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Intellectual capital factors at work in Dominican firms: understanding their influence

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Abstract

From an empirical-based perspective, this paper explores the influence of intellectual capital factors on the performance of firms in the Dominican Republic. A Likert scale from one to seven was used to capture firms' sensitivity to human, structural and relational capital factors. An exploratory factor analysis was carried out using the method of principal components with VARIMAX rotation. The final factorial scores were standardized to execute the regression analysis. Structural capital factors appear to be the dominant intellectual capital components within the Dominican context. Human capital factors play a vital role in performance in manufacturing and in-services firms, and relational capital factors are significant in determining their performance. This research contributes to the regional literature on intellectual capital studies in Latin America and the Caribbean. It puts forward some specific points related to the role of intellectual capital factors in explaining firms' performance in small open economies such as that of the Dominican Republic.

Keywords: Intellectual capital, Firms' performance, Intangibles, Dominican Republic

Introduction

This paper analyses the influence of intellectual capital (IC) on Dominican firms' performance from an empirical-based perspective. IC often refers to a wide range of intangible assets such as variants of knowledge, brands, and intellectual property, including patents, utility models, copyrights, trademarks, etc. (Khalique et al., 2018; Vanini & Rieg, 2019). Based on empirical evidence, IC assets tend to aid firms in several ways, including building and protecting business reputation, market value, bargaining power, and the investment in its acquisition by improving the workforce through training or by carrying out research and development (R&D) activities, usually a recommended path to foster competitiveness at the level of both single firms and in the broader industrial economy (Dzenopoljac et al., 2017; Gorz & Turner, 2010; Hussinki et al., 2017).

Aims and scope

To narrow the scope for investigating IC in this paper, we refer to human capital (HC), structural capital (SC), and relational capital (RC) as the three major components of

intellectual capital. (Daou et al., 2014; J. Chen et al., 2004; van den berg, 2007; Sánchez et al., 2000; Bollen et al., 2005). In this analytical context, HC mainly refers to the tacit knowledge and skills of workers, SC to codified knowledge, routines, technical and physical resources that support HC activities and RC to those more comprehensive resources that support external relations and networking activities in firms, including customers and supplier relationships (Andriessen, 2007; Bontis, 1998; Gorz & Turner, 2010; Serenko & Bontis, 2013). In "A practical approach to the definition of intellectual capital" section, a broader perspective on IC definition will be treated. An exploratory and context-based approach has been deployed to look at IC role in the Dominican firm context. Therefore, this paper departs from two related research questions: (1) What IC factors most influence the Dominican firms? (2) Is there any significant difference in the weight and magnitude of the influence of the IC factors by considering the firm's characteristics? Thus, this paper aims to characterize the influence of the intellectual capital factors (ICF) in Dominican firms' business and innovative performance to empirically understand how the ICF factors operate to support value creation in a developing economy as the Dominican Republic (Habib et al., 2019). For an exploratory study in this paper means the primary methodological approach which consisted of a factor analysis of principal components as a relevant approach in IC field studies (Bontis, 1998; Cricelli et al., 2018; Vergauwen et al., 2007), and also it implies an exploration in terms of inquiry into the hitherto unknown role of the IC in the performance of Dominican firms. Consequently, this work has a more ideographic and descriptive nature than nomothetic. A more fundamental review of the conceptual and theoretical framework can find it, emphasizing the methodological aspects.

The findings in this paper correspond to an exhaustive exploration of the IC factors in the performance of Dominican firms. From a more heuristic perspective, its principal value relies on an exploratory approach to understanding the role of ICF to follow firms' performance in barely (academically) explored economic contexts such as the Mesoamerican and the Caribbean ones. Therefore, this paper could serve as a reference for subsequent analyses in the context of developing countries like the Dominican Republic. In this sense, flexibility, and methodological adaptability in defining the components and scales of the IC could be beneficial aspects to other studies of similar purposes.

The ICF analysis was conducted considering firms' performance in terms of the perceived financial success and innovative performance resulting from the knowledge management process (Bollen et al., 2005; Chen et al., 2005; Dzenopoljac et al., 2017; Nold, 2012). The indicated approach followed the focus placed at the regional level on these two aspects of firms' performance in Latin America and the Caribbean, taking into account pioneering works developed a decade ago (de Castro et al., 2009; Jardón & Martos, 2008; Maria & Landeiro Vaz, 2005). Therefore, and more specifically, business performance refers to the ability to attain both financial and innovative success as a result of identifying the ICF dynamics inside firms (Bollen et al., 2005; Chen et al., 2005; Duff, 2018; Lopez Saez, 2010; Pew et al., 2007; Vanini & Rieg, 2019). The preliminary results of this research were presented at the Seventh European Conference on IC, held in Cartagena, Spain, in April 2015. This version is based on the same source and shares a similar structure and related content in some sections. However, the analysis, results, and conclusions have been extended and elaborated on, marking this paper as the final version.

Finally, this research was possible thanks to the collaboration and support of the Association of Industries of the Dominican Republic (AIRD), the National Office of Industrial Property (ONAPI), the National Competitiveness Council (CNC) and the Atabey Center.

The Dominican Republic and its economic context: an overview

According to data from the World Bank, the Dominican Republic (DR) is the largest economy in Central America and the Caribbean, with a gross domestic product or GDP of over US$81 billion in 2018 and an annual growth rate of 6.6% between 2014 and 2018 (TWB, 2019). Based on the same source and for the same year, the Dominican Republic is considered an upper-middle-income country with a gross national income per capita of around US$7,370. Manufacturing and service firms together represented 91.2% of the total economic activity in 2016, of which 61.2% related to the service sector and 30% belonged to the manufacturing sector, according to the country's Central Bank (Banco-Central, 2017).

Since the middle of the first decade of the XXI century, a substantial change has been the convergence in the indicator of technological content of exports, measured as a percentage of the country's total exports, according to the World Bank's global development indicators (TWB, 2019). Figure 1 shows the convergence with Costa Rica, a country that until 2016 exhibited high-value results at first, with the legacy left by the INTEL processor technologies company and the intelligent strategy to attract foreign investment in technology-intensive sectors (Bailey & Warby, 2019).

The improvement in this indicator, which is positive, occurs in a macroeconomic context in which the industry and manufacturing sector have been losing ground concerning the service sector as components of GDP, according to the data available from the Central Bank of the Dominican Republic (2019). Figure 2 shows the change in the sectoral composition of the GDP along three selected periods.

