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Exploratory study of competitive intelligence in Mexico

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ABSTRACT In order to increase their competitiveness, companies need information for problem analysis, to develop strategies and for decisions making. One way to achieve this is through methodologies, among which competitive intelligence stands out. For Pellissier & Nenzhelele (2013) competitive intelligence is a process or practice that produces and disseminates actionable intelligence by planning, ethically and legally collecting, processing and analyzing information from and about the internal and external or competitive environment in order to help decision-makers in decision-making and to provide a competitive advantage to the enterprise. Because of its importance this paper presents an investigation using a meta-analysis methodology of 72 papers published between 2000 and 2015 of applications of competitive intelligence in México. In recent years the practice of competitive intelligence has been increasing in México, though its use is not yet widespread. This is why it is important to disseminate and promote the growth of competitive intelligence theory.

KEYWORDS CI practices in México, competitive intelligence, meta-analysis

1. INTRODUCTION

Companies need useful information to develop strategies, make decisions and implement them through the organization in order to increase their competitiveness and market share. Competitive intelligence (CI) is a designed methodology that stands out to improve decision making. For Prescott & Miller (2002) CI is any intelligence function that provides a competitive advantage. CI has become an important part of North American business due to the need for companies to keep abreast of technological changes, reduce associated risks, and invest in the acquisition of advanced technology (Calof & Smith, 2010). However, in Mexico, its use is only beginning and there is an opportunity to determine where and how it is being applied.

To identify the critical factors in Mexican CI practices, a systematic review (SR) of literature was carried out using a meta-analysis (MA) (Moher et al., 2009). For Basu (2017), MA is essentially a systematic review, but the analysis also pools the results of the studies and provides conclusions. Glass (1976) proposed MA as a method of analysis of disorganized knowledge for its integration and organization. It is a process based on statistical methods, or the statistical analysis of a knowledge body searching for valid synthesis. MA uses statistical techniques to integrate the results of the included studies. Even though the methodologies developed for MA have been carried out mainly in the social, medical and psychological areas, some recent MA applications have been in the Mexican manufacturing industries such as Demand and Kanban Flow (Valles et al., 2006); manufacturing (Collins, 2007); cellular manufacturing (Noriega et al., 2010); and project management (García, 2016).

In Mexico the majority of the theoretical and empirical publications on CI theory are focused

on describing the implementing process of CI. Publications also cover different approaches where CI can be applied successfully. However, most of these articles do not identify or mention the contributors in which the success of CI practices reside. Therefore, it is necessary to carry out a review of the published literature to thoroughly analyze each paper and identify critical factors in the success practices of CI in México. The present article carrys out a MA in order to identify the main contributors that impact or influence the success of the application and implementation of CI in México.

1.1   Description of the Problem

In Mexico, the majority of theoretical and empirical publications on CI theory are focused on describing the implementing process of CI. Publications also cover different approaches where CI can be applied successfully. However, most of these articles do not identify or mention the contributors in which the success of CI practices reside. Therefore, it is necessary to carry out a review of the published literature, thoroughly analyzing each paper/article and identifying critical factors in the success of CI practices in México.

2. LITERATURE REVIEW

CI is defined as any processable intelligence that can provide a competitive advantage (Porter and Millar,1985). It is a systematic, goal-oriented, ethical and timely effort to compile, synthesize and analyze information of the external environments, such as competition and markets (Fleisher, 2009). It also is considered a process of legally and ethically gathering and analyzing information about competitors and the industries in which they operate (SCIP, 2016). Ideally, the use of such information in decision making process aims to adjust activities to improve performance (Wright et al., 2009). Corporate intelligence, business intelligence, market intelligence, and other similar terms are often used interchangeably, and more often than not, any difference between them is one of semantics more than substance (SCIP, 2016).

The CI process consists of the following steps: monitoring business environment (external data, information and knowledge), gathering, analyzing, filtering and disseminating intelligence that will support decision making process in order to increase competitiveness and improve position of organization (Nasri,2012).

