Journal of Intellectual Capital

Managing intellectual capital through a collective intelligence approach: An integrated framework for universities

Giustina Secundo John Dumay Giovanni Schiuma Giuseppina Passiante

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Giustina Secundo
Department of Innovation Engineering, University of Salento, Lecce, Italy
John Dumay
Department of Accounting and Corporate Governance, Macquarie University, Sydney, Australia
Giovanni Schiuma
Department of Economics, University of Basilicata, Matera, Italy, and
Giuseppina Passiante
Department of Innovation Engineering, University of Salento, Lecce, Italy

Abstract

Purpose – The purpose of this paper is to provide a new framework for managing intellectual capital (IC) inside a university considering the collective intelligence perspective.

Design/methodology/approach – The research method uses the fourth stage of IC research and adopts the collective intelligence approach. The underlying assumption behind the framework is to consider the university as a collective intelligence system in which the tangible and intellectual assets are coordinated towards the achievement of strategic goals.

Findings – The conceptual framework for IC management harnesses the power of IC, collectively created by the engagement of multiple stakeholders inside the university network. The main components are the final goal of a university (what); the collective human capital to achieve the goal (who); the processes activated inside the university (how); and finally the motivations behind the achievement of the goal (why).

Research limitations/implications – The research is exploratory and the framework offers opportunities for refinement. Future research is needed to verify the application of the framework to other organisations in the public sector intended as collective intelligence systems. A new perspective for managing IC in universities adopting the collective intelligence approach is developed. Contribution to the fourth stage (ecosystem) of IC research is highlighted, expanding the concept of IC value creation beyond the university into wider society.

Practical implications – The framework can be used to manage IC strategically in all the systems interpreted as collective intelligence systems in which the role of IC creation from multiple actors is relevant. This makes possible the understanding of how IC helps create value for the society and the region in which the university operates.

Originality/value – The originality of the paper is in bringing together issues usually dealt within the literature in separate domains, such as IC management and collective intelligence perspective. The concept of collective intelligence remains an unexplored field in relation to IC management in the public sector. The collective intelligence approach provides a novel contribution to managing IC and is intended to inspire future research.

Keywords Stakeholders, Intellectual capital, Intellectual capital management, Collective intelligence, Entrepreneurial university

Paper type Research paper

Journal of Intellectual Capital
Vol. 17 No. 2, 2016
pp. 298-319

1469-1930
DOI 10.1108/JIC-05-2015-0046

1. Introduction

Although the intellectual capital (IC) concept was first developed as a framework to analyse the contributions of intellectual resources in for-profit enterprises, it has been extended to public and non-profit organisations (NPOs) (Mouritsen *et al.*, 2004; Kong and Prior, 2008). Among NPOs there is growing interest in applying an IC approach to managing universities, since the main goals of universities include the production of knowledge (research), the diffusion of knowledge assets (teaching) and investing in human resources (Veltri *et al.*, 2014; Leitner and Warden, 2004; Sánchez *et al.*, 2009).

In recent decades, European universities have engaged in an important transformation process aimed at making them more autonomous, economically efficient and competitive (Ramırez Corcoles *et al.*, 2011). This transformation is taking place in a context of social, economic, cultural and political change in the public sector, in which universities are moving towards an organisational model more consistent with the promotion of economic development, in synergy with institutions and industries (Etzkowitz, 2004). These developments can be considered under the umbrella "entrepreneurial university", in which new dynamics and collaboration with industrial communities and social institutions are facilitated (Clark, 1998; Etzkowitz, 2004; Gibb and Hannon, 2006; Lazzeroni and Piccaluga, 2003; Ropke, 1998).

Among the key principles of the entrepreneurial university, the engagement of multiple stakeholders for the achievement of the "third mission" is today more pressing than in the past. Universities – and in general all higher education institutions – have moved from focusing exclusively on their traditional twin missions of teaching and research, towards a more active role for economic and cultural growth, the so called third mission (Etzkowitz *et al.*, 2000; Vorley and Nelles, 2008). Generally, third mission activities comprise three dimensions in which universities engage externally: technology transfer and innovation; continuing education; and social engagement. This has been motivated by stakeholder demand for greater transparency, increasing competition between universities and firms, greater autonomy, and the push by universities towards the adoption of new management and performance systems that incorporate intangible assets and IC (Sánchez *et al.*, 2009; Secundo *et al.*, 2010, 2015; Secundo and Elia, 2014).

For the purpose of this paper, the authors define IC as "[…] the sum of everything everybody in a company knows that gives it a competitive edge […] Intellectual Capital is intellectual material, knowledge, experience, intellectual property, information […] that can be put to use to create [value]" (Stewart, 1997, p. x). The inclusion of the word "value" in the definition is justified by the application to the public sector context, and not just the "wealth creation" as described by Stewart. The concept of value, rather than wealth creation, seems to be more appropriate because although value can include wealth, the outputs of a university are mainly intangible (Dumay and Guthrie, 2012). The authors are more concerned with how IC helps create value for the society and the region the in which the university operates (Dumay and Garanina, 2013; Dumay, 2014). Expanding the concept of value creation beyond organisational wealth creation into wider society aligns with Dumay and Garanina's (2013, p. 21) concept of fourth-stage IC research which helps "navigate the knowledge created by countries, cities and communities and advocates how knowledge can be widely developed thus switching from a managerial to an ecosystem focus". Therefore, the changed IC definition aligns with the third mission of universities.

However, in universities and the research context only a small part of this value is identified and very limited tools exist to create, manage and measure them. Among the approaches emerging in the literature, the IC management approach is based on

qualitative IC measurement models and stresses the usefulness of IC in decision making (Kujansivu, 2009; Lönnqvist *et al.*, 2009).

One dimension traditionally neglected in the process of IC creation and management is the "collective" involvement of all the university stakeholders contributing to the mission's achievement. The achievement of the third mission is ambitious and cannot be limited to the actions of a limited number of university actors. Rather it needs a collective approach, hence the concept of "collective intelligence", defined as the ability of a community to carry out a task or solve a problem more effectively and efficiently than by individuals, through collaboration and knowledge sharing (Malone *et al.*, 2008; Leimeister, 2010).

