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Effect of competitive intelligence on innovation capability: An exploratory study in Mexican companies

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ABSTRACT Market globalization and fast technological change drive organizations to apply information management systems that allow them to analyze information and convert it into intelligence. Because of this, companies need to manage information for decision making. This process is complex, beginning at the level of the company's strategy, and reaching all the way to manufacturing strategy, with the creation, development and deployment of the technological capabilities needed for quick and flexible responses to customers and market situations and their changes. The information can be gathered and managed through several models, mainly, competitive intelligence, knowledge management and intellectual capital. This article presents an investigation using a methodology of structural equation modeling for the identification of the intelligence factors, to evaluate their relative importance and relationships with the innovation capability of Mexican companies. The empirical results show that the relationship between competitive intelligence and the innovation capability is indirect, with knowledge management as a mediating factor.

KEYWORDS Competitive intelligence, innovation capability, structural equations modelling

1. INTRODUCTION

In our highly competitive business environments, companies need ways to manage information for decision making purposes. This is a difficult management function. Deciding the needs, type and specific information can be a hazardous problem, as is the design and characteristics of the information management system required, so useful and timely information is available for the determination and management of the technological capabilities and competences for the delivery of the right goods. This information has several sources and can be obtained by typical functions of competitive intelligence, knowledge management and intellectual capital, which are briefly discussed in the following paragraphs.

Competitive intelligence (CI) is defined as a systematic effort aimed at specific objectives, ethical and in a timely manner, to collect, synthesize and analyse relevant information on competition, markets and the external environment, with the purpose of producing actionable information that can provide a competitive advantage (Fleisher, 2009; Rodríguez & Chávez, 2011; Prescott & Miller, 2002). Knowledge management (KM) is of great interest in areas of business administration, industrial engineering and communication because it focuses on the organization, acquisition, storage and use of knowledge to achieve objectives such as problem solving, dynamic learning, strategic planning and decision making (Hammed 2004, cited by Herschel and Jones, 2005). The interest related to the set of intangible assets, such as knowledge, held by a company known as intellectual capital (IC) has aroused similar interest. Also worth noting is that knowledge is an important source of competitive advantage (Shujahat et al., 2017; Rodríguez Gómez, 2006; Prusak, 1997), therefore, the identification of the most important factors for the effective management of the three information sources (CI, KM & IC) has the utmost importance. Although these theories manage information and knowledge, the relationship between them and innovation capability is not clear in the literature.

2. METHODOLOGY

This investigation is managed by a three-step process. First, a literature review made a list of the factors of CI, KM, the IC and innovation capability. With the list of factors, a questionnaire was constructed, tested and evaluated. The internal reliability was also estimated. In step two, an initial exploratory analysis gave outlier values using the Mahalanobis distance method. Following that was a Kaiser-Meyer-Olkin test for sample fit and a Bartlett's Sphericity test of the correlations. This determined if they were adequate for the modelling process. Step three, was the structural equations modelling process, beginning with the model specification, followed by the identification and the estimation, the test of the model and the Lomax & Schumacker (2012) modification. Statistical analyses are done with Minitab v. 17, SPSS v. 22, and Amos v. 22.

For the purpose of this study, structural equations modelling (SEM) is utilized because it is useful for the analysis of the relationships between the observed variables (items) and the latent variables (factors). SEM uses a confirmatory approach for the analysis of the theory related to some phenomena (Byrne, 2010). It is increasingly used because researches are aware of the need to use multiple constructs or observed variables to explain the phenomena in question, investigating more advanced and complex theoretical models. The software is also spreading and getting friendlier (Lomax & Schumacker, 2012). SEM has been applied in several fields is the search for predictors of effectiveness in Mexico. For instance, in total productive maintenance (Hernández et al., 2018), organizational philosophy, (Davila et al., 2017), and in single minute exchange of dies (Romero et al., 2011).

3. RESULTS

In the first step, with the critical success factors obtained from the literature review, we constructed a questionnaire with a five category Likert scale, in which 1 represents a "non-important" level and the highest, 5, means "extremely important". It is applied to a sample size of 40 participants who possess the attributes to be measured from the target population. This sample size ranges from 30 to 40, as recommended by Hertzog (2008). The type of sampling is for convenience (Malhorta, 2008), and the information gathered was determined by the questionnaire for internal consistency with the Cronbach alpha coefficient. A Cronbach alpha of 0.965 indicates the questionnaire reliability is good, accordingly to Tavakol & Dennick, (2011). Then, the questionnaire was given to 214 engineers from 32 automotive and electronics transnational companies. A sample size of more than 200 is recommended by Lloret et al. (2014).