The cycle of intelligence provides a frame of reference for the management of CI research projects, in such way that projects can be continuously developed, systematically and ad-hoc (Tena & Comai, 2001). It is a fundamental basis of the strategic decision-making process (Dishman & Calof, 2008). In the literature, coincidence is identified in relation to the following processes of the competitive intelligence cycle (Miller, 2001; Rodriguez, 2005; Bose, 2008; Dishman and Calof, 2008): planning and direction, collection of information, analysis of information, dissemination and feedback.

The first phase (planning), focuses on the identification of the needs to gather the relevant information (second phase); then, in the third phase the information collected must be evaluated, determine its usefulness and objectivity, and with this information generate intelligence (third phase) and subsequently, communicate it appropriately to the interested

Table 1 Description of three themes

Generic themes	Description	No. papers
Applications in the industry, services and environment	Papers related to competitive intelligence practices in the private or public sector with impact on their performance, operations, strategic plan, environment or commercial strategy	21
Applications in academia	Papers related of competitive intelligence application in higher education schools related to the teaching-learning process, areas of research and development, design of laboratories or linkage with the productive sector	9
Disclosure / dissemination articles	Papers related to CI state of the art, proposal of application in different sectors, relation with other areas of knowledge (capacity of innovation, knowledge management)	13

parties (dissemination). The fourth phase requires adequate policies and procedures so that the CI can make a positive contribution to the organization. The importance of the CI cycle lies in its understanding of the stages and support for its application in organizations.

In order to identify papers on CI practice in Mexico, a search for publications from 2000 to 2015 was carried out. They were identified through the BIVIR Database Integrator (of the Autonomous University of Juarez-UACJ), which has 30 databases (including Annual Review, Ebsco, Elsevier, Emerald, Sciencedirect, and Wiley), and then perform a debugging of the papers found based on reading the introduction, summary and conclusions.

After the phases of identification and selection of the SR, 43 articles out of 72 were considered. To facilitate the review, the articles were grouped into three types: 1) applications in industry, services and the environment; 2) applications in academia and 3) articles of disclosure / dissemination; as presented in Table 1.

2.1. Narrative summary of the literature by generic themes

2.1.1 Applications in the industry, services and environment

Alcántar (2001) describes the development of the practice of CI in the oil industry in Mexico; Lozano (2003) proposes a pragmatic view about the advantages and disadvantages of patent analysis; Huerta et al. (2003) identify basic design elements to create a CI unit; Rodríguez (2003), presents a patent analysis of an advanced materials case; Lechuga et al. (2007) apply CTI in the search of information about several seawater desalination processes; Esquivel et al. (2008) propose to perform information extraction tasks from corporate news published on the web to provide intelligence; Saad (2009) uses CI to determine technological trends in biotechnology-phytoremediation; Chávez et al. (2010) make use of CI in hotels and restaurants; Vera (2011) proposes an intelligence strategy for Mexican wine companies to increase their competitiveness; López & Alcántara (2011) describe the implementation of a system of competitive and technological intelligence (CTI) to sustain strategic decisions in wastewater treatment; Rodríguez & Tello

(2012) present a methodology that integrates patent analysis in a study of CTI applied in a plastics industrial sector.

Millán (N.A) identify the most used practices related to CI of export companies in Sinaloa; Rodríguez & Salinas (2012) apply CI to investigate and identify drivers that support the decision making of a plastics company; Rodríguez-Borbón et al. (2013) present the design of a CI model for horticulturalists in southern Sonora; Montiel et al. (2014) use CI in the bond industry in Mexico; Rodríguez et al. (2014a) apply patent analysis as part of a CTI methodology on open die forging, also develop a patent analysis on additive manufacturing (Rodríguez at al., 2014b); Ahumada & Perusquia (2016) propose a set of factors for the development of the capacity to manage the knowledge applied for the expansion of business intelligence. Regarding to the integration of CI with other approaches, some papers are about a QFD - deployment of the quality function application (Rodríguez-Salvador et al., 2006), Kansei Engineering in the design of stoves (Rodríguez and Moreno, 2011), blue ocean strategy (Rodríguez and Bautista, 2011), and applications of total quality management with CI (Rodríguez et al., 2007).