Principles of collective intelligence are today applied in sociology, business management, computer science and communication. The collective intelligence approach combined with IC management can support universities in improving the quality of the higher education system, supporting the achievement of the third mission. The application of collective intelligence is aimed at leveraging collaboration and IC sharing and allows the evaluation of the impact of IC value creation within the wider society.

This paper's aim is to combine the perspective of collective intelligence with IC management, developing a new practical framework that incorporates how IC can be managed and created in a university to increase the university's impact on society. The proposed conceptual framework harnesses the power of collectively created IC (i.e. created by all stakeholders) inside the university network. The framework helps the university to achieve its mission of social engagement and regional development – or "third mission" (Molas-Gallart, 2005; Laredo, 2007) – by focusing on measures other than the traditional approaches based on self-referential indicators and highly debated and criticised metrics. The model identifies four building blocks – to use a biological metaphor, the "genes" – that are at the heart of collective intelligence systems, the conditions under which each gene is useful, and the possibilities for combining and re-combining these genes to harness university stakeholders effectively in the process of creating and managing IC.

The paper is organised as follows. Section 2 presents a review of the literature related to IC management in the public sector with a focus on universities. Section 3 describe the research approach based on the principles of collective intelligence. Section 4 develops an integrative framework for IC management in the "entrepreneurial university" while Section 5 discusses the framework as well as identifying avenues for further research.

2. Theoretical background

This section examines what IC is in the context of universities, the rationale for proposing IC management for these institutions and the evolution of IC research towards the fourth stage.

2.1 IC and public services

Intangible assets and IC are seen as elements essential for value creation in companies (Moustaghfir and Schiuma, 2013). However, the concept and tools have progressively extended to public sector and NPOs mainly due to the high degree of "intangibility" of these organisations (Mouritsen *et al.*, 2004; Kong and Prior, 2008; Kong, 2010; Guthrie and Dumay, 2015). A review of the literature indicates during recent decades an increasing number of public organisations and NPOs have made efforts to identify, measure, manage and disclose IC (Kong, 2010; Kong and Prior, 2008; Dumay *et al.*, 2015).

Recent reviews of the IC literature in Guthrie *et al.* (2012, p. 74) and Dumay and Garanina (2013) find that the public sector is one of the least researched IC areas.

This is surprising considering that the public sector contributes a significant proportion of gross domestic product in most economies (Guthrie and Russo, 2014; Dumay *et al.*, 2010), and is strongly reliant on the generation and utilisation of capabilities and knowledge in its service delivery (Cuganesan *et al.*, 2012). However, as Broadbent and Guthrie (2008, p. 129) identify, the delineation between the private and the public sector is blurred because many "public services now are significantly managed, delivered and governed by private and third sector organisations". Therefore, what researchers classify as public sector services is continually evolving and will continue to evolve in the future.

Additionally, many public sector services are becoming privatised or turning into government business enterprises that seek to offer public services at a profit (see Dumay and Rooney, 2011). Thus, there is a lack of IC research about the public sector given the differences between it and other economic sectors, and the continued blurring of the lines between public and private services that create value for citizens (Farneti and Dumay, 2014; Dumay, 2014). Therefore, public sector IC research is an area worth exploring, especially in the context of the change in the way these services are delivered and paid for. Additionally, Guthrie and Dumay (2015, p. 264) "stress how important it is for future public sector IC research to address important and innovative current issues such as the changes in education", as discussed next.

2.2 IC in entrepreneurial universities

A threefold mission is commonly associated with the entrepreneurial university: the development of an existing knowledge and competence system (the "teaching" mission); the development of a technology and innovation system (the "research" mission); and the development of a regional and economic system (the "third" mission) (Etzkowitz, 2004). Thus, the model of an entrepreneurial university arose to generate socio-economic value, in synergy with institutions and industries (Etzkowitz, 2004), opening the university's boundaries to the external community of actors and stakeholders. The distinguishing features of the new university raise the problem of identifying proper frameworks for managing and analysing IC performance, particularly in terms of IC and knowledge assets collectively generated by all the university stakeholders and their impact within the wider societal and regional ecosystem.

The concept of IC has also been categorised in different ways by academics and business management since the mid-1990s (Bontis, 2001; Kaplan and Norton, 2004; Klein and Prusak, 1994; Seemann *et al.*, 2000). IC is defined as a dynamic system of intangible, knowledge-based resources and activities capable to create value for the stakeholders (European Commission, 2006). IC has been described as intellectual material that has been formalised, captured and leveraged to produce a higher valued asset (Klein and Prusak, 1994). An interesting conceptualisation sees IC as the combination of intangible resources and activities that allows an organisation to transform a bundle of material, financial and human resources in a system capable of creating stakeholder value and organisational innovation (Marr *et al.*, 2004). However, without doubt, the tripartite classification is the one most widely accepted in the IC literature, in which IC is structured in three blocks: human capital, structural capital and relational capital (Secundo *et al.*, 2010; Veltri *et al.*, 2014). It is important to note that the real value from IC not only resides in the sum of the elements that make up the whole, but in the interconnections between them. In the context of the higher education

sector and universities, elements of IC for universities can be classified and defined in terms as shown in the list below (Leitner *et al.*, 2014):

(1) Human capital: referring to the intangible value that resides in the people individual competencies, this includes the expertise, knowledge and experiences of researchers, professors, technical and administrative staff and students' competencies.

(2) Structural capital: referring to the resources found in the organisation itself, i.e., what remains without the employees, this includes the databases, the research projects, research infrastructure, the research and education processes and routines, the university culture, image and reputation, and so on.

(3) Relational capital: referring to the intangible resources capable of generating value linked to the university's internal and external relations. This includes its relations with public and private partners, position and image in (social) networks, the brand, involvement of industry in training activities, collaborations with international research centres, networking with professors, international exchange of students, international recognition of the universities, attractiveness, and so on.

