was 0.952.

Table 1 Reliability analysis

Dimension	Cronbach's α
<i>Human capital</i>	0.707
<i>Customer capital</i>	0.861
<i>Process capital</i>	0.852
<i>Innovational capital</i>	0.866
<i>All dimensions</i>	0.957

After the reliability analysis all the variable are taken into account for the Freidman Test. Thus a ranking of 30 intellectual capital indicators was achieved. Kaplan and Norton in 1996 stated that 20-25 measures are sufficient for firm evaluation. Therefore the first 20 high-ranked indicators after Freidman Test were chosen for the second survey.

Among these 20 chosen indicators 6 indicators belong to human capital, and 14 of them belong to three dimensions of structural capital (5 of them belong to customer capital, 5 of them to process capital, and 4 of them to innovation capital). Due to aim of this research which is going to prioritize the structural capital indicators, only 14 indicators that describe structural capital are taken into account for the next survey.

Second expert's survey

In the second survey 12 experts were asked to fill in questionnaire which was designed for AHP analysis. 6 of them were university professors in e-business and information technology management areas. The other 6 experts were executive managers of e-business companies which had Msc in e-business.

First, respondents were asked to compare three main dimensions of structural capital (customer capital, process capital, and innovational capital) pair wisely. Second, the respondent compared 5 main indicators of customer capital together. Then, a comparison between 5 indicators of process capital was done. Finally, 4 indicators of innovational capital were compared together.

The result of the survey was analyzed by AHP technique. The following figure indicates the weights of each dimension (customer capital, process capital, and innovational capital) and the weights of their indicators.

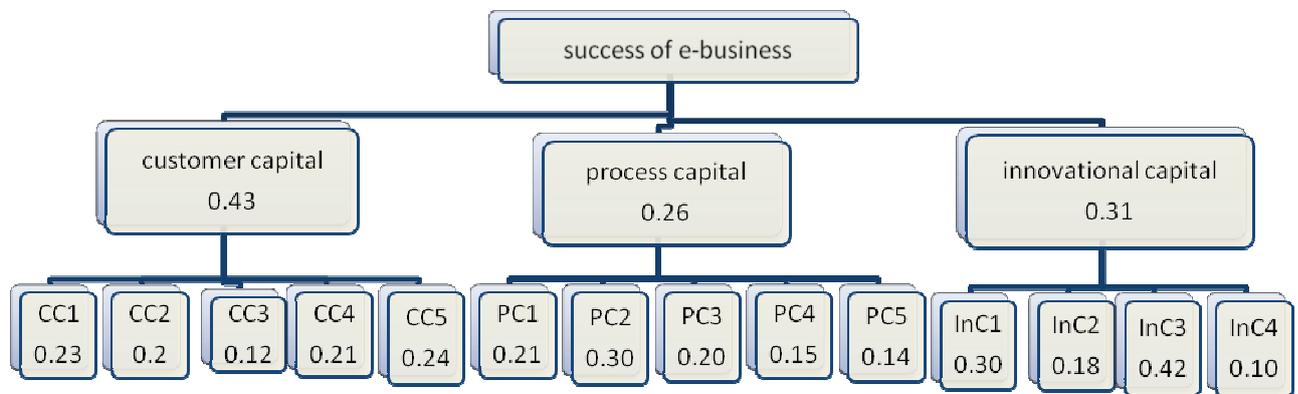


Figure 2 the weights of each dimensions of structural capital and their indicators

Table 2 summarizes the overall weights of each indicator and their ranking regarding other indicators.

