Review of empirical research on intellectual capital and firm performance

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Abstract

Purpose – The basis of value creation has shifted from tangible factors of production towards intangible resources such as intellectual capital (IC) (e.g. Grant, 1996). The average organisation's IC has been estimated to be three to four times over its book value (Edvinsson and Malone, 1997); thus, it is vital for companies to understand how it is created, managed, measured and evaluated. However, there are still many debated and complex issues, and the empirical measurement of IC is one of those. The purpose of this paper is to determine if IC systematically influences firm performance.

Design/methodology/approach – A systematic review procedure was utilised as this study's research design.

Findings – The findings demonstrate that IC influences firm performance mainly through interactions, combinations and mediations. Also, there is a great deal of evidence on the significant relationship between IC and firm's innovation performance.

Research limitations/implications – This paper reviews only empirical studies based on survey data and statistical methods of analysis.

Practical implications – The research points to some focal aspects of IC that are associated with firm performance.

Originality/value – This is the first study to review empirical literature on IC and firm performance. It increases the current understanding by bringing together the research related to the issue and drawing meta-level analysis.

Keywords Performance, Empirical, Intellectual capital, Systematic review

Paper type Literature review

Introduction

Nowadays, an organisation's value creation is largely based on intangible resources and capabilities, i.e. intellectual capital (IC) (Drucker, 1993; Edvinsson and Malone, 1997; Grant, 1996; Stewart, 1997; Sveiby, 1997). Edvinsson and Malone (1997) suggested that intellectual assets clearly outweigh the tangible corporate value, and the World Bank (2005) reported that intangibles account for 77 per cent of the total global wealth. In addition, a company's sustainable ability to compete in the modern knowledge economy is increasingly derived from the exploitation of knowledge resources (Stewart, 1997; Teece *et al.*, 1997; Zack, 1999). Another stream of literature has argued that IC has a positive relation to a company's innovation capability (Subramaniam and Youndt, 2005). Indeed, the conceptual literature has suggested that IC has a positive impact on firm performance (e.g. Bontis, 1998, 2001).

The key definitions and concepts of IC have been extensively discussed by scholars. In the late 1990s, several authors contributed to the first large wave of IC publications. As the outcome, IC was conceptualised as the combination of all the knowledge and competences that can manifest as a company's sustained competitive advantage (Roos and Roos, 1997; Stewart, 1997; Sullivan, 1998). In other words, IC consists of information, intellectual property, intellectual material, knowledge, core

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techniques, customer relationships and experience that can be utilised to make a company rich (Stewart, 1997). On a similar note, IC is about the knowledge, applied experience, organisational technology, customer relationships and professional skills that make a firm competitive in the marketplace (Edvinsson and Malone, 1997). Therefore, IC is not just a static intangible asset; rather, it is a means to an end (Bontis, 1998). IC can also be seen as the sum of the combined "hidden" assets of an organisation's members and what is left when they depart the office at the end of the working day (Roos and Roos, 1997), or the inventory of the knowledge-based resources owned by an organisation (Dzinkowski, 2000). Finally, IC is said to be associated with the social collective's knowledge and knowing capability (Nahapiet and Ghoshal, 1998).

As noted, IC consists of several types of knowledge-based resources. A three-dimensional categorisation of IC – human-, organisation- and relationship-centred – has been established as an emergent standard and a premise for how to build the measurement models. Human capital regards the firm's employees and their knowledge, education, skills, capabilities and characteristics (Bontis, 1998; Dzinkowski, 2000; Edvinsson and Malone, 1997; Roos and Roos, 1997; Stewart, 1997). Organisation-centred (e.g. organisational and structural) capital includes the knowledge embedded in information technology (IT) systems and the outcomes and products of knowledge conversion, such as documents, databases, process descriptions, plans, the intellectual properties of the firm and all the non-human storehouses of knowledge within a firm (Bontis, 1998; Edvinsson and Malone, 1997; Stewart, 1997). Finally, relationship-centred (e.g. relational and customer) capital consists of the value and knowledge embedded in the firm's external relationships, such as its connections with its customers, suppliers, distributors, partners, the local community and all the related parties (Dzinkowski, 2000; Edvinsson and Malone, 1997; Roos and Roos, 1997). As the above-mentioned discussion shows, the three-dimensional categorisation of IC was the main approach described by the pioneering scholars. While there are slight terminological differences between the definitions, the fundamental components are almost identical.

The special focus of this paper is to determine if IC systematically influences firm performance. The secondary objective is to examine how empirical IC research has developed over time by reviewing empirical IC literature published in peer-reviewed journals. The review is strictly limited to empirical IC research papers, even though the association between knowledge issues and firm performance has received attention in other similar domains, such as knowledge management (KM) practices (e.g. Palacios Marqués and Garrigós-Simón, 2006; Andreeva and Kianto, 2012). Previous IC reviews have not focused on firm performance issues, but the evolution of the IC field has received some attention; for instance, Petty and Guthrie (2000) examined the empirical literature in terms of measurement and reporting, Bontis (2001) reviewed utilised IC measurement models, Serenko and Bontis (2004) examined the citation impacts and research productivity rankings and Guthrie *et al.* (2012) recapped the literature on IC accounting research. More recently, Serenko and Bontis (2013) reviewed IC literature, but focused on the current state and impact of IC as an academic discipline, while Dumay and Garanina (2013) reported on IC research models and their utilisation.

It is highly important to review IC literature in the firm performance context in order to evaluate if IC really matters for the company's bottom-line. Also, the general development of empirical IC research should be examined, as it provides researchers with up-to-date information by disclosing how IC conceptualisations have evolved over time, what types of measurement models have gained ground and what the geographical spread of the field is.

The results of this study contribute to the current understanding of IC and firm performance by analysing 54 empirical research papers. The main finding is that IC influences firm performance mainly through interactions, combinations and mediations. Further, a great deal of evidence exists concerning the positive relationship between IC dimensions and firm's innovation performance. In addition to the findings regarding the firm performance issues, this review indicates that the conceptualisations of IC and the empirical measurement models are strongly influenced by a handful of early studies. Finally, the field of empirical IC research has grown in terms of the number of publications per year and the geographical spread of the field. However, recent diminishing figures may be a sign of a waning interest.

Research approach

The purpose of this study is to systematically review empirical IC literature and judge whether IC has influence over firm performance outcomes. The systematic review started with a literature selection process, which is depicted in Figure 1. In the first stage of the process, a computerised search was carried out to find the targeted body of literature. The abstract and citation database Scopus (www.elsevier.com/online-tools/scopus) was utilised as the search tool because it is capable of producing the most accurate search results among the major scientific databases (Falagas *et al.*, 2008). In the second stage,

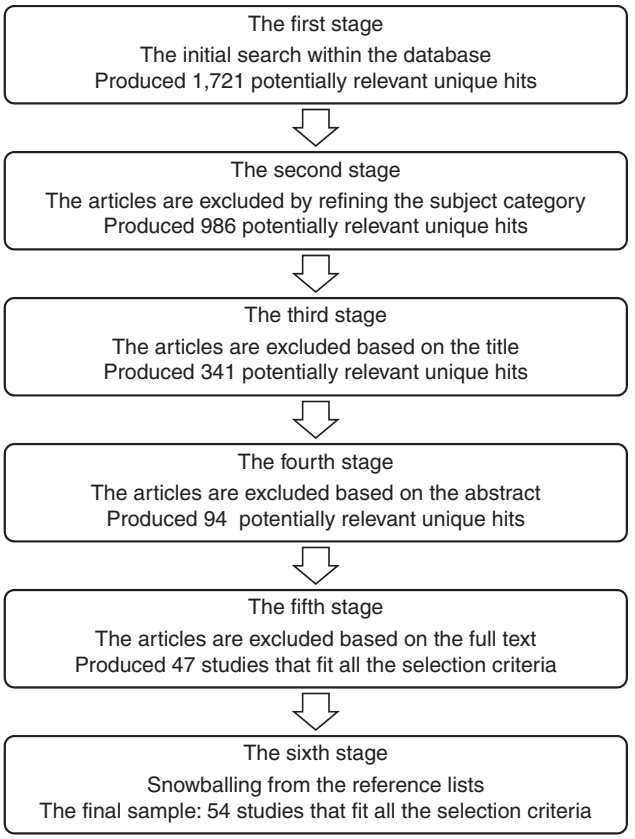

Figure 1.
The literature selection process

articles were excluded based on refining the subject category. In the third stage, the selected articles were screened by title. In the fourth stage, articles were eliminated after examining the abstracts. In the fifth stage, publications were excluded based on the full text. Finally, in the sixth stage, the "snowballing" technique was used to identify useful literature from the reference lists of remaining literature.

There were three important inclusion criteria for the potentially relevant articles. First, only papers that examine the relationship between IC and firm performance were included, as this area was identified as the obvious research gap in the literature. Second, only empirical research papers utilising survey data and quantitative methods were included because they have the potential to provide the most suitable evidence that can be utilised to close the identified gap within the literature. Case studies were not considered as feasible articles for this particular review, as they tend to deal with standout companies and thus provide evidence from only a small sample with exceptional conditions and/or performance. Also, papers with an accounting approach were excluded because they utilise solely balance sheet figures to calculate the values for IC. Some of those studies have even been criticised for their fundamental inability to tap into the phenomenon of IC (Ståhle *et al.*, 2011). Third, only articles from peer-reviewed journals were selected, in order to ensure trustworthiness and a minimum quality of the studies.

The literature selection process

The first stage – the initial search. The initial search for potential articles took place on 22 September 2014. In this stage of the process, the abstract and citation database Scopus was used as the search tool to identify the targeted literature. Scopus was considered to be suitable for the purposes of this study because of its wide coverage of academic literature. The single search term "intellectual capital" was utilised, and the search was limited to journal articles written in English. The single term was selected because a scan of the empirical IC literature suggested that the authors practically always included the term "intellectual capital" among the keywords; thus, the selected search strategy was expected to include the majority of the relevant studies. Furthermore, the search was limited only to one subject area, "Social Sciences and Humanities", as that area included the most prominent sub-areas, such as management. The first search produced 1,721 unique hits.

The second stage – articles excluded by refining the subject category. The vast majority of the first search results did not serve the purpose of this study; therefore, the search was further limited to the subject area "Business, Management and Accounting". Publications under that subject area were expected to have a high managerial approach; thus, they would represent the targeted group of publications more accurately. After the subject area limitation, the number of potentially relevant articles was 986.

