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Exploring the Effect of Intellectual Capital Management on Innovativeness in a R&D Institute

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Abstract: The literature that empirically investigates the relationship between intellectual capital management and innovativeness in R&D institutions is scarce. Moreover, no sources have been found to extend the analysis to include the technological orientation as a strategic approach to developing innovative capabilities. This study builds on the theoretical premises of the intellectual capital-based view of the firm and the dynamic capabilities view. The paper addresses a research gap by setting out to study the impact of intellectual capital management on innovativeness in an R&D institute while also considering the relationship with technological orientation. It is proposed that intellectual capital management, through its components of human, structural and relational capital, positively affects innovativeness in an R&D institute. Moreover, it is hypothesised that human capital and innovativeness positively affect innovativeness in an R&D institute. The research employs PLS-SEM analysis on data collected from a sample of N=61 employees of an R&D institute. Data has been acquired using a questionnaire measuring intellectual capital management through human, structural and relational capital components as well as innovativeness and technological orientation. Findings confirm the significant direct effects of structural and relational capital on innovativeness and the positive direct effect of human capital and innovativeness on technological orientation. This research represents an original contribution to the academic literature by bringing new evidence concerning the relationships between intellectual capital management, innovativeness, and technological orientation in an R&D institute in Eastern Europe.

Keywords: intellectual capital management; innovativeness; technological orientation; R&D sector.

Introduction

While intellectual capital (IC) research was established as a field of study already decades ago, extant empirical studies measuring the effects of various IC components on an organisation's performance and competitive advantage gains are far from exhausting the whole range of theoretical assumptions that have been put forward. Furthermore, the investigations into IC's impact on organisations have yet to cover a diversity of industries and economic sectors, or national and regional peculiarities, as most of the research so far has focused on manufacturing and IT industry, on SMEs (Dinu, 2022), and on advanced economies (Andreeva & Garanina, 2016).

As stressed by Subramaniam and Youndt (2005) and Buenechea-Elberdin, Saenz and Kianto (2018), nowadays, business success depends on innovation, and IC is a key factor in this respect. Developing innovative capabilities relies on successfully managing IC resources. Furthermore, innovation relies on technology, and this is truer than ever, especially in the current context of accelerated digitalisation. Information technology is present today in all of an organisation's functional areas. It facilitates various managerial processes, from strategic management to operational management, including IC management, knowledge management (KM) and communication with stakeholders. Toivonen, Smedlund and Järvenpää (2007) have stressed that many business software systems and IT organisational tools (i.e., supporting enterprise resource planning, supply

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chain management, customer relationship management and human resource management) are aimed to support the management of organisational knowledge.

Since few studies exist that look into the management of IC in R&D institutions, the current paper is one of the first that addresses such a research gap and seemingly the first of its kind empirically investigating the relationships between IC management, innovativeness and technological orientation, to the best of the author's knowledge. In addition, this research has been conducted in an R&D institution from an emergent economy in Eastern Europe, which brings another novelty element to this research.

The paper commences with a review of the academic literature to define the concepts of intellectual capital management, technological orientation, and innovativeness and to summarise the extant knowledge, followed by the proposition of a research model and research hypotheses. In the second section, the research methodology is introduced, and a detailed account of the development of the research instrument, the sample and data collection and the data analysis is provided. The final part of the document comprises the discussion of the findings, as well as sections on theoretical and practical implications, the research conclusions, limitations, and future research directions.

Literature review

Several theoretical approaches have considered the source of competitive advantage and firm performance in the post-industrial economy that relies substantially on intangible assets. Following the line of thought advocated by Barney (1991) in the resource-based view, which placed physical and intangible resources in the centre of a company's vital valuables for achieving competitive position and growth, and the knowledge-based view (Grant, 1996), which placed the focus on knowledge as the fundament for value creation, Reed, Lubatkin and Srinivasan (2006) have advanced the Intellectual Capital-based view of the firm. In accordance with this latter approach, it is specifically the knowledge amassed in an organisation's human capital, social relationships and organisational information technology systems and processes that drive the business success. These dimensions generally correspond to the three main components of IC widely agreed upon in the literature, which are human capital (HC), structural capital (SC) and relational capital (RC) (Bontis, 1998; Edvinsson & Malone, 1997; Petty & Guthrie, 2000; Andriessen, 2004; Nazari & Herremans, 2007). Some authors have proposed other classifications by renaming, e.g., structural capital as organisational capital (Youndt, Subramaniam, & Snell, 2004) or by introducing other categories, e.g., customer capital (Edvinsson, 1997; Stewart, 1997; Mouritsen, Bukh, Larsen, & Johansen, 2002), social capital (Nahapiet & Goshal, 1998), both encompassing relational capital, or renewal capital (Kianto, 2007).

