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### A competitive intelligence model based on information literacy: organizational competitiveness in the context of the 4<sup>th</sup> Industrial Revolution

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# A competitive intelligence model based on information literacy: organizational competitiveness in the context of the 4<sup>th</sup> Industrial Revolution

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**ABSTRACT** This paper investigated how information literacy and competitive intelligence are connected in business management and information science fields. It demonstrates the contribution of information literacy in the phases of the competitive intelligence process. This paper is relevant, since the model supports creativity and collaborative innovation in small businesses in the context of Industry 4.0. Furthermore, it contributed to connect the information science and business management fields, so it is multidisciplinary. It also proposes a theoretical model of information literacy and competitive intelligence in the context of Industry 4.0, which can be used for applied research. The methodology was developed based on a systematic literature review (SLR) of information literature and competitive intelligence. These concepts contribute to the development of a framework and a conceptual model in which the three themes are interconnected and demonstrate that information literacy can efficiently contribute to the competitive intelligence process, especially in the context of the Fourth Industrial Revolution.

**KEYWORDS** Competitive intelligence; Industry 4.0; information literacy; systematic literature review

## 1. INTRODUCTION

Information literacy is understood as lifelong learning (Belluzzo and Feres, 2015; Bruce, 1999; Lloyd, 2017) and it is useful to competitive organizations. Information literacy enables organizational individuals to better understand information and convert it into knowledge. The knowledge constructed during the professional life contributes to the densification of critical thinking about the consulted information, so individuals can understand their backgrounds (Lloyd, 2017).

Competitive intelligence (CI) is based on scanning and monitoring information that significantly influences the market. In this

perspective, the development of CI tools provides organizational individuals with more adequate conditions to face challenges. CI generates analyzed data and information that can be integrated into the organizational business (Tisluk et al., 2015). It also provides insights from external contexts, supports decision-making, and contributes to medium- and long-term strategies. CI reduces uncertainties about the competitive environment (Valentim and Souza, 2013).

The competitive environment became more complex in the context of Industry 4.0, which refers to the 4th Industrial Revolution. Industry 4.0 is related to the digital

transformation and many technological drivers that allow organizations to create and innovate their products, services, and processes, whose differentials will be key to remaining in the marketplace (Anderl and Fleischer, 2015; Schwab, 2016). An increased amount of data generated by different technologies becomes available for individuals, but the value creation coming from the usage of data needs more investigation (Bordeleau, et al., 2018). Moreover, individuals who are involved in this revolution need to know how to intelligently access, evaluate, and use data and information in the CI process in order to improve decision making and better orient business strategy.

Information literacy is a significant predictor of online information search competencies (Çoklar et al., 2016), which is important to access information. However, having information access offers no guarantee that the information will be well evaluated and used by individuals. Librarians pointed out the relevance of effective instructions in order to fill gaps in the curriculum and prepare students to improve their skills to get and use valuable information (Howard and Stonebraker, 2018).

Considering information literacy is a critical competency in digital age, it can help managers to identify relevant information for decision making in business management. This paper has three purposes: the first one is to investigate how information literacy and CI are connected in the business management and information science fields. The second one is to demonstrate the contribution of information literacy in the phases of the CI process, which supports creativity and collaborative innovation in small businesses in the context of Industry 4.0. The third purpose is to propose a theoretical model of information literacy and CI in the context of industry 4.0, which can be used for applied research.

In the context of Industry 4.0 and digital transformation, a large amount of data and information is generated in all digital activities. Managers and employees need to know how to search and use information to construct meaningful knowledge. They can construct knowledge through information literacy. This process also happens with CI professionals because they also need to access external information (Ottonicar, 2016). Information literacy and CI are relevant elements to Industry 4.0 since they allow individuals to access different information sources.

This paper is organized as follows. The next section discusses the concepts of information literacy, CI and Industry 4.0. The subsequent section explains the methodology and shows some results of the SLR. The discussions and results section show the inter-relation between information literacy and CI in the context of Industry 4.0. Furthermore, it demonstrates a conceptual model that can be applied in business as future research. The conclusions highlight the directions for further research, the limitations of the paper and its relevance to businesses management and information science.