The process of deindustrialization in the Dominican economy and the need to reverse it has already been pointed out by other authors (Attali, 2010; Hausmann et al., 2011),

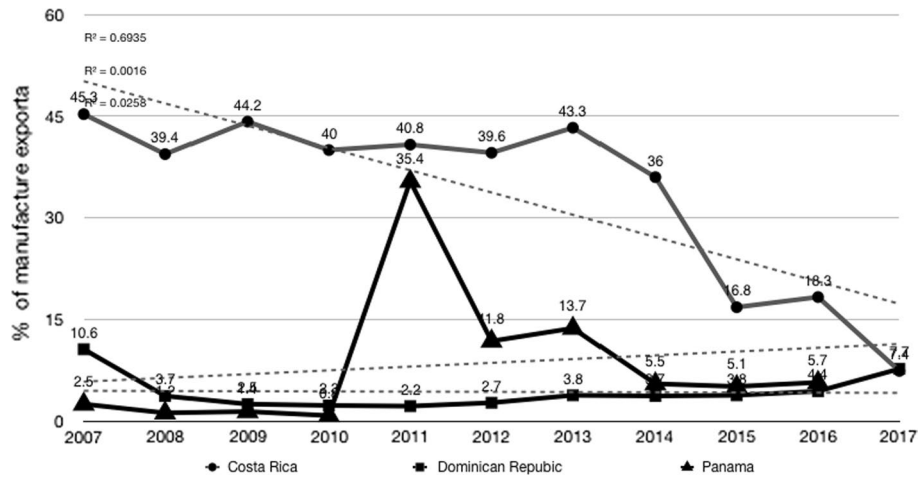

Fig. 1 Convergence in technology content of exports 2007–2018 (source: World Bank (2019a))

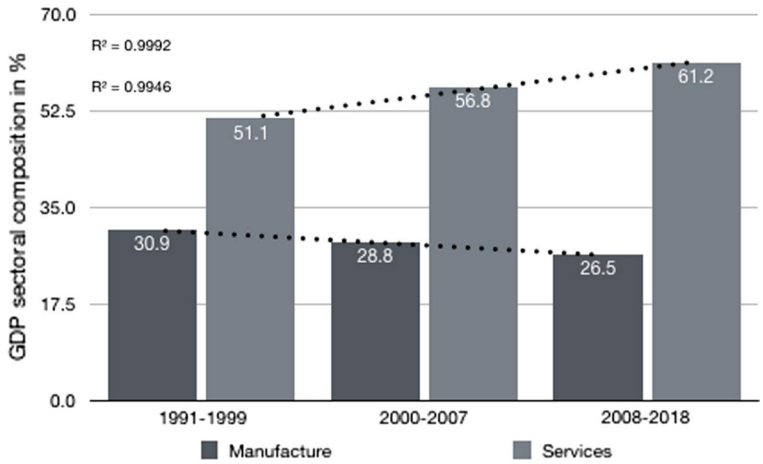

Fig. 2 Changes in the GDP sectoral composition in selected periods (source: Central Bank of the Dominican Republic (2019))

marking what seems to be a secular trend. Notwithstanding the technical explanation of how the decrease in the share of manufacturing in GDP and the increase in the technological level as a percentage of them have occurred, maybe due to different factors that require a type of analysis beyond the scope of this article, but which undoubtedly constitutes a pending assignment.

The Dominican Act, 488-08, lays out a regulatory framework based on the labor force size regarding the firm size. Micro-firms have 1 to 15 workers, small firms have 16 to 60 workers, and medium-sized firms have between 61 and 200 workers. Large firms have 201 or more workers. In this context of accelerated economic transformations since the first decade of the twenty-first century and growing regional integration, the analysis of intellectual capital factors acquires greater importance for Dominican companies and the general competitiveness of their economy, especially in the manufacturing and services sectors.

Finally, concerning human development, as the United Nations Development Program defines it, the DR is considered a high human development country (UNDP, 2018), despite being a country with significant social distortions concerning poverty and income distribution (Attali, 2010). The DR occupies over two-thirds of the island of Hispaniola, which it shares with the Republic of Haiti. It has a surface area of 48,670 km^2 and a total population of 10.6 million (UNDP, 2018).

A practical approach to the definition of intellectual capital

Although there is no precise definition of IC, there is a clear consensus around the idea that IC refers to the body of knowledge, information, intellectual property, and experience or know-how that an organization possesses to enable value creation (Buenechea-Elberdin et al., 2018; Duff, 2018; Dzenopoljac et al., 2017). This set of knowledge resources makes up one of the central elements for the management and evaluation of internal and external processes that create value in a business organization, thus, potentially affecting its market value (Ousama et al., 2019: 41; Martín-de Castro et al., 2019).

As it was indicated in the Introduction, and following some authors, in practical terms, IC assets can be defined as a combination of three components: human capital, structural or organizational capital and relational capital (Bontis, 1998; Gorz & Turner, 2010; Khalique et al., 2018; Martín-de Castro et al., 2019; Sánchez et al., 2000; Vergauwen et al., 2007).

Departing from the above perspective and briefly indicated in the Introduction, HC refers to the tacit knowledge, skills, training, education, and experience of individual workers (M.-C. Chen et al., 2005; Duff, 2018). It is considered the main component of IC because it can act as a driver of the other IC components (J. Chen et al., 2004; Feitas Rodriguez et al., 2010; Khalique et al., 2018). The economic role of human talent is widely recognized, not only at the firm level, but also at the country level (Nahapiet & Ghoshal, 1998; Pasamar et al., 2019). The tacit status of HC implies that it resides in the individual, and therefore it cannot be easily transferred or codified (Abeysekera, 2003; Andriessen, 2007; Bollen et al., 2005). In the case of SC, it may refer to the stock of assets that support HC activities, including routines, codified knowledge (handbooks, manuals, reference systems) and tools such as information technology (IT), and other support resources (J. Buenechea-Elberdin et al., 2018; Chen et al., 2004; Dzenopoljac et al., 2017). The SC belongs solely to the firm, and its value can be measured as physical assets using conventional accounting procedures (Bontis, 1998). SC could also be called "organizational capital" (Hejazi et al., 2016; Nahapiet & Ghoshal, 1998; Subramaniam & Youndt, 2005). About RC, it may refer to the range of external "relationships and networks" in which firms' activities are situated (Buenechea-Elberdin et al., 2018). Some authors have pinpointed "marketing channels and customer relationships" as the critical features of RC (Bontis, 1998; Dzenopoljac et al., 2017; Hormiga et al., 2011; Ogundipe, 2012). However, it is accepted that RC is much more than simple customer relations and includes government relations, social responsibility activities, and branding and positioning, which are factors that can affect the market value of firms (Buenechea-Elberdin et al., 2018; Hejazi et al., 2016; Tan et al., 2007). Regarding the relation between IC and firms' performance, evidence suggests a clear link between firms' performance and market value. Furthermore, some evidence suggests different effects in the specific dimensions of firm activities, such as innovation, business and market valuation (M.-C. Chen et al., 2005; Khalique et al., 2018).