2.1.2 Applications in academia

Rodríguez & Gaitán (2002) propose a holistic model for teaching CTI, integrating collaborative learning; the learning of CTI for future strategic improvements (Rodríguez & Mora, 2000) and to improve the identification of opportunities (Rodríguez et al.; Fuentes et al.) present a methodology that incorporates CTI with methodologies of design and product development for a learning environment of an engineering laboratory; Gutierrez et al., analyze the degree of acceptance of high school students in the business intelligence and development program as a proposal for competitiveness in Universities. For research and development centers, Lopez & Alcántara (2010) present the first results of a methodology proposed to implement a CTI System; and López-Martínez (2011) proposes the application of CI and data mining for the identification of patterns that reveal the structure of scientific research and applied research, as well as their concordance in the surroundings of a country; Luna & Solleiro (2007) explain intellectual property
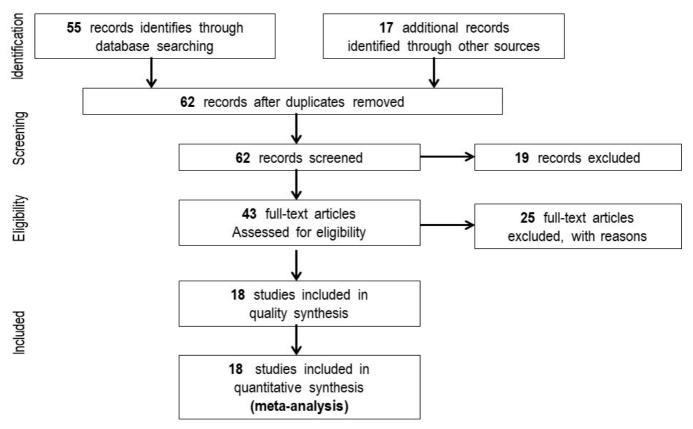
Figure 1 Four Phases flow diagram of the meta-analysis.

management in centers of Mexican research: the case of the institute Mexican oil.

2.1.3 Disclosure / dissemination articles

Rodríguez & Valdez (2003) present a review centered on the importance of the CTI systems for the detection of innovation opportunities and threats; Mier (2003) emphasizes the importance of CI as a factor to build a technological tradition in organizations; Rincón-A & Ortiz (2005) present an overview on the analysis in technological intelligence; Güemes and Güemes & Rodríguez (2007) clarify the situation of the innovation structure used by Mexican Companies and their relationship with CI practices; Bertacchini et al. (2007) present a case studies in Mexico & in Gafsa university from territorial intelligence to CI & sustainable system; Solliero et al. (2009) identify the state of the art and trends of the CTI through the analysis of the literature; González (2011) describes the link between two tools of Technology Management: the CTI and the management of knowledge to achieve business competitiveness through technological innovations; González (2012) proposes an electronic cluster for the competitive development of Small & Medium Companies based on CI actions.

Vizcarra et al. (2012) offer information that highlights the usefulness of CI by analyzing concepts that describe the application of this development and entrepreurship; Cantú et al., (2011) deepen the analysis of previous work concerning the building of National System of CTI and suggest a theoretical systemic framework to constitute it; and Sánchez-López (2012) presents the implementation of a CI and technological surveillance portal; Perez-Villarreal & Valdez-Zepeda (2014, 2015) propose a system based on CI as a fundamental factor to increase chances of electoral success in political campaigns.

3. METHODOLOGY

The flow of information of the phases (identification, screening, eligibility and included) of a SR/MA proposed by PRISMA statement (Mohoer et al., 2009) is shown in Figure 1.

The eight steps of the MA methodology (Noriega et al., 2010) were applied to generate statistical support and to obtain a high grade of confidence about the papers for the study. The steps of the MA methodology are described as follows:

Table 2 Data for all papers used in the meta-analysis.