HC is generally understood as comprising competencies, skills, creativity (Edvinsson & Malone, 1997), education, know-how, innovativeness, entrepreneurial spirit (Petty & Guthrie, 2000), knowledge, abilities, behaviours (Martin de Castro, Delgado-Verde, López-Sáez, & Navas-López, 2011). SC includes customer, innovation, and process capital (Edvinsson & Malone, 1997), intellectual property, management philosophy, corporate culture, ICT infrastructure (Petty & Guthrie, 2000), and technological and organisational capital (Martin de Castro et al., 2011). Finally, RC covers relationships and networks that include an organisation's stakeholders, like customers and brands (Petty & Guthrie, 2000) or internal and external relations (Inkinen, 2015).

The foundation of IC is knowledge (Buenechea-Elberdin, Saenz, & Kianto, 2018) and transforming it into valuable organisational resources that can be leveraged is the purpose of IC management (Edvinsson & Sullivan, 1996). According to Edvinsson (2013), through IC management, an organisation's knowledge capital can be identified, measured, disclosed and reported with the aim of achieving a competitive advantage. Harnessing the value of knowledge is the ultimate goal of IC management (Santos-Rodrigues, Figueroa Dorrego, & Fernandez-Jardon, 2011). People generate knowledge, and the human capital

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is converting it into structural capital through routines and codification, utilising information systems. The relational capital is a source of external knowledge input.

Unlike codified knowledge, which is collected and stored inside the organisation, tacit knowledge is transferred between people through information flows. The tacit knowledge is linked to HC and is the „source of innovation and strategic renewal" (Bontis, 1998, p. 65). One of the challenges of KM is harnessing tacit knowledge and transforming it into explicit knowledge through codification. Such knowledge can be retrieved inside organisations in databases, procedures, scientific formulae, and others (Nonaka & Takeuchi, 1995), blueprints, code, etc. (Edvinsson & Sullivan, 1996) and can be collected, compiled, stored, and organised. Tacit knowledge, on the other hand, appears as personal insights (Nonaka & Takeuchi, 1995), lore, and experience (Edvinsson & Sullivan, 1996), being shared at the individual level (López-Nicólas & Meroño-Cerdán, 2011).

Knowledge-intensive organisations such as R&D institutions depend on enticing the most knowledgeable staff, preserving the best competencies and skills among their human resources and establishing successful external partnerships to ensure knowledge input. At the same time, effectively managing human, structural and relational resources is a prerequisite for positive organisational outcomes. More stable markets allow for efficient management of extant knowledge, while dynamic markets, i.e., knowledge-forward sectors, require the continuous generation of adaptive knowledge (Eisenhardt & Martin, 2000).

Furthermore, according to the dynamic capabilities view (Teece, Pisano, & Shuen, 1997), prosperous organisations must look ahead and develop and adapt their capabilities dynamically, in line with their core competencies, to adjust to market changes successfully and maintain competitive advantage. Dynamic capabilities are path-dependent technological, organisational, and managerial processes that enable organisations to swiftly coordinate and (re)combine resources and competencies (Teece et al., 1997). They are intangible resources such as knowledge embodied in R&D, intellectual property rights and complementary assets that can be reconfigured with the aim of obtaining competitive advantage (EC RICARDIS, 2013).