The need for universities to have greater involvement with their wider community and the general concern to ensure the informational transparency of these institutions makes it advisable to present information on IC management (Ramırez Corcoles *et al.*, 2011). General methods for evaluating intangibles within universities are justified on the one hand in the political and managerial challenges that universities have to manage (Harayama, 1997; Johnes *et al.*, 2008; Parker, 2011; Veltri *et al.*, 2014) and disclose information to stakeholders, and on the other hand by the consideration that national and supranational organisations recognise the central role of universities in the contemporary knowledge-based society (European Commission, 2006). Below some of the reasons why institutions strategically manage IC are outlined:

- Universities produce knowledge through scientific and technical research, teaching or entrepreneurial activities (technology transfer, licensing, spin-off, etc.). Universities' inputs and outputs are largely intangible assets (Cañibano and Sánchez, 2009).
- There is continual demand for greater information and transparency about the use of public money (Warden, 2003), mainly due to the fact that most of the funding for public universities is sourced by the government (Sánchez and Elena, 2006).
- The greater autonomy of universities regarding their organisation, management and budget distribution requires greater social accountability to facilitate and satisfy the information needs of internal and external stakeholders.
- Universities are now facing growing competition due to lower funding, which puts them under greater pressure to communicate their results.

2.3 IC management in universities: moving towards the fourth stage of IC research

During the last two decades, some attempts have been made to apply IC measurement models in universities and research centres, especially in European countries (Leitner *et al.*, 2014; Ramırez and Gordillo, 2014; Sánchez *et al.*, 2009). Recently, Dumay (2009) criticised the apparent quest to develop more IC measurement frameworks, because a plethora of IC measurement frameworks already exist (Sveiby, 2010). Thus developing just another measurement framework would add little if anything to understanding IC in a traditional university setting. However, the distinguishing aspects of the

entrepreneurial university call for an effort to capture its strategic mission and objectives into an integrated framework. Thus, IC approaches need to be reinvented to facilitate a more balanced approach to management, measurement and reporting to contribute to the strategic management of universities (Secundo *et al.*, 2015). The focus should be on developing IC theory in practice and effective IC management through praxis (Dumay and Garanina, 2013) in order to provide a better view of the process of developing IC and the impact of IC in action.

The evolution of IC research can be traced as organised into four main stages. Originally, Petty and Guthrie (2000) outlined two stages associated with developing IC as a research field. The first stage of IC research focused on raising awareness and understanding IC's potential for creating and managing a sustainable competitive advantage in private organisations. This stage is grounded in the work of practitioners in the 1980s and 1990s. The main focus was the awareness of IC as something significant to be measured and reported, but with little empirical research provided in support (Petty and Guthrie, 2000).

In contrast, during the second stage, IC was established as an approach related to strategic management and evidence was gathered to justify its use (Petty and Guthrie, 2000, pp. 155-156). In this stage, a plethora of IC frameworks were applied in practice to demonstrate their potential value creation impacts. Different classifications were created, which helped to define and group different methods of IC evaluation (Boedker *et al.*, 2008; Ricceri, 2008). As a result, by the mid-2000s, more than 50 methods were created (Pike and Roos, 2007; Sveiby, 2010).

Later, a third stage of IC research gained impetus to study how organisations understand, adapt and apply IC as a management technology (Guthrie *et al.*, 2012), especially in cases of attempting to manage IC for the first time. Advanced models developed in the third stage adopted the evolved notion of IC as a dynamic system on intangibles resources based on knowledge (Veltri *et al.*, 2014). In these kinds of models, attention is focused on the interactions between the IC components and intangible activities essential in the production, maintenance and development of intangible resources (Silvestri and Veltri, 2011). The assumption behind these models is that measurement of IC is necessary for the management of knowledge, and their main aim is to identify the paths of an organisation's value creation based on knowledge (Veltri *et al.*, 2014).

Some features are considered relevant when analysing and defining an integrated IC management model: the potential value of IC, its dynamic and the organisation-specific nature. Dumay and Rooney (2011, p. 344) found "that it is possible to effectively implement IC practices without necessarily needing concrete IC measures because organisational measurement needs continually evolve depending on factors such as the characteristics of individual organisations; changing internal and external political, social and economic environments; and evolving business plans and strategies". Another essential aspect of the third stage is empirically researching IC practices inside organisations rather than IC measures (Guthrie *et al.*, 2012). Other researchers have highlighted the need for reporting and disclosing IC both to internal and external stakeholders, underlining the link with stakeholder theory and legitimacy theory (Guthrie *et al.*, 2006).

These assumptions form the basis of a further stream of research often identified as the fourth stage. The main pillar is the possible ways to create a bridge between knowledge inside the organisation, known as human capital, and knowledge outside the organisation, known as relational capital (Borin and Donato, 2015). This evolution of focus from previous concepts of IC converges the dimensions of human capital, relational capital and structural capital, towards new dimensions of IC, especially social capital. The social dimension of IC is now taken into account, incorporating citizenship and global brain

power, as outlined by the growing interest surrounding the dynamic process of value creation, the interdependencies and knowledge flows between different stakeholders.

Dumay and Garanina (2013) underline a broader view on the path of IC, focusing on the IC of countries, cities and communities as opposed to specific firms. This approach shifts the focus of IC to the ecosystems at national, regional or local level, where knowledge could be created and developed on a wider scale. Thus, the key questions this paper aims to address are: how is it possible to strategically manage IC within entrepreneurial universities to capture the distinctive role of all the stakeholders involved to achieve the third mission goal? How can the impact of IC management within the region/ecosystem where the university is located to be assessed?

3. Research methodology

The research approach of this study is based on the third and fourth stages of IC research (Dumay and Garanina, 2013), as outlined in the previous section. The entrepreneurial university and its vocation to achieve the third mission requires a focus on ecosystems (fourth stage) where intangible assets and IC are created and developed on a wider scale, because these stages connect IC with strategy. When dealing with IC in the public sector the gap between theory and practice is very broad. The benefits of IC approaches advocated by the literature and policy recommendations are clear but clash with the daily life and the reality of these institutions. What is needed are frameworks that address what Guthrie and Dumay (2015) call the "practice turn" because to develop practice it is necessary to use normative frameworks that help to implement IC and which can be tested in practice.