The interplay between components of IC, for instance, HC and SC, tends to be more related to innovative performance, including R&D activities (Vergauwen et al., 2007), and RC seems to influence financial business performance depending on sectoral activities (Dzenopoljac et al., 2017; Khalique et al., 2018; Tan et al., 2007). IC studies highlight that knowledge management, including managing intellectual property, is a fundamental element of the factor and can be traced throughout its different aspects and in the process of value creation (Bollen et al., 2005; Chen et al., 2005; Martín-de Castro et al., 2019).

It implies that IC can ultimately be summarized as a diversified and hierarchical structure of knowledge available for creating value in firms. Moreover, defining IC as a set of capabilities signifies the concept of knowledge to be an intellectual capability for "intellectual or physical action" (Foray, 2004; Martín-de Castro et al., 2019; Schiuma, 2011). The idea of IC as a hierarchical structure of knowledge in firms' management provides

the IC concept with a heuristic scope as a tool for analysis. It reinforces the approach based on resources and knowledge as key factors for developing business organizations and creating value in firms (Andriessen, 2007). Ultimately, the empirical evidence suggests that the combined effect on the value of the different elements that make up IC on companies' brand value may be responsible for up to two-thirds of their market value when analyzing the firms' market-to-book ratio (Dzenopoljac et al., 2017: 887).

Methodology: an exploratory approach

Given the fact that this has been the first measurement of IC in the DR, an exploratory and context-based approach was chosen, denoting a participatory process to build and define every item of the IC scale used in the IC survey, to structure a scale that made sense in the context of Dominican firms (Andriessen, 2004; Ferreira, 2010; Lin & Edvinsson, 2010). A context-specific approach necessarily implies that the different components of IC selected for analysis (specifically, HC, and structural and RC) were derived from the literature review carried out, but locally structured with the active support of a focal group of local experts s aware of the day-to-day reality of Dominican firms. The group of local experts was made up of four AIRD staff analysts, three representatives from ONAPI specializing in intellectual property, two economists from the CNC, two representatives from the Atabey Center, one of whom was an expert in tax issues, and a business leader.

Defining IC items and scales

About the definition of IC scales, the first step consisted of exploring literature on measuring IC, including variables and indicators used in the Meritum Project (Cañibao Calvo et al., 2002; Dzenopoljac et al., 2017: 887), the Skandia Navigator (Roy, 1999) and the intellectual assets approach (OECD, 2006). Among the results derived from the workshop with the group of local experts in the headquarters of AIRD are: (1) using a scale of one to seven like other studies of this type to capture a more significant variability of responses; (2) the definition of the items of the scales of intellectual capital, and (3) test the scales with a small sample of companies, to ensure their understanding and ease of use in firms. A scale from one to seven was used to capture more detailed variance and higher degrees of sensitivity (Tseng & James Goo, 2005b).

The recommendation of the workshop also included items on firms' performance and control variables. The result of the discussion was sent via an electronic survey platform to approximately 40 firms randomly selected in collaboration with IRD. The firms responded and recommended reducing the number of the proposed items, simplifying the questions, and re-grouping several items into IC components and scales.

The IC components and scales were generated and sent to firms via the same electronic survey platform. The firms' responses were again discussed with the local group of experts, and as a result, a final third version was approved. In operational terms, 84 variables were agreed as part of this IC analysis: ten dependent variables (performance), 22 variables or items of HC, 26 variables of SC, 16 variables of RC and ten control variables. Table 1 shows the final items of the human, structural and RC scales and the items of business and innovative performance.

Table 1 Items of the scale of intellectual capital and firms' performance

Human capital	Structural capital	Relational capital	Performance items
HC1901: Quality of the education	SC2301: Manual job description	RC2701: Firm's market share	PERFOM1701: In the last two years, the company has introduced at least one new product (good or service)
HC1902: Percentage of workers with a college education	SC2302: Manuals of processes and procedures	RC2702: Existence of customer database	PERFORM1702: In the last two years, the company has improved at least one product (good or service)
HC1903: Proportion of workers with graduate education	SC2303: Standardized maintenance equipment and machinery	RC2703: Existence of a customer relationship management system	PERFORM1703: In the last two years, the company has introduced at least one new production process or has improved an existing one
HC1904: Technical and administrative skills	SC2304: Process maps and critical points	RC2704: Ability to identify potential customers	PERFORM1704: In the last two years, the company has introduced at least one new marketing or distribution method
HC2001: Human resources policy (equal employer)	SC2305: Report generation based on indicators	RC2705: Capacity to measure customer satisfaction	PERFORM1705: In the last two years, the company has introduced at least one new management or organizational method
HC2002: Gender policy	SC2306: Documentation of corrective actions	RC2705: Degree of customer satisfaction (previous year)	PERFORM1801: In the last two years, the company has launched more products (goods or services) than the competition
HC2003: Analytical and problem-solving capabilities	SC2307: R&D expenditure	RC2707: Capacity to track and recover customers	PERFORM1802: In the last two years, the company has increased its market share
HC2004: Creativity and inventiveness	SC2308: Time development and launch of product and services	RC2801: Degree of interest in strategic alliances (other firms and actors)	PERFORM1803: Nowadays, the company is in a stronger financial and economic position than the local competition
HC2005: Employee turnover rate	SC2309: Firm's innovative profile of products and processes (high, medium, low)	RC2802: Capacity to identify competitors	PERFORM1804: Shareholders and partners are pleased with the firm's performance
HC2006: Years of tenure of workers (experience)	SC2310: Degree of collaboration with universities and research centers	RC2803: Ongoing cooperative initiatives with other actors	PERFORM1805: In the last two years, the company has expanded into new regional and international markets

Table 1 (continued)