In the second step, the initial scan analysis indicated that data were missing in 35 questionnaires. This was followed by the identification of outliers in the remaining 178 questionnaires. This was done using the Mahalanobis distance method, using Minitab V. 17. Given the points on the reference line, Y = 6.387, there are 29 outliers that will be eliminated (Figure 1).

Next we performed a Kaiser-Meyer-Olkin fit test and a Bartlett's sphericity test of the correlation between the variables and the adequacy of the sample for the factor the analysis gave. The former was 0.930, indicating small partial correlations, which was precisely measured as a common factor. In the Barter's test, the Chi-square = 2918.587, fd = 325, & a p-value = 0.000 means that the correlations matrix is not an identity matrix,

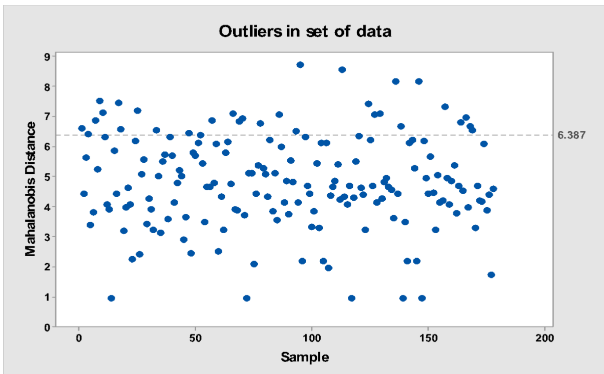

Figure 1 Outliers data chart.

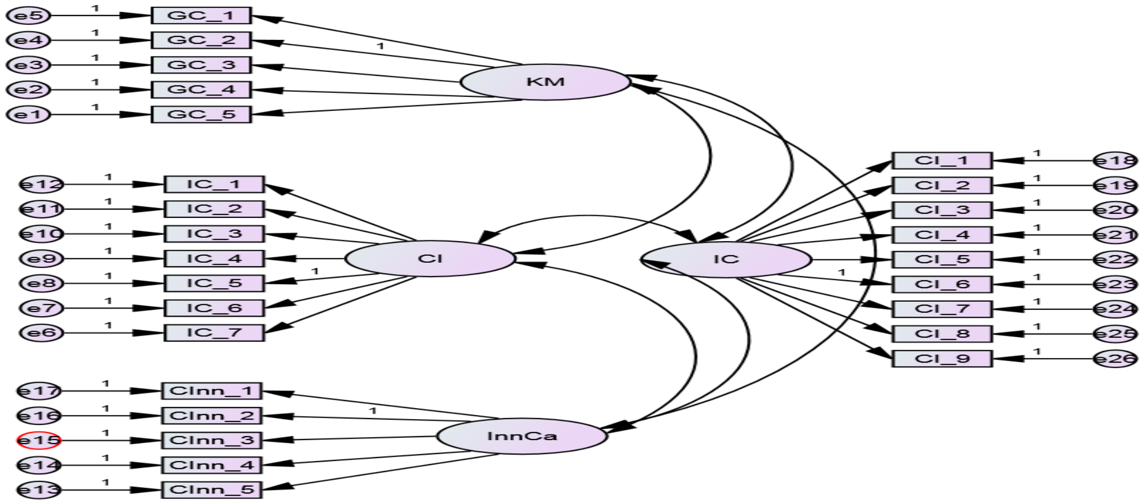

Figure 2 Hypothesized confirmatory factorial model.

indicating there is a high correlation, which is acceptable according to Levy et al. (2003).

Finally, the factor correlations and the factor loads were determined using the main axes method to extract the factors, and the Promax method for its rotation. The factor loads for all items exceeded the recommended level of 0.60 (Hair et al., 1998). This was followed by calculations of the composite reliability, convergent validity and discriminant validity. The composite reliability (CR) values are in the range of 0.87 to 0.92, exceeding the recommended level of 0.70. The average variances extracted (AVE) are in the range of 0.59 to 0.64, exceeding the recommended level of 0.5 (Hair et al., 1998). The discriminant validity was examined and results of the analysis show that the square correlations for each construct are smaller than the average variance extracted (Matzler & Renzl, 2006). These results indicate that the measured items have good reliability and validity.

In step three, we established relationships between the variables of the theoretical model, according to the theory being scrutinized. This was required to specify the model, meaning that to determine the best model capable of producing the sample covariance matrix, we must find the one that presents the theory under construction. Now we have the second order hypothetical factorial model (Figure 2), giving four latent variables and 26 observed variables. Then, the model is identified. In this process, all the parameters have to be specified as free, restricted or fixed. Then the parameters are combined to construct the implicit variance-covariance matrix of the model, to determine the differences between the real model by the data gathered and the implicit theoretical model.