## 2. THEORETICAL REFERENCES

### 2.1 Information literacy

The information literacy concept emerged parallel to social changes, which resulted from the renewal of means of production. These changes influenced educational systems and libraries, since they are both traditional environments of information storage and dissemination (Gomes and Dumond, 2016). Furthermore, information literacy is fundamental to citizens and to their social integration. This literacy helps people to access, choose, manage and evaluate information (Belluzzo and Feres, 2015).

Information literacy is present in different organizations. It is related to individuals' capabilities and behaviors which were developed in their lives (Ottonicar et al., 2016).

Information literacy is studied in the field of information science, which is interdisciplinary. Because of that, information literacy is related to the political, technological, educational and organizational context (Ottonicar et al., 2016). Furthermore, this literacy is connected to individuals' experiences, since it shows how they seek, evaluate and create information (Demasson et al., 2016).

Information literacy has become more than individuals' abilities and skills. Bruce et al. (ACRL, 2014) demonstrated that information literacy is also relational. It depends on the context studied and described in a complex information environment. The advantage of this approach is the creation of many information literacy models in different fields.

According to ALA (2016, 3) information literacy is the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of

learning. It is also understood as “the ability to think critically and make balanced judgements about any information we find and use. It empowers us as citizens to develop informed views and to engage fully with society” (CILIP, 2018).

In the context of the workplace, information literacy contributes to employability, and it helps individuals to develop work analysis, solve problems (CILIP, 2018) and support efficient decision making (Ottonicar, 2016; Yafushi, 2015). These studies demonstrate that information literacy research is increasing in the field of business and management (Rader, 2002).

According to Sproles et al. (2013, 409) “information literacy has become an integral part of the library literature and has been adopted and implemented outside the traditional venues of reference and instruction services”. Information literacy is fundamental for business processes within organizations (Jinadu and Kiran, 2014, 2016). Strategic, tactical and operational levels can benefit from identifying and using critical knowledge. This knowledge inspires creativity, innovation and competitiveness (Ottonicar, 2016).

## 2.2 Competitive intelligence

The term competitive intelligence (CI) was coined in 1980 and its purpose was to monitor the external environment. This process allows the integration of information and data in real time and influences decisions that are useful, considering time and speed in data generation nowadays (Souza, 2016). Information and data are different. Data is understood as facts, measurements and statistics. Information is defined as the action of informing, and knowledge involves the development of experience through learning. Intelligence is the ability to understand and use knowledge practically (Bouthillier and Shearer, 2003).

The main purpose of CI is to access, interpret, evaluate and disseminate information. This information is gathered in the external context of the organization. The analysis of external information is fundamental to the process, since intelligent information contributes to product and service innovation. Furthermore, it influences innovation speed and the quality of the final products (Hassani and Mosconi, 2017).

CI is a continuous process, since it has no beginning, middle or end. That process works in a business environment continuously (Valentim, 2004). It allows the explanation of

data through graphics, charts and tables, so individuals can construct knowledge from that information (Teixeira, 2014). Other professionals such as business managers also need to understand the opportunities and threats that influence organizations (Hoffmann and Chemalle, 2006).

Innovative technologies contribute to CI since a professional can use potential information available in social media and in emergent technologies that are catalyzers of the 4<sup>th</sup> Industrial Revolution (Hassani and Mosconi, 2018). In the past few years, only formal information sources were analyzed, but it is not enough anymore (Tisluk et al., 2015; Cubillo, 1997). According to Jin and Ju (2014) the complexity of the task influences the professional to access more information sources, making information literacy fundamental to guide individuals to analyze the quality of these sources.

Calof (2016, p. 48) explains that: “Competitive intelligence assists organizations in developing a proactive approach that identifies and responds to changes in the competitive environmental, helping organizations (companies, governments, universities, associations and others) thrive in turbulent times”. This intelligence is useful for many kinds of organizations.

CI has many concepts in both the business management and information science fields. In this paper, CI is understood as a process that is the result of individuals’ actions. Professionals need to access and evaluate data to transform it into information. The use of that information allows for knowledge construction, decision making, problem solving and innovation.