Effective IC management positively impacts firm performance by a joint effect of IC capabilities and knowledge management practices, sometimes mediated by organisational dynamic capabilities and innovation capabilities, as shown by empirical research (Inkinen, 2015). IC by itself is not conducive to value creation in the lack of suitable KM practices (Kianto, Ritala, Spender, & Vanhala, 2014). Garcia-Perez, Ghio, Occhipinti and Verona (2020) argued that the stock of knowledge represented by IC requires implementing KM strategies in order to generate value. Youndt et al. (2004) have found that investments in HR management, IT and R&D vary depending on a company's IC profile. Only high-performing organisations develop high levels of human, social, and organisational capital, while most firms concentrate on one component. The authors have empirically proven that HRM and IT investments influence IC development more than R&D investments.

It has been suggested that knowledge generation and technological innovation result from joint management of knowledge, technologies and organisational resources (Heffner & Sharif, 2008), with intangible assets playing a central role in the knowledge economy enabled by advanced technology (Dumay & Garanina, 2013). An organisation's technological level is affected by its R&D intensity (OECD, 2011). IT systems and advanced digital technology are enablers of knowledge collection, storage and processing, even though tacit knowledge can still elude codification. Additionally, IT offers tools for collaboration, communication and development of RC, whose impact on innovation has been frequently invoked in the academic literature (Toivonen et al., 2007).

Technology-forward organisations are inclined to significantly acquire and utilise technology, a characteristic which has been described as technological orientation (TO)

(Gatignon & Xuereb, 1997). This is one of the main strategic orientations within a company, the other two dimensions being customer and market orientations. Strategic orientations positively affect organisational performance (Masa'deh, Al-Henzab, Tarhini, & Obeidat, 2018). TO is an indicator of innovation commitment, as innovation relies on technology more than ever before, especially in the current digital advancement. Furthermore, innovation incrementally or radically alters an extant technological trajectory (Gatignon, Tushman, Smith, & Anderson, 2002).

Some researchers have attempted to empirically prove the relationship between TO and innovation, with mixed results. Al-Ansari, Altalib and Sardoh (2013) have found a significant relationship while investigating small and medium-sized enterprises (SMEs) in Dubai but could not demonstrate a direct effect on business performance. Palazzi, Sgrò, Ciambotti and Bontis (2020) have researched the linkage between technological intensity and IC performance and have argued that SMEs in the technology industry show several knowledge levels; hence IC management positively impacts performance. The authors suggested that more research should address this relationship. Another research limitation was found by Li, Song, Wang and Li (2019) regarding the technological innovation performance.

Eurostat Glossary defines innovation as "a new or significantly improved product (good or service) introduced to the market, or the introduction within an enterprise of a new or significantly improved process". According to OECD (2015), innovation includes new organisational methods in business practices, workplace organisation or external relations. An organisation's inclination for innovation generation and adoption is described as innovativeness (Damanpour, 1991; Garcia & Calantone, 2002). It is assumed that innovativeness is higher in bigger companies due to the availability of more significant resources, i.e., funding, talent acquisition, technological capabilities, R&D capabilities and technical knowledge, etc.

IC components affect an organisation's innovative capabilities differently, based on how they are configured (Subramaniam & Youndt, 2005). These authors' empirical research showed that HC interacts with the social capital to impact radical innovation, while the latter affects incremental innovation also. Organisational capital has a significant effect on incremental innovative capability. These findings have not been (entirely) confirmed by other researchers. HC was found to influence innovativeness significantly only in highly performing firms. However, SC had no effect on its own but only jointly with HC (Leitner, 2011).

On the other hand, unexpectedly, R&D spending was not linked to innovativeness. Kipkirong Tarus and Kiptanui Sitienei (2015) have empirically established that HC and SC impact innovativeness in small firms. Social capital has a significant effect on innovation generation and adoption, and organisational capital affects innovation creation (Dost et al., 2016). According to McDowell, Peake, Coder and Harris (2018), in small firms, HC and SC have a direct effect on organisational performance, while innovativeness plays a mediator role between IC and performance. Positive links between IC and innovativeness have been confirmed by Gomezelj Omerzel and Smolčić Jurdana (2016) in the Serbian tourism industry, which further impacts growth, while Rehman, Bresciani, Ashfaq and Alam (2021) have found positive links among IC, knowledge management and innovativeness, which also mediates the relationship with competitive advantage.