The third stage – articles excluded based on the title. This stage involved going through the list of remaining article titles one-by-one, and eliminating the ones that did not seem to fit the pre-defined inclusion criteria. After the article title limitation, the number of potentially relevant articles was reduced to 341.

The fourth stage – publications excluded based on the abstract. In the fourth stage, all the remaining articles were subjected to abstract examination. It soon became apparent that there were still a considerably high number of unsuitable studies among the list of hits. In particular, many studies which calculated the IC figures from the company balance sheet figures were excluded in this stage of the review because their approach

to IC measurement differs fundamentally from the studies that utilise a survey strategy. After the abstract reading limitation stage, the number of potentially relevant articles was reduced to 94.

The fifth stage – publications excluded based on the full text. Full-text reading finally completed the list of studies that were found through the initial search and met the inclusion criteria. In this stage, the full texts of the remaining potential articles were carefully examined, and the number of relevant articles was reduced to 47.

The sixth stage – snowballing from the reference lists. The final stage of the review process was to conduct a snowballing procedure. This stage was included to identify potentially suitable publications among the reference lists of the articles that went through full-text examination. Snowballing increased the number of relevant articles to 54, which was the final number of the included studies.

Findings

Development of empirical IC research

Conceptualisations of the IC dimensions. Alongside the main research objective, the aim of this study is to clarify how empirical IC research has developed over time. As Table I showcases, the majority of the reviewed studies utilised the three-dimensional IC measurement model that consists of human, organisational (structural) and relational (customer) capital. Interestingly, some additional IC dimensions have been adopted within IC research; as a result, it is worthwhile to examine the contents of the dimensions in order to compare them with one another and judge if the new dimensions add any novelty value to the original measurement models. In total, nine IC dimensions were identified within the reviewed literature.

Human capital is "the intelligence of the organizational member" (Bontis, 1998, p. 65). It contains features such as the employees' sheer intelligence, values, attitudes, aptitudes, know-how, skills, capabilities, individual relationships, creativity, education, experience, qualifications, motivation, commitment, loyalty, resolve, interactions, expertise, proactivity, leadership abilities, flexibility, learning capacity, behaviour, intellectual agility and risk-taking propensity (e.g. Bontis, 1998; Bozbura, 2004; Youndt and Snell, 2004; Tovstiga and Tulugurova, 2007; Wu *et al.*, 2007; Cabrita and Bontis, 2008; F-Jardón and Martos, 2009; Hsu and Fang, 2009; Yang and Lin, 2009; Huang and Hsueh, 2007; Sharabati *et al.*, 2010; Chien and Chao, 2011; Leitner, 2011). All of the attributes regarding human capital originate from the knowledge and skills embedded in and available through the employees.

Structural capital is the organisational factors that support the human capital to perform (Bollen *et al.*, 2005; Chen *et al.*, 2004). It includes elements such as employee-supporting mechanisms and structures, organisational know-how, technological elements (such as information systems and databases), routines, procedures and processes, corporate culture, methods, business development plans, intellectual property (such as patents, copyrights and trademarks), strategy, organisational charts, manuals and programmes (e.g. Bontis, 1998; Bontis *et al.*, 2000; Wu and Tsai, 2005; Cabrita and Bontis, 2008; Wu *et al.*, 2008; Hsu and Fang, 2009; Kamukama *et al.*, 2010). On a slightly different note, some research models extend structural capital to incorporate relationships with the firm's external networks (Aramburu and Sáenz, 2011; Leitner, 2011; Tovstiga and Tulugurova, 2007).

Relational capital is the knowledge embedded in the firm's external relations (e.g. Cabrita and Bontis, 2008; Wu *et al.*, 2007). That covers the relations with agents,

Table I.
General characteristics of the reviewed articles

Author and year	Country	Industry	Human capital	Structural capital	Organisational capital	Customer capital	Relational capital	Social capital	Innovation capital	Information capital	Technological capital
Bontis (1998)	Canada	Multi-industry	X	X		X					
Bontis *et al.* (2000)	Malaysia	Multi-industry	X	X		X					
Yli-Renko *et al.* (2001)	The UK	High-tech						X			
Yli-Renko *et al.* (2002)	Finland	Electronics						X			
Youndt *et al.* (2004)	The USA	Multi-industry	X		X			X			
Bozbura (2004)	Turkey	Multi-industry	X		X		X				
Chen *et al.* (2004)	China	High-tech	X	X		X			X		
Youndt and Snell (2004)	The USA	Multi-industry	X		X			X			
Bollen *et al.* (2005)	Germany	Pharmaceutical	X	X		X					
Wu and Tsai (2005)	Taiwan	Multi-industry	X	X		X		X			
Subramaniam and Youndt (2005)	The USA	Multi-industry	X		X			X			
Tseng and Goo (2005)	Taiwan	Manufacturing	X		X		X		X		
Chen *et al.* (2006)	Taiwan	Manufacturing	X	X			X				
Reed *et al.* (2006)	The USA	Financial	X		X			X			
Bontis *et al.* (2007)	Egypt	Software	X								
Tovstiga and Tulugurova (2007)	Russia	Multi-industry	X	X							
Wu *et al.* (2007)	Taiwan	Information technology	X	X			X				
Menor *et al.* (2007)	The USA	Manufacturing	X	X				X			
Huang and Hsueh (2007)	Taiwan	Engineering consulting	X	X			X				
Cabrita and Bontis (2008)	Portugal	Financial	X	X			X				
Wu *et al.* (2008)	Taiwan	Multi-industry	X	X		X		X			

(*continued*)

Table I.

Author and year	Country	Industry	Human capital	Structural capital	Organisational capital	Customer capital	Relational capital	Social capital	Innovation capital	Information capital	Technological capital
Čater and Čater (2009)	Slovenia	Multi-industry	X	X		X					
F-Jardón and Martos (2009)	Argentina	Wood manufacturing	X	X			X				
Hsu and Fang (2009)	Taiwan	Information tech	X	X			X				
Yang and Lin (2009)	Taiwan	Healthcare	X		X		X				
Carmona-Lavado *et al.* (2010)	Spain	Industrial			X			X			
Huang and Wu (2010)	Taiwan	Pharmaceutics	X		X			X			
Kamukama *et al.* (2010)	Uganda	Financial	X	X			X				
Kianto and Waajakoski (2010)	Finland	Multi-industry						X			
Maditinos *et al.* (2010)	Greece	Multi-industry	X	X		X			X		
Namvar *et al.* (2010)	Iran	Computers and electronics	X	X			X				
Sharabati *et al.* (2010)	Jordan	Pharmaceutical	X	X			X				
Steinfield *et al.* (2010)	Denmark and Sweden	Biotech						X			
Aramburu and Sáenz (2011)	Spain	Manufacturing		X							
Cabello-Medina *et al.* (2011)	Spain	Multi-industry	X					X			
Chien and Chao (2011)	Taiwan	Financial	X		X					X	
Delgado-Verde *et al.* (2011a)	Spain	Manufacturing			X						
Delgado-Verde *et al.* (2011b)	Spain	High-tech and medium tech					X	X			
Hormiga *et al.* (2011a)	Spain	Start-ups					X				
Hormiga *et al.* (2011b)	Spain	New ventures	X	X			X				

(*continued*)

Table I.

Author and year	Country	Industry	Human capital	Structural capital	Organisational capital	Customer capital	Relational capital	Social capital	Innovation capital	Information capital	Technological capital
Kamukama *et al.* (2011)	Uganda	Financial	X	X			X				
Leitner (2011)	Austria	Manufacturing	X	X							
González-Loureiro and Dorrego (2012)	Spain	Innovative SMEs	X	X			X				
Jardon and Martos (2012)	Argentina	Wood manufacturing	X	X			X				
Mathuramaytha (2012)	Thailand	Industrial	X	X			X				
Suraj and Bontis (2012)	Nigeria	Telecom	X	X		X					
Hsu and Sabherwal (2012)	Taiwan	Multi-industry	X		X			X			
Kim *et al.* (2012)	South Korea	Hotels	X		X	X					
Mehdivand *et al.* (2012)	Iran	Nano-businesses	X	X			X				
Castro *et al.* (2013)	Spain	Technology-based	X			X					X
Ling (2013)	Taiwan	Multi-industry	X	X			X				
Mention and Bontis (2013)	Belgium and Luxemburg	Finance	X	X			X				
Wang and Chen (2013)	China	Multi-industry	X		X			X			

Note: X indicates which IC dimensions were examined in each reviewed article

customers, suppliers, competitors, partners, clients, shareholders, industry associations, members of the community, society, government, the state and informal networks (e.g. Bozbura, 2004; Wu *et al.*, 2007; Cabrita and Bontis, 2008; F-Jardón and Martos, 2009; Hsu and Fang, 2009; Huang and Hsueh, 2007; Namvar *et al.*, 2010; Sharabati *et al.*, 2010; González-Loureiro and Dorrego, 2012). Thus, relational capital may reside at both individual and institutional levels. There is one exception to the otherwise solid conceptualisation, as Yang and Lin (2009) related relational capital to the value of the firm's internal relationships.

Organisational capital and structural capital seem to overlap, as they have been used as interchangeable terms since the early IC studies. According to quite a famous notion, organisational capital consists of a firm's institutionalised knowledge assets which stay behind when the employees go home at night (e.g. Youndt *et al.*, 2004). The attributes of organisational capital that are mentioned most frequently within the literature are organisational culture, databases, information systems, processes, manuals, patents, routines and structures (e.g. Youndt and Snell, 2004; Youndt *et al.*, 2004; Subramaniam and Youndt, 2005; Carmona-Lavado *et al.*, 2010; Huang and Wu, 2010). In comparison, the same keywords for structural capital are routines, databases, patents, processes, structures, culture, information systems, mechanisms, charts, manuals and strategies (e.g. Bontis, 1998; Bontis *et al.*, 2000; Wu and Tsai, 2005; Cabrita and Bontis, 2008; Wu *et al.*, 2008; Hsu and Fang, 2009; Kamukama *et al.*, 2010). Therefore, the comparison of the key attributes of organisational and structural capital validates the prevailing understanding that the two IC dimensions address the same phenomena and are interchangeable terms.