Human capital	Structural capital	Relational capital	Performance items
HC2007: Competitive salary level	SC2311: Flexibility and openness in the organization	RC2901: Legally established suppliers	
HC2101: Training and education program	SC2401: Quality certification system implemented and verified (ISO-9000 series; ISO-1400 series)	RC2902: Preference for accredited and certified suppliers	
HC2102: Observable improvement of technical skills	SC2402: Accreditation of lab testing and equipment calibration (i.e., ISO/IEC-17025)	RC2903: Strong relationships with suppliers	
HC2103: Observable improvement of administrative skills	SC2501: Degree of knowledge of the national IP legal system	RC3001: Policy of corporate social responsibility	
HC2104: Percentage of staff in training activities (last year)	SC2502: Degree of use of ONAPI facilities	RC3002: Bargaining power of the brand	
HC2105: Average hours of training per employee	SC2503: Degree of use of IP legal procedures	RC3003: Firm's prestige	
HC2106: Average annual investment in training	SC2504: Degree of use of IP international procedures (PCT, USA, Japan, EU)		
HC2201: Supportive and stimulating environment for learning	SC2505: Degree of the legal protection of developed innovations		
HC2202: Codification of informal knowledge (learning-by-using-by-interacting)	SC2506: Degree of protection of trademarks		
HC2203: Stimulating environment for team working	SC2601: Quality of ICT infrastructure (hardware and software)		
HC2204: Degree of workers' commitment and engagement	SC2602: Percentage of workers with access to terminals		
HC2205: Good communication between management and staff	SC2603: Automation of production process of goods and services		
	SC2604: Automation of the procurement process		
	SC2605: Automation of the customer management process		
	SC2606: Automation of the administrative processes		
	SC2607: Degree of automation of human resource management		

The grouping of the different items of the IC scales of Table 1 reflects the context-specific approach of the study, as mentioned before. For example, it is the case of the items HC2001 (human resources policy), HC2002 (gender policy), and HC2005 (employee turnover rate), of the human capital component, which could well be considered elements of the organizational culture (Antoncic & Antoncic, 2011; Khalique et al., 2018; Nold, 2012), but which in the opinion of local experts, were grouped as elements of human capital.

Sample design and data collection process

Thanks to the collaborating and supporting organizations, it was possible to build a sampling frame of 6,877 firms. Firms with ten workers or less were excluded from the study (MESCYT, 2011). A simple random design with proportional allocation by activities (manufacturing or services) was used (Harrison & Brady, 2004). The final sample comprised 372 firms. The distribution by regions was as follows: the metropolitan area of Santo Domingo (62.1%), the North region (21%), the South region (11.3%) and the East region (5.6%). The final sample had a confidence level of 95% and a margin of error of 5% (Morales Vallejo, 2008). According to the project partners, the sample size achieved here is one of the highest achieved during the last two decades in the DR, surpassed only by the National Survey of Innovation carried out in 2010 by the Ministry of Higher Education, Science and Technology (MESCYT, 2011).

The number of respondent firms was higher than that in other studies conducted in Europe and Asia's more extensive and complex economies. Some similar studies to mention are the IC analysis of German pharmaceutical firms based on 41 responses (Bollen et al., 2005), the IC study of Taiwanese manufacturing firms based on the analysis of 81 firms (Tseng & James Goo, 2005b) and the case of an IC analysis of service firms in Spain, based on the answers of 120 firms from a planning sample of 700 (de Castro et al., 2009). The fieldwork corresponding to this study was carried out from October 2012 to May 2013 across the whole country.

Given the local conditions, the data collection process was carried out by a professional team of pollsters trained in explaining scale variables and IC components. Once the selected firm confirmed the appointment, the IC questionnaire was sent to them with the necessary information about the study and with the information regarding the assigned pollster. It is vital to point out that the supporting organizations played a crucial role in confirming and encouraging firms to participate in the study by creating a collaborative atmosphere between pollsters and firms. The field coordinator received all the completed questionnaires from pollsters and checked that they were adequately completed. The fact that the IC questionnaires were sent in advance gives time for firms to understand the questions and the scales and, thus, facilitates the pollster's work.

Step-by-step analytical approach

The analytical phase consisted of a two-step approach: (1) an exploratory factor analysis (EFA) and (2) multiple regressions to estimate the influence of IC on Dominican firms' performance. The EFA was performed deploying the method of principal components using VARIMAX rotation, which was intended to reduce the number of variables and group them into components, which could explain the variability of each IC component

(Bontis, 1998; Vergauwen et al., 2007). The final factorial scores were standardized to perform regression analysis. Two basic tests were carried out: Cronbach's alpha and the Kaiser–Meyer–Olkin (KMO) test. The first enables testing of the reliability of the scales used to measure the IC components through correlations between items and scales. It is recommended to keep in the analysis items with values over 0.6 (J. Chen et al., 2004).

Secondly, the KMO test helps identify the factor variances that could be analyzed and values below 0.7 to rule out the EFA adopting a restrictive framework analysis (Chen et al., 2005; de Castro et al., 2009). In essence, two major regression models were defined as the first to evaluate the response in terms of innovation and the other for business performance. These two models were applied to manufacturing and service firms generating four regression models. The approach used for the regressions utilized generalized linear models, which facilitate flexible generalization of multiple linear regressions by allowing response variables that follow error distribution models different from a normal distribution (Dzenopoljac et al., 2017; Ousama et al., 2019; Subramaniam & Youndt, 2005). The first two regression models correspond to manufacturing firms' business and innovative performance, and the latter corresponds to service firms' business and innovative performance; all models are explicated in "Regression analysis" section. As was indicated in the Introduction, business performance and innovative performance factors were treated as dependent variables according to the agreed criteria (de Castro et al., 2009; Maria & Landeiro Vaz, 2005). The relationship between firm characteristics and ICF was tested using a series of multivariate analyses of variance or MANOVA (Ferreira, 2010; Hsu & Sabherwal, 2012).

Results and discussion

Most firms sampled were in the metropolitan area of Santo Domingo and the country's northern region (83.1% combined). The firms are urban (92.5%) and are part of the standard tax regime (89.5%). The surveyed firms are predominantly small (82%) and mainly owned by Dominican shareholders (85.8%).

Concerning market focus, the primary activity is focused on internal markets (87.4%), and only 12.6% of them have declared an orientation toward international markets. Regarding the technological level of products/services, 51.1% of firms declared that they offered medium–low to low-tech-level products/services, and 48.9% declared that they offered medium–high to high-tech products/services. Regarding the life cycle of products and services, 60.2% of firms declared that their products/services have a medium long-life cycle. The proportion of manufacturing and service firms is 49.5% for the former and 50.5% for the latter. Table 2 shows the results related to the reliability tests of the agreed and used scales.