## 2.3 Industry 4.0

The first Industrial Revolution occurred through steam engines in 1784. The second one started in 1870 because the machines worked with electrical power. The third Industrial Revolution started in 1969 with the arrival of electronics and information technology. This technology evolved and connected to cyber-physical systems (CPS), so those connected technologies became more complex. It includes the Internet of Things (IoT) of objects and services. (Kagermann et al., 2013).

Therefore, Industry 4.0 is an ongoing process (Kagermann et al., 2013). Xu et al. (2018, 2942) agree with Kagermann et al. (2013), since they emphasize: “During the Fourth Industrial Revolution, the use of cyber-

physical systems (CPS) has triggered a paradigm shift in industries, in particular the manufacturing sector” (Xu et al. 2018, 2942). Industry 4.0 is a current phenomenon and it will influence the production of society. CPS are a fuel that encourages that revolution. CPS are objects with software and computer skills, so the products are smart. The objects are based on connectivity and self-management (Almada-Lobo, 2015).

Mass production is disappearing; there are more and more customized products based on clients’ needs. The production chain is becoming transparent and its elements are becoming integrated, since the physical fluxes are controlled by digital platforms (Almada-Lobo, 2015). Because of that, Industry 4.0 will influence business in a positive way, and it can be used in developing countries (Silva et al. 2018).

In this paper, the IoT is not understood as a synonym of Industry 4.0, because it involves

objects and biological technology. The IoT is part of the Industry 4.0 processes. The IoT allows the dissemination of electronic information between objects. Therefore, the family, logistics and public management will be affected by those changes (Dutton, 2014). Industry 4.0 is transforming individuals’ lives (Schwab, 2016), and furthermore, it encourages competitiveness and process improvement (Anderl and Fleischer, 2015).

### 3. METHODOLOGY

This methodology was developed based on a systematic literature review (SLR) of information literacy and CI (Sampaio and Mancini, 2007; Cook and Mulrow, 1998). The primary study is the first step of the SLR, in which we analyzed the title and the keywords of papers. They were “information literacy” AND “competitive intelligence”. Table 1 shows the protocol of the SLR followed by the authors to get the results.

*Table 1 – The connection between information literacy, competitive intelligence and Industry 4.0.* The information on literacy standards, indicators and expected results developed by Belluzzo (2007), the steps of competitive intelligence based on concepts and results of Industry 4.0 to business and society. This table allowed to connect these three themes, and also demonstrate the importance of competitive intelligence based on information literacy. Therefore, information literacy can help in every step of competitive intelligence, so information can be gathered in a more effective way. Information literacy contribute to competitive intelligence because it helps individuals to find quality information and evaluate the information source critically.

<b>The context of Industry 4.0</b>	<b>CI Steps</b>	<b>Information literacy standards, indicators and expected results</b>
The context provides a lot of information	Identify the niches of external and internal intelligence.	<b>S1</b> Individuals identify the nature and extent of the information need. <b>I. 1.1</b> Define and recognise information need; <b>I. 1.2</b> Identify a variety of formats and potential information sources; <b>I. 1.3</b> Consider the costs and benefits of information acquisition;
Smart and connected technology emergence, such as smart factory	Prospect, access and gather data, information and knowledge in the internal and external context of the organization.	<b>S2</b> Individuals access needed information effectively; <b>I. 2.1</b> Select the appropriate research methods or information systems; <b>I. 2.2</b> Construct and implement search strategies established effectively; <b>I. 2.3</b> Seek information electronically or with people. Use a variety of methods; <b>I. 2.4</b> Rework and improves the search strategy when it is needed; <b>I. 2.5</b> Extract, register and manage information and its sources.
The information sources are humans, technology, biological and digital elements	Select and filter data, information and knowledge relevant to people and organizations	<b>S3</b> Individuals evaluate information and its sources critically; <b>I. 3.1</b> Demonstrate knowledge about the information gathered; <b>I. 3.2</b> Apply evaluation criteria to information and its sources;
The smart technology transforms data in information adding value to the information	Treat and add value to data, information and knowledge	<b>I. 3.3</b> Compare the new knowledge of the previous knowledge to determine the value added, contradictions, or other characteristics of information;
New systems of information storage in groups of technology in real time	Store data, information and knowledge through technology focusing on quality and safety	<b>S4</b> Individuals use information effectively to reach a goal or a result individually or in a group; <b>I. 4.1</b> Individuals are capable of synthesising information to complete a project, activity or task;
The smart technology and factory share information in a massive way	Disseminate data, information and knowledge through services and high value-added products	<b>R. 4.1.2</b> Understand how to use an author’s citations, paraphrases or texts to support ideas and arguments. This item is used for writing activities, reports, documents and manuals; <b>I. 4.2</b> Communicate the results of the projects, activities or work effectively; <b>R. 4.2.1</b> Use documentation norms and formats properly to develop a project, activity or work task.
The smart technology and factory bring new issues to be debated. For example, the disappearing of some professions and unemployment	Create mechanisms of feedback to generate new data, information and knowledge	<b>S5</b> Individuals understand economic, legal and social issues of information use. Also, they access and use information ethically and legally. <b>I. 5.1</b> Understand the legal, ethical and socioeconomic issues which involve information, communication and technology; <b>I. 5.2</b> Respect laws, rules, institutional policies and guidelines related to information access and information source use. <b>I. 5.3</b> Indicate the information source in the communication of results;