Social capital is "the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit" (Nahapiet and Ghoshal, 1998, p. 243; see also Wang and Chen, 2013), and it concerns both the firm's internal and external relations (Yli-Renko *et al.*, 2002). Simply put, social capital can be described as the value of the firm's social relations (Reed *et al.*, 2006). Social capital is said to be a collective exchange of knowledge (Youndt and Snell, 2004) and the trait of social relations which can be mobilised to facilitate action (Steinfield *et al.*, 2010; Wu and Tsai, 2005). Concerning how social capital compares to some other IC dimensions, Subramaniam and Youndt (2005) explained that it resembles more organisational than human capital because the staff turnover most likely will not devastate it. However, organisational and social capital also differ drastically, as organisational is associated largely with codified knowledge whereas social capital deals with the more tacit type of knowledge (Subramaniam and Youndt, 2005).

Customer capital refers to the valuable knowledge embedded in customer relationships and marketing channels (e.g. Bontis, 1998; Bollen *et al.*, 2005; Čater and Čater, 2009; Kim *et al.*, 2012). Customer capital is also said to originate from the customer-supplier relationship (Maditinos *et al.*, 2010). Some conceptualisations were broader. For instance, Bontis (1998, p. 67) wrote that customer capital is "the potential an organization has due to ex-firm intangibles". Other descriptions have highlighted the magnitude of customer relationships but also explicitly incorporated the other ex-firm intangibles as factors constituting customer capital (Wu *et al.*, 2008; Castro *et al.*, 2013). Therefore, it seems that the customer and relational capital concepts overlap, at least partially. This argument is supported by the findings visualised in Table I, which demonstrates that the two IC dimensions have not been included in the same measurement models.

Innovation capital translates as the firm's ability to utilise the existing knowledge to create new knowledge, ideas, products and technologies (Maditinos *et al.*, 2010; Tseng and Goo, 2005), or the organisation's ability to successfully transform its knowledge into business value (Chen *et al.*, 2004). Sometimes innovation capital is incorporated within the structural capital dimension as intellectual property (Hsu and Fang, 2009), which also tells about the firm's ability to carve end products out of their knowledge base. There are few instances addressing innovation capital among the reviewed literature, but all of them seem to agree about it. Further, the innovation capital component is usually embedded in human capital as innovative employees (Castro *et al.*, 2013; Chien and Chao, 2011; Kim *et al.*, 2012; Leitner, 2011; Mehdivand *et al.*, 2012; Tovstiga and Tulugurova, 2007) or in the structural capital dimension as the firm's innovativeness (Aramburu and Sáenz, 2011; Bontis, 1998; Hormiga *et al.*, 2011b; Hsu and Fang, 2009; Wu *et al.*, 2007). It seems that innovation capital has not been overlooked within contemporary IC research, but it has not been given similar status as the more traditional IC dimensions. However, the inclusion of this new IC dimension might enable more fine-grained analysis and bring along research results with novelty value.

Information capital was examined in one of the reviewed papers. Chien and Chao (2011) defined it as a measure of the quality of the firm's information system. Technological capital also appeared in one study. Castro *et al.* (2013) defined it as the level of utilisation of technological knowledge and efforts put in research and development. Conventionally, IT systems are embedded in the firm's structural capital, as they play an integral role in the modern organisation's structural intelligence. Furthermore, IT systems represent one of the most tangible aspects of otherwise primarily intangible IC, and thus its separation as an additional IC dimension is questionable.

General findings. Table I presents the general findings of the systematic review. First, in line with the findings of Bontis *et al.* (2007), this review confirms the argument that IC research has developed in two major phases. The first phase, in the late 1990s, gave IC some publicity and included the seminal theoretical papers by Edvinsson and Malone (1997), Roos and Roos (1997), Stewart (1997), Sveiby (1997), Bontis (1998), Nahapiet and Ghoshal (1998) and Sullivan (1998). The second phase began in the early 2000s with more focus on the measurement models and new levels of analysis. It includes, for instance, the empirical research that is reviewed in this study. Almost all of the reviewed papers are less than ten years old, and the majority of those are post-2010 publications. Figure 1 presents the growing tendency of the annual publication activity of empirical IC research, but also indicates substantial variation between the years. The activity seems to have peaked in 2011 followed by two years of diminishing quantities. This finding can be regarded as either a part of the naturally occurring variation pattern or a warning signal of the waning line of research.

Second, empirical IC research seems to have truly global presence. Table I shows that the studies have focused mainly on European and Asian companies, but some papers have examined IC and firm performance in North and South American, African and Middle Eastern firms. The most actively studied companies have been Taiwanese (12), Spanish (nine) and American (five) firms. This finding indicates that the line of research is no longer dominated by American and British academics, as it was until the early 2000s (Serenko and Bontis, 2004). IC is nowadays a topical subject of interest for academics from a variety of cultural and economic backgrounds. This development is welcome, as many authors hope that IC research models will be tested in international

contexts (e.g. Yli-Renko *et al.*, 2001; Cabrita and Bontis, 2008; F-Jardón and Martos, 2009; Yang and Lin, 2009; Namvar *et al.*, 2010; Sharabati *et al.*, 2010; Delgado-Verde *et al.*, 2011b). Further, it seems that empirical IC research is conducted without industry boundaries.

Third, Figure 2 demonstrates that empirical IC research is rarely conducted without incorporating human and structural/organisational capital within the measurement model. Also, relational or customer capital are frequently included as the third IC dimension. Hence, the three-dimensional IC model has remained up until today very similar to what it was in the early conceptualisations (e.g. Edvinsson and Malone, 1997; Stewart, 1997). The citation count column in the Appendix is filled with information retrieved from Google Scholar (scholar.google.com). It shows that the highly cited publications from Bontis (1998) and Bontis *et al.* (2000) have shaped the empirical state of the field by strengthening the status of the three-dimensional IC measurement model. Additionally, social capital has emerged as another standard IC dimension. The citation count indicates that the articles from Yli-Renko *et al.* (2001), Youndt *et al.* (2004) and Subramaniam and Youndt (2005) have had the biggest impact on cementing social capital's status within empirical IC literature. Further, a close examination of those three influential publications suggests that their conceptualisations of social capital follow the one developed by Nahapiet and Ghoshal (1998) (Figure 3).

IC and firm performance outcomes

The inter-relatedness of IC and firm performance has been studied increasingly since the early 2000s. The summarised results of this systematic literature review are presented in the Appendix. According to the findings, a variety of different measurement models of IC and firm performance have been utilised; thus, the answer to the main research question "Does IC systematically influence firm performance?" is far more complex than a plain "yes".

The interactions of the IC dimensions. The majority of the reviewed empirical literature suggests that the IC dimensions enhance firm performance through their combinations and interactions (e.g. Kamukama *et al.*, 2010; Maditinos *et al.*, 2010; Sharabati *et al.*, 2010; Jardon and Martos, 2012; Kim *et al.*, 2012). One way of describing the interactions is to say

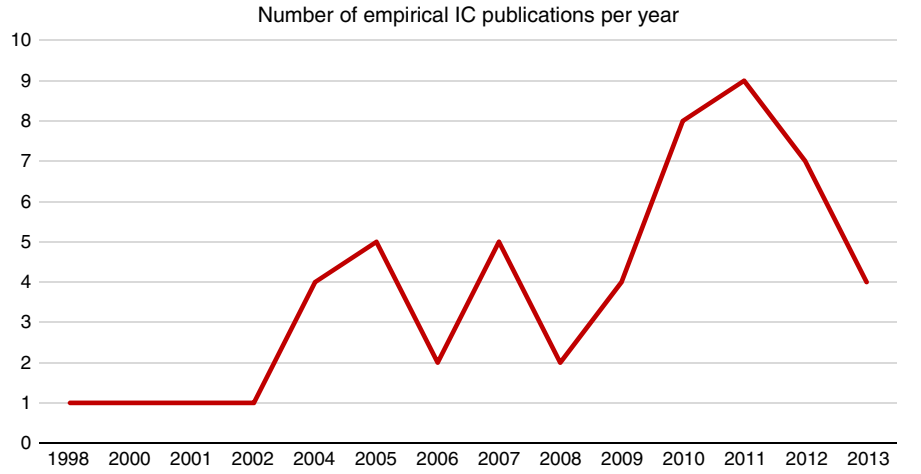

Figure 2.
The number of empirical IC publications per year

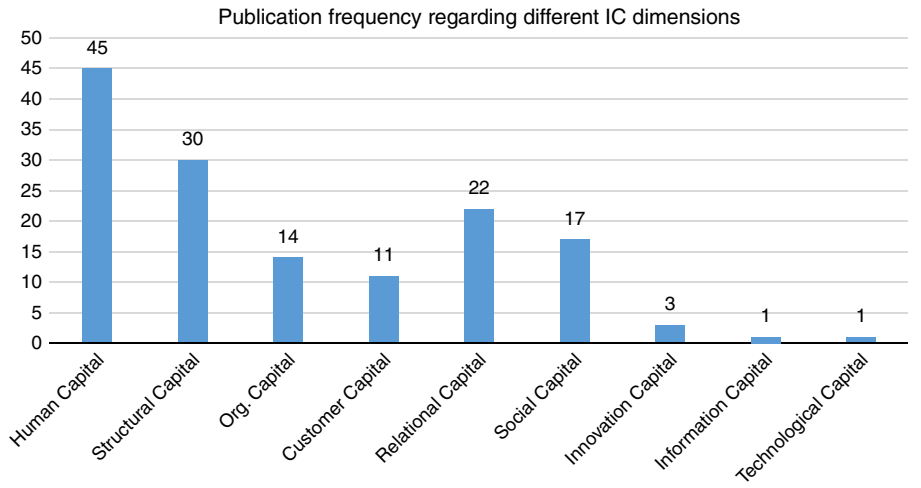

Figure 3.
The publication frequency regarding different IC dimensions

that human capital is required to establish structural capital – the stock of knowledge for the firm – and that structural capital is required to build relational capital with the environment (F-Jardón and Martos, 2009; Jardon and Martos, 2012). In a similar fashion, researchers have also argued that the firm's cumulative growth is best explained with their ability to transform the employees' knowledge into organisational knowledge (González-Loureiro and Dorrego, 2012) and that firms which are strong in both human and structural capital have a higher probability of being innovative (Leitner, 2011). Curiously, Bontis *et al.* (2000) reported that employees' intelligence (human capital) is not related to the extent of non-human storehouses of knowledge (structural capital) among the service companies.