Author (year)	Name of Paper
Mier (2003)	Competitive intelligence: an important factor in building a technological tradition
Rodríguez & Gaitán (2003)	Holistic Model for the Teaching of Competitive and Technological Intelligence: Integration of Collaborative Learning
Rodríguez (2005)	National System of Competitive and Technological Intelligence: Education for the Innovative Development.
Guemes & Rodriguez (2007)	The relationship between Competitive Intelligence and the Innovative Capacity of Mexican companies
Lechuga et al. (2007)	Analyze the Desalination Processes of Sea Water by Applying the Competitive and Technological Intelligence
Ezquivel et al. (2008)	Business News on the Web as a Source of Competitive Intelligence
Solleiro et al. (2009)	The state of the art of competitive technological intelligence: trends and perspectives
López-Martínez (2011)	Use of Data Mining and Technological Intelligence Tools to Identify Patterns of Publications and Patenting in National Environments, as well as their Matches
Rodríguez & Moreno (2011)	Proposed integration of Competitive and Technological Intelligence with *Kansei Engineering* in the Design of Magnetic Induction Stoves
Rodríguez & Tello (2012)	Applying paten analysis with Competitive Intelligence: The case of Plastics
Rodríguez & Salinas (2012)	Applying Competitive Intelligence: The Case of Thermoplastics Elastomers
Vizcarra et al. (2012)	The Competitive Intelligence in the Companies of the City of Tijuana B.C.
Rodríguez-Borbón (2013)	Design of a Competitive Intelligence System of the Pumpkin Market for Producers in Southern Sonora, México
Pérez & Valdez (2014)	Competitive Intelligence in electoral campaigns
Montiel- Campos et al. (2014)	A Competitive Intelligence Model Where Strategic Planning is not Usual: Surety Sector in México
Rodríguez et al. (2014)	Strategic Foresight: Determining Patent Trends in Additive Manufacturing
Rodríguez, Palacios & Cortez	Technical Intelligence Approach: Determining Paten Trend in Open Die Forging
Millán (n.a.)	The Competitive Intelligence of Sinaloan Exporting Companies

1. **Problem definition**. In this step the problem must be clearly and precisely defined. In this case, it was defined as the determination of CI factors that can be obtained in successful CI practices.

2. **Identification of the information sources and the studies to be analyzed**. Once the boundaries of the meta-analysis are determined, then, all the studies that fit within those bounds are to be determined. The purpose of this step is to list the sources of the literature. In this research the total number of studies considered was 72, among them are research papers and conference proceedings.

3. **Information discrimination**. In this step, the information is classified according to the degree of scientific strictness, credibility and confidence. For this purpose, a set of inclusion and exclusion criteria is developed and it is applied to all the documents, excluding the papers that do not fulfill the criteria. This is one of two quality filters. In this step, it was reduced from 72 to 43 papers.

4. **Publications database**. The purpose of this step is to generate a papers database with the aim of facilitating the management, localization and treatment of the information gathered.

5. **Evaluation of articles.** The purpose of paper evaluation is to determine, based on the stated criteria, whether or not an article should be included in the MA. At this stage, a questionnaire of 13 items (adapted from García, 2016) was applied to all the
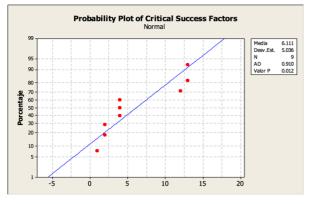
Table 3 Success factors identified

Code	Success Factor	Freq.
A	Source of information	2
B	Analysis of information	13
C	Selection of information	2
D	Information extraction/Search	4
E	Dissemination of information	4
F	Generation of information / intelligence	4
G	Opportunities and Threats	12
H	Decision making	13
I	Organization information	1

documents. Each document is judged and assigned a grade according to a Likert scale from 1= not important to 4= most important. In this step, it was reduced from 43 to 18 papers.

6. **Classification and coding of information**. In this process, the extraction of data from each study is based on a coding sheet that specifies what data to extract and a key that interprets the various aspects conducted. The coded information is summarized to identify moderating variables, to be used to group studies for conducting MA.

