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Knowledge management, intellectual capital, structural holes, economic complexity and national prosperity

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Abstract

Purpose – The purpose of this paper is to tie together the insights from the body of research relating to economic complexity theory, structural holes, non-price based competition, and knowledge management. The insights relating to generating national prosperity are synthesised through an intellectual capital lens.
Design/methodology/approach – The paper uses literature review combined with insights from an Australian project on state-based economic complexity.
Findings – The connectivist and autopoietic epistemological paradigms are found to be most aligned with the need to manage transformation between organisational and human resources that will achieve causal ambiguity and hence inimitability. This inimitability forms the basis for achieving non-price based competition and if there is a rich network of economic agents that, both individually and collectively through collaboration, have these characteristics a large share of the economy can operate on the basis of non-priced based competition. If all these agents have an export focus the economic complexity of the economy will be high, and likely increasing, which will enable both the creation and the appropriation of large amounts of value and hence result in increasing national prosperity.
Research limitations/implications – Findings are only relevant for OECD countries given the origins of the data used.
Practical implications – Managerial implications are outlined as are major implications for public policy.
Originality/value – This is the first time that these concepts are linked.

Keywords Knowledge management, Intellectual capital, Economic complexity, National prosperity, Non-price-based competition, Structural holes

Paper type Conceptual paper

National prosperity

Prosperity is a function of the value that an economy can both create and retain. Key drivers of national prosperity have been argued to be well-functioning institutions (North, 1990), good institutional infrastructure, capital accumulation, free trade, efficient markets, personal initiative, and appropriate role for government (Smith, 1776).

Today's economists generally point to three important characteristics influencing growth: the extent of a country's openness to trade and its integration with the rest of the world; the quality of a country's institutional infrastructure; and the success of its policy makers in implementing the measures necessary for macroeconomic stability (Greenspan, 2002, p. 4). Additional drivers for economic growth through competitiveness are as follows: a highly and relevantly educated labour force[1] that together with the appropriate infrastructure can innovate and that through concentration (normally in cities) in the form of clusters generate untradeable spillovers (Berube, 2007).

Oprescu (2012) linked national intellectual capital to national competitiveness, and similar work aimed at linking national intellectual capital with economic growth, prosperity and/or national competitiveness have been carried out by[2], e.g. Bontis (2004), Andriessen and Stam (2005), Bounfour and Edvinsson (2005), Ståhle (2007), Edvinsson and Lin (2008), Lin and Edvinsson (2010), Käpylä *et al.* (2012), Lazuka (2012), Salonius and Lönnqvist (2012), Seleim and Bontis (2013), Januškaitė and Užienė (2015), and Mačerinskienė *et al.* (2016).

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Some of the studies aim to explain the dynamics of intellectual capital at the national scale, while others focus on how national intellectual capital can be optimised and guided to enhance economic growth.

These approaches and studies all use an indicator-based approach towards capturing intellectual capital, and critical questions aligned with measurement theory can be asked around the selected indicators, e.g. is the chosen set of indicators complete? Are the indicators distinct from each other so that no double counting takes place? Is construct validity in place for the indicators chosen as relates to the construct that is to be captured? And finally, is the non-additive combinatorial behaviour of the indicators captured when they are aggregated? (For a detailed discussion of these issues see Pike and Roos, 2007). Since many of these answers would have to be negative there are questions to be asked around the meaning of the correlations between the intellectual capital indicators found and the national construct studied, that is frequently found. Based on these studies and the critique of the methodologies used it is neither possible to reject the relationship between national intellectual capital and prosperity nor to reject that there is no relationship. It seems likely that many of the indicators are, as far as can be judged from the published studies, also indicators of the previously mentioned known drivers of national prosperity.

The way the concentrating and dispersing forces of economic activity change over time impacts the benefit of proximity vs the benefit of dispersion as relates to competition for access markets and to increasingly scarce resources which in turn impacts a nation's ability to capture the increasingly mobile flow of capital and people. Technological externalities add to the concentrating forces since networks of regionally clustered businesses and institutions provides for both the formal exchanges of knowledge through market relationships, where proximity allows the establishment of closer ties, and the informal exchange of knowledge in social networks of individuals (Döring and Schnellenbach, 2006). Those beneficial aspects of close proximity which firms cannot control or achieve in any other way than through close geographical and specialisation proximity have been named untraded interdependencies by Storper (1995). The importance of agglomerations has found empirical support in work by, e.g., Graham (2006, p. 26) who found that a 10 per cent increase in the level of agglomeration is associated on average with a 1.25 per cent increase in aggregate productivity in the UK.

Pecuniary externalities are a by-product of market interactions in imperfectly competitive markets in the presence of market mediated linkages which has a positive impact on the concentrating forces. The reduction in transportation costs and the diseconomies of scales for agglomerations (e.g. disease, waste handling, crime, etc.) has also contributed to the concentrating forces (Fujita and Thisse, 2013).

Our understanding today is not to dissimilar from the understanding articulated by Thünen (1826) and the conclusion is that the presence of attractive, well-functioning, well internally and externally connected large cities is an increasingly important driver for the creation of value that underpin national prosperity. This was confirmed by some statistics in Berube, 2007, p. 7) that show that in 2005 the 100 largest metropolitan areas in the USA had 12 per cent of the surface area and 65 per cent of the population but: generated recipients for 94 per cent of venture capital funding, had 81 per cent of all R&D employment, received 80 per cent of all NIH/NSF funding, generated 78 per cent of all patents, had 76 per cent of all knowledge economy jobs, and had 75 per cent of all degree holders. Further underpinning of this can be found in Devitt (2009) and in Naudin (2013) that estimated that around 66 per cent of global economic activity and about 85 per cent of technological and scientific innovation can be attributed to 40 urban mega regions.

In the intellectual capital literature, there has been several approaches to measuring the intellectual capital of cities, e.g. Carrillo (2004), Viedma (2005), Queiroz *et al.* (2005), Schiuma *et al.* (2008), Cabrita and Cabrita (2010), Ergazakis and Metaxiotis (2011),

López-Ruiz *et al.* (2014), Matos (2014), Dameri and Ricciardi (2015), and Krušinskas and Bruneckienė (2015). The same issues arise around these indicator-based approaches as around the ones for nations above albeit there seem to be some interesting insights gained that support research findings from, e.g., economic geography (see e.g. Swann, 2006). Adler and Kwon (2002) summarised several studies that found how social capital facilitates the creation of intellectual capital, the resource exchange between firms, innovation, entrepreneurship, and supplier relationships within clusters.

The key insight from this section is that the ability to capture value is increased if a large share of the economy has managed to achieve non-price based competition in the global market, which requires the ability to produce goods or services that cannot be produced by anyone else and for which there is a high demand on the global market. This normally requires continuous innovation that in terms in facilitated by being in proximity to relevant agents and being able to develop and deploy the exiting intellectual capital.

Economic complexity

Economic complexity analysis has been developed as a method to identify current export capability as well as predict future economic growth (Hidalgo and Hausmann, 2009; Hausmann and Hidalgo, 2013; Hausmann, Hidalgo, Stock and Yildirim, 2014). EC analysis has been used at a global level (Hausmann, Hidalgo, Bustos, Coscia, Simoes and Yildirim, 2014; Felipe *et al.*, 2012), the national level (Hausmann and Hidalgo, 2013), the sub-national state level (Reynolds *et al.*, 2017), and at the city level (Nepelski and De Prato, 2015).

The core concept of economic complexity is that specific products are produced when a combination of different resources (e.g. monetary, physical, relational organisational, and knowledge) are deployed in a, for the economy, unique way. The economic complexity theory proposes that since physical endowment resources and monetary resources are scarce, the growth of available knowledge will determine the amount of new products that can be produced, specifically for export, in an economy. It is the differentiation of primarily knowledge capital between economies that will contribute to shaping a specific economy's economic complexity.

The economic complexity of an economy is, as indicated above, also influenced by: relationship capital, e.g. cultural propensity to collaborate, the extent to which firms participate in global value chains, the extent to which firms are involved in export activities, network and agglomeration economic effects due to the density of economic agents, etc.; and organisational capital, e.g. institutions, institutional structure and stability, policy landscape and the predictability of this landscape, available information, etc. Due to the difficulty in capturing these two forms of capital they are not considered in the economic complexity modelling and hence economic complexity can only explain about 70 per cent of the prosperity development (or economic transformation) in an economy, using r^2 as a measure (Reynolds *et al.*, 2017).

The integration of economic complexity and intellectual capital has shown to be fruitful in, e.g., Hartmann *et al.* (2014). Using indicators for intellectual capital (human capital, structural capital, and relational capital) combined with economic complexity they construct an innovation capability indicator on the national level which in turn is an indicator for future prosperity.

The amount of knowledge capital in an economy can be expressed in terms of how many different products are exported by an economy (labelled diversity) and how common, across all economies, the export of a given product exported by the economy is (labelled ubiquity). Diversity captures the breadth of the knowledge base of an economy and ubiquity captures both how close to (or far from) the knowledge frontier the economy is as well as if the economy has all the requisite knowledge for producing a given product. The more products the economy is able to export both in absolute terms and as a share of the products

produced, and the fewer other economies are able to produce and export these products, the more value can be captured by the economy. This information is captured in the economic complexity index articulated from the diversity and ubiquity of the economy.

The discussion in this section follows that achieving a high level of economic complexity means that a large share of firms will have achieved non-price based competition. This in turn means that we need to understand how non-price based competition is being achieved and how we can increase the share of firms that achieve non-price based competition.

Structural holes

The ability to generate and embody new knowledge into offerings (i.e. the ability to innovate) has a higher dependency on network structures within the economy the higher the economic complexity of the economy. A single company cannot innovate a new complex product offering, like, e.g., a conventional submarine, on its own but is instead highly dependent on the network of which the firm forms part. This network needs to be large, i.e. have the ability for any network participant to reach many other participants due to the size (number of participants) in the network. This size provides scale (Ahuja, 2000), speed (Moreira and Markus, 2013), complementarity (Richardson, 1972; Arora and Gambardella, 1990; Richardson, 2003; von Raesfeld *et al.*, 2012; Broekel and Brachert, 2015), and knowledge sharing (Berg *et al.*, 1982).

The network also needs to be complex, in the information theoretical sense (see Wilhelm and Hollunder, 2007), in order to both minimise the route from any given participant to any other participant and to maximise the number of new knowledge domains that can be created due to the interaction between exiting knowledge domains that resides within organisations that form part of the network (i.e. the network needs to be neither extremely democratic nor extremely dictatorial in the meaning of Wilhelm and Hollunder, 2007). All of this must also be underpinned by a high propensity for collaboration since coordination through collaboration is increasingly important when the focus is on the ability to develop and exchange knowledge (Andersen, and Drejer, 2006; Andreoni, 2014). A lack of connections between participants in a network indicates the presence of structural holes and if this lack of connections could be bridged the network would increase its productivity.

The positive impact by spanning or reducing the presence of structural holes are shown on the individual level within firms (Tortoriello, 2015), and on the firm level within intra-firm networks (Talmud, 1994; Dyer and Nobeoka, 2000; Zaheer and Bell, 2005; Liao and Phan, 2015). The importance of network structures, structural holes, and the network centrality has been shown to matter for both innovation performance and inward investment on the sub-national level, national level, and global level (see e.g. Shi *et al.*, 2012; Guan *et al.*, 2015).

The linkage between intellectual capital and structural holes is discussed in, e.g., Burt (2002) with a focus on the social capital as the contextual complement to human capital and that, in the words of Putnam (1993, p. 167) can improve the efficiency of society by facilitating coordinated action, identified that areas of weak connections in networks create competitive advantage for those whose networks span this area of weak connections – or structural hole. The way in which Burt (2002) use the concept of social capital is very similar to the way in which relational capital is defined and used in parts of the intellectual capital literature (see McElroy, 2002; Pomeda *et al.*, 2002; Roos *et al.*, 2005). Lock Lee (2008) show a strong link between social capital and firm performance and Lock Lee and Guthrie (2011) builds social capital into intellectual capital and show how intellectual capital contributes to building firm and network performance by bridging structural holes.