At the same time, Castro *et al.* (2013) stated that the creative, experienced and skilful employees together with the company's customer networks lead to a high number of product innovations. That finding tells us that the firm's internal expertise combined with knowledge embedded in the external relations can accelerate innovativeness even without strong structural capital support. Likewise, Hormiga *et al.* (2011b) reported that new ventures benefit mostly from internal knowledge, skills and activeness, as well as from factors related to the firm's reputation, connectivity, accessibility and support from its networks. Also, the interaction of human and relational capital, especially staff training and education levels, strongly influences firm performance (Huang and Hsueh, 2007), and the combined effect of human and relational capital improves the organisational learning capability and new product development performance (Hsu and Fang, 2009). Indeed, many research papers have provided evidence that human capital supports the other IC dimensions, which in turn have a direct impact on firm performance (Bontis, 1998; Cabrita and Bontis, 2008; Kim *et al.*, 2012).

Interestingly, Bozbura (2004) pointed out a different aspect of the interaction between the IC dimensions. According to that study, it is the supporting infrastructure (structural capital) that enables creative activities within a firm and allows human and relational capital to contribute to firm performance. Moreover, innovation capital – one of the most scarcely studied IC dimensions – influences firm performance and is facilitated

largely by the existence of human and organisational capital (Tseng and Goo, 2005). Lastly, one study among the set of the reviewed literature did not find significant interactions between the IC dimensions (Reed *et al.*, 2006).

All in all, it seems that firm performance is largely generated by the interactions of the IC dimensions. Some sources suggested that human capital provides the skills to build the organisational knowledge base which enhances firm performance, whereas other studies indicated that the knowledge embedded in employees combined with functioning external networks is the most effective equation to achieve success. Then, there is additional evidence about the central role of structural capital, as it allows the contribution of human and relational capital. The common theme for these findings is that the employees, the organisational supporting structures or the established relations possess only little value separately, but establish a strong firm performance driver when combined. Thus, it can be stated that companies with high overall IC are able to attain significantly better firm performance than the less IC-rich companies (Youndt *et al.*, 2004), or that firms need to increase their total IC in order to improve firm performance (Chen *et al.*, 2004).

The mediator models. Another prevailing theme among the empirical IC literature is the mediator models. By "mediator", this study means a variable that explains the relationship between the independent variable(s) and the dependent variable, which is firm performance. As the empirical research on IC has developed, models to measure the relationship between IC dimensions and firm performance have also advanced. The mediator models have become especially popular among researchers (e.g. Bollen *et al.*, 2005; Wu *et al.*, 2007, 2008; Menor *et al.*, 2007; Kamukama *et al.*, 2011; Mehdivand *et al.*, 2012; Namvar *et al.*, 2010; Chien and Chao, 2011; Youndt and Snell, 2004; Youndt *et al.*, 2004; Yang and Lin, 2009). The reason for this popularity could be organisational complexity. In other words, the measurement models incorporate mediator variables because of the perceived ambidexterity of the relationship between IC dimensions and firm performance outcomes. Further, firm performance improvements can be seen to originate from the combined effect of IC and systematic and deliberate managerial activities (KM practices); thus, the overarching view of the phenomenon cannot be reached by focusing on only the direct relationships (Kianto *et al.*, 2014).

The first key finding among the mediator models is that IC has a positive influence on several organisational capabilities which have a tendency to improve firm performance. In particular, dynamic capabilities and innovation capabilities are seen as significant mediators. Dynamic capabilities are typically defined as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environment" (Teece *et al.*, 1997, p. 516), while researchers have defined innovation capability as the ability to translate knowledge and ideas into new products and processes (Lawson and Samson, 2001). Evidence has shown that the dynamic capabilities explain, for instance, the relationship between IC and innovativeness (Hsu and Sabherwal, 2012) and the impact of relational capital on innovative performance (Wu *et al.*, 2007). Innovation capability mediates the impact of IC on firm's competitive advantage (Mathuramaytha, 2012), while product innovation capability together with process flexibility mediate the effect of IC on business performance (Menor *et al.*, 2007). Furthermore, organisational learning capability is defined as the mediating factor that explains the relationship between human and relational capital and new product development performance (Hsu and Fang, 2009).

Another key finding is that quite often IC is found to mediate the relationship between organisational and managerial activities and firm performance. Particularly, human resources (HR) management is seen to contribute to IC and therefore enhance company success. For example, HR management practices, such as recruiting and selection, provision of healthier and safer working conditions, performance appraisal and training and development, are factors that increase the amount of IC and thus positively influence firm performance (Yang and Lin, 2009). Wang and Chen (2013) added that core HR practices, such as staffing, training, knowledge- and skill-based compensation, teamwork and employee participation, support both organisational and social capital, which in turn facilitate a firm's innovative capability. Also, Youndt and Snell (2004) agreed that HR configurations and practices play a fundamental role in the development of IC and firm performance, and Youndt *et al.* (2004) supported the view that investments in HR management lead to a higher amount of IC and higher firm performance rates.

The evidence regarding the mediator models is varied. One source argued that intellectual property is the mechanism that enables IC to improve firm performance (Bollen *et al.*, 2005). That is, when the amount of IC increases, the stock of intellectual property (e.g. patents and licences) also tends to increase, which can be utilised to improve firm performance. Then again, Namvar *et al.* (2010) explained that the phenomenon is the other way around – that IC mediates the influence of intellectual property on firm performance.

Furthermore, several other mediating factors contribute to the effect that IC has on firm performance. Among those, competitive advantage facilitates the relationship between the IC dimensions and financial performance (Kamukama *et al.*, 2011), cross-functional integration and co-production mediate IC's effect on new product sale performance (Chien and Chao, 2011) and entrepreneurial orientation has a similar impact on IC and business performance (Mehdivand *et al.*, 2012). Finally, empirical proof has also illustrated that IC can be seen as the mediating variable in the relationship between entrepreneurial orientation and innovation (Wu *et al.*, 2008).

In summary, growing evidence suggests that firm performance outcomes accrue through mediations between IC and other factors. Some sources have argued that IC is the driver for several organisational capabilities, whereas others have inferred that organisational and managerial practices, such as HR management and cross-functional activities, are precedents for IC and again for firm performance. Additionally, the firm's intellectual property and entrepreneurial orientation have been found to support IC and vice versa, and competitive advantages have also been seen as potential intermediators. Taking into account all the presented support, the conclusion is that organisational capabilities, activities, assets and orientation help us to understand how IC influences firm performance.

IC and innovations. The third well-covered topic within empirical IC literature is the relationship between IC and innovations (e.g. Subramaniam and Youndt, 2005; Carmona-Lavado *et al.*, 2010; Cabello-Medina *et al.*, 2011; Delgado-Verde *et al.*, 2011b; Leitner, 2011; Wang and Chen, 2013). Incremental and radical innovations have been discussed in a handful of studies. One popular view is that the organisational capital feeds social capital, which is a very fruitful interaction in terms of product innovations, especially radical ones (Carmona-Lavado *et al.*, 2010). Wang and Chen (2013) reported almost identical results about organisational and social capital. Their study found that the pair has a direct influence on incremental innovative capability, and social capital

alone also affects radical innovative capability. Subramaniam and Youndt (2005) added that social capital – the knowledge embedded in relations – is linked to both the firm's incremental and radical innovative capabilities and is a significant factor in transforming human capital's effect on innovative capability from negative into positive. In addition, they found that institutionalised knowledge (organisational capital) positively and directly influences incremental innovations. Delgado-Verde *et al.* (2011b) delivered supporting evidence about how the knowledge embedded in and obtained from internal (social capital) and external (relational capital) relations strongly and positively influences radical innovations.

The association between IC and innovation performance has attracted further discussion within empirical IC literature. For instance, Cabello-Medina *et al.* (2011) stated that a company's innovative performance is directly related to social and human capital and especially to the combination of them, and Leitner (2011) argued that high amounts of both human and structural capital leads to a higher probability of a firm's being innovative. Innovation-related measures have also been utilised as mediators in some research models; for example, the impact of IC on competitive advantage is intermediated by innovation capability (Mathuramaytha, 2012), and among several other mediating factors, dynamic capabilities and innovativeness are able to most successfully explain the relationship between IC and firm performance (Hsu and Sabherwal, 2012).

Ultimately, the empirical results suggest that IC is one of the major drivers for a firm's innovativeness. Social capital, in particular, seems to play a key role in transforming organisational knowledge into innovations. Typically, social capital has been defined as "the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit" (Nahapiet and Ghoshal, 1998, p. 243). Therefore, the reviewed literature has emphasised quite strongly the value of social relationships for a firm's innovativeness. The finding is in line with the core argument of "open innovation" literature, which states that external relationships in particular can bring along new knowledge and insights into the firm, allowing opportunity for novel ideas and collaborations (Chesbrough, 2003; Huizingh, 2011).

Conclusions

This review of empirical IC research highlights three key themes that are related to how IC influences firm performance. First, IC dimensions increase firm performance through interactions and combinations. Second, quite often the relation between IC and firm performance is best comprehended via mediator models. Third, strong empirical evidence exists regarding the effect that IC has over a firm's innovation performance and other aspects of innovativeness.

The impact of IC on firm performance outcomes stems from interactions and combinations. That is, employees' individual-level knowledge, a firm's structural arrangements and valuable relations support each other. The IC dimensions may not produce firm performance-enhancing effects separately, but strength in each of them increases the potential of doing so. This strengthens Bontis' (1998) argument that the utilisation of the firm's knowledge base requires an interplay between IC dimensions. Further, this study partially substantiates the view that more IC inspires better firm performance (e.g. Youndt *et al.*, 2004; Chen *et al.*, 2004) but also emphasises that firms may benefit from different IC profiles. It seems that a combination of human and

structural capital matters the most for some firms (e.g. Leitner, 2011; González-Loureiro and Dorrego, 2012), whereas some other companies' success is based on talented employees and the value of knowledge embedded in relations (e.g. Huang and Hsueh, 2007; Hsu and Fang, 2009; Hormiga *et al.*, 2011b; Castro *et al.*, 2013).