7. **Statistical Analysis**. In this step, the aim is to apply the statistical methods to the studies that were selected for inclusion in the MA. The selection of the appropriate ones depends on the specifications of the comparisons to be made. For this research, the statistical treatment began with the normality test applied to the final results, an Anderson Darling test was applied (for sample size, $n<30$). If the data shows a normal behavior, a difference in means test

Figure 2 Normality test for the nine success factors identified

is to be used in the next step. The differences in means test was done to determine the relative contributions of the factors and to establish the most important factors. Minitab was used for statistical analyses.

8. **Generation of conclusion**. This is the last step of this methodology, which consists of interpretation of the results obtained and generates the conclusion for the defined problem. A MA result is simply evidence that may be used in the attempt to integrate results from multiple studies. Also, the assumptions necessary for the MA should be evaluated for the adequacy of the study.
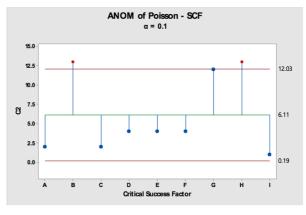

Figure 3 Analysis of means for the success factors identified.

4. RESULTS

In this section, the results obtained from the MA of CI practices literature are presented. The total number of studies considered was 72, including research and conference proceedings. In the identification phase, it was reduced to 62 papers. Later, a first quality filter (screening phase) excluded 19 records, and then each document was judged and assigned a rating according to a Likert scale (second quality filter). In this step, the records were reduced from 43 to 18 items (eligibility phase). Table 2 shows the author, year and title of each paper.

The next step was the determination of the success factors that are critical for CI practices (Table 3). For this step the frequency of each factor was summarized. A total of nine critical factors (CF) were found in the documents reviewed. The CFs in order of decreasing importance are: analysis of information; decision making, opportunities and threats; information search and extraction, dissemination of information; generation of information/intelligence.

Once the total frequency was tallied, a normality test was required. The results are

shown in Figure 2. The approximate P-value = 0.012, and the significance was above 0.01, so it is safe to assume that the data is normally distributed and it is adequate to perform a parametric test.

The next step was the application of a Poisson Analysis of Means (ANOM). The test determined that 3 of the 9 factors can be considered critical (with the exception of factor 7 having sufficient evidence). These were number 2 (information analysis); 8 (decision making), and 7 (identification of opportunities and threats), shown in Figure 3.

5. FINAL REMARKS

This research shows, as a first approximation, the critical success factors (CSF) identified for the practice of CI in Mexico. This research takes over the interest of identifying the variables of competitive intelligence (Güemes & Rodríguez, 2007), and intends to present a new perspective for CI professionals and researchers in Mexico. The findings show that at least 18 articles out of the 43 mentioned CSF in different cases or approaches. Therefore, research to find the most important CSF in the practice of CI is a contribution to the field. Regarding the application of MA in engineering areas, as well as the adaptation of MA procedures to the CI framework of research practices, this can be considered successful.

In Mexico, the main practice of CI is a variation with a strong emphasis on science and technology and its impact on research and development activities (Dou & Massari (2001) quoted by Dou and Manullang (2004)). In this study the term CTI is understood as a type of CI.

Results supports the claim that in Mexico CI is an emerging practice. Although it is taking place in both the public and private sectors, it still has a long way to go in policies to improve its development, as well as in infrastructure and the creation of entities to support this activity (Rodríguez, 2005). As shown in this review, some Mexican companies conduct CI practices to anticipate future changes, innovations with a high impact on the market, and to enter new market niches and develop new products.

The main limitation of the study is the sample size (43). Although we consider several issues that may allow for the validity of this study, Hunter and Schmidt (2000) say that for sample sizes in the range of 25 to 1600, the Type I error for random effects is 5% for fixed effects with homogeneous cases. However, this

search was exhaustive. Both MA and CI are relatively new theories in Mexican academia and industry. Close to 95 % of México´s businesses have less than 16 employees, so we figure the sample is close to representative of the population. These results pinpoint the critical success factors of CI practice in México and help to define the course for new studies of this sort.

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