Given that it is possible to scale the structural hole and intellectual capital linkage and reasoning from the level of the individual to the level of the firm, and from the level of the firm to the level of the network it is a logic of scalability that it can be further extended to the level of the economy as a whole.

The conclusion from this section is that national prosperity generation can be strengthened by filling structural holes, normally by attracting and introducing partners coming from ecosystems whose knowledge and resources are locally lacking (Padgett and Ansell, 1993; Klerkx and Leeuwis, 2008). The benefit of doing this within an otherwise large network structure is proportional to the collaboration propensity between the agents in the network.

Non-price based competition

Non-price based competition is most commonly observed in high-cost production locations. Firms operating in such locations have developed a series of inimitable strategies in response to price-based competition. Inimitability can be achieved by a combination of: customisation through co-production; superior service experience; design-based innovation; art-based innovation; reverse-hermeneutics-based innovation; science and technology-based innovation, normally in combination with a global niche strategy. Some insights from the literature (Piore and Sabel, 1984; Lohse and Spiller, 1998; Bagchi-Sen, 2001; Rugman and Verbeke, 2002; Tokatli, 2004; Bryson and Rusten, 2010; Bryson and Taylor, 2010; Tokatli, 2011; Mulhall, 2013) around this have been summarised in Table I.

On a resource basis, inimitability can arise from: property rights, path dependencies and time compression diseconomies in resource accumulation, or causal ambiguity (Bingham and Eisenhardt, 2008). Causal ambiguity can be further broken down into: resources resulting out of organisational processes unobservable from the outside, tightly coupled resources where the interrelationship and mutual synergistic effects are unobservable from the outside, processes that are a combination of simple heuristics with idiosyncratic and real-time improvisations are in practice both unobservable from the outside and un-inferable from any outcomes (Eisenhardt and Tabrizi, 1995; Miner *et al.*, 2001; Bingham and Eisenhardt, 2008).

Further grounds for inimitability can arise out of the specific choices made as relates to which resources are leveraged in what specific way (e.g. Bingham and Eisenhardt, 2008):

Inimitability strategy	Low-tech manufacturing firms	High-tech manufacturing firms	Consumer goods providers	Industrial goods providers	Consumer service providers	Industrial service providers
Customisation through co-production	X			X	X	X
Bundling (products or products with services)		X		X		
Superior skills or unique craftsmanship			X		X	
Provenance	X	X	X	X		
High responsiveness	X	X	X	X	X	X
Superior experience	X	X	X	X	X	X
Unique and protected production processes		X	X	X		
Intrinsic and/or extrinsic value delivery	X	X	X	X	X	X
Design-based innovation	X		X		X	X
Art-based innovation			X		X	
Reverse-hermeneutics-based innovation			X		X	
Science and technology-based innovation		X		X		X

Note: Strategies used are identified by X

Table I.
Inimitability-based strategies in different industry types

moderately linked core and complementary resources (normally with the aim of maintain strength in existing markets and to leverage into new markets by substituting for different complementary resources); mundane resources with tight mutually reinforcing linkages (normally with the aim of forming a defensible strategic position); and loosely linked, semi-structured processes comprised of simple and improvised action (normally with the aim of seizing narrow windows of opportunity).

From here on, this section follows that inimitability have its origins in resources and resource deployment systems and hence the intellectual capital lens is a useful tool for better understanding as well as creating the basis for resource-based inimitability.

Intellectual capital

The field of intellectual capital has its origins in practitioners and consultants and has, according to Dumay (2013), progressed through three phases.

The first phase had a first stage which lasted from inception to the take-off point for the field which developed frameworks in 1996 and focussed on awareness raising around intellectual capital as a concept and why it was important (Petty and Guthrie, 2000). In this phase, numerous frameworks for intellectual capital were developed and in this phase was also established the intellectual capital field's tendency to classify rather than to define the intellectual capital construct. The key claims were (Dumay, 2012): that intellectual capital somehow represented the difference between market value and book value, and that intellectual capital understanding and management could result in greater profitability. These claims were at the time without empirical evidence and at least the first one turned out to be erroneous.

During this phase of development, the field was dominated by practitioner and consultant-based publications of which the most important were: Sveiby and Risling (1986), Sveiby (1990), Stewart (1991), Edvinsson (1993), Hudson (1993), Klein and Prusak (1994), Skandia AFS (1994), Stewart (1994), Albert and Bradley (1996), Bartlett and Mahmood (1996), Boudreau and Ramstad (1996), Bontis (1996a, b), Brooking (1996a, b); Brooking and Motta (1996), Drew (1996a, b), Edvinsson and Sullivan (1996), Graef (1996), Grantham *et al.* (1996), Hall *et al.* (1996), Koenig (1996), Masoulas (1996), Oliver *et al.* (1996), Robinson and Kleiner (1996), Roos (1996), Roos and von Krogh (1996), Roos and Roos (1996), Petrash (1996), Saint-Onge (1996), Stuart (1996), Sullivan and Edvinsson (1996), Watson (1996), and Zickner (1996).

The first phase had a second stage which lasted from 1997 to around 2004. This period was characterised by a focus on classification systems, managerial aspects and the introduction of the resource transformation perspective, in addition to the resource perspective. Towards the end, there were some publications summarising the state of the field (e.g. Kaufmann and Schneider, 2004) as well as some publications questioning the field and its future (e.g. Kennie, 1999; Fincham and Roslender, 2003; Marr and Chatzkel, 2004). Key publications based on achieving more than 20 citations per year between the publication year and 2017 are listed in Table II.

The second phase continued the classification focus (a form of taxonomy focus) as well as aiming to find causality and correlation relationships between intellectual capital, or aspects thereof, and value creation and/or financial performance and/or achieving competitive advantage (Alwis, 2004; Firer, 2005; Roos *et al.*, 2005; Wu *et al.*, 2006; Edvinsson and Martin, 2007; Bismuth and Tojo, 2008; Kong and Prior, 2008; Koçoğlu *et al.*, 2009; Puntillo, 2009; Selamat and Hamzah, 2009; Nazari, 2010). There was also a continued focus on measurement, reporting, and disclosure (Burgman and Roos, 2007; Burgman *et al.*, 2007; Steenkamp, 2007; Adams and Simnett, 2011).

This continued emphasis on classification and reclassification of the intellectual capital components as well as other aspects of intellectual capital is preventing widespread adoption

Year	1997	1998	1999	2000	2001	2002	2003	2004
Publications in order of highest average annual citation first	Edvinsson and Malone Roos *et al.* Edvinsson Roos and Roos Wiig Sveiby Bassi	Stewart and Ruckdeschel Bontis Ulrich Sullivan	Bontis Bontis *et al.* McAdam and McCreedy	Bontis *et al.* Petty and Guthrie Sullivan Guthrie and Petty Mårtensson Pulic Brennan and Connell Rastogi	Bontis Sveiby Guthrie Mouritsen *et al.* Brennan Bukh *et al.*	Choo and Bontis Bontis and Fitz-Enz Pena Ordónez de Pablos	Ittner and Larcker Firer and Mitchell Williams Riahi-Belkaoui Bozzolan *et al.* Dierkes *et al.* Kakabadse *et al.* Marr *et al.* Bontis	Youndt *et al.* Andriessen (a) Guthrie *et al.* Chen *et al.* Bontis Youndt and Snell Andriessen (b) Kaufmann and Schneider Marr *et al.* (a) Pulic Serenko and Bontis Marr *et al.* (b) Egbu Mavridis Goh and Lim

Table II.
Influential intellectual capital publications in the period 1997-2004

among managers (Dumay and Garanina, 2013) as well as acceptance in neighbouring fields of research (Roos and Pike, 2007). A further reason for the poor uptake of intellectual capital among practitioners is articulated as "intellectual capital management can be carried out using typical general management approaches and therefore does not necessarily need any specific intellectual capital management model" by Kujansivu (2008, p. 432).

This phase also emphasised the dynamic aspects of intellectual capital (Kianto, 2007; Montemari and Nielsen, 2013; de Santis, 2016): in creating value as exemplified by IC navigators (Fernström *et al.*, 2004; Roos *et al.*, 2005), value creation maps (Marr *et al.*, 2004b; Marr, 2008), combinations of both (Cuganesan and Dumay, 2009; Jhunjhunwala, 2009), knowledge asset value spiral (Carlucci and Schiuma, 2006), the analytical hierarchy process (Liu, 2006, 2007, 2010a, b; Carlucci and Schiuma, 2007; Grimaldi and Cricelli, 2009; Chen, 2009; Asonitis and Kostagiolas, 2010; Chang *et al.*, 2010; Lee, 2010) and the further development of the analytical hierarchy process into the Conjoint Value Hierarchy approach (Pike and Roos, 2004; Roos *et al.*, 2005; Garnett *et al.*, 2008; Millar *et al.*, 2010), strategy maps (Kaplan and Norton, 2004), and causal performance maps (Abernethy *et al.*, 2005), of which the two latter were not developed specifically for intellectual capital applications but include aspects of intellectual capital when used. In addition, there was greater insights into the role of intellectual capital within differing strategic logics, i.e. value chains, value shops, and value networks (e.g. Gottschalk, 2003; Ballow *et al.*, 2004; Fernström and Roos, 2003; Pike *et al.*, 2005; Roos *et al.*, 2005) and therefore a greater insight into the complexity that follows from the interactions of the different components of intellectual capital as well as with other resources (Roos *et al.*, 2005).

There is still during this phase a lack of empirical evidence underpinning many of the claims made and what evidence there is can be argued to suffer from survival bias of the sample or case. Dumay (2012, p. 12) points out that winners and losers frequently have the same or very similar strategies but differ in how they are executed. Dumay (2014) recommend researchers in the intellectual capital field to concentrate on research based on managing IC at the operating level of case/field study/interviews rather than taking a top-down approach.

The third phase moves on from the focus on understanding the causality relationship between intellectual capital and financial or other forms of value creation to the managerial implications around managing intellectual capital in all types of organisations. This includes broadening to a stakeholder perspective (Dumay, 2009) and to a broader understanding of value than just financial. This phase is characterised by an involvement

with the practice of implementing intellectual capital management inside organisations (Dumay and Garanina, 2013; Döring and Papula, 2015). Dumay (2014) claims that there is an increasing interest in performative research (Mouritsen, 2006; Dumay, 2009; Kim and Kumar, 2009; Secundo *et al.*, 2010). This means that research in the third stage should be based on either in-depth case studies to identify what works and what does not work in terms of managing intellectual capital in a given organisation (exemplified by Guevara-Espejel, 2011) or statistically valid causality studies across organisations (exemplified by Cabrita *et al.*, 2007; Tovstiga and Tulugurova, 2007; Tovstiga *et al.*, 2007; Moeller, 2009; Longo and Mura, 2010; Sharabati *et al.*, 2010; Fan and Rongbin, 2011; Maditinos *et al.*, 2011; Aramburu *et al.*, 2013; Wang and Chen, 2013; Osman, 2014; Tsao and Hung, 2014; Roos and O'Connor, 2015; Verbano and Crema, 2016). The field is moving towards the third phase although a substantial amount of work is still taking place within the second phase thinking (Dumay and Garanina, 2013).