Another line of research focused on the relationship between IC components and technical innovation (Subramaniam & Youndt, 2005; Martín-de-Castro et al., 2011; Dost, Badir, Ali, & Tariq, 2016). Organisational learning significantly affects technical innovation and is influenced by the organisational culture (Sanz-Valle, Naranjo-Valencia, Jimenez-Jimenez, & Perez-Caballero, 2011). While comparing the relationships between IC and leadership across several industries and sectors in Poland, Kucharska (2021) has found that transformational leadership focused on innovativeness and knowledge management significantly impacts HC and RC evolution through promoting tacit knowledge sharing. An

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organisational learning culture that stimulates knowledge codification leads to SC development in the IT industry. According to Delgado-Verde, Martín de Castro, and Amores-Salvadó (2016), technological capital (which pertains to SC) enables radical innovation to some extent. Nevertheless, HC and social capital have a significant positive effect on innovation.

Following the literature review, which supports the view that effective management of IC components has a positive impact on organisation innovativeness, given the fact that technological orientation is a strategic orientation decided by the organisational leadership, and taking into consideration the link between innovation and technology, the hypotheses below are proposed:
Hypothesis 1. HC management positively affects innovativeness in R&D institutions.
Hypothesis 2. SC management positively affects innovativeness in R&D institutions.
Hypothesis 3. RC management positively affects innovativeness in R&D institutions.
Hypothesis 4. HC management positively affects technological orientation in R&D institutions.
Hypothesis 5. Innovativeness positively affects technological orientation in R&D institutions.

The research model and the hypothesised relationships are represented in Figure 1.

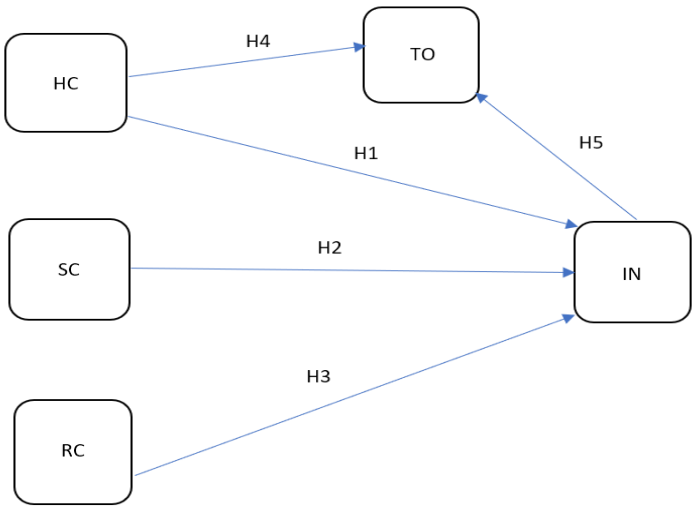

Figure 1. Research model
Source: author's elaboration

Methodology

Research instrument

To assess the relationships between the variables Intellectual Capital Management, Innovativeness and Technological Orientation, a questionnaire has been drafted based on the sources identified during the literature review, and the survey items have been clustered into five constructs and a section on demographics, which referred to the work position, experience with the R&D institution and the gender of the respondents. Intellectual Capital Management is made of the sub-constructs Human Capital (HC1-HC6), Structural Capital (SC1-SC6) and Relational Capital (RC1-RC6). Technological Orientation comprises three items (TO1–TO3) and Innovativeness eight items (IN1-IN8). Replies have been assessed with a five-point Likert scale, ranging from ''Strongly agree'' to ''Strongly disagree''. Items IN6 and IN7 have been reverse-coded. The items and constructs included in the questionnaire are summarised in Table 1.