Firm performance outcomes accrue also through mediations between IC and other factors. IC can be, on one hand, the driver for various organisational capabilities which bolster firm performance (e.g. Menor *et al.*, 2007; Wu *et al.*, 2007; Hsu and Fang, 2009; Hsu and Sabherwal, 2012) and, on the other hand, the intermediator that explains why organisational and managerial activities, such as HR management, bear fruit (Wang and Chen, 2013; Yang and Lin, 2009; Youndt *et al.*, 2004). This understanding amplifies the dual-message of the knowledge-based view of the firm, which can be summarised that the prior knowledge resources provide the basis for knowledge-based organisational capabilities, which in turn can inspire an increase in the firm's knowledge resources (Cohen and Levinthal, 1990; Grant, 1996; Nahapiet and Ghoshal, 1998; Nonaka and Takeuchi, 1995; see also Amit and Schoemaker, 1993). In addition, the results of this study bolster Kianto *et al.*'s (2014) view about the potential moderation and mediation effects between IC and KM practices.

This review also finds that IC has a strong influence on a firm's innovation performance (Subramaniam and Youndt, 2005; Carmona-Lavado *et al.*, 2010; Cabello-Medina *et al.*, 2011; Delgado-Verde *et al.*, 2011b; Leitner, 2011; Wang and Chen, 2013). Especially, social capital is seen as a key factor that is needed to achieve a high level of innovativeness. Therefore, this study also agrees with the open innovation literature about the magnitude of the relationship and interaction-based knowledge on encouraging productive new ideas and fruitful collaborations within the organisation (Chesbrough, 2003; Huizingh, 2011).

Finally, empirical IC research began in the early 2000s and has developed into a globally renowned active field of study. However, there has been a slight dip in the number of publications after 2011, which may be a cause for concern or only a temporary condition. Further, the early conceptualisations (e.g. Edvinsson and Malone, 1997; Stewart, 1997; Nahapiet and Ghoshal, 1998) and the most actively cited empirical studies (e.g. Bontis, 1998; Bontis *et al.*, 2000; Yli-Renko *et al.*, 2001; Youndt *et al.*, 2004; Subramaniam and Youndt, 2005) have had a strong influence over how IC measurement models have evolved.

Implications for research and practice

This study made a contribution to the literature on IC by drawing upon meta-analysis of the empirical research on IC and firm performance outcomes. The results indicate that the relationship between IC and the firm performance outcomes follows several patterns; therefore, IC research models should accordingly be thorough enough to capture the whole essence and the several potential associations, including the direct effects and mediator models. Moreover, this study also furthers the knowledge-based view of the firm by amplifying its dual-message; on one hand, the prior knowledge assets enable the development of several organisational capabilities, such as dynamic capabilities and KM practices, and on the other hand, the organisational capabilities strengthen the knowledge base. Also, the publication figures have diminished during the last two years, which could be an early sign of the declining empirical IC research line. In order to build positive momentum, the IC research community should aim at continuous development by utilising original ideas, different research angles and various research methods.

For practicing managers, the meta-analysis on empirical IC studies reveals that firms are able to capitalise on several different IC profiles. In other words, some firms need high overall IC to inspire good performance outcomes, whereas other companies gain good results even with relatively low levels of structural or relational capital. There is no "one size fits all" type of solution available, but instead managers should analyse their IC needs by reflecting on their actual business needs. Business managers should also understand that is not just about what sort of knowledge or IC a firm possesses, but it is equally important to know what to do with it. For instance, hiring a knowledgeable individual or establishing a brand new KM system will merely provide the potential, while the deliberate and systematic practices are needed to unleash that potential. Finally, this study indicates that an IC profile with a strong social capital feature is associated with relatively strong innovation performance. That is, innovation tends to benefit from the extra-firm resources that are available through both individual and organisational relationships. Thus, the firms that have traditionally relied on fairly closed intra-firm innovation strategy should open up to establish a more efficient model.

Limitations and the future research

Despite its considerable contribution to the body of literature, this study also has some limitations. First, the literature selection process leaves room for personal preferences. Only the studies based on survey data and statistical methods of analysis were accepted within the scope of this study. Therefore, case studies and research based on the company balance sheet figures were excluded. One potential avenue for future study could be to systematically examine the case studies on IC. Second, this review concentrated on IC and firm performance, but the focus could be set elsewhere as well. For example, another future study idea could be to conduct an industry-specific systematic review about the differences in IC between various industries. Third, the reviewed literature consists predominantly of correlational, one-time studies. However, IC and firm performance should also be examined longitudinally, as suggested by quite a few authors, in order to determine the effect of causality and the long-term influence of IC over the success of the firms (e.g. Wu and Tsai, 2005; Chen *et al.*, 2006; Hsu and Fang, 2009; Hormiga *et al.*, 2011a). Fourth, another potential idea could be to use a recursive model, and determine if strong firm performance is associated with better IC, which in turn supports firm performance.

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Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
Bontis	1998	Human capital: intelligence of the organisational member Structural capital: contains elements of efficiency, transaction times, procedural innovativeness and access to information for codification into knowledge Customer capital: mainly the knowledge embedded in marketing channels and customer relationships	To determine which items effectively capture the constructs of human capital, structural capital, customer capital and performance, and thus build a foundation for further study	64	Structural equation modelling (SEM)	The findings largely confirm the hypothesised item-level contents of each IC dimension. Also, the results suggest that IC has a significant and substantive impact on performance, with customer and structural capital directly influencing firm performance and human capital having a positive effect on the other two IC dimensions	2,029
Bontis *et al.*	2000	Human capital: intelligence of the organisational member Structural capital: all non-human storehouses of knowledge in organisations which include the databases, organisational charts, process manuals, strategies, routines and anything whose value to the company is higher than its material value Customer capital: mainly the knowledge embedded in marketing channels and customer relationships that an organisation develops through the course of conducting business	To determine the interrelationships of three IC dimensions and firm performance in two industry sectors (service/non-service) in Malaysia	107	SEM	First, the relationship between human and customer capital is strongest in the structural model for both types of companies. Second, the influence of human capital to structural capital is positive but non-significant for the service companies and positive and significant for non-service companies. Third, the relationship between customer and structural capital is positive, substantive and significant for the both firm categories. Finally, structural capital and firm performance are positively related regardless the firm type	1,093
Yli-Renko *et al.*	2001	Social capital consists of social interaction, relationship quality and customer network ties	To study if social capital is related to the amount of external knowledge	180	SEM	Results indicate that social interaction and network ties are positively related to knowledge acquisition, but that relationship quality is negatively	1,920

(*continued*)

Table AI.
Key findings of the reviewed articles

Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
			acquired and exploited by young technology-based firms			related to knowledge acquisition. Moreover, knowledge acquisition is positively related to new product development, technological distinctiveness, and sales cost efficiency. There is also a mediating role of knowledge acquisition between social capital and knowledge exploitation	
Yli-Renko *et al.*	2002	Internal social capital reflects the extent and quality of relationships between individuals and units within an organisation External social capital consists of contacts of management, involvement of customers and involvement of suppliers	To explain the role of intra- and inter-organisational relationships in building the firm's distinctive knowledge base and in achieving international growth	56	Regression analysis	Internal and external interaction seems to lead to a higher accumulation of knowledge within the organisation, and therefore, to greater knowledge-intensity. External social capital, in terms of contacts of management, also increases firm's foreign market knowledge. There was no such effect found between the internal social capital and foreign market knowledge. Finally, and most importantly, knowledge can be argued to be a key resource for international growth, as both knowledge-intensity and foreign market knowledge were important factors in the international growth path	436
Youndt *et al.*	2004	Human capital: an individual employee's knowledge, skills and abilities Organisational capital: the	To examine how IC dimensions coexist to form distinct IC profiles across	208	MANOVA and Bonferroni	High HRM investments produce high overall IC profile, and high social and human capital profiles. Additionally, high overall IC profile showed	535

(*continued*)

Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		knowledge, skills and information that stays behind when an organisation's people go home at night Social capital: embedded within, available through and derived from a network of relationships	organisations, and how investments in HR management, IT and R&D differ across these IC profiles and dictate the firm performance		multiple comparisons	significantly higher IT investment than high human capital profile. The high overall IC profile had significantly higher R&D investment than low overall IC profile and the high overall IC profile outperformed the low overall IC profile in firm performance	
Bozbura	2004	Human capital: a mixture of employees' occupational or general knowledge accumulation, the leadership abilities, risk-taking and problem-solving capabilities Relation capital: the relations with customers, shareholders, suppliers and rivals, the state, the official institutions and society Organisational capital: the sum of all assets that make the creative ability of the organisation possible	To try to determine the criteria that forms IC of the Turkish firms and to reveal the relations between IC and market values	71	Regression analysis	Human capital and relation capital of firms have positive and strong relationships with market/book value of firms in Turkey, while organisational capital has a positive and strong correlation with human and relation capital	132
Chen *et al.*	2004	Human capital: individual tacit knowledge embedded in the mind of the employees Structural capital: a mechanism and structure of an enterprise that can help support employees in their quest for optimum intellectual performance Innovation capital: a competence of organising and implementing R&D, unremittingly bringing forth new	To design a measurement model and a qualitative index system of IC, so as to provide a good tool for enterprises to manage their IC	31	SEM	A positive correlation exists between IC and firm performance. It seems that human capital can remarkably influence both structural capital and customer capital, and so does structural capital to both innovation capital and customer capital. Relatively, the influence of human capital on innovation capital and that of innovation capital on customer capital is less significant. This	495

(*continued*)

Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		technology and new products to meet the customer demands Customer capital: a bridge and a catalyst on the operations of IC, is the main requirement and determinant in converting IC into market value and thereupon organisation business performance				indicates that an interactive relationship exists between the four IC elements and that the enterprise must understand and improve its entire IC level to active better firm performance	
Youndt and Snell	2004	Human capital refers to individual employee's knowledge, skills and expertise Social capital describes the collective exchange of knowledge among people (and systems) Organisational capital refers to institutionalised knowledge and codified experience stored in systems, processes, databases, routines, patents, manuals, structures and the like	To introduce IC as a mediating construct between HR configurations and firm performance, thereby combining research streams in HR and strategic management	208	Regression analysis	The results point out that most of HR configurations' effects on performance are mediated by the IC variables. Human and social capital are the primary drivers of firm performance and HR systems are fundamental in the development of IC	408
Bollen *et al.*	2005	Human capital comprises the organisational members' individual tacit knowledge. These are skills which cannot be articulated that are necessary to perform their functions Structural capital comprises mechanisms and structures, which help to support the employees Customer capital mainly comprises knowledge of marketing channels and customer relationships	To examine what are the links between IC, intellectual property and firm performance	41	Regression analysis	There is no direct link found between IC dimensions and firm performance. However, all three IC dimensions have association with firm performance when intellectual property is used as a mediator. Further, the IC dimensions positively influence each other, i.e. when improving one of the components the other two components are improved as well	139