Using the insights from the discussions around economic complexity, structural holes, and non-price based competition we can apply the intellectual capital, language of resources and transformations as an extension of the resource-based view of the firm (Dragonetti and Roos, 1998). Although, as identified by Seoudi (2009), the RBV is one of three distinct "strategic views" of the firm (the others being the dynamic capability view (exemplified by the writings of Nelson and Winter, 1982; Teece *et al.*, 1997) and the competence-based view (exemplified by Hamel and Heene, 1994; Sanchez and Heene, 1997)). The intellectual capital view can be applied as an extension of all these three views to better understand the drivers of firm performance (Johnson, 1999; Fernández *et al.*, 2000; Riahi-Belkaoui, 2003; Herremans and Isaac, 2004; Marr *et al.*, 2004b; Rialp-Criado *et al.*, 2004; Reed *et al.*, 2006; Mention and Bontis, 2013, exemplifies this for the resource-based view; Sveiby, 2001; Khalique *et al.*, 2013 for the resource-based and the knowledge-based view of the firm; Grippa *et al.*, 2009 for the dynamic capability view; and Bontis, 2002; Verma, 2016 for the competence-based view).

Against this backdrop Lerro and Schiuma (2008) and Chao *et al.* (2015) have shown that it is possible to look at a region through the intellectual capital lens and gain insight around a given regions development and this means that it is also possible to look at an economy as a whole through the intellectual capital lens and gain insight.

The intellectual capital perspective views the object under observation (e.g. the firm) as a bundle of resources possible to classify into resource types. The types used can be listed as (Mohtar *et al.*, 2015): human capital, customer capital, structural capital, business capital, social capital, technological capital, and spiritual capital. The resource types that are most commonly used, including the traditional physical and monetary, are (based on a review of the literature and equalling the term structural with organisational and the term capital with resource) as follows:

- Physical: anything that can be touched, e.g. have a physical presence (e.g. what you would normally find under the heading of plant and equipment in the balance sheet).
- Monetary: financial resources that take the form of cash assets (such as marketable securities) that can easily be converted to pure cash.
- Relational: the relationships held by individuals on behalf of the firm or that are embodied in the form of contracts with firm as one party as well as the outcome of desires to hold explicit or implicit relationships with the firm by external parties (e.g. customer loyalty). (For an overview of the human capital definitions used in the literature see Martín-de-Castro *et al.*, 2011, Table V, p. 659).
- Organisational: the result of human endeavours developed internally in the firm or acquired externally by the firm that is now owned by the firm and that are not physical in nature. (For an overview of the structural capital definitions used in the literature see Martín-de-Castro *et al.*, 2011, Table IV, p. 657).

- Human: all useful attributes to the firm that are embodied in people under the requirement that it cannot be replaced by machines or written down on a piece of paper. (For an overview of the human capital definitions used in the literature see Martín-de-Castro *et al.*, 2011, Table III, p. 655).

The intellectual capital perspective further focusses on the way these resources are deployed, i.e. transformed to generate the ultimate desirable value (Roos and Roos, 1997; Fritzell and Cazacu, 2013; Roos, 2013). A good discussion of the relationship between resources grouped into the intellectual capital categories and firm performance can be found in Fernández *et al.* (2000). This transformation perspective can then be expanded to a regional or national view on prosperity generation (Roos, 2014; de Zubielqui *et al.*, 2015).

The discussion in this section follows that non-price based competition has its root in intellectual capital (this since the resource-based view of the firm alludes to intangibles as having higher probability of being firm-specific and hence inimitable, Itami, 1987; Conner, 1991). In the intellectual capital terminology this would primarily refer to organisational (frequently information) and human (frequently knowledge in an explicit or tacit form and frequently embodied in behaviours and characteristics) resources resulting in inimitable path dependencies, time compression diseconomies in resource allocation which cannot be overcome, causal ambiguity linked to resource transformations, which by definition, and similar to property rights are inimitable, unique historical conditions under which resource bundles are created, and the social complexity of the resources (Nelson and Winter, 1982; Wernerfelt, 1984; Barney, 1986; Dierickx and Cool, 1989; Reed and DeFillippi, 1990; Barney, 1991; Armstrong and Shimizu, 2007; Wills-Johnson, 2008).

Knowledge management

Knowledge management have from its inception as a domain suffered from an epistemological confusion of the relationship between knowledge and information. It is necessary to outline the relevant epistemological paradigms to put to use the insights from the discussions in the previous sections.

The three epistemological paradigms discussed in Varela *et al.* (1991) and von Krogh and Roos (1996) are interpreted by Carter (2002):

- Cognitivist epistemological paradigm: the beginnings of cognitivist epistemology can be traced back to the mid-1950s and view organisations as open systems, that develop knowledge by formatting increasingly accurate representations of their predefined worlds (Venzin *et al.*, 1998). The cognitivist epistemology was in a clear way first represented by Simon (1982). In the cognitivist epistemology, data accumulation and dissemination are the major knowledge activities. The cognitivist approach is to equate knowledge with information and data. The truth of knowledge is understood as the degree to which inner representations correspond to the world outside (Venzin *et al.*, 1998). To a cognitivist, the human brain and organisation are machines of logic and deduction (von Krogh and Roos, 1995).

- Connectionist epistemological paradigm: in this paradigm, the process of representing reality is different and it has many similarities to the cognitivist viewpoint but there exist no universal rules. The connectionist epistemology was in a clear way first represented by Kogut and Zander (1995). As rules are team-based, organisations are seen as self-organised networks composed of relationships and driven by communication (Venzin *et al.*, 1998). Connectionist models are founded on many interacting units that influence one another by sending activation signals down interconnecting pathways. For connectionists, the process of shaping an organisation depends not only on the stimuli entering the system but also the system

itself. Information processing is the basic process of connectionist organisations; the network is the key.

- Autopoietic epistemological paradigm: the word autopoietic derives from the Greek, auto (self) and poiesis (production). Autopoiesis, a term coined by Maturana and Varela (1980) for application in theoretical biology, refers to the self-reproduction of living systems. It was redefined by von Krogh and Roos (1995) for application in an organisational context "as the internal and recursive self-reproduction of the basic elements of a social system to describe their autonomous and self-referential operations". The autopoietic epistemological paradigm provides a fundamentally different understanding of the input coming from outside a system. The input is not information but data. The organisation is a system that is simultaneously open (to data) and closed (to information and knowledge). The system is controlled by its rules and organises itself. Information and knowledge cannot be transmitted easily, since they require internal interpretation within the system according to the individual's rules. Individual knowledge is developed and respected in others. The cycle of self-production characterises the theory of autopoiesis (Venzin *et al.*, 1998). In summary, autopoietics view knowledge as socially constructed, context sensitive, and dependent on history (von Krogh *et al.*, 1994).

Roos (2005) have, grounded in empirical research executed by Marr *et al.* (2003), synthesised the intellectual capital resource framework with the different epistemological paradigms and arrived at a view of what epistemological paradigm provides the highest performing basis for managing a given resource transformation. The results are shown in Table III.

The conclusion is that the most prominent epistemological paradigms should be connectionist where specific groups develop knowledge relevant to their own environment and the local rules determine how knowledge is accumulated, the resulting knowledge resides in the connections of experts and is problem-solution orientated and the level of knowledge depends on the state of the network (which fits with the need for collaboration and co-creation) and autopoietic where knowledge is private and there is respect for different individuals in the organisation, the resulting knowledge resides in the complete system of mind, body, and social system. In this paradigm knowledge development is the process of interpreting incoming data through conversations enabling finer distinctions to be made and meaning to be created in accordance with observations and previous experiences (this fits with the need for continuous and integrated innovation).

Table III.
The fit between epistemological paradigms and different resource transformations

From	To Monetary resources	Physical resources	Relational resources	Organisational resources	Human resources
Monetary resources	Cognitivist epistemological paradigm		Balanced cognitivist/ connectionist epistemological paradigm		Balanced cognitivist/ autopoietic epistemological paradigm
Physical resources					
Relational resources	Balanced cognitivist/ connectionist epistemological paradigm		Connectionist epistemological paradigm		Balanced connectionist/ autopoietic epistemological paradigm
Organisational resources					
Human resources	Balanced cognitivist/ autopoietic epistemological paradigm		Balanced connectionist/ autopoietic epistemological paradigm		Autopoietic epistemological paradigm

The implicit preferences in individuals to hold one or the other of these paradigms is grounded in the personal value system of the individual influenced by the social differences that exist between cultures and the accompanying cognitive processes (Hofstede *et al.*, 2010; Mason, 2007; Nisbett *et al.*, 2001) as well as any influence from the economic, political, and technological setting (Ralston, 2008).

On the organisational level the predominant epistemological paradigm becomes a synthesis of the organisational epistemology and the epistemologies of all the individuals in the organisation (Jelavic, 2011).

If we now scale this to the national level, we find that we need firms that are successful in achieving a non-price based competitive position grounded in imitability achieved through resource transformations involving organisational and human resources and deploying a high level of individuals holding a connectionist and/or autopoietic epistemological outlook.

Conclusion

Findings

The key insights from the discussion in this paper are that:

(1) Continuous maximisation of national prosperity is a critical objective as a means of achieving other societally desirable outcomes.

(2) National prosperity can be increased if the economic complexity of the nation is increased.

(3) Economic complexity is increased if:

- Increasing number of firms through innovation manages to achieve a position of non-price based competition.
- Policy measures are put in place that facilitates and encourages development of firms in, new to the economy, areas that have, in economic complexity terms, a close proximity to existing activity areas and that have, as areas, an economic complexity that is higher than the average economic complexity of the nation.
- Policy measures are put in place to bridge structural holes in existing networks, enlarging of these existing networks, establishment of new networks, and increasing collaborative propensity. This since the increase in economic complexity is facilitated by the existence of large networks of agents with strong mutual connections allowing for achieving scale benefits, speed benefits, complementarity benefits, and knowledge sharing benefits.

(4) On the firm-level achieving a non-price based competitive position requires inimitability. This inimitability is normally grounded in property rights, path dependencies, time compression diseconomies in resource allocation and causal ambiguity linked to resource transformations, unique historical conditions under which resource bundles are created, and the social complexity of the resources. Specifically, non-price based competition has its root in organisational resources (frequently information) and human resources (frequently knowledge in an explicit or tacit form and frequently embodied in behaviours and characteristics) and their associated transformation.

(5) On the firm level the development and deployment of the necessary human and organisational resources must be well managed to achieve the desired inimitability. This will require the presence of individuals with a connectionist and/or autopoietic epistemological paradigm and this may be more or less easy to achieve given the cultural and social environment both of the environment in which the firm exists as well as the environment within the firm.

Limitations of the research and findings

The findings are limited to the economies from which date is drawn in the different studies used in the discussion in this paper. This means that the findings can only with certainty be said to be relevant for OECD countries.

Implications for practitioners and researchers

For managers, the implications are that a strategy aimed at achieving non-price based competition is desirable and will, for its success, require continuous innovation. Given that inimitability is achieved by developing and deploying resources, the intellectual capital lens provides useful insights around evaluating the effectiveness of the chosen resource deployment system. The management of this strategy will require a large share of individuals with a connectionist and/or autopoietic epistemological paradigm which means that the firms' internal culture and ways of working must be aligned with these paradigms. This is visible by, e.g. a high propensity for collaboration, an understanding that personal interaction cannot be completely substituted for interaction via or through technology and that proximity matters.

For policy makers, there are clear insights regarding policies conducive to economic growth and the resulting prosperity. Most of these insights relates to the importance of growing economic complexity as an overarching policy objective. The intellectual capital lens is a useful conceptual lens to generate insights around which resources are weak and which aspects of the resource deployment system can be improved to facilitate achieving an increase in economic complexity.

For researchers, the above discussion opens the door for potentially fruitful interdisciplinary research aimed at improving national prosperity generation using an intellectual capital lens integrated with other economic and strategic fields of research.

Notes

1. This was well articulated as "Prosperity flows not just to those who generate new knowledge, but in even greater measure to those who find ways to make effective use of such knowledge" by the Canadian Council of Chief Executives (2006, pp. 3-4).
2. For a review of the different approaches to assessing intellectual capital on the national level see Labra and Paloma Sánchez (2013) and Mačerinskienė and Aleknavičiūtė (2015).