Based on the Cronbach's alpha test (over 0.8), all the agreed-upon scales deployed were efficient (Bontis, 1998). Likewise, the KMO and Bartlett's sphericity test scores indicate that the factor analysis is appropriate for all the scales of the IC survey (Bollen et al., 2005; Khalique et al., 2018).

Factor analysis and some implications

Although items with scores over 0.6 could be considered valid in the VARIMAX rotation, for this study, the IC items with scores below 0.7 were excluded from the saturation

matrix, and only the stronger ones were kept in (Stewart, 1981). The synthetic results of the factor analysis are shown in Table 3.

The original 22 human capital (HC) items were reduced to the following five factors:

- TRA (training and educational support in the firm)
- ENV (learning environment in the firm)
- ESP (proportion of workers with college education)
- EXP (employees' permanence in the firm)
- POL (human resources policy).

The TRA factor also refers to the HC items related to training programs or training activities inside the firm. The ENV factor also covers the environment in firms that supports and stimulates learning processes (learning-by-doing-by-using-by-interacting), which could be a relevant dimension of the innovation process, especially in developing countries (Cohen & Levinthal, 1989; Pasamar et al., 2019). The SPE factor reflects the importance of college education for Dominican firms. The EXP factor refers to the experience of employees regarding years of tenure in firms. The POL factor refers to the existence of a human resource policy regarding equity practices. All these five factors underscore the relevance of HC in creating value in firms in the Dominican context and locate them as drivers of some fundamental innovation process that could depend on the qualification of HC factors in firms (Feitas Rodriguez et al., 2010). The 26 structural capital (SC) items were reduced to the following four factors:

- DOC (the documented process in the firm)
- ICT (information and communication technologies)
- IPU (intellectual property management)
- R&D (Research and Development).

The DOC factor also refers to written processes and procedures in handbooks, manuals, or instructions. The ICT factor comprises information and communication technologies and related infrastructures. The IPU factor addresses the utilization of intellectual property legislation by firms. The R&D factor highlights the effort of Dominican firms in developing and launching new products or services, shedding some light on a latent pattern and level R&D and innovation activities not yet formalized and recognized as such by firms, which could explain the underestimated R&D expenditure of Dominican firms (de Groote, 2015; UNCTAD, 2012). Nonetheless, it is most likely that the R&D pattern and innovative activities highlighted by SC factors could be related to the learning process and associated dynamics in terms of the interaction of SC and HC factors (Cohen & Levinthal, 1989; Habib et al., 2019). Further analysis is required on this specific matter in the Dominican context. The 16 relational capital (RC) items were reduced to the following four factors:

- CLI (customer orientation)
- SUP (strength of the relationship with input suppliers)
- IMA (corporate external image)
- COP (willingness to cooperate with potential external partners).

Table 2 Reliability tests of IC and performance scales

Scales	Number of items	Cronbach's alpha	KMO	Bartlett's test of sphericity
Human capital	22	0.878	0.874	3338.444 (0.000)
Structural capital	26	0.927	0.877	4528.383 (0.000)
Relational capital	16	0.869	0.869	2204.079 (0.000)
Firms' performance	10	0.886	0.885	1599.442 (0.000)

The CLI factor emphasizes firms' customer orientation, and the SUP factor refers to relations with suppliers. The IMA factor focuses on the firm's external perception, image, and prestige concerning other firms regarding bargaining power and social responsibility. Finally, the COP factor focuses on a firm's attitude to cooperating and developing projects with other firms, universities, and research centers. Given the nature of the RC factors and the characteristics of the Dominican context, the RC factors may express the relevance of such factors in terms of the financial success of firms; an issue found salient for the ultimate financial success of firms (Hormiga et al., 2011; Low & Kalafut, 2002; Pew et al., 2007). Concerning firms' performance, the agreed ten items of the scale were reduced to two factors, BUP (business performance) and INP (innovative performance), which act as dependent variables. The BUP factor embraces the elements strictly related to business performance: financial success, market share, expansion into new markets and growth. The variables covered by this factor indicate that the factorial reduction was efficient enough to capture those dimensions of business performance, as understood in the literature on IC analysis (Chen et al., 2005; OECD, 2006; Tan et al., 2007). In the case of the INP factor, it covers the items directly related to innovation activities (the Introduction of new products or services, improvement of existing products or services, process innovation, and marketing activities) in a very efficient way. It clearly shows the core innovation branches to be analyzed in the Dominican context (Subramaniam & Youndt, 2005). Finally, the ICF in Table 3, including human, structural and relational capital, are pretty similar to others, such as those shown in the study on performance in Malaysian knowledge-intensive firms (Khalique et al., 2018). Such similarity validates the approach followed for the Dominican case.

Regression analysis

Table 4 shows the results corresponding to four estimated regressions. Regressions 1 and 2 correspond to business and the innovative performance of manufacturing firms, and Regressions 3 and 4 correspond to service firms' business and innovative performance. In general terms, the results in Table 4 depict a map of ICF and their role in Dominican firms. The IC factors are standardized variables, and the regressions were performed without the intercept (Jardón & Martos, 2008). Standardized coefficients are presented, and those statistically significant at the 1% and 5% levels have been highlighted in bold. On the panel of model specifications in Table 4, all models are correctly specified. The Durbin–Watson test values between 1.6 and 2.1 indicate that the residuals meet the independence criteria. The capacity of the models to explain variance in the dependent