(*continued*)

Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
Wu and Tsai	2005	Structural capital includes all non-human storehouses of organisation knowledge, including databases, organisational charts, process manuals, strategies, routines and anything else with a value exceeding its material value Human capital represents the individual knowledge residing in an organisation. Every individual in an organisation represents a unit of human capital Customer capital comprises four dimensions: depth (penetration), width (coverage), attachment (loyalty) and profitability of corporate operations Social capital is created when relations among people change in ways that facilitate instrumental action. Social Capital inheres in the relations between and among individuals	To develop a comprehensive research framework to integrate the interrelationships among knowledge-creating activities, IC and knowledge management effectiveness. Also, to study the influence of social capital and business operation mode on knowledge-creating activities, IC and knowledge management effectiveness	134	SEM	Human capital and customer capital positively influence KM effectiveness. Furthermore, firms with higher levels of social capital tend to achieve higher levels of human, customer and structural capital. Thus, significant interrelationships exist among the IC stocks. Also, higher levels of social capital displayed increased knowledge creation and IC	34
Subramaniam and Youndt	2005	Human capital is knowledge, skills and abilities residing with and utilised by individuals Organisational capital is institutionalised knowledge and codified experience residing within and utilised through databases, patents, manuals, structures,	To study how different aspects of IC influence various innovative capabilities in organisations	93	Regression analysis	Organisational capital is significantly related to incremental innovative capability. However, social capital by organisational capital interaction is not significantly related to incremental innovative capability. Human capital exhibits, against the hypothesis, a significant, negative relationship with	1,360

(*continued*)

Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		systems and processes Social capital is knowledge embedded within, available through, and utilised by interactions among individuals and their networks of interrelationships				radical innovative capability. However, human capital by social capital interaction has a significant, positive relationship with radical innovative capability. Finally, social capital is significantly and positively relates to both incremental and radical innovative capabilities, indicating that its influence is both moderating and direct	
Tseng and Goo	2005	Human capital is a collective capability of a firm to extract the optimum solutions from employee knowledge, and is a direct consequence of the sum of workforce expertise, knowledge and attitude Innovation capital is defined as the ability to build on previous knowledge and generate new knowledge. It includes the ability of a company to develop new products, as well as any creative ideas Organisational capital belongs to company, and is the actual environment established by a firm to manage and generate its knowledge effectively. It includes information systems, operation processes and organisation culture Relationship capital refers to the external relationships or network of	To connect IC deployment with changes in corporate value, and specifically tries to establish a link between the two	81	SEM	Organisational capital does not directly impact corporate value, but does it indirectly through its positive effect on innovation capital. This phenomenon implies that organisational culture, information systems and operation processes are closely connected to a firm's innovation ability. Additionally, effective management of organisational capital helps a company to establish good relationships with other participants in the external environment. Human capital indirectly and positively influences corporate value through innovation capital, organisational capital and relationship capital. That is, if human capital cannot be effectively managed, it reduces other IC dimensions' ability to increase corporate value. Both	239

(*continued*)

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		associates of an organisation, as well as the satisfaction of these associates with and their loyalty to the company				innovation capital and relationship capital directly influence corporate value. Notably, innovation capital positively impacts relationship capital, and also has a stronger effect on corporate value than does relationship capital	
Chen *et al.*	2006	Human capital is embedded in employees Structural capital is embedded in organisations Relational capital concerns external relations	To examine the influence of three IC dimensions on new product development, and figure out if industry growth rate is an influencing factor	159	Regression analysis	IC dimensions have significant and positive relationships with firm's new product development performance. The interaction terms between industry growth rate and three types of IC stocks were significant – the higher the growth rate of an industry, the stronger were the positive relationships. Also, relational capital was the most significant contributor to firm performance, human capital was next and structural capital was the least significant	81
Reed *et al.*	2006	Organisational capital: a repository of knowledge that is accessible through a number of sources, allowing for knowledge sharing and knowledge creation among affiliated employees and external parties Human capital relates to knowledge stocks and flows Social capital: the value of the social relations	To analyse the inter-relatedness of IC components and their influence on financial performance in personal and commercial banks	292	Regression analysis	In the personal banks, the size and age of a firm, when entered by themselves, explain a high percentage of the variance in financial performance, while none of the main effect IC components are significant. In the commercial banks, size and age, when entered by themselves, explain a high percentage of that variance, although unlike personal banks, age does not impart a significant influence. Again,	239

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Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
						none of the IC interactions were significant, but two of the main effect IC components, internal and external social capital, were significant	
Bontis *et al.*	2007	Human capital represents an individual stock of knowledge embedded in the firm's collective capability to extract the best solutions from its individual employees	To investigate is there a correlation between human capital and firm performance	38	Regression analysis	Organisational performance is especially influenced by superstar employees who have capabilities such as high levels of intelligence, creative ideas, ability to initiate, ambition or inimitability. Other attributes which have a positive influence are team working skills, ability to translate customer needs into products and project management skills. Contrary to hypotheses, a high employee turnover does not drag down firm performance. Moreover, certified and experienced employees are non-significant in relation to firm performance	79
Tovstiga and Tulugurova	2007	Human capital: competence (knowledge, skill sets and experiential knowledge), attitude (level of motivation, behavioural patterns) and intellectual agility (innovation, creativity, flexibility, adaptability) of the enterprise's employees Structural capital: organisational routines and attributes (including the organisation's cultural	To examine the impact of IC on firm performance among small innovative enterprises in the Saint-Petersburg, Russia region	20	Regression analysis	There is a high association between different IC dimensions. On one hand, the results suggest that internal, IC-related, factors are the most significant in determining firm performance; thus, external factors were clearly outweighed. Firm's human capital seems to be the strongest single antecedent for firm performance	46

(*continued*)

Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		attributes), organisational and managerial mechanisms, processes and procedures and the firm's relational networks with external players (customers, alliance partners, suppliers, regulatory institutions, agencies, etc.)					
Wu *et al.*	2007	Structural capital is an infrastructure that can help to support the generation of employees' valuable ideas, innovation of new products and help to transform new ideas into profit Relational capital represents all relationships an organisation develops whether they are with suppliers, strategic alliance partners, customers, competitors or the government Human capital is employee-dependent, such as employees' education, competence, experience, commitment and loyalty	To study the influence of IC and dynamic capabilities on innovative performance	100	Regression analysis	Results indicate that structural and relational capital fully mediate the effects of human capital on innovative performance. Moreover, firm's dynamic capabilities have a direct impact on innovative performance. Also, the findings show that dynamic capabilities, as a moderating variable, enhance the positive effect of relational capital on innovative performance	47
Huang and Hsueh	2007	Human capital: knowledge, skill, expertise of employees and managers, proactive response and entrepreneurship Structural capital: system, structure, strategy and culture Relational capital: the relationship between enterprises, customers, suppliers and partners	To investigate what is the influence of IC to firm performance	101	Path analysis	The only significant path is found between relational capital and firm performance. However, human capital seems to be the feeding force for relational capital, and thus equally important factor for firm performance. Employees' education and training was the most important item among human capital that influence firm performance	51

(*continued*)

Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
Menor *et al.*	2007	Human capital: tacit and explicit knowledge manifested through the technical skill levels of the workforce and relative organisational learning capabilities Structural capital: codified knowledge in state-of-the-art manufacturing processes and superior information systems Social capital (supply chain integration): the relative degree of strategic internal integration and of external integration with suppliers and customers	To study if operational IC influences organisation level operating capabilities such as process flexibility and product innovation, which, in turn, influence business performance	264	SEM	Human capital, structural capital and social capital constitute an important antecedent for process flexibility, product innovation capabilities and for business performance. Greater level of IC is associated with better market and financial performance, as well as with higher levels of human capital, structural capital, and to a lesser degree supply chain integration (social capital)	59
Cabrita and Bontis	2008	Human capital: education, skills, values and experiences Structural capital: non-human assets such as information systems, routines, procedures and databases Relational capital: knowledge embedded in relationships with customers, suppliers, industry associations or any other stakeholder that influence the organisation's life	To study what are the interrelationships among IC components and business performance	53	SEM	IC positively and significantly influences business performance. IC is a phenomenon of interactions, combinations and transformations, with human capital ultimately being the most important construct in the context as it influences business performance through relational and structural capital	173
Wu *et al.*	2008	Human capital: skills and capabilities of the people working in an organisation Customer capital: the potential an organisation has due to ex-firm intangibles	To develop a comprehensive research model to integrate the interrelationships among social	159	Regression analysis	IC can enhance firm's level of innovation. Also, entrepreneurial orientation, and social capital are significantly related to innovation, but not without a perfect mediating effect of IC. Entrepreneurial orientation	118

(*continued*)

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		Structural capital: all non-human storehouses of knowledge in organisations, including databases, organisational charts, process manuals, strategies, routines, etc. Social capital: social interactions or network ties, assets that are rooted in relationships, and those resources that provide shared representations, interpretations and systems of meaning among parties	capital, entrepreneurial orientation, IC and innovation			provides a stronger moderating effect between IC and innovation than social capital does. Also, there were no differences in IC and entrepreneurial orientation between manufacturing industries and non-manufacturing industries. However, the levels of social capital in non-manufacturing industries are significantly higher than in manufacturing industries	
Čater and Čater	2009	Human capital is an individual-level construct Structural capital includes organisational know-how and therefore falls within the boundaries of a firm Customer capital represents the knowledge embedded in marketing channels and customer relationships that an organisation develops through the course of conducting business	To study how do different capitals (IC, physical, financial) influence firms' competitive advantage and performance	182	SEM	The IC resources have higher influence on competitive advantage than financial and physical resources. Financial resources positively influence competitive advantage, but physical resources do not. Customer capital is the only IC dimension that significantly affects both a cost-leadership advantage and differentiation advantage. Human capital and structural capital positively affect only the differentiation advantage	29
F-Jardón and Martos	2009	Human capital: set of employees' values, attitudes, aptitudes and capacities that allow organisational value creation Structural capital: what remains in a company when employees go home for the night Relational capital: set of company's external relations	To examine the influence of IC on firm performance, as well as the interrelation of IC dimensions and human capital's role as the source of company's IC	113	SEM	Human capital is the source of the other dimensions of IC, while human and relational capitals are sources of structural capital, which again is the main driver of firm performance	26

(*continued*)

Table AI.

Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
Hsu and Fang	2009	Human capital comprises all business capital embedded in employees and not owned by the organisation Relational capital includes all value in stakeholder, customer and supplier relations Structural capital includes process capital and innovation capital. Process capital is defined as workflow, operation processes, specific methods, business development plans, information technology systems and cooperative culture, etc. Innovation capital is defined as intellectual property within an organisation, including patents, copyrights, trademarks and know-how, etc.	To research the influence of IC dimensions on each other and their relation to new product development performance via the mediating role of organisational learning capability	123	SEM	Human and relational capital improve new product development performance through organisational learning capability, while human capital has also a direct influence. All three IC dimensions significantly influence organisational learning capability. Further, both human and relational capital significantly affect structural capital, but structural capital's direct influence on new product development performance is negative	150
Yang and Lin	2009	Human capital is a core asset of an organisation, including knowledge, skills, experience, competence, attitude, commitment and individual personal characteristics. Relational capital is the value embedded in internal relationships (among employees) Organisational capital encompasses any structural element of an organisation that facilitates the employees' ability to create wealth for the firm and its stakeholders	To examine what human resource management can best support IC and does IC explain firm performance	277	Sobel test	The three types of IC dimensions significantly explain firm performance. In particular, organisational capital has almost two times better predicting power compared to human and relational capital. Also, the link from HRM practices to firm performance via IC is empirically confirmed. The most influential HRM practices to firm performance are recruiting and selection, health and safety, performance appraisal and training and development	78

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Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
Carmona-Lavado *et al.*	2010	Social capital: relationships such as friendship, trust and respect, which influence people's behaviour Organisational capital: knowledge which is institutionalised within firm's processes and databases, documents, patents and manuals that are used to store and retain knowledge	To study what is the influence of organisational capital on social capital and what are the effects of both types of IC on product innovation. Also, to confirm if there is there a moderating role of radicalness of innovations to firm performance	90	SEM	Organisational capital has a positive effect on social capital, and social capital in turn influences product innovation positively. That means that social capital totally mediates the effect of organisational capital on product innovation. Also, social capital's influence on product innovation is higher as when the radicalness of innovation rises, but organisational capital does not have similar effect	71
Huang and Wu	2010	Human capital is knowledge, skills and abilities residing within and utilised by individuals Organisational capital is institutionalised knowledge and codified experience residing within firms and utilised through databases, patents, manuals, structures, systems and processes Social capital is defined as knowledge embedded within, available through, and utilised by, interactions among individual and their networks of interrelationships	To investigate the relationship between IC and knowledge productivity	113	Regression analysis	Knowledge productivity exhibit a significantly positive relation with human, organisational and social capital. Social capital significantly and positively moderated the relationship between human capital and knowledge productivity. However, the interaction between social capital and organisational capital was negative but not significantly related to knowledge productivity	46
Kamukama *et al.*	2010	Human capital is professional competence, social competence, employee motivation and leadership ability	To investigate how IC dimensions interact to influence firm performance	51	Regression analysis	Human and structural capital were significant predictors of financial performance. The inclusion of interactive term (structural×human)	33

(*continued*)

Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		Structural capital is competitive intelligence, formulas, information systems, patents, policies, etc., resulted from products or systems that a firm has created over time Relational capital is an invisible asset based on developing, maintaining and nurturing high-quality relationships with any organisation, individuals or group that influences business performance				even increased the predictive power of the main effects (human and structural capital). Also, inclusion of interactive term human×relational increased the explanatory power of the model	
Kianto and Waajakoski	2010	Social capital consists of ego-centric, socio-centric, structural, relational and cognitive dimensions	To examine what is social capital's influence on firm growth	143	Regression analysis	The only dimension of social capital that is related with turnover growth is external extended structural capital that is the extent to which the key partner relationship allows the firm to access new partners or customers. In the companies not belonging to inter-organisational networks, internal relational social capital is negatively associated with growth. For the firms that belonged to those networks this tendency is reversed. Finally, personnel growth is not associated with any of the social capital variables	16
Maditinos *et al.*	2010	Human capital represents the individual knowledge asset of a company's employees Customer capital is knowledge that is developed to the customer-	To analyse how four elements of IC are associated with business performance	119	SEM	The IC dimensions are highly interrelated with each other. The other IC dimensions support structural capital, and the relationship between structural capital and business	10

(*continued*)

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		supplier relationship when conducting business Structural capital contains databases, organisational charts, process manuals, strategies, routines, etc. Innovation capital is the ability to build on previous knowledge and generate new knowledge				performance is positive and relatively important for non-service industries. On the other hand, the result is less substantive within service industries	
Namvar *et al.*	2010	Human capital is the existing level of knowledge at a point in time in individual's memory Relational capital is the movement of knowledge between entities, including employees, organisations, partners, suppliers and customers Structural capital is investments, processes, structures and activities established by organisations aimed at changing or maintaining human capital, or influencing relational capital	To study the interrelations of IC dimensions and the effects of intellectual property on IC and firm performance in Iran	106	Regression analysis	There is a significant relationship between IP and three dimensions of IC. Also, human, relational and structural capital are all interrelated. Further, there is a positive relationship between IC dimensions and firm performance. However, there is not direct relation between IP and firm performance, but only an indirect link via IC dimensions	24
Sharabati *et al.*	2010	Human capital: competence, skills and intellectual agility of individual employees Structural capital: knowledge in an organisation that is embedded in systems, databases and programmes Relational capital: all knowledge that is embedded in relationships	To examine the relationship between IC and firm performance	132	SEM	Three dimensions of IC have a combined positive association with firm performance. Innovation and creation are the most important features of human capital, whereas relations with partners, suppliers and customers are the strongest influencers within relational capital dimension. Finally, in structural	121

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Table AI.

Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		with external parties such as customers, suppliers, partners and other external stakeholders				capital, systems and programmes have the largest coefficient whereas intellectual property rights have a negative association to firm performance	
Steinfield *et al.*	2010	Social capital: the goodwill that is engendered by the fabric of social relations in which an individual is embedded, and which can be mobilised to facilitate action	To examine if firm performance in knowledge-intensive clusters is dependent on possession of social capital	58	Regression analysis	Social capital influences the likely success of companies in the cluster, especially the start-up R&D companies. The amount of perceived social capital, the extent of ICT use for human capital, and the ease of accessing knowledge resources all significantly predict market exposure. Both personal relationships and the ICT applications that enhance a company's access to people and knowledge resources contribute to visibility and overall market performance	14
Aramburu and Sáenz	2011	External structural capital: external relationships with customers, suppliers or R&D partners Internal structural capital: organisational capital is the set of intangibles which enable company activity to be structured and developed effectively and efficiently. It encompasses elements such as organisational design, culture, policies and guidelines and	To investigate the impact of structural capital on the ideation stage of innovation processes	142	SEM	Structural capital explains a great deal of variance in new idea generation. However, company size dictates the effect of each structural component. In both large and small firms, a balance is needed in management of internal and external resources and capabilities: small companies should not overlook the internal innovation capabilities and large companies should seek additional opportunities from external	18

(*continued*)

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		innovation strategy; technological capital is the ICT infrastructure				networks and agents. Further, having a group of qualified people devoted to new idea generation is of great relevance	
Cabello-Medina *et al.*	2011	Human capital: knowledge, skills and abilities residing with and utilised by individuals Social capital: the sum of the actual and potential resources embedded within, available through and derived from the networks of relationships possessed by an individual or social unit	To study if there is a direct relationship between IC and innovative performance, and to examine the links between IC dimensions. Also, to scrutinise the effects of HR management practices on social and human capital, and the influence of innovative performance on firm performance	85	SEM	Factor analysis resulted two human capital categories: unique HC and valuable HC. Unique HC has a positive and significant influence on innovativeness, but valuable does not. Social capital does not have a direct relationship to innovativeness, but contributes through unique HC (mediator). Finally, HRM practices influence both human and social capital. Employee empowerment (involvement in decision-making processes) enhances unique HC, whereas social capital is enhanced by recruiting candidates who are able to collaborate and by involving them in decision making. Lastly, providing individual and group incentives does not have the expected influence on IC and innovativeness	31
Chien and Chao	2011	Human capital: integration of employee knowledge, technology, task realisation capabilities, innovation capabilities and creativity Organisation capital: organisational culture, management, systems or	To examine the effect of IC on new product sales performance based on cross-functional integration and co-production	871	Regression analysis	IC has a direct positive effect on new product sale performance, cross-functional integration and co-production. There is also a mediating effect of cross-functional integration and co-production on IC and new product sale performance. Firms	6

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Table AI.

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		tools that facilitate communication within a company, and other IC related to knowledge flow such as databases, networks and information systems Information capital: investment in organisational capability, which leads to good performance in terms of speed, quality, flexibility and innovation				should try to take advantage of high amount of IC through internal integration and customer co-production	
Delgado-Verde *et al.*	2011a	Organisational capital consists of operational processes, information systems, organisation culture, internal organisation structure and administrative systems	To study what is the nature and measures of organisational capital, and what is its influence on innovation performance	251	Regression analysis	Factor analysis found two organisational capital categories: culture and CEO commitment (CCC) and communication and information technologies (CIT). Evidence supports that organisational capital is one of the main sources of innovation performance. CCC for innovations encourages human resources with a proactive attitude, shared vision, values and beliefs to reach the innovation aim. Further, CIT are important features of and innovative firm as knowledge transfer, communication, interactions and conversations take place nowadays via these technologies	39
Delgado-Verde *et al.*	2011b	Relational capital: a set of knowledge obtained by a firm derived from relationships with other agents of its environment	To examine the influence of relational and social capital on	251	Regression analysis	Both types of IC have a positive and significant statistical influence on radical innovations. The results show that firms tend to look at themselves	14

(*continued*)