Table 2 prioritized indicators and their weights

Rank	Name	Overall weight	description
1	InC3	0.128542	Commercialization and usage of new ideas
2	CC5	0.102032	Customer satisfaction level
3	CC1	0.099431	Direct to customer and personalization
4	InC1	0.094072	Innovative services and products
5	CC4	0.092861	Market share
6	CC2	0.085507	Customer retention and churn avoidance
7	PC2	0.080451	Information systems
8	InC2	0.054670	Management support for innovation
9	PC1	0.053853	Products and services without errors
10	CC3	0.052025	New customer acquisition and new markers entrance
11	PC3	0.050908	Facilitating systems for communication within or outside the company
12	PC4	0.037713	Organizational structure
13	PC5	0.037292	The process of production and service
14	InC4	0.030642	Educational programs

CONCLUSION

This research contributes to the literature and practices in using a two-step survey in order to discover the most influencing indicators in the success of e-business. The application of the analytic hierarchy process (AHP) is utilized to extract weights for setting the priority among criteria. The two-step approach for prioritizing structural capital helped experts in the second stage to concentrate on few indicators and achieve a better comparison.

The first ranked indicator in this study is “Commercialization and usage of new ideas”. Iranian industries still suffer of many abundant innovations that have never been commercialized. In spite of so many patents that are registered every year, no one enter to the industry. This especially is more deterministic in e-business, due to highly need to innovation and its usage in amongst so many rival firms that are available in internet.

The results of the study highly indicate the role of customer capital in success of e-business. Amongst the high-ranked indicators *direct-to customer* and *customer satisfaction level* are a proof to the customer relationship management in internet environment. As the results of

AHP analysis indicates direct to customer, which is one of the most critical functions of customer relationship management, would help companies to run their e-business successfully.

“Information system” is only indicator of process capital which has been placed in the high-ranked indicators regarding expert’s opinions. Undoubtedly, e-business will not exist without an integrated information system which includes all data of enterprise. The dependency of customer capital to information system is another reason for its critical role. A well-designed information system would prepare sufficient data for all customer analysis especially for data mining techniques. Recommender systems are a very popular function of direct to customer which more than any other thing depend on an integrated information system.

This research could be enhanced with some new approaches. First, a Delphi panel could be run in order to have a more comprehensive expert’s opinion. Furthermore, due to interdependency of most of the indicators some other group decision making techniques should be utilized. Finally, a case study in an e-business company can be done to evaluate the results of expert’s opinion and to examine the affects of high-ranked indicators on the firm’s performance.

REFERENCES

- Asonitis S., and Kostagiolas P. A., 2010, “An analytic hierarchy approach for intellectual capital: Evidence for the Greek central public libraries”, *Library Management*, Vol. 31 No. 3, pp. 145-161.
- Brooking, A., 1996, “Intellectual Capital: Core Assets for the Third Millennium Enterprise”, London: Thomson Business Press, London.
- Bontis, N., 2001 “Assessing knowledge assets: A review of model used to measure intellectual capital”, *International Journal of Management Review*, Vol. 3 No. 1, pp. 41-60.
- Bounfour, A., 2003, “The IC-dVAL approach”, *Journal of Intellectual Capital*, Vol. 4, No. 3, pp. 396-412.
- Bozbura F. T., and Beskese A., 2007, “Prioritization of organizational capital measurement indicators using fuzzy AHP”, *International Journal of Approximate Reasoning*, Vol. 44, pp. 124–147.