References

Abernethy, M.A., Horne, M., Lillis, A.M., Malina, M.A. and Selto, F.H. (2005), "A multi-method approach to building causal performance maps from expert knowledge", *Management Accounting Research*, Vol. 16 No. 2, pp. 135-155.

Adams, S. and Simnett, R. (2011), "Integrated reporting: an opportunity for Australia's not-for-profit sector", *Australian Accounting Review*, Vol. 21 No. 3, pp. 292-301.

Adler, P.S. and Kwon, S.W. (2002), "Social capital: prospects for a new concept", *Academy of Management Review*, Vol. 27 No. 1, pp. 17-40.

Ahuja, G. (2000), "Collaboration networks, structural holes, and innovation: a longitudinal study", *Administrative Science Quarterly*, Vol. 45 No. 3, pp. 425-455.

Albert, S. and Bradley, K. (1996), "The impact of intellectual capital", Working Paper No. 96/15, Open Business School, The Open University, Milton Keynes.

Alwis, D. (2004), "The role of intellectual capital in organisational value creation: an application of a theoretical model to two case studies", doctoral dissertation, School of Information Systems, Computing and Mathematics, Brunel University, London.

Andersen, P.H. and Drejer, I. (2006), "Systemic innovation in a distributed network: paradox or pinnacle?", DRUID Working Paper Nos 06-13, Danish Research Unit for Industrial Dynamics, Aalborg.

Andreoni, A. (2014), "Structural learning: embedding discoveries and the dynamics of production", *Structural Change and Economic Dynamics*, Vol. 29, June, pp. 58-74.

Andriessen, D. and Stam, C.D. (2005), "Intellectual capital of the European Union", *7th McMaster World Congress on the Management of Intellectual Capital and Innovation*, *Hamilton*, *January*.

Aramburu, N., Sáenz, J. and Blanco, C. (2013), "Structural capital, innovation capability, and company performance in technology-based Colombian firms", *Proceedings of the International Conference on Intellectual Capital, Knowledge Management & Organizational Learning*, *April*, pp. 20-29.

Armstrong, C.E. and Shimizu, K. (2007), "A review of approaches to empirical research on the resource-based view of the firm", *Journal of Management*, Vol. 33 No. 6, pp. 959-986.

Arora, A. and Gambardella, A. (1990), "Complementarity and external linkages: the strategies of the large firms in biotechnology", *The Journal of Industrial Economics*, Vol. 38 No. 4, pp. 361-379.

Asonitis, S. and Kostagiolas, P.A. (2010), "An analytic hierarchy approach for intellectual capital: evidence for the Greek central public libraries", *Library Management*, Vol. 31 No. 3, pp. 145-161.

Bagchi-Sen, S. (2001), "Product innovation and competitive advantage in an area of industrial decline: the Niagara region of Canada", *Technovation*, Vol. 21 No. 1, pp. 45-54.

Ballow, J., Burgman, R., Roos, G. and Molnar, M. (2004), "A new paradigm for managing shareholder value", Accenture Institute for High Performance Business, Wellesley, MA, available at: www.accenture.com/institute (accessed 30 January 2017).

Barney, J.B. (1986), "Types of competition and the theory of strategy: toward an integrative framework", *Academy of Management Review*, Vol. 11 No. 4, pp. 791-800.

Barney, J.B. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17 No. 1, pp. 99-120.

Bartlett, C.A. and Mahmood, T. (1996), *Skandia AFS: Developing Intellectual Capital Globally*, Harvard Business School, Boston, MA.

Berg, S.V., Duncan, J. and Friedman, P. (1982), *Joint Venture Strategies and Corporate Innovation*, Oelgeschlager, Gunn & Hain, Caimbridge, MA.

Berube, A. (2007), *MetroNation: How US Metropolitan Areas Fuel American Prosperity*, Blueprint for American Prosperity, Unleashing the Potential of a Metropolitan Nation. Metropolitan Policy Program, The Brookings Institution, Washington, DC.

Bingham, C.B. and Eisenhardt, K.M. (2008), "Position, leverage and opportunity: a typology of strategic logics linking resources with competitive advantage", *Managerial and Decision Economics*, Vol. 29 Nos 2-3, pp. 241-256.

Bismuth, A. and Tojo, Y. (2008), "Creating value from intellectual assets", *Journal of Intellectual Capital*, Vol. 9 No. 2, pp. 228-245.

Bontis, N. (1996a), "There's a price on your head: managing intellectual capital strategically", *Business Quarterly*, Vol. 60 No. 4, pp. 40-78.

Bontis, N. (1996b), "Intellectual capital: an exploratory study that develops measures and models", Western Business School, University of Western Ontario, London, ON.

Bontis, N. (2002), "Managing organizational knowledge by diagnosing intellectual capital", in Choo, C.W. and Bontis, N. (Eds), *The Strategic Management of Intellectual Capital and Organizational Knowledge*, Oxford University Press, Oxford, pp. 621-642.

Bontis, N. (2004), "National intellectual capital index: a United Nations initiative for the Arab region", *Journal of Intellectual Capital*, Vol. 5 No. 1, pp. 13-39.

Boudreau, J.W. and Ramstad, P.M. (1996), "Measuring intellectual capital: learning from financial history", working paper series, Center for Advanced Human Resource Studies (CAHRS), Cornell University, Ithaca, NY, p. 179.

Bounfour, A. and Edvinsson, L. (2005), *IC for Communities, Nations, Regions, Cities, and Other Communities*, Butterworth-Heinemann, Boston, MA.

Broekel, T. and Brachert, M. (2015), "The structure and evolution of inter-sectoral technological complementarity in R&D in Germany from 1990 to 2011", *Journal of Evolutionary Economics*, Vol. 25 No. 4, pp. 755-785.

Brooking, A. (1996a), *Intellectual Capital*, Cengage Learning EMEA, Andover.

Brooking, A. (1996b), "Intellectual capital: current issues and policy implications", *Paper Presented at the 23rd Annual Congress of the European Accounting Association*, *Ludwig-Maximilians-University, Munich*, *March 29-31*.

Brooking, A. and Motta, E. (1996), "A taxonomy of intellectual capital and a methodology for auditing it", *17th Annual National Business Conference, McMaster University*, *Hamilton*, *January*, pp. 24-26.

Bryson, J.R. and Rusten, G. (2010), *Design Economies and the Changing World Economy: Innovation, Production and Competitiveness*, Routledge, Abingdon.

Bryson, J.R. and Taylor, M. (2010), "Competitiveness by design and inimitability through service: understanding the dynamics of firm-based competition in the West Midlands jewellery and lock industries", *The Service Industries Journal*, Vol. 30 No. 4, pp. 583-596.

Burgman, R. and Roos, G. (2007), "The importance of intellectual capital reporting: evidence and implications", *Journal of Intellectual Capital*, Vol. 8 No. 1, pp. 7-51.

Burgman, R., Roos, G., Boldt-Christmas, L. and Pike, S. (2007), "Information needs of internal and external stakeholders and how to respond: reporting on operations and intellectual capital", *International Journal of Accounting, Auditing and Performance Evaluation*, Vol. 4 Nos 4-5, pp. 529-546.

Burt, R.S. (2002), "The social capital of structural holes", in Meyer, E. (Ed.), *The New Economic Sociology: Developments in an Emerging Field*, Russell Sage Foundation, New York, NY, pp. 148-190.

Cabrita, M.R. and Cabrita, C. (2010), "The role of creative industries in stimulating intellectual capital in cities and regions", *Proceedings of the European Conference on Intellectual Capital*, *March*, pp. 171-179.

Cabrita, M.D.R., De Vaz, J.L. and Bontis, N. (2007), "Modelling the creation of value from intellectual capital: a Portuguese banking perspective", *International Journal of Knowledge and Learning*, Vol. 3 Nos 2-3, pp. 266-280.

Canadian Council of Chief Executives (2006), "From bronze to gold: a blueprint for Canadian leadership in a transforming world, ideas and recommendations of the Canadian Council of Chief Executives", Canadian Council of Chief Executives, Ottawa.

Carlucci, D. and Schiuma, G. (2006), "Knowledge asset value spiral: linking knowledge assets to company's performance", *Knowledge and Process Management*, Vol. 13 No. 1, pp. 35-46.

Carlucci, D. and Schiuma, G. (2007), "Knowledge assets value creation map: assessing knowledge assets value drivers using AHP", *Expert Systems with Applications*, Vol. 32 No. 3, pp. 814-822.

Carrillo, F.J. (2004), "Capital cities: a taxonomy of capital accounts for knowledge cities", *Journal of Knowledge Management*, Vol. 8 No. 5, pp. 28-46.

Carter, C. (2002), "Epistemology, culture and knowledge management: is there a link?", MBA project executed at ICS Ltd, University of Westminster, London.

Chang, Y.C., Yu, P.J. and Chi, H.R. (2010), "Prioritizing corporate R&D capabilities: the intellectual capital perspective", in López Sáez, P., de Castro, G.M., López, J.E.N. and Delgado-Verde, M. (Eds), *Intellectual Capital and Technological Innovation: Knowledge-Based Theory and Practice*, IGI Global, Hershey, PA, pp. 209-233.

Chao, L., Xiao, L. and Lingyu, X. (2015), "The influence of regional intellectual capital on regional economic development – evidence from China", *International Journal of u-and e-Service, Science and Technology*, Vol. 8 No. 6, pp. 91-104.

Chen, S.Y. (2009), "Identifying and prioritizing critical intellectual capital for e-learning companies", *European Business Review*, Vol. 21 No. 5, pp. 438-452.

Conner, K.R. (1991), "A historical comparison of resource-based theory and five schools of thought within industrial organization economics: do we have a new theory of the firm?", *Journal of Management*, Vol. 17 No. 1, pp. 121-154.

Cuganesan, S. and Dumay, J.C. (2009), "Reflecting on the production of intellectual capital visualisations", *Accounting, Auditing & Accountability Journal*, Vol. 22 No. 8, pp. 1161-1186.

Dameri, R.P. and Ricciardi, F. (2015), "Smart city intellectual capital: an emerging view of territorial systems innovation management", *Journal of Intellectual Capital*, Vol. 16 No. 4, pp. 860-887.

de Santis, F. (2016), "Designing casual maps adopting an intellectual capital perspective: a case study analysis", *International Journal of Accounting and Financial Reporting*, Vol. 6 No. 2, pp. 274-292.

Devitt, A. (Ed.) (2009), *Our Cities: Drivers of National Competitiveness*, Forfas, National Competitiveness Council (NCC), Dublin.

de Zubielqui, G.C., O'Connor, A. and Seet, P.S. (2015), "Intellectual capital system perspective: a case study of government intervention in digital media industries", in Roos, G. and O'Connor, A. (Eds), *Integrating Innovation: South Australian Entrepreneurship Systems and Strategies*, University of Adelaide Press, Adelaide, pp. 277-302.

Dierickx, L. and Cool, K. (1989), "Asset stock accumulation and sustainability of competitive advantage", *Management Science*, Vol. 35 No. 12, pp. 1504-1511.

Döring, H. and Papula, J. (2015), "Intellectual capital and competitive success: final results of a case study in a software company", *European Conference on Intellectual Capital. Academic Conferences International Limited, April*, p. 384.

Döring, T. and Schnellenbach, J. (2006), "What do we know about geographical knowledge spillovers and regional growth? A survey of the literature", *Regional Studies*, Vol. 40 No. 3, pp. 375-395.

Dragonetti, N. and Roos, G. (1998), "Assessing the performance of government programmes: an intellectual capital perspective", *18th Strategic Management Society Conference, Orlando, FL, November*.

Drew, S. (1996a), "Strategy and intellectual capital", *Manager Update*, Vol. 7 No. 4, pp. 1-10.