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		(as customers, suppliers or allies) which brings the necessary knowledge base to carry out its activity more efficiently Social capital: a set of informal and personal relationships maintained by employees within a firm, and not predetermined by it, which allows improving knowledge base and objectives achieving	development of radical innovations			(social capital) instead of spanning their boundaries (relational capital) when searching new knowledge. However, external relationships have the highest impact on radical innovations, so firms should not rely too much on intra-firm relations	
Hormiga *et al.*	2011a	Relational capital: value generated by relations, with customers, suppliers, shareholders and all the groups of interest, both internal and external	To study that does relational capital enable start-up companies to be more successful	130	ANOVA	Support from informal networks, firm's early reputation, attendance of the entrepreneur at business-related events and easy customer accessibility are significant relational capital items to the success of the start-up companies. On the contrary, the time dedicated to establishing relations with customers and suppliers, the image of the firm, the number of ties and agreements and easy accessibility to suppliers do not contribute to the success of start-ups	30
Hormiga *et al.*	2011b	Human capital: entrepreneur's knowledge, motivation, commitment and resolve, social skills and interaction of the entrepreneurial team Structural capital: routines, innovation, efficacy in production of a product/service and organisational	To examine what is the relationship between IC and success of new ventures	130	Regression analysis	There is a significant and positive correlation between human capital and success of the new ventures, as structural capital explains much less variance in new venture performance. Actually, such capital is difficult to evaluate among young firms as it requires time to develop. All the	56

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Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		culture Relational capital: support from informal networks, reputation, connectivity, accessibility and supplier profile				relational capital items within the research model are significant except the asset labelled "supplier profile", which refers to those firms that opt to purchase from only a few suppliers. Firm's reputation, support from informal networks and a good accessibility display a high level of significance	
Kamukama *et al.*	2011	Human capital encompasses employees' professional competence, social competence, employee motivation and leadership ability Structural capital is what happens among the people, how people are connected within a company and what stays when the employee leaves the company Relational capital is based on developing, maintaining and nurturing high-quality relationships with any organisation, individuals or group that influences or impacts your business	To study if competitive advantage has a mediating effect in the relationship between IC and financial performance	51	Regression analysis	IC has a substantive and significant relationship with financial performance. It is also evident that positive and significant relationships between IC and competitive advantage exist in the studied sample. Competitive advantage mediate the relationship between IC and firm performance	44
Leitner	2011	Human capital: creativity, teamwork capacity, flexibility, motivation, learning capacity and education which positively influence innovativeness and performance of firms Structural capital: structures,	To measure the relationship between IC and different innovation strategies by using a longitudinal study	91	Regression analysis	Human capital has a positive effect within highly innovative group of firms. In contrast, human capital has a negative effect for companies in the less innovative group of firms. The values are negative for structural capital for both firm groups, but not	10

(*continued*)

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		processes and routines, which, for instance, enable efficient product planning processes, facilitate communication within new product development teams and provide the necessary information for product development				significant. Moreover, the firms which have a strength in both human and structural capital have a higher probability of being highly innovative compared to the less innovative firm group. Finally, IC seems to be a good predictor of highly innovative firms, while the R&D expenditure better explains why there some firms are either less or not-at-all innovative	
González-Loureiro and Dorrego	2012	Human capital: a set of values, attitudes, qualifications and skills held by employees that generate value for firms Structural capital: the worth and value created within the organisation that remains when employees go home Relational capital: the result of the value generated by firms in their relations with the environment, including suppliers, buyers, competitors, shareholders, stakeholders and society	To study what are the best variables from each IC dimension at innovative SMEs for explaining the cumulative growth?	140	SEM	Human capital is the basic starting point and the main link that explains cumulative growth is human-structural capital. However, there is an unexpectedly low degree of linkage between human and relational capital. Related to that, SMEs appear to have a low degree of dependence on universities and technological centres. All in all, cumulative growth within innovative SMEs seems to be highly dependent on the process of transforming the knowledge of employees (tacit) into organisational knowledge (explicit)	11
Jardon and Martos	2012	Human capital is a set of values, attitudes, aptitudes and capabilities, of the employees that allow generating value to a company Structural capital is a stock of knowledge owned by a firm and	The study has a double objective: First, to determine the process by which IC increases performance of	113	SEM	Human capital is the primary component of IC. Any improvement in human capital surely will increase structural capital, and structural capital increases relational capital. This is the main mechanisms of IC/	11

(*continued*)

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Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		includes corporate culture, information technology and explicit knowledge Relational capital includes relationships with the environment, and more specifically with the economic agents who participate in different phases from the value chain of the product, i.e. suppliers, competitors and clients	SMEs in a developing country. Second, to analyse the relations among different dimensions of IC			knowledge creation. Relational capital outperforms tangible resources as the supporting mechanism for the organisational capabilities	
Mathuramaytha	2012	Human capital: values, attitudes, aptitudes and know-how Structural capital: contains both organisational and technology elements that enable integration and coordination within a firm Relational capital: value of relationships that the firm maintains with external agents	To research how IC influences innovation capability and sustain competitive advantage	62	Regression analysis	The IC dimensions have significant and positive impacts on innovation capability. Likewise, innovation capability strongly supports sustain competitive advantage. The results suggest that innovation capability is mainly explained by IC	0
Suraj and Bontis	2012	Human capital is the sheer intelligence of the organisational member Structural capital deals with mechanisms and structures of an organisation that can help support employees in their quest for optimum intellectual performance and therefore overall business performance Customer capital is knowledge	To investigate how telecommunications companies leverage their IC in achieving efficient business processes and effective value added services	29	SEM	Customer capital has a more significant path to firm performance compared to other IC dimensions. The relationship between structural capital and business performance is not significant, but human capital has a significant and substantive influence within two company categories. The relationship between human and customer capital is positive, significant and highly substantive. The path from human capital to structural capital is	15

(*continued*)

Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		embedded in marketing channels and customer relationships				positive, substantive and significant for some types of operators while insignificant for other operators. Finally, the relationship between customer and structural capital is positive, substantive and highly significant for one operator, while less significant or even negative for others	
Hsu and Sabherwal	2012	Human capital regards skilled individuals Social capital means strong ties and relationships Organisational capital is institutionalised knowledge	To empirically examine how IC and knowledge management affect each other, and how dynamic capabilities, efficiency and innovativeness mediate their effects on firm performance	510	SEM	IC facilitates KM and dynamic capabilities, while KM, learning culture and dynamic capabilities facilitate innovativeness. Finally, innovativeness and efficiency facilitate firm performance. Neither IC nor KM affect efficiency of a firm. KM neither has effect on IC or dynamic capabilities, and dynamic capabilities do not influence firm performance	28
Kim *et al.*	2012	Human capital: competence, recruitment and training, attitude and motivation to work and creativity and innovativeness Organisational capital: management philosophy, efficiency and effectiveness, organisational culture, renewal and development and information technology Customer capital: satisfaction and loyalty, image and brand, handling customers, market share, customer	To investigate the structural relationships among the IC dimensions and business performance in upper-upscale hotels	253	SEM	Customer capital is the main driver of business performance of upper-upscale hotels, while organisational capital has also significant positive impact but not in the same scale. Human capital is a major influencer for both customer and organisational capital, which means that its influence on business performance is strong but indirect. In similar fashion, organisational capital has a positive effect on customer capital, and therefore its influence on business	7

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Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		orientation and distribution channels				performance is both direct and indirect	
Mehdivand *et al.*	2012	Human capital: employee's competence, innovation and satisfaction Structural capital: culture, organisational process and information technology Relational capital: customer satisfaction and loyalty, relationships with commercial partners and relationships with other partners and groups	To investigate the relationships between IC, entrepreneurial orientation and business performance	202	SEM	Human and relational capital have direct relationships with firm performance. Further, all three IC dimensions have an indirect influence on firm performance through their effect on entrepreneurial orientation	3
Castro *et al.*	2013	Human capital: employees' education and training, experience and abilities and their creative and innovative character Technological capital: R&D efforts and utilisation of knowledge base Customer capital: customer relationships as key informants for product innovation, joint work between the company and its customers to develop solutions and the quality of the firm's customer base	To empirically test the basic link between firms' intellectual/ knowledge endowments and technological innovation	251	Qualitative comparative analysis	Highly creative, experienced, and skilled employees (human capital) jointly with well-structured networks with company's customers (customer capital) are the key sources in obtaining high degrees of product innovations in technology-based industries. Also, technological capital acts as a remedy for non-existence or low endowments of the other intellectual capital assets	3
Ling	2013	Human capital: competence that is critical to a firm's success in the global market Structural capital: institutionalised knowledge and codified experience	To empirically investigate and explain the global performance of	146	Regression analyses	Structural capital has positive impacts on both firm's financial performance and non-financial performance (global initiatives). Human and relational capital also	14

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Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
		embedded in organisational systems and processes Relational capital: knowledge embedded within a network of relationships with external stakeholders, such as customers or suppliers	firms from an IC perspective			have positive impacts on a firm's global initiatives (global agility and global innovation). Also, a carefully selected knowledge management strategy enhances the effect of certain IC dimensions to firm performance, e.g. a combination of structural capital and people-centred knowledge management strategy and another combination of human capital and technology-centred knowledge management strategy	
Mention and Bontis	2013	Human capital: knowledge, skills, experiences and abilities of the members of an organisation Structural capital: the infrastructure that encourages the human resource to create and leverage its knowledge Relational capital: the ability of an organisation to interact with a wide range of external stakeholders (such as customers, suppliers, competitors, trade and industry associations) as well as the knowledge embedded in these relationships	To conduct an empirical investigation using a dedicated survey instrument	69	SEM	Human capital is the only IC dimension to directly influence the other IC dimensions and firm performance. The effect of structural capital to relational capital is positive and significant, and the combination of the two has a significant influence on firm performance. The findings suggest that the banking sector relies heavily upon their human capital	13

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Author	Year	Conceptualisation of the IC dimensions	Research objective(s)	Sample size	Statistical method	Findings in summary	Citation count
Wang and Chen	2013	Human capital: knowledge, skills and abilities residing with and utilised by individuals Organisational capital: institutionalised knowledge and codified experience residing within and utilised through databases, patents, manuals, structures, systems and processes Social capital: knowledge embedded within, available through and utilised by interactions among individuals and their network of interrelationships	To develop a systematic understanding of the mechanisms through which high-performance work systems (the core HR practices) facilitate incremental and radical innovative capabilities of organisations, by utilising the mediating role of IC while examining this issue	164	SEM	In general, IC mediates the relationships between high-performance work systems and innovative capabilities. In more detail, organisational and social capital mediates the relationship between high-performance work systems and incremental innovative capability, whereas social capital mediates the relationship between high-performance work systems and radical innovative capability. Human capital does not have similar impact	1

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