Table 1. Research instrument

Construct & source	Items
Human Capital (adapted from Bontis, 1998)	HC1 Competences & skills HC2 Work experience HC3 Regular training HC4 Technological upskilling HC5 Staff encouraged to contribute new ideas HC6 Staff encouraged to express opinions
Structural Capital (partially adapted from Petty & Guthrie, 2000; Cassol et al., 2016)	SC1 Flexible and efficient business processes SC2 Informal knowledge sharing between staff SC3 Digital technologies for knowledge codification SC4 Technological capability to capture relevant new knowledge SC5 Ability to adapt available technologies to the company's needs SC6 Ability to exploit new knowledge to sustain growth
Relational Capital	RC1 Organisational culture encourages trust and collaboration RC2 Staff feels valued and satisfied RC3 Organisation engages with external stakeholders by employing technology RC4 Organisation uses effectively digital technologies for internal communication RC5 Organisation develops new knowledge and innovation by engaging with partners (academia, industry, governmental agencies, etc.) RC6 Organisation builds and maintains a good reputation online
Technological Orientation (partially adapted from Cabello Medina et al., 2011; Gatignon & Xuereb, 1997)	TO1 Organisation has a strategy based on up-to-date technology for new product/service development TO2 Organisation's business model is based on technological innovation TO3 Organisation stays up to date with the latest technological developments in its industry
Innovativeness (adapted from Kipkirong Tarus & Kiptanui Sitienei, 2015; Cabello Medina et al., 2011)	IN1 Organisation has produced incremental innovations in its sector IN2 Organisation has produced radical innovations in its sector IN3 Organisation continuously improves its work processes IN4 Organisation tries out new professional ideas generated by staff for organisational development IN5 Organisation uses input from partners to develop new products/services IN6 Organisation considers innovation too risky IN7 Organisation considers innovation too expensive IN8 Organisation allocates sufficient funding for R&D

Source: author's elaboration

Sample and data collection

The respondents pertain to a reputable Romanian scientific institution with several hundred employees involved in R&D on permanent bases. The questionnaire has been disseminated through an online form to ensure easy access, free participation, and anonymity; therefore, non-probability methods, namely snowball sampling, have been used to collect the data. Sixty-one responses have been returned and used for the analysis. The descriptive statistics indicate that most of the respondents (34.4%) have a work experience between 5 and 10 years; 29.5% have a tenure of 10 to 15 years; 19.67% have over 20 years of experience, while 16.39% have been in office for less than five years. Out of the total number of replies, three belong to senior managers, while the others came from operational staff and middle managers. The majority of the respondents (55.73%) were men.

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Data analysis

For the data analysis, the Smart PLS version 3 program has been utilised (Ringle, Wende, & Becker, 2015). The evaluation started with the verification of the reliability and validity of the constructs by checking the Cronbach's Alpha value, the Average Variance Extracted (AVE) and the Composite Reliability, which were all within the recommended limits, which are AVE > 0.5, Cronbach's Alpha and CR between 0.7-0.95 to avoid redundancy (Sarstedt, Hair, Pick, Liengaard, Radomir, & Ringle, 2022). The values for each construct are presented in Table 2.

Table 2. Construct reliability and convergent validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
HC	0.890	0.895	0.924	0.754
IN	0.898	0.901	0.925	0.712
RC	0.814	0.824	0.890	0.729
SC	0.845	0.846	0.896	0.682
TO	0.803	0.812	0.884	0.719

Source: author's data

In the next step, the discriminant validity of the constructs has been verified with the Fornell-Larcker criterion (Benitez, Henseler, Castillo, & Schuberth, 2020), and the results of the test can be retrieved in Table 3.

Table 3. Discriminant validity

	HC	IN	RC	SC	TO
HC	0.868				
IN	0.776	0.844			
RC	0.790	0.784	0.854		
SC	0.807	0.799	0.796	0.826	
TO	0.771	0.763	0.713	0.754	0.848

Source: author's data

The collinearity test shows for all the retained items VIF values under the recommended threshold of a maximum of 5. With a few exceptions, the numbers are below 3, significantly reducing the collinearity risk. During the tests, it was noticed that the items with the highest values (HC3 and HC4) significantly affect the discriminant validity; hence it has been decided to keep these items and not remove them. The results of this test are presented in Table 4.