Table 3 Factor analysis of the intellectual capital scale

Human capital	Structural capital	Relational capital	Performance indicators
TRA (training)	**DOC (documentation)**	**CLI (clients)**	**BUP (business performance)**
HC2101: Training and education program	SC2301: Manual job description	RC2702: Existence of customer database	BUPER1801: Launching more products (goods or services) than the competition
HC2102: Improvement of technical skills	SC2302: Manuals of processes and procedures	RC2703: Existence of a system for analysis and customer classification	BUPER1802: Increasing firms' market share
HC2103: Improvement of administrative skills	SC2304: Process maps and critical points	RC2704: Ability to identify potential customers	BUPER1803: Company is in a stronger financial and economic position
HC2104: Percentage of staff in training activities	SC2305: Report generation based on indicators	RC2705: Capacity to measure customers' satisfaction	BUPER1804: Shareholders and partners pleased with firms' performance
HC2105: Average hours of training per employee	SC2306: Documentation of corrective actions	RC2706: Degree of customers' satisfaction	BUPER180: Expanding to new regional and international markets
HC2106: Average annual investment in training	**ICT (information and communication technologies)**	RC2707: Capacity to track and recover customers	**INP (innovative performance)**
ENV (learning environment)	SC2601: Quality of ICT infrastructure (hardware and software)	**SUP (suppliers)**	INPER1701: Introduction of new products (goods or services)
HC2201: Supportive and stimulating environment for learning	SC2602: Percentage of workers with access to terminals	RC2901: The company has legally established suppliers	INPER1702: Improving new products (goods or services)
HC2203: Stimulating environment for team working	SC2603: Automation of production process of goods and services	RC2902: Preference for accredited and certified suppliers	INPER1703: Introduction of new production processes
HC2204: Degree of workers' commitment and engagement	SC2604: Automation of the procurement process	RC2903: Strong relationships with suppliers	INPER1704: Introduction of a new market or distribution methods
HC2205: Good communication between managers and staff	SC2605: Automation of customer management process	**IMA (firm image)**	INPER1705: Introduction of new management or organization methods
SPE (specialized workers)	**IPU (intellectual property)**	RC3001: Policy of corporate social responsibility	
HC1902: Percentage of workers with a college education	SC2504: Degree of use of IP international procedures (PCT, USA, Japan, EU)	RC3002: Bargaining power of firm as a brand	
HC1903: Percentage of workers with graduate education	SC2505: Degree of the legal protection of developed innovations	RC3003: Firms' prestige	
EXP (employee permanence)	SC2506: Degree of protection trademarks	**COP (cooperation)**	

Table 3 (continued)

Human capital	Structural capital	Relational capital	Performance indicators
HC2005: Employee turnover rate	**R&D (research and development)**	RC2801: Degree of interest in strategic alliances (other firms and actors)	
HC2006: Years of tenure of workers (experience)	SC2307: R&D expenditure	RC2802: Capacity to identify competitors	
POL (human resources policy)	SC2308: Time development and launch of products and services	RC2803: Ongoing cooperative initiatives with other actors	
HC2001: Human resource policy (equal employer)			

In bold, the different dimensions of the IC components analyzed are highlighted

variables (R, R^2 adjusted) is similar to that in other studies (Bollen et al., 2005; Dzenopoljac et al., 2017; Khalique et al., 2018; Mention & Bontis, 2013).

In the case of manufacturing firms, regression one about business performance explains 26% of the variance of the dependent variable ($R^2 = 0.261\%$) with three statistically significant IC factors: SPE, CLI, and COP. The SPE factor corresponds to human capital, significant at 5%, while the CLI and COP factors correspond to relational capital. The CLI factor is significant at 1% and the COP factor at 5%, the CLI factor or customer-oriented attitude the most significant of the two relational capital factors. The line-up of the SPE, CLI and COP factors points out the strategic focus of Dominican firms in marketing activities, a focus that is consistent in the literature on company performance, in particularly complex environments in which marketing activities can contribute to improving the feeling of anguish derived from financial leverage needs with the additional benefit of improving valuation and firms positioning in their market niche (Bae et al., 2017; Morgan, 2012).

Regression two on the innovative performance of manufacturing firms explains 29% of the total variance in the dependent variable ($R^2 = 0.287$) with five factors explaining the innovative performance: ENV, SPE, ICT, IPU, and R&D. In this model, factors with a negative sign such as SPE could indicate a selective effect on the firm's understanding of these factors (Estrada & Dutrénit, 2007). The first two factors, ENV and SPE, correspond to HC being the ENV factors significant at 1% and SPE significant at 10%. ENV factors refer to the learning environment in firms pointing out the relevance of internal mechanism for knowledge sharing and the related incentives to create an internal environment for cooperation, recalling the importance of the process of learning-by-doing-by-interaction in innovative value creation in process and product innovation, especially in low and medium technology industries (Trott & Simms, 2017), but also a condition to enhance absorptive capacity in firms (Cohen & Levinthal, 1989; Mothe et al., 2018). ICT, IPU and R&D factors are significant at 1%, a finding which is consistent with the general literature about the role of ICT, intellectual property managing and, of course, R&D in spurring innovation in firms and development (Acemoglu & Akcigit, 2012; Bollen et al., 2005; Gómez-Valenzuela, 2018; Khalique et al., 2018; Lu et al., 2014; Ruta & Macchitella, 2008). The case of the R&D factor is quite interesting in the Dominican context because to be recognized by itself it was explained as the firm's effort in product development, including the human, technical and financial resources devoted to creating new products and related processes (Cohen & Levinthal, 1989; Lopez Saez, 2010). This explanation of R&D made it real for surveyed firms discovering themselves in an innovation role that they use to related to marketing or subsidiaries activities, highlighting an implicit pattern of R&D and innovation, a barely studied phenomenon in the context of developing economies (Lumenga-Neso et al., 2005; Maloney & Rodríguez-Clare, 2007).

Regression three about the business performance of service firms is like regression 1 in terms of the number of IC factors. It explains 24% of the total variance ($R^2 = 0.239$). The three IC factors are: ICT significant at 1%, R&D, which is significant at 5%, these two factors belong to structural capital, and CLI, which is significant at 1% belongs to relational capital. Unlike regression 1 in regression 3, the ICT and R&D factors are present, coinciding with regression 1 and 3 only in the CLI factor. In the case of services firms, there is a remarkable role of ICT in creating value due to the information spillovers derived