Drew, S. (1996b), "Managing intellectual capital for strategic advantage", Working Paper Series No. 9642, Henley Management College, Greenlands, Henely-on-Thames.

Dumay, J. (2009), "Intellectual capital measurement: a critical approach", *Journal of Intellectual Capital*, Vol. 10 No. 2, pp. 190-210.

Dumay, J. (2013), "The third stage of IC: towards a new IC future and beyond", *Journal of Intellectual Capital*, Vol. 14 No. 1, pp. 5-9.

Dumay, J. (2014), "15 years of the Journal of Intellectual Capital and counting: a manifesto for transformational IC research", *Journal of Intellectual Capital*, Vol. 15 No. 1, pp. 2-37.

Dumay, J. and Garanina, T. (2013), "Intellectual capital research: a critical examination of the third stage", *Journal of Intellectual Capital*, Vol. 14 No. 1, pp. 10-25.

Dumay, J.C. (2012), "Grand theories as barriers to using IC concepts", *Journal of Intellectual Capital*, Vol. 13 No. 1, pp. 4-15.

Dyer, J.H. and Nobeoka, K. (2000), "Creating and managing a high-performance knowledge-sharing network: the Toyota case", *Strategic Management Journal*, Vol. 21 No. 3, pp. 345-367.

Edvinsson, L. (1993), "Det intellektuella kapitalet skapar framtidsföretaget", *Scandinavian Insurance Quarterly*, Vol. 2 No. 1, pp. 63-67.

Edvinsson, L. and Lin, C. (2008), "National intellectual capital: comparison of the Nordic countries", *Journal of Intellectual Capital*, Vol. 9 No. 4, pp. 525-545.

Edvinsson, L. and Martin, H. (2007), "Editorial", *International Journal of Accounting, Auditing and Performance Evaluation*, Vol. 4 Nos 4/5, pp. 333-335.

Edvinsson, L. and Sullivan, P. (1996), "Developing a model for managing intellectual capital", *European Management Journal*, Vol. 14 No. 4, pp. 356-364.

Eisenhardt, K.M. and Tabrizi, B.N. (1995), "Accelerating adaptive processes: product innovation in the global computer industry", *Administrative Science Quarterly*, Vol. 40 No. 1, pp. 84-110.

Ergazakis, K. and Metaxiotis, K. (2011), "Formulating integrated knowledge city development strategies: the KnowCis 2.0 methodology", *Knowledge Management Research & Practice*, Vol. 9 No. 2, pp. 172-184.

Fan, I.Y. and Rongbin, W.B.L. (2011), "The complex intellectual capital characteristic of an innovative firm", *Proceeding of The 8th International Conference on Intellectual Capital, Knowledge Management &Organizational Learning, Southeast Asia of Bangkok University*, pp. 172-181.

Felipe, J., Kumar, U., Abdon, A. and Bacate, M. (2012), "Product complexity and economic development", *Structural Change and Economic Dynamics*, Vol. 23 No. 1, pp. 36-68.

Fernández, E., Montes, J.M. and Vázquez, C.J. (2000), "Typology and strategic analysis of intangible resources: a resource-based approach", *Technovation*, Vol. 20 No. 2, pp. 81-92.

Fernström, L. and Roos, G. (2003), "Differences in value creating logics and their managerial consequences – the case of authors, publishers and printers", *International Journal of the Book*, Vol. 1 No. 1, pp. 493-506.

Fernström, L., Pike, S. and Roos, G. (2004), "Understanding the truly value creating resources – the case of a pharmaceutical company", *International Journal of Learning and Intellectual Capital*, Vol. 1 No. 1, pp. 105-120.

Fincham, R. and Roslender, R. (2003), "Intellectual capital accounting as management fashion: a review and critique", *European Accounting Review*, Vol. 12 No. 4, pp. 781-795.

Firer, S. (2005), "Using intellectual capital as a success strategy in South Africa", *Southern African Business Review*, Vol. 9 No. 1, pp. 1-20.

Fritzell, C. and Cazacu, F. (2013), "Branschspecifika egenskapers påverkan på resursomvandlingen: en jämförelse mellan revisionsbyråer och arkitektbyråer", master thesis, Företagsekonomi, Sektionen för Samhälle och Hälsa, Högskolan Kristianstad, Kristianstad.

Fujita, M. and Thisse, J.F. (2013), *Economics of Agglomeration: Cities, Industrial Location, and Globalization*, Cambridge University Press, Cambridge, MA.

Garnett, H., Roos, G. and Pike, S. (2008), "Reliable, repeatable assessment for determining value and enhancing efficiency and effectiveness in higher education", outcomes in higher education: quality, relevance and impact, IMHE OECD, Paris.

Gottschalk, P. (2003), *Ledelse av Intelektuell Kapital*, Universitetsforlaget, Oslo.

Graef, J. (1996), *CFO's Guide to Intellectual Capital*, Montague Institute, Montague, MA.

Graham, D.J. (2006), "Investigating the link between productivity and agglomeration for UK industries", report prepared for the UK Department for Transport, London.

Grantham, C.E., Nichols, L.D. and Schonberner, M. (1996), "A framework for the management of intellectual capital in the health care industry", *Journal of Health Care Finance*, Vol. 23 No. 3, pp. 1-19.

Greenspan, A. (2002), "The wealth of nations revisited", *Presentationat the Banco de Mexico's Second International Conference: Macroeconomic Stability, Financial Markets and Economic Development*, *Mexico City*, *November*.

Grimaldi, M. and Cricelli, L. (2009), "Intangible asset contribution to company performance: the 'hierarchical assessment index'", *Vine*, Vol. 39 No. 1, pp. 40-54.

Grippa, F., Di Giovanni, A. and Passiante, G. (2009), "Fostering innovation by nurturing value-creating communities", in Romano, A. (Ed.), *Open Business Innovation Leadership*, Palgrave Macmillan, London, pp. 109-169.

Guan, J., Zhang, J. and Yan, Y. (2015), "The impact of multilevel networks on innovation", *Research Policy*, Vol. 44 No. 3, pp. 545-559.

Guevara-Espejel, D.-E. (2011), "Monitoring intellectual capital: a case study of a large company during the recent economic crisis", doctoral dissertation, École doctorale, Sciences de l'Homme et de la Société, Paris.

Hall, N.G., Stivers, B., Covin, T. and Smalt, S. (1996), "Fuzzy logic tools needed for intellectual capital management systems", *Proceedings of the 1996 Biennial Conference of the North American Fuzzy Information Processing Society, NAFIPS, Berkeley, California, CA, 19-22 June, IEEE, Neural Networks Council, New York, NY*, pp. 320-327.

Hamel, G. and Heene, A. (Eds) (1994), *Competence-Based Competition*, Wiley, New York, NY.

Hartmann, E.A., von Engelhardt, S., Hering, M., Wangler, L. and Birner, N. (2014), "Der iit-Innovationsfähi gkeitsindikator", *Small Business Economics*, Vol. 8 No. 3, pp. 249-258.

Hausmann, R. and Hidalgo, C.A. (2013), "How will the Netherlands earn its income 20 years from now? A growth ventures analysis for the Netherlands Scientific Council for Government Policy (WRR)", Webpublications 74, The Hague.

Hausmann, R., Hidalgo, C., Stock, D.P. and Yildirim, M.A. (2014), "Implied comparative advantage", CID Working Paper No. 276, Center for International Development, Harvard University, Cambridge, MA.

Hausmann, R., Hidalgo, C.A., Bustos, S., Coscia, M., Simoes, A. and Yildirim, M.A. (2014), *The Atlas of Economic Complexity: Mapping Paths to Prosperity*, MIT Press, Cambridge, MA.

Hidalgo, C.A. and Hausmann, R. (2009), "The building blocks of economic complexity", *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 106 No. 26, pp. 10570-10575.

Herremans, I.M. and Isaac, R.G. (2004), "The intellectual capital realization process (ICRP): an application of the resource-based view of the firm", *Journal of Managerial Issues*, Vol. 16 No. 2, pp. 217-231.

Hofstede, G., Hofstede, G.J. and Minkov, M. (2010), *Cultures and Organizations: Software of the Mind*, McGraw-Hill, New York, NY.

Hudson, W.J. (1993), *Intellectual Capital: How to Build it, Enhance it, Use it*, Wiley, Hoboken, NJ.

Itami, H. (1987), *Mobilizing Invisible Assets*, Harvard University Press, Cambridge, MA.

Januškaitė, V. and Užienė, L. (2015), "Intellectual capital measurements and national strategy development: explaining the gap", *Procedia-Social and Behavioral Sciences*, Vol. 213, pp. 161-166.

Jelavic, M. (2011), "Socio-technical knowledge management and epistemological paradigms: theoretical connections at the individual and organisational level", *Interdisciplinary Journal of Information, Knowledge, and Management*, Vol. 6 No. 1, pp. 1-16.

Jhunjhunwala, S. (2009), "Monitoring and measuring intangibles using value maps: some examples", *Journal of Intellectual Capital*, Vol. 10 No. 2, pp. 211-223.

Johnson, W.H.A. (1999), "An integrative taxonomy of intellectual capital: measuring the stock and flow of intellectual capital components in the firm", *International Journal of Technology Management*, Vol. 18 Nos 5-8, pp. 562-575.

Kaufmann, L. and Schneider, Y. (2004), "Intangibles: a synthesis of current research", *Journal of Intellectual Capital*, Vol. 5 No. 3, pp. 366-388.

Kaplan, R.S. and Norton, D.P. (2004), *Strategy Maps: Converting Intangible Assets into Tangible Outcomes*, Harvard Business School Press, Boston, MA.

Käpylä, J., Kujansivu, P. and Lönnqvist, A. (2012), "National intellectual capital performance: a strategic approach", *Journal of Intellectual Capital*, Vol. 13 No. 3, pp. 343-362.

Kennie, T. (1999), "Practice direction: is knowledge and intellectual capital management a fashionable fad?", *New Law Journal*, pp. 893-894.

Khalique, M., Shaari, J.A.N.B. and Isa, A.H.B.M. (2013), "The road to the development of intellectual capital theory", *International Journal of Learning and Intellectual Capital*, Vol. 10 No. 2, pp. 122-136.

Kianto, A. (2007), "What do we really mean by the dynamic dimension of intellectual capital?", *International Journal of Learning and Intellectual Capital*, Vol. 4 No. 4, pp. 342-356.

Kim, D.Y. and Kumar, V. (2009), "A framework for prioritization of intellectual capital indicators in R&D", *Journal of Intellectual Capital*, Vol. 10 No. 2, pp. 277-293.

Klein, D.A. and Prusak, L. (1994), "Characterizing intellectual capital", Center for Business Innovation, Ernst & Young LLP, Boston, MA.

Klerkx, L. and Leeuwis, C. (2008), "Balancing multiple interests: embedding innovation intermediation in the agricultural knowledge infrastructure", *Technovation*, Vol. 28 No. 6, pp. 364-378.

Koçoğlu, İ., İmamoğlu, S.Z. and İnce, H. (2009), "The relationship between firm intellectual capital and the competitive advantage", *Journal of Global Strategic Management*, Vol. 6, pp. 181-208.

Koenig, M. (1996), "Intellectual capital and knowledge management", *IFLA Journal*, Vol. 22 No. 4, pp. 299-301.

Kogut, B. and Zander, U. (1995), "Knowledge and the speed of transfer and imitation of organisational capabilities: an empirical test", *Organisation Science*, Vol. 6 No. 1, pp. 76-92.

Kong, E. and Prior, D. (2008), "An intellectual capital perspective of competitive advantage in nonprofit organisations", *International Journal of Nonprofit and Voluntary Sector Marketing*, Vol. 13 No. 2, pp. 119-128.