Table 4. Collinearity statistics

Item	VIF	Item	VIF
HC1	2.003	RC2	2.371
HC3	4.674	RC4	1.643
HC4	3.802	SC1	2.006
HC5	2.855	SC2	1.827
IN1	2.327	SC4	1.921
IN2	2.199	SC5	1.933
IN3	3.290	TO1	2.194
IN4	3.589	TO2	1.800
IN5	2.543	TO3	1.587

Source: author's data

Finally, in the last step of this stage, the factor loadings of the retained items have been checked, and all values are above 0.769, as seen in Figure 2 presenting the structural model evaluation.

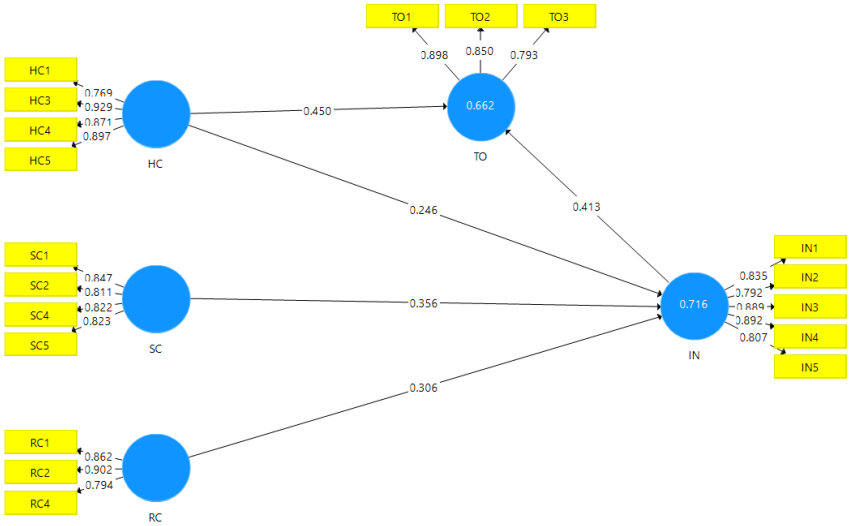

Figure 2. Structural model assessment

The second stage of the analysis was concerned with the structural equation modelling, following a statistical analysis bootstrapping a 5.000 sample. The path coefficients analysis provided in Table 5 indicates that all presumed effects except for the effect of HC on Innovativeness are significant. Additionally, it has been identified that Innovativeness mediates the relationship between RC and TO (see Table 6).

Table 5. Path coefficients

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
HC -> IN	0.246	0.244	0.139	1.770	0.077
HC -> TO	0.450	0.448	0.120	3.761	0.000
IN -> TO	0.413	0.413	0.130	3.182	0.001
RC -> IN	0.306	0.311	0.121	2.521	0.012
SC -> IN	0.356	0.355	0.146	2.447	0.014

Source: author's data

Table 6. Specific indirect effects

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
HC -> IN -> TO	0.102	0.098	0.064	1.591	0.112
RC -> IN -> TO	0.127	0.127	0.064	1.989	0.047
SC -> IN -> TO	0.147	0.151	0.085	1.729	0.084

Source: author's data

The proposed structural model has a good model fit, with an SRMR value of 0.073 for the estimated model and 0.072 for the saturated model, which is under the threshold of 0.080 (Benitez et al., 2020). The R square adjusted value indicates that the model explains 70,1% of the variance in Innovativeness and 65,1% of the variance in Technological Orientation, as shown in Table 7, while the effect size of the sample points to a small impact on what concerns the effect of HC, RC and SC on Innovativeness, at values of 0.062, 0.100 and 0.126 respectively. The effect size is moderate for the HC and Innovativeness impact on Technological Orientation, with values of 0.239 and 0.202, respectively.

Table 7. The coefficients of determination (R square)

	R Square	R Square Adjusted
IN	0.716	0.701
TO	0.662	0.651

Source: author's data

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Given the results of the PLS-SEM analysis, all the proposed hypotheses are validated except for H1.

Discussion of the findings

The data analysis finalised with the structural equation modelling confirms that certain components of IC, i.e., SC and RC have a significant direct effect on Innovativeness in an R&D institution. Unexpectedly, HC does not. While this result did not confirm the initial assumption, a precedent has been identified by Leitner (2011), who established that only in highly innovative companies does HC exert a positive effect, while in the others, a similar result could not be validated. A possible explanation for this finding could be linked to the low allocation of funding in the Romanian R&D sector, combined with the brain drain, which made it difficult for specialised institutions to attract and retain the staff with the highest creativity and innovative drive.