Table 4 Regression analysis

IC factors	Manufacturing firms						Service firms					
	Regression 1. Business performance in manufacturing firms			Regression 2. Innovation performance in manufacturing firms			Regression 3. Business performance in service firms			Regression 4. Innovation performance in service firms		
Human capital	β	**Std. error**	**t**	β	**Std. error**	**t**	β	**Std. error**	**t**	β	**Std. error**	**t**
TRA	0.100	0.087	1.146	0.114	0.090	1.330	0.046	0.087	0.525	0.097	0.079	1.164
ENV	−0.010	0.078	−0.121	**0.258***	0.080	3.264	0.050	0.088	0.590	0.031	0.080	0.383
SPE	**0.148****	0.079	1.945	**−0.141*****	0.081	−1.880	0.074	0.073	0.990	0.053	0.067	0.737
EXP	0.049	0.065	0.736	0.032	0.067	0.484	0.001	0.070	0.021	−0.064	0.064	−0.982
POL	0.004	0.065	0.062	0.023	0.077	0.347	0.029	0.066	0.412	**−0.187***	0.060	−2.788
Structural capital												
DOCS	0.019	0.082	0.227	0.112	0.084	1.379	−0.107	0.077	−1.400	**0.125*****	0.071	1.718
ICT	0.085	0.093	0.961	**0.268***	0.096	3.083	**0.207***	0.075	2.675	**0.109*****	0.069	1.474
IPU	−0.017	0.066	−0.240	**0.222***	0.068	3.187	0.032	0.075	0.451	**0.243***	0.069	3.609
R&D	0.046	0.078	0.592	**0.186***	0.080	2.440	**0.182****	0.083	2.198	**0.205****	0.076	2.581
Relational capital												
CLIP	**0.218***	0.082	2.648	−0.022	0.085	−0.273	**0.213***	0.077	2.761	−0.003	0.070	−0.037
SUP	−0.087	0.078	−1.188	0.107	0.080	1.487	−0.020	0.072	−0.27	**0.169****	0.066	2.349
IMA	0.121	0.091	1.428	−0.006	0.094	−0.073	0.079	0.077	0.963	**0.151*****	0.071	1.931
COP	**0.152****	0.068	2.104	−0.107	0.070	−1.512	0.115	0.079	1.537	−0.006	0.072	−.078
Models' summary	Business performance						Innovation performance					
	Manufacturing firms			Services firms			Manufacturing firms			Services firms		
R	0.511			0.489			0.538			0.551		
R^2	0.261			0.239			0.289			0.304		
Adjusted R^2	0.205			0.183			0.235			0.252		
Standard error	0.836			0.947			0.862			0.868		
Durbin–Watson	2.149			2.093			1.697			2.040		
Significance level	*$p < 0.01$			**$p < 0.05$			***$p < 0.1$					

In bold, IC factors are statistically significant at different p levels

from the adoption of ICT in services firms (Alderete & Gutiérrez, 2014), among several factors that in some cases create the perception of innovation mainly as an ICT adoption process. In the case of R&D in services firms, a growing body of literature highlights the role of R&D activities in services firms considering the differences in nature and scope about manufacturing firms since the seminal works of Ian Miles (2007). In the case of the surveyed firms in the Dominican Republic, services firms associate their business performance with R&D concerning process improvements and marketing development of new products and services, which is a pretty good understanding of R&D considered form from a wider perspective (Doloreux et al., 2016).

Concerning regression four about innovative performance in service firms, it explains little more than 30% of the total variance ($R^2 = 0.304$) with seven factors: POL, DOCS, ICT, IPU, R&D, SUP, and IMA, being the most complex results concerning the role of IC in Dominican firms because of the number of IC factor implied. One factor, POL, corresponds to HC and is significant at 1%. Then the four factors of SC are significant at different levels starting with DOC and ICT, and then IPU significant at 1% and finally R&D at 5%. Two of the three factors of RC were significant SUP at 5% and IMA at 10%. In the innovative performance of service firms, the POL factor stands out. It aligns with other authors' findings that relate firm performance to cultural diversity and gender policy elements related to organizational culture but also directly related to HC (Pasamar et al., 2019; Richard et al., 2004). As in the case of regression 2, the negative sign of the POL factor in regression four could indicate a selective effect associated with the specific labor and market characteristics of Dominican firms, as a kind of "idiosyncratic distortion" specific to the Dominican market structure (Bartelsman et al., 2013). The fact that all the four SC factors are implied in the innovative performance of service firms call the attention because it could indicate the crucial role of SC as a set of organizational resources and physical assets in supporting innovative activities (Hejazi et al., 2016; Subramaniam & Youndt, 2005), especially in the Dominican context where service firms and activities prevail. The SUP factor points out the role of suppliers as sources of innovation (Henke & Zhang, 2010), and the IMA factor could indicate a relation between innovative performance and collaborative activities, which has been documented by other authors (Stuart, 2000). The weight of SC and RC factors in service firms' performance does not fail to draw attention. However, this result is consistent with findings in which these factors, particularly RC, in the long term contribute to the brand value of products and services offered by firms (M.-C. Chen et al., 2005; Khalique et al., 2018; Ogundipe, 2012). The long-term return on activities such as product development and advertising spending could be underpinned by the latent effects of those IC factors (M.-C. Chen et al., 2005). The weight of the SC and RC requires in-depth analysis to reveal the latent relationships determining the importance of these factors for services firms.

Concerning the relation between IC factors and firms' characteristics, no significant differences in IC components were found, consistent with extant findings in the Iberic-American context (de Castro et al., 2009; Joia, 2001; Lemos & Joia, 2012; Lopez Saez, 2010). However, in general terms, and based on the MANOVA procedure shown in Table 5, in the Dominican context, innovation performance was significantly affected by the variable "region" (localization) at the 5% confidence level. The business performance was also significantly affected by the variable "firm's size" at the same confidence level.

The depicted data could be reflecting some related underlying patterns in the Dominican context, such as its historical and highly concentrated market in spatial and economic terms (Arroyo Abad & Santos-Paulino, 2013), and the scaled effect of a geographical concentration of market structures, information, institutions, production and consumption patterns of a developing country (Ács & Varga, 2005; Bloom et al., 2010), characteristics that could be influencing both business and innovation performance but especially the innovation of firms, particularly in a context such as that of the DR (Srholec, 2005). The variable "technological level of products/services" seems to affect both business and innovative performance, at the 5% confidence level, probably highlighting the structural effect of firms' specialization based on the current technological level of their products and services (Corrado & Hulten, 2010; Lopez Saez, 2010; Stuart, 2000).

In this analysis, the IC components of manufacturing firms were not affected by firms' characteristics; however, this could be due to an effect of the research design focused on understanding the influence of IC in firms' performance instead of how IC components interact with firms' characteristics. For this reason, it may deserve further analysis. RC factors prevail in business performance in manufacturing firms, but although SC factors prevail, a relative balance between HC and SC factors was found in innovative performance. These findings are similar to those in which HC and SC factors are firmly related to value creation in the manufacturing sector (Tseng & James Goo, 2005a). In the business performance of service firms, SC factors prevail, but the RC factor relative to client orientation plays a significant role. These findings are similar to those related to service firms in Spain, which point out the relevance of SC factors such as ICT and RC, for example, customer orientation (de Castro et al., 2009; Handzic et al., 2016).

The relevance of SC factors in both business and innovative performance in Dominican firms reflects the importance of capital endowment, tangible assets, and intellectual property assets as sources of knowledge and innovation, in the context of low-intensity knowledge production activities (Barney, 1991; Y. Chen & Puttitanun, 2005; Metcalfe & Ramlogan, 2008). However, and given the relevance of the learning process as a factor of innovation and business performance in a developing productive context, further analysis is required to correctly understand the role of SC factors as a source of value in the Dominican context.