The downloaded papers fulfilled the inclusion and exclusion criteria described in Table 1. The search terms constructed used the keywords described in Table 1. After the transcription of keywords in search mechanisms, we read the title and keywords to apply the inclusion and exclusion criteria. Extracted information referred to contributions of information science and business management in the competitive context. The information search was performed in five databases: SCOPUS, Web of Science, Proquest Library and Information Science Abstracts (LISA), Proquest Central and EBSCO Library, and Information Science and Technology Abstracts (LISTA).

*Table 2 Results of RSL.* The quantitative results of the systematic literature review. The papers were found in 4 data bases: SCOPUS, Web of Science, Proquest Library and Information Science Abstracts (LISA), Proquest Central and EBSCO Library, Information Science and Technology Abstracts (LISTA). The first column shows the names of the data bases, and the second one shows the numbers of papers found. After an analysis of the title and key words, we showed the quantitative results. After, the authors read the abstract and selected the papers that studied both information literacy and competitive intelligence in a multidisciplinary perspective.

Database	Articles		
	Total found	Chosen (based on title, keywords)	Total (after abstract review)
SCOPUS	42	10	3
Web of Science	0	0	0
Proquest (LISA)	161	58	2
Proquest Central	39	16	0
EBSCO (LISTA)	65	3	2

In the second phase of the SLR we analyzed the content of the abstract to identify information literacy and CI in a business context. Most papers that were selected referred to libraries and students, and only a few focused on business or innovation. The SLR found a total of 7 articles related to the theme published in academic journals. In the end, there were only 4 articles, because three of them were duplicated. The SLR shows that information literacy and CI are not studied very often by researchers. There is a gap of knowledge about the theme, especially in the context of Industry 4.0.

#### 4. RESULTS AND DISCUSSION

The connection between CI and information literacy is fundamental to competitive businesses (Ottonicar, 2016; Silva et al. 2016, Ottonicar et al., 2018). This happens because information literacy guides the CI process (Teixeira, 2014) and focuses on quality information and its sources. The CI process contributes to organizational survival in the market (Tarapanoff et al. 2016; Souza, 2016; Teixeira, 2014).

Companies are essential to the economy of a country (Porter, 1998), since they create wealth and employ people. Small businesses need to develop processes to add value to products and services, so they can use CI (Hassani and Mosconi, 2016; Hoffmann and Chemalle, 2006) based on information literacy (Silva et al. 2016; Ottonicar et al., 2018) to achieve competitiveness, as well as larger companies.

The paper "How information literate are you?" is a self-assessment by students enrolled in a CI elective authored by Barbie E. Keiser. The text was published in the Journal of Business and Finance Librarianship in 2016. This paper studied students' information literacy in a CI course. The results demonstrated the use of information literacy to learn and develop skills influenced by the information behavior of students (Keiser, 2016).