Generally, it is assumed that organisations with greater resources enjoy greater innovativeness as they invest more in talent acquisition, technological capabilities, and R&D capabilities. Looking at the items of the HC construct that were included in the structural model, it can be assumed that most of the respondents who provided the answers to the questionnaire felt they could benefit from more training and access to the latest technologies in the field. Additionally, it could be that all staff does not feel encouraged to contribute more to the organisational development.

Notwithstanding this finding, SC and RC do have a significant positive effect on Innovativeness, which is in line with previous research (Kipkirong Tarus, & Kiptanui Sitienei, 2015; Dost et al., 2016; Subramaniam & Youndt, 2005) that indicated either that organisational capital supports incremental innovation, while HC leads the radical innovation, or that RC facilitates innovation adoption, while SC enables innovation generation. Based on the corresponding items that have been retained in the structural equation modelling, it appears that the R&D institution leverages its structural capital by encouraging informal knowledge sharing and ensuring flexible and efficient work processes. In addition, the organisation has the technological infrastructure in place to capture and utilise the new knowledge acquired by the staff with the view to support organisational development. Furthermore, the organisational culture stimulates trust and collaboration while effectively using digital technologies facilitates internal communication. Combined with the informal sharing of knowledge, communication, trust, and collaboration proved to be quintessential for developing innovative capabilities in an R&D institution. Collaboration with external stakeholders is another source of knowledge input that contributes to higher innovativeness.

Though HC is not directly conducive to Innovativeness, the analysis shows the significant positive effect HC has on Technological Orientation, thus confirming previous research by Gatignon and Xuereb (1997). The link between innovation and technology is once again validated by the significant direct effect of Innovativeness on Technological Orientation. These findings were expected, considering the inherent reliance of R&D institutions on technology, as their purpose is scientific and technological advancement, and their core competencies are centred around technology.

Conclusions and implications

This research has endeavoured to investigate from a new perspective the effects of intellectual capital management on innovativeness in R&D institutions while introducing in a structural model the technological orientation dimension as a strategic organisational approach to developing innovation capabilities. The initial assumptions were that all intellectual capital components have a direct positive influence on innovativeness. However, the findings demonstrate that, while structural and relational capital

significantly affect innovativeness in an R&D institution, human capital does not have a similar effect. Nevertheless, human capital has a significant impact on an organisation's technological orientation, which has a reinforcing effect on the development of innovation capabilities. Furthermore, innovativeness significantly influences technological orientation in R&D institutions, whose core competencies and business models are technology-related and technology-based.

The research results align with the scarce investigations previously dedicated to the relationship between intellectual capital management and innovativeness in R&D institutions while adding to the extant knowledge in the field.

From a theoretical perspective, this research adds to the scientific literature on the intellectual capital-based view as well as to the literature on dynamic capabilities and innovation by providing new evidence on the role of intellectual capital in organisational growth through the development of innovative capabilities. In addition, the paper contributes to the literature on strategic management by bringing new proof of the importance of strategic technological orientation on innovativeness.

From a managerial point of view, this research confirms that proper intellectual capital management is paramount for leveraging all knowledge stocks inside the organisation, while effectively managing knowledge, both from internal and external sources, is the prerequisite for success. Continuous training and upskilling, an organisational culture of collaboration, partnerships with stakeholders that can enhance knowledge acquisition as well as the effective use of up-to-date technological infrastructure are all critical factors for organisational development that relies on appropriate management of intellectual resources.

Several limitations can be identified concerning this research. First of all, the coefficients of determination and the effect size are sample related, and the sample size is limited by the voluntary participation of the respondents in this investigation. Moreover, the replies represent the respondents' subjective views, which can further affect the results and their replicability. In addition, the responses are reflective of the local R&D situation. Future research would ideally involve a larger sample and possibly include samples from more R&D institutions to allow comparability of results.

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