Once the model and the parameters are specified, they are combined in the Σ variance-covariance matrix implicit of the model. A free parameter is unknown, but needs to be specified. A fixed parameter has a specific value in the range [0,1] and a restricted one, also is unknown but is equal to one or more parameters (Lomax & Schumacker, 2012). Because the number of values estimated (S = 171) is bigger than the number of free parameters (42), the model is identified and the free parameters can be estimated.

The estimation of the model gives the estimation of all the parameters. The regression weights and structure coefficients of the hypothetical model are significant as α =0.05 is lower than the p-value. Calculations were made with AMOS v.22 with the method of maximum likelihood, which is adequate for normally distributed data, as well as ordinal and moderately non-normal data.

The test of the model indicates the degree at which the variance-covariance data of the sample fit the structural equations model. For this purpose, several fit indexes are calculated, among them, Chi-square = 522.176, p-value = 0.000, and CMIN/DF = 1.782, which is smaller than the value recommended of 3. AGFI = 0.77, which is less than 0.80; the comparative adjustment index, CFI = 0.94, is bigger than 0.9, as recommended by Chau & Hu (2001). The

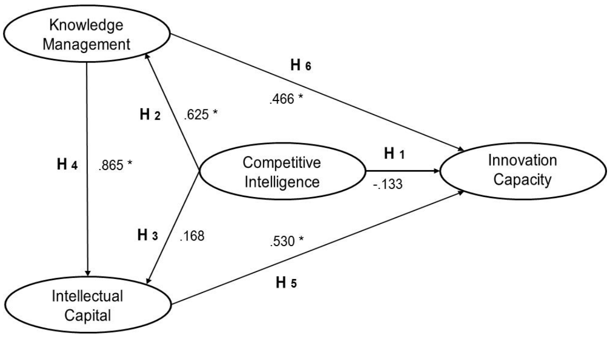

Figure 3 Hypothesized structural model.

root mean square error aprox. (RMSEA) is 0.073, which is lower than the limit 0.08 proposed by Browne & Cudeck (1993). The estimated adjustment indexes combined indicate a good adjustment of the data to the model. Due to this there was no modification of the model.

4. CONCLUSIONS

In the hypothesized structural model, four factors are identified with six structural coefficients, assuming that each of the estimations is an effect between the latent variables. We have the four hypotheses (H_2, H_4, H_5 and H_6) with significant structural coefficients (Figure 3).

These empirical results support the acceptance of the hypotheses:

H_2: Competitive intelligence influences knowledge management

H_4: Knowledge management influences intellectual capital

H_5: Intellectual capital influences innovative capability

H_6: Knowledge management influences innovative capability

That is, CI has a positive effect on KM; intellectual capital has a positive effect on IC, and KM has a positive effect on both intellectual capital and IC. The results are consistent with studies that analyze the relationship of KM with intellectual capital (Serenko et al., 2010; Diez et al., 2010; Kianto et al., 2014); and intellectual capital with IC (Santos-Rodrigues, 2011; Wang & Chen, 2013; Sivalogathasan & Wu, 2013).

However, the results also reflect, for lack of sufficient statistical evidence, that the following hypotheses are rejected:

H_1: Competitive intelligence influences innovation capability

H_3: Competitive intelligence influences intellectual capital

In the case of H_1, the empirical results coincide with a similar study that concludes CI activities are not yet carried out (formally) in order to improve the innovation capability of (Mexican) companies (Güemes & Rodríguez, 2006). This might be explained by means of the combination of several factors, the fact that CI activities are incipient. Recommendations are not acknowledged and followed, therefore, although CI has a direct impact, it is small, but its combination with KM enhances the explanations and because the information is more properly managed, increases the impact. On the other hand, when analyzing the results of the indirect effects, a high value is observed of the indirect effect of CI and IC (.667). Given the above, although there is no direct effect of CI on IC, there is an effect through KM as a mediating factor. These results support the importance of integrating KM and CI with the intention of obtaining better results (Herschel & Jones, 2005; Galeano et al., 2008; Sharp, 2008; Ramirez et al., 2012) and as a source of competitive advantage for companies (Rothberg & Erickson, 2013; Chawinga & Chipeta, 2017; Shujahat et al., 2017).

5. RECOMMENDATIONS

The results obtained are valuable, because they could be used to carry out studies to evaluate the effect of CI on the IC of organizations, and even consider the possibility of defining the course of study that evaluated the mediating effect of KM between CI with IC.

Although the main limitation of the study is the sample size, several aspects indicatate the study is still valid. These include:

- The internal consistency of the IM (Cronbach's alpha) and KMO greater than the recommended of .70;
- Compliance with the cases of convergent validity and discriminant validity;
- Compliance with the model fit criteria.

This paper constitutes evidence that SEM is a powerful tool for the determination of total or partial effects, direct or indirect between a measurable variable and a latent variable, as in the effects between latent variables or constructs.

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