The paper was focused on the field of education, but it was considered in the SLR because the appropriate information literacy can be used by individuals who work with CI processes. Furthermore, the paper values the librarian profession as fundamental to information access, especially in companies. The paper also pointed out that students have difficulties to learn which information can help them to face challenges (Keiser, 2016).

The second paper perceived environmental uncertainty, information literacy and environmental scanning towards a refined framework focuses on the context of businesses and uses the term environmental scanning, which is also understood as CI. It was written by Zhang et al. and it was published by Information Research in 2012 (Zhang et al., 2012). Forty-two travel agents in Singapore answered the questionnaire. The authors found out that information literacy is fundamental to the steps of CI. Furthermore, they showed that information quality is not related to information quantity. The quality of information is based on the process,

organization, dissemination and evaluation in an effective way (Zhang et al., 2012).

These same authors also published another two papers that are based on information literacy in the context of businesses and environmental scanning. The first paper, entitled *The Role of Information Literacy in Environmental Scanning as a Strategic Information System - A Study of Singapore SMEs*, was published in 2010. Zhang et al. (2010) explained the importance of information literacy to business management in a practical context.

In that paper, environmental scanning is understood as a strategic information system and they discuss information literacy in small and medium-size companies. They researched SMEs in Singapore thorough a questionnaire which guided the quantitative analysis and an interview which contributed to a qualitative analysis (Zhang et al, 2010).

Another paper was published in 2010 in the *Journal of Information Science* with the title *Environmental scanning: An application of information literacy skills at the workplace*. The authors studied information literacy to monitor the external environment of organizations to achieve a competitive advantage (Zhang et al. 2010).

There are only a few researches that connect the scan of external context and information literacy. Furthermore, few researches have studied information literacy as a tool to achieve businesses competitiveness. The authors applied information literacy in every step of environmental scanning. They concluded that scanning can be used by every organizational level, it is not limited by the strategic one (Zhang et al., 2010).

The SLR showed that there are no researchers who focus on CI and information literacy in an interdisciplinary perspective. Because of that, this study is fundamental, since it aims to use concepts from information science and business management. We strongly recommend that those fields should work together in order to share knowledge and apply research through research groups and researchers.

Information literacy needs to be incorporated in the business management field, since studies have demonstrated its relevance to improve processes and competitive advantage (Yafushi, 2015; Ottonicar, 2016; Santos, 2014). Other researches have emphasized the applicability of information literacy for decision-making (Yafushi, 2015)

and for creativity and innovation (Ottonicar, 2016; Ottonicar et al., 2018). We would like to emphasize the importance of Zhang et al.'s work (2012, 2010, 2010) as an international parameter to connect information literacy and CI to others researchers in the field.

Furthermore, this paper developed an interdisciplinary connection between information literacy and CI to help business in the context of Industry 4.0. The results were based on Valentim's (2002) CI steps, since it explains seven main actions developed in this process. Belluzzo's (2007) information literacy standards and indicators were chosen, since it was based on international standards from the International Federation of Library Associations and Institutions (IFLA).

According to Valentim (2002), CI has the following steps:

- Identify the niches of internal and external intelligence;
- Prospect, access and gather data, information and knowledge;
- Select and filter data, information and knowledge which are relevant to people and organizations;
- Treat and add value to data, information and knowledge which are mapped and filtered in order to seek interactions language of users and systems;
- Store data, information and knowledge in information technology focusing on quality and safety;
- Disseminate and transfer data, information and knowledge through services and high-value-added products. The goal is to develop people and organizations;
- Create mechanisms of feedback in order to generate new data, information and knowledge to feed back to the system.

The information literacy standards and indicators can be used as a tool to evaluate the process. They serve as a guide of the activities developed during the process.

The context of the Fourth Industrial Revolution allows physical and biological technology to produce data and information in real time (Schwab, 2016). During the CI process, the professional must understand information needs to identify the 'niche' of external and internal intelligence (Valentim, 2002). Therefore, professionals can develop a

strategy to define a research topic or information. They verify the value and potential information sources, and they seek information in several formats through a checklist (Belluzzo, 2007; Ottonicar, 2016).