Krušinskas, R. and Bruneckienė, J. (2015), "Measurement of intellectual capital of Lithuanian cities by a composite index", *Journal of Business Economics and Management*, Vol. 16 No. 3, pp. 529-541.

Kujansivu, P. (2008), "Intellectual capital management: understanding why Finnish companies do not apply intellectual capital management models", PhD Dissertation, Tampere University of Technology, Tampere.

Labra, R. and Paloma Sánchez, M. (2013), "National intellectual capital assessment models: a literature review", *Journal of Intellectual Capital*, Vol. 14 No. 4, pp. 582-607.

Lazuka, V. (2012), "National intellectual capital: concept and measurement", master thesis, School of Economics and Management, Lund University, Lund.

Lee, S.H. (2010), "Using fuzzy AHP to develop intellectual capital evaluation model for assessing their performance contribution in a university", *Expert Systems with Applications*, Vol. 37 No. 7, pp. 4941-4947.

Lerro, A. and Schiuma, G. (2008), "The impact of intellectual capital on regional development: an RCA application", *International Journal of Innovation and Regional Development*, Vol. 1 No. 2, pp. 147-165.

Liao, Y.C. and Phan, P.H. (2015), "Internal capabilities, external structural holes network positions, and knowledge creation", *The Journal of Technology Transfer*, Vol. 41 No. 5, pp. 1-20.

Lin, C.Y.Y. and Edvinsson, L. (2010), *National Intellectual Capital: A Comparison of 40 Countries*, Springer Science & Business Media, Berlin.

Liu, C.C. (2006), "Developing measurements of intellectual capital in the e-learning platform industry by the analytic hierarchy process", *International Journal of Innovation and Learning*, Vol. 3 No. 4, pp. 374-386.

Liu, C.C. (2007), "Developing measures of intellectual capital in commercial wireless television by the analytical hierarchy process", *International Journal of Mobile Communications*, Vol. 5 No. 4, pp. 474-486.

Liu, C.C. (2010a), "Prioritizing enterprise environment management indicators by intellectual capital perspective", *The Journal of International Management Studies*, Vol. 5 No. 2, pp. 110-117.

Liu, C.C. (2010b), "Exploring digital capital measures of hospital service websites from the user's perspective", *International Journal of Technology, Policy and Management*, Vol. 10 No. 4, pp. 333-342.

Lock Lee, L. (2008), "Corporate social capital and firm performance", *Academy of Management Conference, Anaheim, CA, 8-13 August*.

Lock Lee, L. and Guthrie, J. (2011), "Corporate social capital in business innovation networks", *International Journal of Learning and Intellectual Capital*, Vol. 8 No. 3, pp. 272-284.

Lohse, G.L. and Spiller, P. (1998), "Electronic shopping", *Communications of the ACM*, Vol. 41 No. 7, pp. 81-87.

Longo, M. and Mura, M. (2010), *A Methodology for Measuring Intellectual Capital. A Structural Equations Modelling Approach*, INTECH Open Access Publisher, Rijeka.

López-Ruiz, V.R., Alfaro-Navarro, J.L. and Nevado-Peña, D. (2014), "Knowledge-city index construction: an intellectual capital perspective", *Expert Systems with Applications*, Vol. 41 No. 12, pp. 5560-5572.

McElroy, M. (2002), "Social innovation capital", *Journal of Intellectual Capital*, Vol. 3 No. 1, pp. 30-39.

Mačerinskienė, I. and Aleknavičiūtė, R. (2015), "Comparative evaluation of national intellectual capital measurement models", *Business: Theory and Practice/Verslas: Teorija ir Praktika*, Vol. 16 No. 1, pp. 1-14.

Mačerinskienė, I., Mačerinskas, J. and Aleknavičiūtė, R. (2016), "Change of national intellectual capital in EU countries", *Montenegrin Journal of Economics*, Vol. 12 No. 4, pp. 65-75.

Maditinos, D., Chatzoudes, D., Tsairidis, C. and Theriou, G. (2011), "The impact of intellectual capital on firms' market value and financial performance", *Journal of Intellectual Capital*, Vol. 12 No. 1, pp. 132-151.

Marr, B. (2008), "Making the invisible visible", *Journal of Accountancy*, Vol. 206 No. 3, pp. 64-66, 14.

Marr, B. and Chatzkel, J. (2004), "Intellectual capital at the crossroads: managing, measuring, and reporting of IC", *Journal of Intellectual Capital*, Vol. 5 No. 2, pp. 224-229.

Marr, B., Gupta, O., Pike, S. and Roos, G. (2003), "Intellectual capital and knowledge management effectiveness", *Management Decision*, Vol. 41 No. 8, pp. 771-781.

Marr, B., Schiuma, G. and Neely, A. (2004a), "The dynamics of value creation: mapping your intellectual performance drivers", *Journal of Intellectual Capital*, Vol. 5 No. 2, pp. 312-325.

Marr, B., Schiuma, G. and Neely, A. (2004b), "Intellectual capital – defining key performance indicators for organizational knowledge assets", *Business Process Management Journal*, Vol. 10 No. 5, pp. 551-569.

Martín-de-Castro, G., Delgado-Verde, M., López-Sáez, P. and Navas-López, J.E. (2011), "Towards 'an intellectual capital-based view of the firm': origins and nature", *Journal of Business Ethics*, Vol. 98 No. 4, pp. 649-662.

Mason, R.M. (2007), "Culture: an overlooked key to unlocking organizational knowledge", in Pauleen, D.J. (Ed.), *Cross-Cultural Perspectives on Knowledge Management*, Libraries Unlimited, Westport, CT, pp. 21-34.

Masoulas, V. (1996), "Organizational requirements definition for designing systems to support intellectual capital management", Society for Design and Process Science, Austin, TX.

Matos, F. (2014), "Cities auditing model", in Giaffreda, R., Cagáňová, D., Li, Y., Riggio, R. and Voisard, A. (Eds), *Internet of Things.IoT Infrastructures. Revised Selected Papers, Part II*, *International Internet of Things Summit*, Springer International Publishing, Cham, pp. 43-51.

Maturana, H.R. and Varela, F.J. (1980), *Autopoiesis and Cognition. The Realization of the Living*, Reidel, Boston, MA.

Mention, A.L. and Bontis, N. (2013), "Intellectual capital and performance within the banking sector of Luxembourg and Belgium", *Journal of Intellectual Capital*, Vol. 14 No. 2, pp. 286-309.

Millar, L.A., McCallum, J. and Burston, L.M. (2010), "Use of the conjoint value hierarchy approach to measure the value of the national continence management strategy", *The Australian and New Zealand Continence Journal*, Vol. 16 No. 3, pp. 81-86, 88.

Miner, A.S., Bassof, P. and Moorman, C. (2001), "Organizational improvisation and learning: a field study", *Administrative Science Quarterly*, Vol. 46 No. 2, pp. 304-337.

Mohtar, S., Rahman, I.S.A. and Abbas, M. (2015), "Intellectual capital and its major components", *Journal of Technology and Operations Management*, Vol. 10 No. 1, pp. 15-21.

Montemari, M. and Nielsen, C. (2013), "The role of causal maps in intellectual capital measurement and management", *Journal of Intellectual Capital*, Vol. 14 No. 4, pp. 522-546.

Moreira, S. and Markus, A. (2013), "All for one and one for all: how intrafirm networks affect the speed of knowledge recombination", *Paper Presented at The 35th DRUID Celebration Conference 2013: Innovation, Strategy and Entrepreneurship, ESADE Business School, Ramon Llull University, Barcelona, 17-19 June*.

Mouritsen, J. (2006), "Problematising intellectual capital research: ostensive versus performative IC", *Accounting, Auditing & Accountability Journal*, Vol. 19 No. 6, pp. 820-841.

Mulhall, R.A. (2013), "Manufacturing change: competitiveness and adjustment through evolving production relationships", doctoral dissertation, University of Birmingham, Birmingham.

Naudin, T. (Ed.) (2013), *State of the World's Cities 2012/2013: Prosperity of Cities. United Nations Human Settlement Programme (UN-Habitat)*, Routledge, New York, NY.

Nazari, J.A. (2010), "An investigation of the relationship between the intellectual capital components and firm's financial performance", doctoral dissertation, Haskayne School of Business, University of Calgary, Alberta.

Nelson, R.R. and Winter, S.G. (1982), *An Evolutionary Theory of Economic Change*, Belknap Press, London.

Nepelski, D. and De Prato, G. (2015), "Corporate control, location and complexity of ICT R&D: a network analysis at the city level", *Urban Studies Urban Stud March*, Vol. 52 No. 4, pp. 721-737.

Nisbett, R.E., Peng, K., Choi, I. and Norenzayan, A. (2001), "Culture and systems of thought: holistic versus analytic cognition", *Psychological Review*, Vol. 108 No. 2, pp. 291-310.

North, D.C. (1990), *Institutions, Institutional Change and Economic Performance*, Cambridge University Press, Cambridge, MA.

Oliver, D., Marchand, D. and Roos, J. (1996), "Skandia Assurance and Financial Services: measuring and visualizing intellectual capital", International Institute for Management Development (IMD), Lausanne.

Oprescu, R. (2012), "Bridging intellectual capital and the competitiveness of nations", *Management & Marketing*, Vol. 7 No. 1, pp. 73-88.

Osman, J. (2014), "An empirical investigation into the significance of intellectual capital and strategic orientations on innovation capability and firm performance in Malaysian Information and communications Technology (ICT) small-to-medium enterprises (SMEs)", doctoral dissertation, RMIT University, Melbourne.

Padgett, J.F. and Ansell, C.K. (1993), "Robust action and the rise of the medici, 1400-1434", *American Journal of Sociology*, Vol. 98 No. 6, pp. 1259-1319.

Petrash, G. (1996), "Dow's journey to a knowledge value management culture", *European Management Journal*, Vol. 14 No. 4, pp. 365-373.

Petty, R. and Guthrie, J. (2000), "Intellectual capital literature review: measurement, reporting and management", *Journal of Intellectual Capital*, Vol. 1 No. 2, pp. 155-176.

Pike, S. and Roos, G. (2004), "Mathematics and modern business management", *Journal of Intellectual Capital*, Vol. 5 No. 2, pp. 243-256.

Pike, S. and Roos, G. (2007), "The validity of measurement frameworks: measurement theory", in Neely, A. (Ed.), *Business Performance Measurement: Unifying Theory and Integrating Practice*, Chapter 10, Cambridge University Press, Cambridge, MA, pp. 218-236.

Pike, S., Roos, G. and Marr, B. (2005), "Strategic management of intangible assets and value drivers in R&D organizations", *R&D Management*, Vol. 35 No. 2, pp. 111-124.

Piore, M.J. and Sabel, C.F. (1984), *The Second Industrial Divide: Possibilities for Prosperity*, Basic Books, New York, NY.

Pomeda, J., Moreno, C., Rivera, C. and Martil, L. (2002), "Towards an intellectual capital report of Madrid: new insights and developments", The Transparent Enterprise, The Value of Intangibles, Madrid.

Puntillo, P. (2009), "Intellectual capital and business performance: evidence from Italian banking industry", *Electronic Journal of Corporate Finance*, Vol. 4 No. 12, pp. 97-115.

Putnam, R.D. (1993), *Making Democracy Work*, Princeton University Press, Princeton, NJ.

Queiroz, A.B., Callén, Y.F. and Cinca, C.S. (2005), "Reflexiones en torno a la aplicación del capital intelectual en el sector público", *Spanish Journal of Finance and Accounting/Revista Española de Financiación y Contabilidad*, Vol. 34 No. 124, pp. 211-245.

Ralston, D.A. (2008), "The crossvergence perspective: reflections and projections", *Journal of International Business Studies*, Vol. 39 No. 1, pp. 27-40.

Reed, K.K., Lubatkin, M. and Srinivasan, N. (2006), "Proposing and testing an intellectual capital based view of the firm", *Journal of Management Studies*, Vol. 43 No. 4, pp. 867-893.