The review of theoretical approaches and previous experience in terms of IC management in the public sector suggested a set of requirements for defining and measuring IC in universities and provide the necessary criteria and methods for building an initial normative integrated framework to manage IC in a university. This is distinctly different from a second-stage research approach, which seeks to develop measurement approaches concentrating measuring IC performance on current practice. Indeed, the approach here used is a model that aims to shape praxis and performance, rather than measure performance outcomes (Dumay and Garanina, 2013, p. 19). To design the new framework, the collective intelligence approach (Lévy, 1994; Pór, 1995; Boder, 2006; Malone *et al.*, 2008) is adopted, starting from the assumption that the university is a collective Intelligence system. Before introducing the framework, the next section provides an overview about collective intelligence and its building blocks.

3.1 Collective intelligence as a research approach

In the last ten years, the participation of large groups of people in the solution of problems, such as global warming and earthquakes, has highlighted the "scientific" approach to leverage and exploit collective intelligence. The concept is not new; the core idea emerged at the end of the 1970s and evolved and formalised in the 1990s (Lévy, 1994; Pór, 1995; Malone *et al.*, 2008). In its broad sense, collective intelligence is a shared or group intelligence that emerges from the collaboration and competition of many individuals. The term "collective" describes a group of individuals, who are not necessarily required to have the same attitudes or viewpoints, however they work together to find solutions to a given problem. "Intelligence" refers to the ability to learn, to understand and to adapt to an environment by using knowledge (Leimeister, 2010).

Collective intelligence appears where local and distributed assets and expertise are coordinated to achieve a collective (although not necessarily consensual) goal (Mulgan

et al., 2012). Four basic elements have been identified (Boder, 2006): a group of competent actors in specific knowledge domains; a set of resources (physical resources, information, knowledge, relationships) and interaction mechanisms (mind mapping, database navigator, visual discussion, etc.) available to the actors; the objectives and results the actors should reach; a way of evaluating the results reached. According to Lévy (1994), collective intelligence is important for democratisation, as it is interlinked with knowledge-based culture and sustained by collective idea sharing.

A collective intelligence framework can support the understanding of how organisational and governance structures, connectivity patterns and technological platforms can improve the flow of information, inspiration and resources across creative and innovation ecosystems to generate the desired innovation outcomes. In other words, collective intelligence describes a phenomenon where, under conditions of diversity (of the people involved), independence (contributions of one individual are not influenced by those of other individuals) and aggregation (mechanisms for pooling and processing individual estimations to a collective estimation), large groups can achieve better results than any single individual in the group. This phenomenon is also known as the "wisdom of crowds" (Surowiecki, 2004).

3.1.1 The building blocks of collective intelligence. The Massachusetts Institute of Technology (MIT) has institutionalised the interest in collective intelligence as a research field by creating a dedicated research centre (The Centre for Collective Intelligence) that in 2006 provided the following definition: "Collective Intelligence is a group of individuals doing things collectively that seem intelligent" (Malone, 2006).

MIT's researchers have identified a relatively small set of building blocks that are combined and recombined in various ways in different collective intelligence systems. Employing an analogy from biology, they call these building blocks the "genes" of the collective intelligence system. They define a gene as a particular answer to one of the key questions (what, who, why or how) associated with a single task in a collective intelligence system. Like the genes from which individual organisms develop, these organisational genes are the core elements from which collective intelligence systems are built. The full combination of genes associated with a specific example of collective intelligence can be viewed as the "genome" of that system (Malone *et al.*, 2010). To classify these building blocks, four questions have been defined: what is being done; who is doing it; why are they doing it; how is it being done? Figure 1 illustrates MIT's Genoma model.

A brief description of each gene follows.

What? The organisation's mission. This is obtained through two actions: create, the actors generate something new, and/or decide, the actors evaluate and select

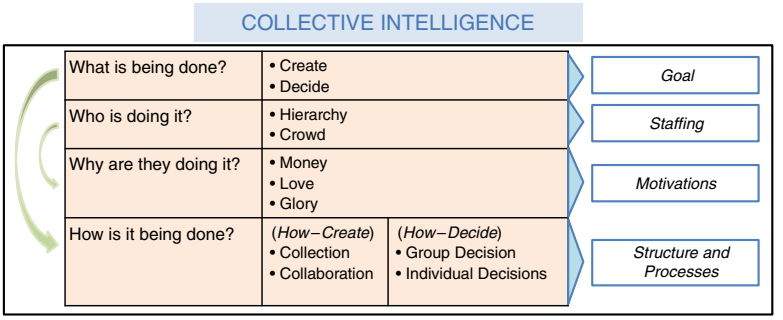

Figure 1.
The collective intelligence MIT Genoma

alternatives. Identifying the basic goal determines which of these two genes are used to start a business.

Who? The people involved in the actions developed to achieve the mission. People can be: hierarchy, someone in authority assigns a particular person or group of people to perform the task; or crowd, activities can be undertaken by anyone in a large group without being assigned by someone in a position of authority.

Why? The motivation behind the actions. These are, love, in which people can be motivated by their intrinsic enjoyment of an activity or because it makes them feel they are contributing to a cause larger than themselves. Glory, where recognition is another important motivator. Money, that is, the promise of financial gain as an important motivator for most actors in markets and traditional organisations. Sometimes people receive direct payments, like a salary, and sometimes they hope to increase the likelihood of their earning future payments, as in cases where people perform a task to enhance their professional reputation or improve their skills.