After that, there is information access (Ottonicar, 2016). In Industry 4.0, access occurs through smart and connected technology. That technology is capable of producing information and disseminating it to other platforms (Almada-Lobo, 2015). The CI professional needs to prospect and monitor internal and external data (Valentim, 2002) which are shared by IoT and other tools. The professional selects information systems that are available, observes the type of information in smart technology, creates keywords based on specific vocabulary and uses people, services and other media to access information (Belluzzo, 2007; Ottonicar, 2016).

It is fundamental to be attentive to the information source, because information sources are people, objects and biological technology in the context of Industry 4.0. Because of that, the professional selects and filters data to create smart information and to contribute to competitiveness (Valentim, 2002). The information needs to be created based on the quality of sources. Individuals need to read and learn from gathered information, develop criteria to evaluate information sources, observe the hidden intentions and understand the factors that influence information sources such as culture, geography and history (Belluzzo, 2007; Ottonicar, 2016).

There is the information treatment and addition of value in CI (Valentim, 2002). Therefore, professionals can aggregate their previous knowledge and new information during information seeking (Belluzzo, 2007; Ottonicar, 2016). They need to understand the language used between the user and system (Valentim, 2002), and furthermore, they understand the information dissemination through smart technology. They compare the knowledge constructed with other information, which is a result of different sources to learn a new perspective (Belluzzo, 2007).

In the context of Industry 4.0, systems are integrated and store information together. Because of that, professionals understand how to store data securely (Valentim, 2002). They synthesize and organize information and also understand smart technology to adjust it based on its structure (Belluzzo, 2007; Ottonicar, 2016).

The convergence of smart technology allows the systems to share information in real time and make people's lives easier. The CI professional uses those technologies to share smart information in order to contribute to organization members' decisions (Valentim, 2002). Therefore, individuals need to understand the ideas developed based on reports, manuals and documents. Furthermore, they need to communicate intelligent information through systems and technology. They respect the rules of documentation in businesses (Belluzzo, 2007; Ottonicar, 2016).

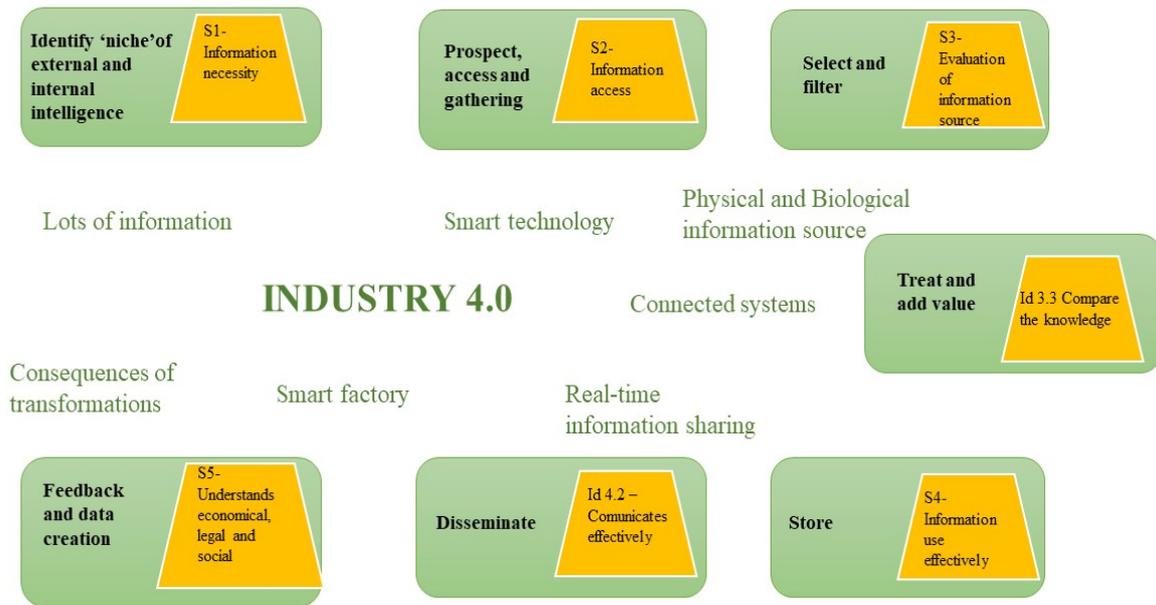
The CI professional must know the legal and ethical issues of information use (Belluzzo, 2007; Ottonicar, 2016). They create new mechanisms of feedback to retrieve smart and ethical information in the future (Valentim, 2002). After the professional understands the context, he or she can realize the impacts of actions on competitiveness, innovation and creativity. In Industry 4.0, technology has been replacing some jobs, especially the ones that can be replaced by smart machines. An individual who works with CI understands the impact of the profession on society. Therefore, information must be made available in an ethical and legal way.