Reed, R. and DeFillippi, R.J. (1990), "Causal ambiguity, barriers to imitation, and sustainable competitive advantage", *Academy of Management Review*, Vol. 15 No. 1, pp. 88-102.

Reynolds, C., Agrawal, M., Lee, I., Zhan, C., Li, J., Taylor, P., Mares, T., Abedin, F., Morison, J., Angelakis, N. and Roos, G. (2017), "A sub-national economic complexity analysis of Australia's states and territories", *Journal of Economic Geography*, pp. 1-12.

Riahi-Belkaoui, A. (2003), "Intellectual capital and firm performance of US multinational firms: a study of the resource-based and stakeholder views", *Journal of Intellectual Capital*, Vol. 4 No. 2, pp. 215-226.

Rialp-Criado, A., Rialp-Criado, J., Axinn, C.N. and Thach, S. (2004), "Intangible resources and export marketing strategy as determinants of export performance: an empirical analysis from the resource-based view", in Ghobadian, A., O'Regan, N., Gallear, D. and Viney, H. (Eds), *Strategy and Performance*, Palgrave Macmillan, Houndmills, pp. 98-131.

Richardson, G. (2003), "The organization of industry re-visited", DRUID Working Paper No. 02-15, Danish Research Unit for Industrial Dynamics, Aalborg.

Richardson, G.B. (1972), "The organization of industry", *Economic Journal*, Vol. 82 No. 327, pp. 883-896.

Robinson, G. and Kleiner, B.H. (1996), "How to measure an organization's intellectual capital", *Managerial Auditing Journal*, Vol. 11 No. 8, pp. 36-39.

Roos, G. (2005), "An epistemology perspective on intellectual capital", *Perspectives on Intellectual Capital*, Abingdon, pp. 196-209.

Roos, G. (2013), "The intellectual capital navigator as a strategic tool", in Ordóñez de Pablos, P. (Ed.), *International Business Strategy and Entrepreneurship: An Information Technology Perspective*, IGI Global, Hershey, PA, pp. 1-22.

Roos, G. (2014), "Regional economic renewal through structured intellectual capital development", *Proceedings of the 11th International Conference on Intellectual Capital, Knowledge Management and Organisational Learning: ICICKM2014. Academic Conferences Limited*, *October*, pp. 337-346.

Roos, G. and O'Connor, A. (2015), "Government policy implications of intellectual capital: an Australian manufacturing case study", *Journal of Intellectual Capital*, Vol. 16 No. 2, pp. 364-389.

Roos, G. and Pike, S. (2007), "Intellectual capital research: a personal view", *The Proceedings of the IC-Congress, Inholland University*, *Haarlem*, *3-4 May*.

Roos, G. and Roos, J. (1996), "Intellectual performance: exploring an intellectual capital system in small companies", *Knowledge in Action Conference*, *Herzliya*, *October*.

Roos, G. and Roos, J. (1997), "Measuring your company's intellectual performance", *Long Range Planning*, Vol. 30 No. 3, pp. 413-426.

Roos, G., Pike, S. and Fernström, L. (2005), *Managing Intellectual Capital in Practice*, Butterworth-Heinemann (an imprint of Elsevier), London.

Roos, J. (1996), "Intellectual capital – what you can measure you can manage", *IMD Perspectives for Managers*, Vol. 26 No. 10, p. 4.

Roos, J. and von Krogh, G. (1996), "The epistemological challenge: managing knowledge and intellectual capital", *European Management Journal*, Vol. 4 No. 14, pp. 333-337.

Rugman, A.M. and Verbeke, A. (2002), "Edith Penrose's contribution to the resource-based view of strategic management", *Strategic Management Journal*, Vol. 23 No. 8, pp. 769-780.

Saint-Onge, H. (1996), "Tacit knowledge the key to the strategic alignment of intellectual capital", *Planning Review*, Vol. 24 No. 2, pp. 10-16.

Salonius, H. and Lönnqvist, A. (2012), "Exploring the policy relevance of national intellectual capital information", *Journal of Intellectual Capital*, Vol. 13 No. 3, pp. 331-342.

Sanchez, R. and Heene, A. (1997), "Reinventing strategic management: new theory and practice for competence-based competition", *European Management Journal*, Vol. 15 No. 3, pp. 303-317.

Schiuma, G., Lerro, A. and Carlucci, D. (2008), "The knoware tree and the regional intellectual capital index: an assessment within Italy", *Journal of Intellectual Capital*, Vol. 9 No. 2, pp. 283-300.

Secundo, G., Margherita, A., Elia, G. and Passiante, G. (2010), "Intangible assets in higher education and research: mission, performance or both?", *Journal of Intellectual Capital*, Vol. 11 No. 2, pp. 140-157.

Selamat, F. and Hamzah, N. (2009), "The linkage between intellectual capital management and organization performance", in Chapter two in Maelah, R. (Ed.), *Sustaining Competitiveness in a Liberalized Economy: The Role of Accounting*, Cambridge Scholars Publishing in Association with GSE Research, Newcastle upon Tyne, pp. 202-224.

Seleim, A. and Bontis, N. (2013), "National intellectual capital and economic performance: empirical evidence from developing countries", *Knowledge and Process Management*, Vol. 20 No. 3, pp. 131-140.

Seoudi, I. (2009), "The resource-capability-competence perspective in strategic management: a reappraisal of the epistemological & theoretical foundations", PhD thesis, Department of Economics, School of Graduate Studies, Case Western Reserve University, Cleveland, OH.

Sharabati, A.A.A., Naji Jawad, S. and Bontis, N. (2010), "Intellectual capital and business performance in the pharmaceutical sector of Jordan", *Management Decision*, Vol. 48 No. 1, pp. 105-131.

Shi, W.S., Sun, S.L. and Peng, M.W. (2012), "Sub-national institutional contingencies, network positions, and IJV partner selection", *Journal of Management Studies*, Vol. 49 No. 7, pp. 1221-1245.

Simon, H. (1982), *Models of Bounded Rationality*, Vol. 2, MIT Press, Cambridge, MA.

Skandia AFS (1994), *Visualizing Intellectual Capital in Skandia. Supplement to Skandia's Annual Report*, Skandia AFS, Stockholm.

Smith, A. (1776), *An Inquiry into the Nature and Causes of the Wealth of Nations*, Methuen & Co. Ltd, London.

Ståhle, P. (2007), *Five Steps for Finland's Future. A High-Level Round Table Initiated by the New Club of Paris Held in Helsinki, November 11th, 2006 with and for Prime Minister Matti Vanhanen. Technology Review*, Vol. 202, Tekes, Helsinki.

Steenkamp, N. (2007), "Intellectual capital reporting in New Zealand: refining content analysis as a research method", doctoral dissertation, Auckland University of Technology, Auckland.

Stewart, T.A. (1991), "Brainpower: how intellectual capital is becoming America's most valuable asset", *Fortune*, 3 June, pp. 44-60.

Stewart, T.A. (1994), "Your company's most valuable asset: intellectual capital. Business pioneers are finding surprising ways to put real dollars on the bottom line as they discover how to measure and manage the ultimate intangible: knowledge", *Fortune*, 3 October, pp. 68-74.

Storper, M. (1995), "The resurgence of regional economies, ten years later the region as a nexus of untraded interdependencies", *European Urban and Regional Studies*, Vol. 2 No. 3, pp. 191-221.

Stuart, R. (1996), "Viewpoint – an opportunity and a call for builders of intellectual capital", *CMA Magazine*, Vol. 70 No. 7, pp. 3-4.

Sullivan, P. and Edvinsson, L. (1996), *A Model for Managing Intellectual Capital. Technology Licensing*, John Willey & Sons, New York, NY.

Sveiby, K.E. (2001), "A knowledge-based theory of the firm to guide in strategy formulation", *Journal of Intellectual Capital*, Vol. 2 No. 4, pp. 344-358.

Sveiby, K.-E. (Ed.) (1990), *Den Osynliga Balansräkningen, Nyckeltal för Redovisning, Styrning och Värdering av Kunskapsföretag*, Affärsvärlden Förlag AB & Arbetsgruppen Konrad, Stockholm.

Sveiby, K.-E. and Risling, A. (1986), *Kunskapsföretaget: seklets viktigaste ledarutmaning?*, LiberFörlag, Malmö.

Swann, G.P. (2006), "Place is what we think with: spatial history, intellectual capital and competitive distinction", in Vertova, G. (Ed.), *The Changing Economic Geography of Globalization*, Routledge, Abingdon, pp. 93-109.

Talmud, I. (1994), "Relations and profits: the social organization of Israeli industrial competition", *Social Science Research*, Vol. 23 No. 2, pp. 109-135.

Teece, D.J., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18 No. 7, pp. 509-533.

Thünen, J.V. (1826), "Der isolierte Staat. Beziehung auf Landwirtschaft und Nationalökonomie", Friedrich Perthes, Hamburg.

Tokatli, N. (2004), "Upgrading in the global clothing industry: Mavi jeans and the transformation of a Turkish firm from full-package to brand-name manufacturing and retailing", *Economic Geography*, Vol. 80 No. 3, pp. 221-240.

Tokatli, N. (2011), "Old firms, new tricks and the quest for profits: Burberry's journey from success to failure and back to success again", *Journal of Economic Geography*, Vol. 12 No. 1, pp. 55-77.

Tortoriello, M. (2015), "The social underpinnings of absorptive capacity: the moderating effects of structural holes on innovation generation based on external knowledge", *Strategic Management Journal*, Vol. 36 No. 4, pp. 586-597.

Tovstiga, G. and Tulugurova, E. (2007), "Intellectual capital practices and performance in Russian enterprises", *Journal of Intellectual Capital*, Vol. 8 No. 4, pp. 695-707.

Tovstiga, G., Birchall, D.W. and Tulugurova, E. (2007), "Determinants of enterprise performance in small technology-intensive enterprises: intellectual capital and innovation capability in the firm", Management of Engineering and Technology, Portland International Center for Management of Engineering and Technology, IEEE, August, pp. 550-553.

Tsao, H.H. and Hung, Y.C. (2014), "Intellectual capital and performance in banking industry of Taiwan", *International Journal of Innovation and Learning*, Vol. 16 No. 1, pp. 34-52.

Varela, F.J., Thompson, E. and Rosch, E. (1991), *The Embodied Mind: Cognitive Science and Human Experience*, MIT Press, Cambridge, MA.

Venzin, M., Von Krogh, G. and Roos, J. (1998), "Future research into knowledge management", in von Krogh, G., Roos, J. and Kleine, D. (Eds), *Knowing in Firms: Understanding, Managing and Measuring Knowledge*, Sage, Thousand Oaks, CA, pp. 26-66.

Verbano, C. and Crema, M. (2016), "Linking technology innovation strategy, intellectual capital and technology innovation performance in manufacturing SMEs", *Technology Analysis & Strategic Management*, Vol. 28 No. 5, pp. 524-540.

Verma, S. (2016), "Exploring the correlates of knowledge management", *The International Journal of Indian Psychology*, Vol. 3 No. 3, pp. 1-43.

Viedma, J.M.M. (2005), "Cities' Intellectual Capital Benchmarking System (CICBS): a methodology and a framework for measuring and managing intellectual capital of cities: a practical application in the City of Mataro", in Bounfour, A. and Edvinsson, L. (Eds), *Intellectual Capital for Communities: Nations, Regions and Cities*, Elsevier Butterworth-Heinemann, Oxford, pp. 317-336.

von Krogh, G. and Roos, J. (1995), *Organizational Epistemology*, St Martin's Press, New York, NY.

von Krogh, G. and Roos, J. (1996), "Five claims on knowing", *European Management Journal*, Vol. 14 No. 4, pp. 423-426.

von Krogh, G., Roos, J. and Slocum, K. (1994), "An essay on corporate epistemology", *Strategic Management Journal*, Vol. 15 No. S2, pp. 53-71.

von Raesfeld, A., Geurts, P. and Jansen, M. (2012), "When is a network a nexus for innovation? A study of public nanotechnology R&D projects in the Netherlands", *Industrial Marketing Management*, Vol. 41 No. 5, pp. 752-758.