Concluding remarks

Based on the results presented in "Results and discussion" section, it can be concluded that it is clear the influence of IC factors presents in the performance of Dominican firms in business and innovation. Concerning the first research question, which IC factors influence the most in the Dominican firms, the following seven ICF were identified: ENV, SPE, ICT, IPU, R&D, CLI, and COP. In service firms, the following eight factors were identified: POL, DOC, ICT, IPU, R&D, CLI, SUP, and IMA. HC and SC are relevant in manufacturing firms, but SC factors prevail, while structural and RC factors prevail in service firms. Besides, SC is the IC component that prevails in the Dominican context, implying the importance of capital goods endowment, which refers to firms' resources as competitive advantages in creating value. The relevance of SC refers to the transversal role of HC as a driving force of the SC factors across the firms—which is consistent with

Table 5 Tests of between-subject effects of the MANOVA procedure

Source	Dependent variable	Type III sum of squares	df	Mean square	F	Sig
Corrected model	Business performance	42.793*	22	1.945	2.085	0.003
	Innovation performance	40.799**	22	1.854	1.975	0.006
Intercept	Business per	0.011	1	0.011	0.012	0.914
	Innovation per	1.891	1	1.891	2.013	0.157
Region (localization)	Business performance	3.692	3	1.231	1.320	0.268
	Innovation performance	8.657	3	2.886	3.073	**0.028**
Tax regime	Business performance	0.816	1	0.816	0.875	0.350
	Innovation performance	2.534	1	2.534	2.698	0.101
Firm's age	Business performance	1.429	2	0.714	0.766	0.466
	Innovation performance	1.300	2	0.650	0.692	0.501
Shareholders	Business performance	3.095	4	0.774	0.830	0.507
	Innovation performance	8.269	4	2.067	2.201	**0.069**
Firm's size	Business performance	7.177	2	3.588	3.847	**0.022**
	Innovation performance	0.533	2	0.266	0.284	0.753
Activity	Business performance	0.013	1	0.013	0.014	0.905
	Innovation performance	0.387	1	0.387	0.412	0.522
Market orientation	Business performance	1.570	3	0.523	0.561	0.641
	Innovation performance	3.323	3	1.108	1.179	0.318
The technological level of products/services	Business performance	11.351	3	3.784	4.057	**0.008**
	Innovation performance	11.267	3	3.756	3.999	**0.008**
Products/services life cycle	Business performance	4.000	3	1.333	1.429	0.234
	Innovation performance	0.100	3	0.033	0.035	0.991
Error	Business performance	288.207	309	0.933		
	Innovation performance	290.201	309	0.939		
Total	Business performance	331.000	332			
	Innovation performance	331.000	332			
Total corrected	Business performance	331.000	331			
	Innovation performance	331.000	331			

In bold, the firm's characteristics are statistically significant at different p levels

*R-squared = 0.129 (adjusted R-squared = 0.067); **R-squared = 0.123 (adjusted R-squared = 0.061)

some findings of IC studies in the Latin American context. The possible selective effect of some IC factors could highlight the relevance of the cultural context and values concerning firms' management practices. Therefore, these findings indicate that R&D and other innovative activities are performed by Dominican firms but casually and implicitly and can be explained through the impact of ICF. This finding could support a more suitable formal and explicit innovation policy that fosters best practices in IC management.

Concerning the second research question, about the significant difference in the weight and magnitude of the IC factors influence by considering the firm's characteristics, as was stated in "Results and discussion" section, no significant differences in IC factors were found, which does not mean that such a difference does not exist. These findings are similar, likely indicating that such differences could be related to other contexts and characteristics of sectoral firms.

Despite these preliminary conclusions, a key finding is that Dominican companies have a clear potential for growth and expansion in the context of nationally and Central

America and the Caribbean. Dominican firms must unleash their innovation potential making explicit and intentional activities that create new products and services for the market.

An important issue that must be addressed in the short and medium-term by a detailed policymaking process will be strengthening local manufacturing and promoting a more incredible culture of innovation in manufacturing companies with the potential to be competitive in the regional context. One step in the right direction is to stop the growing deindustrialization of the Dominican economy through the appropriate incentives to lift Dominican manufacturing.

Regarding public policy implications and considering the Dominican institutional context, this research indicates a path in which R&D activities should be formalized regarding intellectual property management, which means that potential R&D outputs could be treated as intellectual property items. Further research and analysis are required to identify the possible sectoral effects of IC in Dominican firms in a more precise way. Another exciting research implication could be understating the structural relations of IC components and firms' allocation of tangible and intangible resources, and, as it was mentioned before, could be relevant for a better understanding of the role of intellectual capital in firms in a developing context, such as in the DR, the interaction of intellectual capital components and factors with firms' characteristics.

In more heuristic terms, the experience of exploring, defining, and constructing in a flexible, open, adaptive, and participatory way, but within well-defined conceptual limits, the components and scales of IC are possibly one of the most exciting elements of this study. In this sense, the main lesson that can be learned from this experience is that both the conceptual framework that served to define and delimit the concept of IC and the analytical approach based on the analysis of principal components could be equally valuable in developing contexts like the DR. This final thought probably means a context-specific approach. Finally, this is a work whose initial scope has been mainly descriptive. Hence, its most important contribution is precise to provide information that allows for further studies on the IC field in the region. It is expected to contribute to a better understanding of the role of IC in the Central American and Caribbean context.

Abbreviations

AIRD: Dominican Industrial Association; BUY: Business performance; CLIP: Customer orientation; CNC: National Council of Competitiveness; COP: Willingness to cooperate with potential external partners; DOC: Documented process in the firm; DR: Dominican Republic; EVA: Exploratory factor analysis; ENV: The learning environment in the firm; ESP: The proportion of workers with a college education; EXP: Employees' permanence in the firm; HC: Human capital; IC: Intellectual capital; ICF: Intellectual capital factors; IT: Information and communication technologies; IMA: Corporate external image; INP: Innovative performance; IPU: Intellectual property management; KMO: Kaiser–Meyer–Olkin test; MESCYT: Ministry of Higher Education, Science and Technology; OKAPI: Dominican Office of Industrial Property; POL: Human resources policy; R&D: Research and Development; RC: Relational capital; SC: Structural capital; SUP: Strength of the relationship with input suppliers; TRA: Training and educational support in the firm.

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Declarations

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Authors' contributions
The preparation of this paper in each of its parts is 100% the corresponding author's responsibility. The author read and approved the final manuscript.

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