How? Whether the different members of the crowd make their contributions and decisions independently of each other or whether there are strong dependencies between them. This insight gives rise to four types of "How" genes associated with the actions "create" and "decide". The two "how" genes associated with the create task are "collection" and "collaboration". Collection occurs when the items developed by members of the crowd are created independently of each other. Collaboration occurs when members of a crowd work together to create something with dependencies existing between their contributions. The two "how" genes associated with the decide task are "group decision" and "individual decisions". Group decision occurs when inputs from members of the crowd are assembled to generate a decision that holds for the group as a whole. The decision determines the subset of contributed items that will be included in the final output. Individual decision occurs when the members of a crowd make decisions that, though informed by crowd input, do not need to be identical for all (Malone *et al.*, 2010).

4. A framework for managing IC in the entrepreneurial university

The review of theoretical approaches suggest a set of requirements for creating and managing IC and provide the necessary components for building an integrated framework for IC practice in the entrepreneurial university. Thus, the purpose of this section is to introduce the framework developed for the strategic management of IC within the university intended as a collective intelligence system, starting from an introduction about the university's plan for a collective intelligence system and moving towards the description of the framework's main components related to management and measurement of IC.

4.1 The entrepreneurial university as a collective intelligence system

The framework is aimed at supporting the entrepreneurial university as a collective intelligence system in which the tangible and intellectual assets are coordinated towards the achievement of the third mission (social engagement and regional development). The application of collective intelligence is aimed at leveraging collaboration to create more favourable conditions for managing IC within an entrepreneurial university in which there is involvement from both internal and external stakeholders of the region/ecosystem where the university is located. The proposed framework (Figure 2) integrates the three components of IC (human, structural and relational capital) with the collective intelligence "genes", identifying those that are useful for strategically managing IC inside a university focused on the achievement of the third mission. In this way, the model emphasises the

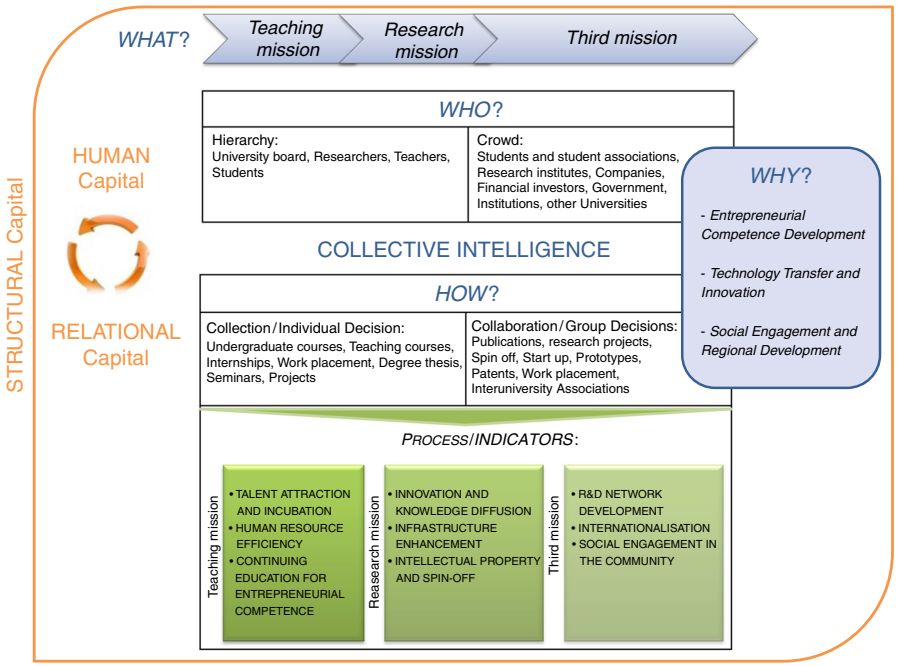

Figure 2.
IC practice in the entrepreneurial university using the collective intelligence approach

features of an entrepreneurial university that enhance each individual in the "crowd" (human capital), as the bearer of value to the entire organisation (stakeholders). The next section illustrates the components of the framework.

4.2 IC practice in university through collective intelligence

The underlying assumption of the framework (Figure 2) is the bidirectional relationship between human capital and relational capital, because the human component of IC creates the processes and structures that bring together the university with businesses and institutions. In addition, relational capital creates value for all members of the university and develops impact for its stakeholders. Structural capital creates an environment facilitating the development of the third mission of the university (Secundo *et al.*, 2014).

To describe the model, the structure of the approach of the collective intelligence genoma is considered through the key questions (what, who, how, why):

- What? This component includes the final goal of an entrepreneurial university intended as a collective intelligence system that can be expressed in terms of achievement of the third mission, overcoming the traditional teaching and research mission.
- Who? This component represents the actors/human capital of the university, collectively contributing to the third mission. The framework identifies two genes in the human capital: hierarchy and crowd:
  - hierarchy includes the university board (technical, administrative and auxiliary staff), researchers, professors, teachers and students. Hierarchy represents the traditional forms of human capital involved in the achievement of the teaching and research mission; and

- crowd includes students and student associations, other universities, research institutions, companies, financial investors, government and institutions. Crowd represents all the human capital forms belonging to the university's networks and impacted by the value creation process of the university.

- Why? Original motivations of IC practice have been identified in accordance with the third mission of the university, inspired by the genes love and glory. These are:
  - entrepreneurial competence development: the highest purpose of the university and affecting the development of capacities and skills of its human capital, characterised by a mindset dedicated to innovation and development;
  - technology transfer and innovation: linked to the concept of capacity for action and achievement of development and innovation, with the logic of cost minimisation; and
  - social engagement and regional development: the transmission of knowledge together with the development of entrepreneurial skills creates wealth and development in the regional ecosystem.

The gene money does not appear because the university is considered an NPO:

- How? This component includes the main activities of the university, classified with respect to the ability of human capital to create and decide on their own (collection/individual decision), or considering the collective contribution of different actors (collaboration/group decision) to the final aim. In particular, collection and individual decision, defined in the form of degree courses, teaching courses, apprenticeships, internships, theses, seminars and projects, represent the traditional tasks of a university included in its teaching and research mission.