Wang, D. and Chen, S. (2013), "Does intellectual capital matter? High-performance work systems and bilateral innovative capabilities", *International Journal of Manpower*, Vol. 34 No. 8, pp. 861-879.

Watson, J. (1996), "Managing intellectual capital: making the most of the best", *The Canadian Manager*, Vol. 21 No. 3, pp. 11-14.

Wernerfelt, B. (1984), "A resource-based view of the firm", *Strategic Management Journal*, Vol. 5 No. 2, pp. 171-180.

Wilhelm, T. and Hollunder, J. (2007), "Information theoretic description of networks", *Physica A: Statistical Mechanics and its Applications*, Vol. 385 No. 1, pp. 385-396.

Wills-Johnson, N. (2008), "The networked firm: a framework for RBV", *Journal of Management Development*, Vol. 27 No. 2, pp. 214-224.

Wu, W.Y., Tsai, H.J., Cheng, K.Y. and Lai, M. (2006), "Assessment of intellectual capital management in Taiwanese IC design companies: using DEA and the Malmquist productivity index", *R&D Management*, Vol. 36 No. 5, pp. 531-545.

Zaheer, A. and Bell, G.G. (2005), "Benefiting from network position: firm capabilities, structural holes, and performance", *Strategic Management Journal*, Vol. 26 No. 9, pp. 809-825.

Zickner, E. (1996), "Intellectual capital management in service organizations", MBA thesis, Wits Business School. Johannesburg.

Further reading

Andriessen, D. (2004a), *Making Sense of Intellectual Capital: Designing a Method for the Valuation of Intangibles*, Routledge, Abingdon.

Andriessen, D. (2004b), "IC valuation and measurement: classifying the state of the art", *Journal of Intellectual Capital*, Vol. 5 No. 2, pp. 230-242.

Bassi, L.J. (1997), "Harnessing the power of intellectual capital", *Training & Development*, Vol. 51 No. 12, pp. 25-31.

Bontis, N. (1998), "Intellectual capital: an exploratory study that develops measures and models", *Management Decision*, Vol. 36 No. 2, pp. 63-76.

Bontis, N. (1999), "Managing organisational knowledge by diagnosing intellectual capital: framing and advancing the state of the field", *International Journal of Technology Management*, Vol. 18 Nos 5-8, pp. 433-462.

Bontis, N. (2001), "Assessing knowledge assets: a review of the models used to measure intellectual capital", *International Journal of Management Reviews*, Vol. 3 No. 1, pp. 41-60.

Bontis, N. (2003), "Intellectual capital disclosure in Canadian corporations", *Journal of Human Resource Costing & Accounting*, Vol. 7 No. 1, pp. 9-20.

Bontis, N. and Fitz-Enz, J. (2002), "Intellectual capital ROI: a causal map of human capital antecedents", *Journal of Intellectual Capital*, Vol. 3 No. 3, pp. 223-247.

Bontis, N., Chua Chong Keow, W. and Richardson, S. (2000), "Intellectual capital and business performance in Malaysian industries", *Journal of Intellectual Capital*, Vol. 1 No. 1, pp. 85-100.

Bontis, N., Dragonetti, N.C., Jacobsen, K. and Roos, G. (1999), "The knowledge toolbox: a review of the tools available to measure and manage intangible resources", *European Management Journal*, Vol. 17 No. 4, pp. 391-402.

Bozzolan, S., Favotto, F. and Ricceri, F. (2003), "Italian annual intellectual capital disclosure: an empirical analysis", *Journal of Intellectual Capital*, Vol. 4 No. 4, pp. 543-558.

Brennan, N. (2001), "Reporting intellectual capital in annual reports: evidence from Ireland", *Accounting, Auditing & Accountability Journal*, Vol. 14 No. 4, pp. 423-436.

Brennan, N. and Connell, B. (2000), "Intellectual capital: current issues and policy implications", *Journal of Intellectual Capital*, Vol. 1 No. 3, pp. 206-240.

Bukh, P.N., Larsen, H.T. and Mouritsen, J. (2001), "Constructing intellectual capital statements", *Scandinavian Journal of Management*, Vol. 17 No. 1, pp. 87-108.

Chen, J., Zhu, Z. and Yuan Xie, H. (2004), "Measuring intellectual capital: a new model and empirical study", *Journal of Intellectual Capital*, Vol. 5 No. 1, pp. 195-212.

Choo, C.W. and Bontis, N. (Eds) (2002), *The Strategic Management of Intellectual Capital and Organizational Knowledge*, Oxford University Press, Oxford.

Dierkes, M., Antal, A.B., Child, J. and Nonaka, I. (2003), *Handbook of Organizational Learning and Knowledge*, Oxford University Press, Oxford.

Edvinsson, L. (1997), "Developing intellectual capital at Skandia", *Long Range Planning*, Vol. 3 No. 3, pp. 366-373.

Edvinsson, L. and Malone, M.S. (1997), *Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower*, HarperCollins, New York, NY.

Eerikäinen, K. (2015), "Modelling the simultaneous effects of intellectual capital and knowledge management on the organisational performance of Finnish companies", master thesis, Information and Knowledge Management, School of Business and Management, Lappeenranta University of Technology, Lappeenranta.

Egbu, C.O. (2004), "Managing knowledge and intellectual capital for improved organizational innovations in the construction industry: an examination of critical success factors", *Engineering, Construction and Architectural Management*, Vol. 11 No. 5, pp. 301-315.

Firer, S. and Mitchell Williams, S. (2003), "Intellectual capital and traditional measures of corporate performance", *Journal of Intellectual Capital*, Vol. 4 No. 3, pp. 348-360.

Goh, P.C. and Lim, K.P. (2004), "Disclosing intellectual capital in company annual reports: evidence from Malaysia", *Journal of Intellectual Capital*, Vol. 5 No. 3, pp. 500-510.

Guthrie, J. (2001), "The management, measurement and the reporting of intellectual capital", *Journal of Intellectual Capital*, Vol. 2 No. 1, pp. 27-41.

Guthrie, J. and Petty, R. (2000), "Intellectual capital: Australian annual reporting practices", *Journal of Intellectual Capital*, Vol. 1 No. 3, pp. 241-251.

Guthrie, J., Petty, R., Yongvanich, K. and Ricceri, F. (2004), "Using content analysis as a research method to inquire into intellectual capital reporting", *Journal of Intellectual Capital*, Vol. 5 No. 2, pp. 282-293.

Herremans, I.M., Isaac, R. and Bays, A. (2008), "Tracing intellectual capital cash flows", *CIMA Research Executive Summaries Series*, Vol. 3 No. 2, pp. 1-8.

Ittner, C.D. and Larcker, D.F. (2003), "Coming up short on nonfinancial performance measurement", *Harvard Business Review*, Vol. 81 No. 11, pp. 88-95.

Kakabadse, N.K., Kakabadse, A. and Kouzmin, A. (2003), "Reviewing the knowledge management literature: towards a taxonomy", *Journal of Knowledge Management*, Vol. 7 No. 4, pp. 75-91.

McAdam, R. and McCreedy, S. (1999), "A critical review of knowledge management models", *The Learning Organization*, Vol. 6 No. 3, pp. 91-101.

Marr, B., Gray, D. and Neely, A. (2003), "Why do firms measure their intellectual capital?", *Journal of Intellectual Capital*, Vol. 4 No. 4, pp. 441-464.

Marr, B., Schiuma, G. and Neely, A. (2004a), "The dynamics of value creation: mapping your intellectual performance drivers", *Journal of Intellectual Capital*, Vol. 5 No. 2, pp. 312-325.

Marr, B., Schiuma, G. and Neely, A. (2004b), "Intellectual capital – defining key performance indicators for organizational knowledge assets", *Business Process Management Journal*, Vol. 10 No. 5, pp. 551-569.

Mårtensson, M. (2000), "A critical review of knowledge management as a management tool", *Journal of Knowledge Management*, Vol. 4 No. 3, pp. 204-216.

Mavridis, D.G. (2004), "The intellectual capital performance of the Japanese banking sector", *Journal of Intellectual Capital*, Vol. 5 No. 1, pp. 92-115.

Mitchell Williams, S. (2001), "Is intellectual capital performance and disclosure practices related?", *Journal of Intellectual Capital*, Vol. 2 No. 3, pp. 192-203.

Moeller, K. (2009), "Intangible and financial performance: causes and effects", *Journal of Intellectual Capital*, Vol. 10 No. 2, pp. 224-245.

Mouritsen, J., Larsen, H.T. and Bukh, P.N.D. (2001), "Intellectual capital and the 'capable firm': narrating, visualising and numbering for managing knowledge", *Accounting, Organizations and Society*, Vol. 26 No. 7, pp. 735-762.

Ordónez de Pablos, P. (2002), "Evidence of intellectual capital measurement from Asia, Europe and the Middle East", *Journal of Intellectual Capital*, Vol. 3 No. 3, pp. 287-302.

Pena, I. (2002), "Intellectual capital and business start-up success", *Journal of Intellectual Capital*, Vol. 3 No. 2, pp. 180-198.

Pulic, A. (2000), "VAIC™ – an accounting tool for IC management", *International Journal of Technology Management*, Vol. 20 Nos 5-8, pp. 702-714.

Pulic, A. (2004), "Intellectual capital – does it create or destroy value?", *Measuring Business Excellence*, Vol. 8 No. 1, pp. 62-68.

Rastogi, P.N. (2000), "Knowledge management and intellectual capital – the new virtuous reality of competitiveness", *Human Systems Management*, Vol. 19 No. 1, pp. 39-48.

Roos, J., Roos, G., Edvinsson, L. and Dragonetti, N. (1997), *Intellectual Capital: Navigating in the New Business Landscape*, Macmillan Publications, London.

Serenko, A. and Bontis, N. (2004), "Meta-review of knowledge management and intellectual capital literature: citation impact and research productivity rankings", *Knowledge and Process Management*, Vol. 11 No. 3, pp. 185-198.

Stewart, T. and Ruckdeschel, C. (1998), *Intellectual Capital: The New Wealth of Organizations*, Wiley Online Library, Hoboken, NJ.

Ståhle, P. and Grönroos, M. (2000), *Dynamic Intellectual Capital Knowledge Management in Theory and Practice*, WSOY Porvoo, Helsinki.

Sullivan, P.H. (1998), *Profiting from Intellectual Capital: Extracting Value from Innovation*, John Wiley & Sons, Hoboken, NJ.

Sullivan, P.H. (2000), *Value Driven Intellectual Capital: How to Convert Intangible Corporate Assets into Market Value*, John Wiley & Sons, Inc, Hoboken, NJ.

Sveiby, K.-E. (1997), "The intangible assets monitor", *Journal of Human Resource Costing & Accounting*, Vol. 2 No. 1, pp. 73-97.

Ulrich, D. (1998), "Intellectual capital = competence x commitment", *Sloan Management Review*, Vol. 39 No. 2, pp. 15-26.

Wiig, K.M. (1997), "Integrating intellectual capital and knowledge management", *Long Range Planning*, Vol. 30 No. 3, pp. 399-405.

Youndt, M.A. and Snell, S.A. (2004), "Human resource configurations, intellectual capital, and organizational performance", *Journal of Managerial Issues*, Vol. 16 No. 3, pp. 337-360.

Youndt, M.A., Subramaniam, M. and Snell, S.A. (2004), "Intellectual capital profiles: an examination of investments and returns", *Journal of Management Studies*, Vol. 41 No. 2, pp. 335-361.

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