The connection shown in Figure 1 allowed the construction of a theoretical model to demonstrate how information literacy can contribute to every step of competitive intelligence in the context of Industry 4.0.

Information literacy is present in every step of the CI process, so it can contribute and guide this process during the new changes resulting from IoT and other technologies of Industry 4.0.

The first phase of the CI process is to identify the 'niche' of internal and external intelligence. That is equivalent to the 'information need' phase of information literacy. Professionals need to observe the information they need to explain the context of the organization and competitors in terms of production, services and competitiveness. In the context of Industry 4.0 there is a lot of information available through technology, so the challenge is to identify information needs.

The next step is the storage of accessed information in physical and biological technology. The purpose is to know how to access technology and use strategy to find information. The most useful information is



*Figure 1 Competitive intelligence and information literacy in Industry 4.0.* Information literacy is represented by the standards and indicators in yellow, and the steps of CI are demonstrated in green. This shows a conceptual model that can be used by business and competitive intelligence professionals to guide the information seeking process about competitors. There are 7 green rectangles that represent competitive intelligence. The yellow contains information literacy standards, indicators and results based on the table 3 (third column). Industry 4.0 is represented as the context in which firms operate nowadays. The words around Industry 4.0 represent keywords extracted from the first column of the table 3. These words can be connected to a technology, a process of the consequences of transformation to society.

chosen and filtered. This process is based on information quality through the evaluation of the source. After that, information is treated and new knowledge is added to it to add value. In that moment, the organization and information systems are connected in every organizational level. The goal of this process is to use information efficiently through creativity, innovation, problem solving and decision making.

Smart information also needs to be used by other people, so it is disseminated through communication. Professionals share information with people and smart systems, following documentation rules. They evaluate the performance of the process and create mechanisms of feedback in order to criticize the CI process. Therefore, individuals need to understand the economic, social and legal results of that process to smart organizations.

## 5. CONCLUSIONS

The SLR showed that information literacy and CI need the development of interdisciplinary studies between information science and business management. The concept of information literacy should be studied in the business management field in order to develop practical studies. This literature review showed that the theme is emergent, so both fields can improve their body of knowledge.

The information literacy standards and indicators can be useful in the CI steps, especially in the context of Industry 4.0. In that context, biological and physical technology are the main sources of information to understand the demands and variations of the market, as well as the main channels of communication and dissemination of their products and services. Businesses that use information literacy and CI can find market opportunities in the 4<sup>th</sup> Industrial Revolution.

The model of information literacy and CI in the context of Industry 4.0 can guide both small and large businesses to have better information quality. Information quality is essential to solve problems and take decisions in an effective way. Managers may work based on information literacy concepts and standards, especially when monitoring competitors. Therefore, reliable information can contribute to decision making, problem solving and innovation.

Future research may use the model as a guide to develop a practical study, for example, creating a CI process based on information literacy to encourage innovation and creativity. Furthermore, academics may investigate if the technology of CI will be capable of analysing the information source. Researchers may analyze this gap of information literacy. Artificial intelligence modernized some

technologies, so maybe it will be capable of doing CI.

Also, managers can use information literacy models and adapt them into their context, especially in developing countries. Future studies could address this aspect and adapt tools such as TRAILS 9 (Syazillah et al., 2018), which guides the translation and adaptation of information literacy models.

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