Moreover, the activities related to collaboration and group decision, defined as publications, research projects, spin-offs, start-ups, prototypes, patents, work placement, interuniversity consortia, encompass the most important goal of an entrepreneurial university. Collaboration and group decision are the results obtained from the exchange of information and the readiness to disseminate knowledge with the external environment to create skills, innovation and technology, and regional and economic development.

Finally a set of practices represent the modalities through which the university achieved respectively the three missions:

(1) The teaching mission (entrepreneurial competence development) through the processes:
   - talent attraction: the capacity of the organisation to draw and retain talent through a strategy of high quality and a culture of openness;
   - human resources efficiency: i.e., the ratio between output/value created and human resources used at this purpose; and
   - continuing education the capacity of the university to develop new competences for entrepreneurship and innovation.

(2) The research mission (technology transfer and innovation) through the processes:
   - innovation and knowledge diffusion: refers to the performance of the institution in terms of scientific publications, research projects, etc.;

- infrastructure enhancement: refers to the enhancement of IT systems for teaching, learning and research, as well as the development of "traditional" facilities such as libraries and laboratories; and
- intellectual property and spin-off: relates to the capacity to contribute to technology transfer mechanisms.

(3) The third mission (social engagement and regional development) through the processes:

- R&D network development: the delivery of education and research results to the external environment and the monitoring of relations created with external factors such as governments, industry and other research centres;
- internationalisation: includes the aspects aimed to evaluate at which extent the institution is open to exchanges with the international scientific and industrial community; and
- social engagement in the community: to what extend the university is involved within the community through the setting up of events for engaging citizens.

4.3 IC measurement in an entrepreneurial university

The integration of the IC practice with IC measurement is realised through the identification of a set of indicators to assess the value generated by the entrepreneurial university within the wider society and region. In keeping with IC's fourth stage, the IC generated within the university impacts outside the university. A set of indicators to measure IC assets consider a set of important requirements. First, the system of metrics should function as a practice tool to help set measurable objectives, develop and allocate resources, create strategy, monitor results and facilitate decision making (internal reporting). Second, the measurement system should function as a communication tool to attract financial resources, human resources and enhance relationships with stakeholders (external reporting). Third, indicators have to promote a visualisation of outputs for each strategic objective, they have to refer to the institution's value creation process moving beyond financial indicators, and they need to be easily collected and available inside the organisation (Kok, 2007). Finally, indicators should be useful to evaluate the impact of IC within the region where the university is located so contributing to regional development and social engagement.

IC represents, at the same time, the main mission and the performance of the university (Secundo *et al.*, 2010). IC in the entrepreneurial university is ultimately the set of knowledge assets that drive the mechanisms of value creation according to the targets defined by the internal stakeholders (staff, researchers, director, governance body, etc.) and the external shareholder and stakeholder. IC measurement can help to identify structural strengths and weaknesses, reveal the current state of the different university missions and can be a controlling and monitoring instrument. This means that the objectives of the institution should be clear and the goal must relate to the university's third mission, complementing the traditional teaching and research mission.

In the framework, the gene "how" includes a number of processes belonging to the teaching, research and third mission, that are associated with indices for measuring IC. Processes represent the strategic objectives associated with each IC component and they are classified according to the objectives of teaching, research and third mission. A first group considered is the development of teaching mission enabled by the

education programmes organised at the university (talent attraction and incubation, human resource efficiency, continuing education for entrepreneurial competence). The second group analysed is the development of research mission (innovation and knowledge diffusion, infrastructure enhancement, intellectual property and spin-off). The third group analysed is the goal of the third mission (R&D network development, internationalisation, social engagement in the community). Subsequently, for each process the most relevant indicators to measure the creation of value for the entrepreneurial university (Figure 2) have been listed, keeping the classification based on the perspective of collective intelligence.

To identify the key indicators that can better define and measure the performance of the processes in the model, the authors started from the project E3M (European indicators and ranking methodology for university third mission) and from the other relevant projects already mentioned because they relate to the third mission. Also they were compared with the IC dashboard realised by the University of Salento (Italy) (Secundo *et al.*, 2010). Tables I-III contain the most relevant indicators for each process associated to the university's missions.

5. Discussion and conclusion

The last decade has seen increasing relevance for IC in higher education and universities (Siboni *et al.*, 2013) thanks to the greater adoption of qualitative decision-making models based on IC widely adopted in the public sector. Additionally, since the late 1980s, the European university system has undergone a profound change, led by the structural transformations driven by the Bologna Process aimed at increasing research quality and making universities more comparable, competitive, dynamic and

University's goal	Process	Indicators
Entrepreneurial competence development	Talent attraction and incubation	% of key stakeholders satisfaction
		No. of PhD studies on entrepreneurship
		No. of master programme on entrepreneurship
		No. of undergraduate courses on entrepreneurship
		No. of PhD students with entrepreneurial competences
		No. of post graduate students with entrepreneurial competences
	Human resource efficiency	No. of staff employed for specific tasks (e.g. external co-operations)
		No. of research fellows (scientific staff funded by scholarships)
		No. of staff funded by competitively funded R&D projects
		% of faculty involved into entrepreneurial courses on total students
		% of staff members on total students involved into entrepreneurial projects
		Average age of faculty
		Average age of staff
	Continuing education (CE) for entrepreneurial competence	No. of staff who attended continuing training courses
		Total number of continuing education programmes active in that year for implementation
		Total number of the European Credit Transfer and Accumulation System (ECTs) credits of the delivered CE programmes
		No. of graduate students with entrepreneurial competences

Table I.
IC indicators for entrepreneurial competence development

University's goal	Process	Indicators
Technology transfer and innovation	Innovation and knowledge diffusion	Expenditures for online-research databases (in €)
		Expenditures for scientific journals (in €)
		No. of books available in the library
		No. of pilot applications developed
		No. of ongoing research projects
		No. of publications in international journals and books
	Infrastructure enhancement	No. of software platforms for educ./research
		No. of software for entrepreneurial learning
		IT expenditure per person
		% of IT expenditure on total costs
		No. of PCs per student
		No. of PCs per staff member
		No. of PCs per faculty member
	Intellectual property and spin-off	% of success in project acquisition
		No. of spin-off companies
		No. of start-up companies
		No. of patents
		No. of international awards received
		No. of creative commons and social innovation project

Table II.
IC indicators for technology transfer and innovation

transparent (Siboni *et al.*, 2013). This process has resulted in the creation of a European dimension for higher education in which universities are moving from traditional academic organisations to new organisational forms called the entrepreneurial university (Clark, 1998) in which innovative academic and administrative management are required (Weber, 2006). Therefore, universities need to take into account new IC management strategies for identifying, measuring and valuing intangibles as part of an overall management perspective. The creation and management of IC is an operational priority to evaluate the alignment between the strategic orientation and the performance of universities contributing to regional and economic development.