- Choong, K.K., 2008, “Intellectual capital: definitions, categorization and reporting models”, *Journal of Intellectual Capital*, Vol. 9 No. 4, pp. 609-38.
- Edvinsson, L. and Malone M. S., “Intellectual Capital, The proven way to establish your company's real value by measuring its hidden brain power”, Harper, London, 1997.
- Ittner, C.D. and Larcker, D.F. (2003), “Coming up short”, *Harvard Business Review*, November, pp. 88-95.
- Kaplan, R.S. and Norton, D.P. (1996), “The Balanced Scorecard: Translating Strategy into Action”, Harvard Business School Press, Boston, MA.
- Kim D. Y., and Kumar V., 2009, “A framework for prioritization of intellectual capital indicators in R&D”, *Journal of Intellectual Capital*, Vol. 10, No. 2, pp. 277-293.
- Han D., and Han I., 2004, “Prioritization and selection of intellectual capital measurement indicators using analytic hierarchy process for the mobile telecommunications industry”, *Expert Systems with Applications*, Vol. 26, pp. 519–527.
- Lee S. H., 2009, “Using fuzzy AHP to develop intellectual capital evaluation model for assessing their performance contribution in a university”, *Expert Systems with Applications*, under press.
- Leadbeater, C., 2000, “Living on Thin Air: The New Economy”, Penguin, London, .
- Liu C. C., and Chen S. Y., 2009, “Prioritization of digital capital measures in recruiting website for the national armed forces”, *Expert Systems with Applications*, Vol. 36, pp. 9415–9421.
- Moczydlowska J., 2007, “Organizational knowledge measurement”, *6th International Conference on Computer Systems and Industrial Management Application IEEE*, 2007.
- Moodley, S. 2003, "The challenge of e-business for South African apparel sector", *Technovation*, Vol. 23 No.7, pp.557-70.
- Moon and Kym, 2006, “A model for the value of intellectual capital”, *Canadian Journal of Administrative Sciences*, Vol. 23 No. 3, pp. 253-269.
- Mouritsen, J., Bukh, P. N., Larsen, H. T., and Johansen, M. R. 2002. “Developing and managing knowledge through intellectual capital statements” *Journal of Intellectual Capital*, Vol. 3 No. 1, pp.10–29.
- Namvar M., Fathian M., Akhavan P., Gholamian M. R., 2010, “Exploring the impacts of intellectual property on intellectual capital and firm’s performance: The case of Iranian computer and electronic industries, *Management Decision*, Vol. 48, No. 5, under press.

- Pike, S., Fernstrom, L. and Roos, G. 2005a, “Intellectual capital management approach in ICS Ltd”, *Journal of Intellectual Capital*, Vol. 6 No. 4, pp. 489-509.
- Pike, S., Roos, G. and Marr, B. 2005b, “Strategic management of intangible assets and value drivers in R&D organizations”, *R&D Management*, Vol. 35 No. 2, pp. 111-24.
- Saaty T. L., and Tran L. T., 2007, “On the invalidity of fuzzifying numerical judgments in the Analytic Hierarchy Process”, *Mathematical and Computer Modeling*, Vol. 46, pp. 962–975.
- Reisinger, H., Cravens, K.S. and Tell, N. 2003, “Prioritizing performance measures within the balanced scorecard framework”, *Management International Review*, Vol. 43, pp. 429-37.
- Roos, J., Roos, G., Dragonetti, N. C. and Edvinsson, L., 1997, “Intellectual capital: Navigating in the new business Landscape”, Macmillan, Houndmills, Basingtoke.
- Sveiby, K. E., 1997, “The Intangible Assets Monitor”, *Journal of Human Resource costing and accounting*, Vol. 2, No. 1, pp. 73-97.
- Sonnier et al., 2007, “Accounting for intellectual capital: The relationship between profitability and disclosure”, *The Journal of Applied Management and Entrepreneurship*, Vol. 12 No. 2, pp. 3-14.
- Stewart, T. A., 1997, “Intellectual Capital”, Nicholas Brealey, London.
- Sullivan, P. H., 2001, “Profiting from Intellectual Capital: how to convert intangible corporate assets into market value”, New York, NY: John-Wiley & Sons, Inc, 2001.
- Tan H. P., Plowman D., Hancock P., 2007, “Intellectual capital and financial returns of companies” *Journal of Intellectual Capital*, Vol, 8 No.1, pp. 76-95.
- Wang, S., Cheung, W. 2004, "E-business adoption by travel agencies: prime candidates for mobile e-business", *International Journal of Electronic Commerce*, Vol. 8 No.3, pp.43-63.
- Wu H. Y., Chen J. K., and Chen I. S., 2010, “Innovation capital indicator assessment of Taiwanese Universities: A hybrid fuzzy model application”, *Expert Systems with Applications*, Vol. 37, pp. 1635–1642