5.1 Theoretical implications

This paper's main contribution to the IC literature is to provide a new practical framework whereby IC in the evolving entrepreneurial university is created and managed. The underlying assumption behind the framework is to consider the university as a collective intelligence system in which the tangible and intellectual assets are coordinated towards the achievement of strategic goals. An application of the framework is provided to the emerging model of the entrepreneurial university, the traditional missions of which – teaching and research – are being broadened to include third mission activities that facilitate universities' engagement with society and regional development.

The conceptual framework harnesses the power of IC collectively created by the engagement of multiple stakeholders inside the university network. Indeed, collective intelligence aligns with the focus of the third mission of the entrepreneurial university, describes the powers of human capital through the identification and description of the crowd (stakeholders of the university), highlights the relational capacity of human capital (in terms of collaboration and collection of actions) and defines what motivates the human capital to share the knowledge generated within the university network.

Taking the metaphor from biology, the framework is broken down into four main blocks or genes harnessing the IC collectively created. The genes are aimed at

University's goal	Process	Indicators
Social engagement and regional development	R&D network development	Expenditures for large equipment for R&D (in €)
		No. of competitively funded R&D projects (third-party funded projects)
		No. of internally funded R&D projects
		No. of new partnerships developed
		No. of companies involved in education activities
		No. of companies involved in research activities
		No. of research institutes involved in educ. activities
		No. of research institutions involved in research activities
	Internationalisation	No. of scientific staff who stayed abroad for at least 5 days
		No. of scientists employed abroad who completed a stay at the university (incoming staff)
		No. of staff who fulfil functions in scientific journals
		No. of staff who fulfil functions in scientific boards
		No. of students who participated in an international mobility programme (outgoing)
		No. of foreign students participating in an international mobility programme (incoming)
		No. of international joint degrees/double degree programmes
		No. of scientific publications
		No. of presentations at scientific conferences
		No. of students with international experience
		% of international students
		No. of countries with collaborations developed
		No. of faculty members in international conferences
	Social engagement in the community	No. of co-operation partners (institutes/companies) with a co-operation contract
		No. of units which aim to support disabled persons
		No. of visits to partner companies and res. centres
		Budgetary assignment to social engagement
		No. of events open to community/public
		No. of research initiatives with direct impact on the community

Table III.
IC indicators for social engagement and regional development

particularly answering four questions. What is being done? Who is doing it? How it is done? Why it is done? These questions provide the conceptual pillars to describe, respectively, an overall approach to IC management articulated in the final goal of an entrepreneurial university (what), the collective human capital to achieve the goal (who), the processes activated inside the university (how) and finally the motivations behind the achievement of the goal (why). The creation and management of IC is thus an operational priority to evaluate the alignment between the strategic orientation and the performance within a university contributing to social engagement and regional development.

The framework describes an approach that all universities can use to enhance their intangible resources and endorse the capacity of their "crowd", on which a profitable interaction with the external environment is based. The model outlines explanations that create the motivation for human capital to participate towards achieving the entrepreneurial university mission, identifying the motivations, activities and processes that allow for effectively managing strategic IC. Additionally, universities, interpreted as collective intelligence systems, have potentially a pivotal role to play in the social and economic development of their regions because they are a critical "asset" of the region. Therefore, the conceptual framework developed allows the analysis of the

impact of managing IC according to an individual perspective (university level) and a collective perspective (society and regional level).

Regarding the impact of IC management at a university level, it is found in mission and performance. At first IC development can be interpreted as a mission for universities as they are created and funded with the purpose of building the workforce of tomorrow, stimulating organisational and technological innovation, and enhancing the network of relationships that cross-fertilise industrial and academic expertise. Second, IC is a metric of performance, and intangible asset measurement are for universities and research organisations what the balance sheet and the income statement are for businesses. Moreover, the framework has been framed within the "third stage" of IC research (Dumay and Garanina, 2013), since it highlights the praxis of IC approaches and models rather than its theoretical conceptualisation.

The advantages of IC management refer to the opportunities to move beyond metrics and measurement to focus on the strategy process in practice grounded on IC assets (Edvinsson, 2013). Traditional measurement tools and frameworks do not capture the flow of intangible assets and their impact on value creating dimensions over time (Guthrie *et al.*, 2012). In overcoming these limitations, the framework is coherent with the third stage of IC research because it allows for the implementation and examination of how the IC approach works in practice within the university context to create stakeholders' value. However, incorporating the university's third mission with managing, is coherent with the fourth stage of IC research (Dumay and Garanina, 2013).

In keeping with fourth-stage IC research, the impact of managing IC according to a collective perspective (at societal and regional level) is found in external steering processes with university stakeholders and in regional development. The changes at university level demand from universities an entrepreneurial orientation with increasing market relations and a stronger self-reliance, which is associated with considerable opportunities and also with risks. Thus universities are called on to articulate a clear mission and vision, to interact with the external stakeholders in the "outside" ecosystem, to identify a diversified funding base and to adopt interdisciplinary activities for developing an integrated entrepreneurial culture. Realising the right balance requires responsible and competent leadership, mobilising the institution's crowd towards a common goal, and bonding stakeholders in the regional context. These collective actions allow for the implementation of active engagement of universities in regional innovation strategies, in co-operation with research centres, businesses and other partners in civil society.

5.2 Practical implications

The authors call for researchers to consider helping public sector practitioners implement IC frameworks and models through interventionist research to help unlock IC's potential (Dumay, 2010; Chiucchi and Dumay, 2015; Vagnoni and Oppi, 2015). In keeping with the performative third-stage IC research agenda, interventionist research makes it possible for academic researchers to act as a catalyst for strategically implementing IC frameworks and models in practice within a university setting (Dumay, 2011). Moreover, in advancing the fourth stage of IC research, the paper supports the comprehension of how IC is used in the context of higher education and universities in which unexpected changes are occurring as a consequence of global competition (Secundo *et al.*, 2015). The framework addresses a wider view about IC management, developed not just for internal university

stakeholders, but for external stakeholders (the crowd) within the regional ecosystems where the university is located. In thinking about the concept of IC as an ecosystem (Borin and Donato, 2015), it is more appropriate to include a wide set of intangible assets related to the university's external environment. This demonstrates how public sector IC researchers are willing to explore new ground and experiment with IC in practice through action and interventionist research (Chiucchi and Dumay, 2015; Vagnoni and Oppi, 2015).

5.3 Limitations and future research

Limitations of the study include the necessity to further validate the framework with experts, university administration, professors and students and with the "crowds" characterising the human capital of a university. Future research will be devoted to experimenting the framework in real-life settings by involving universities, research centres and university administrators in the design of experimental scenarios.

For this reason, the authors intend to implement the framework adopting the interventionist research approach to gather data and make changes in the case study universities. To investigate the issue at hand, a multiple case study will be undertaken, using two universities that have been measuring their IC for several years to comply with regulation related to the evaluation of teaching and research. Adopting a critical perspective, the framework implementation project will be conducted using an interventionist approach favouring IC practice and mobilisation. It will examine the role of actors/administrators who design and implement the system and how their IC learning processes and their take up of IC management practices are influenced.

The following steps are planned:

(1) understanding the strategic goal and vision of the universities for the next years;

(2) validation of the framework using interviews with universities' board, directors of departments and faculty;

(3) refinement of the framework;

(4) identification of the IC awareness and implementation level in the universities through systematically collecting IC data;

(5) application of the framework; and

(6) assessment of the implications for decision making in the universities and the impact at regional/ecosystem level.

The application of the framework allows us to highlight key issues of the third and fourth stage of IC research:

- the IC practice connection to the university's strategic objectives;
- the system's interactive design and its complexity;
- the predominant use of non-financial indicators to accomplish the need to assess and compare research and innovation among universities;
- the backward- or forward-looking nature of the resultant management tools; and
- the exchange between the university-wide ecosystems.

Applying the framework in practice adds to building IC knowledge by completing the cycle of developing normative frameworks and testing their validity in real life settings.

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About the authors

Giustina Secundo is a Senior Research Fellow at the University of Salento (Italy) and an Assistant Professor in Project Management. Her research is characterised by a cross-disciplinary focus, with a major interest towards knowledge assets management, innovation management in learning network and knowledge intensive entrepreneurship. These research activities have been documented in about 105 publications in international journals, conference proceedings and book's chapters. Her research appeared in *Journal of Intellectual Capital*, *Journal of Management Development*, *International Journal of Innovation and Technology Management*, *International Journal of Management Education*. She's a Lecturer of Project Management, Technology Entrepreneurship and Intellectual Capital Management at the Faculty of Engineering of the University of Salento since 2001. In 2015, she was a Visiting Researcher at the Innovation and Insights Hub of the University of the Arts in London (UK). Giustina Secundo is the corresponding author and can be contacted at: giusy.secundo@unisalento.it

John Dumay is an Associate Professor in Accounting at the Macquarie University, Sydney. Originally as a Consultant he joined Academia after completing his award winning PhD in 2008. John's research specialties are intellectual capital, knowledge management, non-financial reporting, management control, research methodologies and academic writing. John has published over 30 peer reviewed articles in leading academic journals. He is also on the Editorial Board of Advice for the *Electronic Journal of Knowledge Management*; *Meditari Accountancy Research*; *Accounting, Auditing and Accountability Journal* and is the Australasian Editor of the *Journal of Intellectual Capital*.

Giovanni Schiuma is a Professor of Arts-Based Management at the University of Basilicata, Italy. He has held Visiting Teaching and Research Appointments at the Cranfield School of Management, Graduate School of Management St. Petersburg University, Cambridge Service Alliance – IfM University of Cambridge, University of Kozminski, University of Bradford, Tampere University of Technology. Giovanni has a PhD in Business Management from the University of Rome Tor Vergata (Italy) and has authored or co-authored more than 180 publications, including books, articles, research reports and white papers on a range of research topics particularly embracing strategic knowledge asset and intellectual capital management, strategic performance measurement and management, innovation systems, and organisational development. He serves as a Chief-Editor of the journal *Knowledge Management Research and Practice* and as a Co-Editor in Chief of the international journal *Measuring Business Excellence* and he has acted as a Guest Editor of the *Journal of Knowledge Management*, *Journal of Intellectual Capital*, *International Journal of Knowledge-Based Development* and *Journal of Learning and Intellectual Capital*. Giovanni Chairs the International Forum on Knowledge Assets Dynamics.

Giuseppina Passiante is a Full Professor of Innovation Management and Technology Entrepreneurship at the Department of Innovation Engineering, Faculty of Engineering, University of Salento, (Italy). Currently her research fields concern technology entrepreneurship, and more specifically the experiential learning environment encouraging enterprise and entrepreneurship capabilities, skills and competencies. She is also expert in knowledge-based organisations and local systems, ITs and clusters approach, complexity in economic systems. In these research fields she has published several books and about 100 papers. She is an Associate Editor of the *International Journal of Innovation and Technology Management* and a Coordinator of the International PhD Programmes on Technology Innovation and Entrepreneurship at the University of Salento (Italy). Professor Passiante is a Member of the Independent Evaluation Committee (OIV) of the Italian National Research Council (CNR).