**Transforming the stakeholders’ Big Data for intellectual capital management**

**Abstract**

**Purpose** – The paper defines a conceptual framework for transforming Big Data into organizational value by focusing on the perspectives of Service Science and Activity Theory. In coherence with the agenda on the evolutionary research on Intellectual Capital, the study also provides a momentum for researchers and scholars to explore the emerging trends and implications of the Big Data for IC management.

**Design/methodology/approach** – The paper adopts a qualitative and integrated research method based on a constructive review of the extant literature related to IC management, Big Data, Service Science and Activity Theory in order to identify features and processes of a conceptual framework emerging at the intersection of research topics previously identified.

**Findings –** The proposed framework harnesses the power of Big Data, collectively created by the engagement of multiple stakeholders based on the concepts of service ecosystems, using Activity Theory. The transformation of Big Data for IC management addresses the process of value creation on the basis of a set of critical dimensions useful to identify goals, main actors and stakeholders, processes and motivations..

**Research implications/limitation** – The paper throws light on how organizational values can be created from Big Data through the co-creation of value in service ecosystems. Activity theory is used as theoretical lens to support the development of the IC ecosystem. This research is exploratory and the framework offers opportunities for refinement and can be used to spearhead directions for future research.

**Originality/value** –The originality of the paper is in bringing together research from Big Data, value co-creation from service ecosystems and Activity Theory to address the complexity issues involved in IC management The integration of such multidisciplinary perspectives as lens for shaping the complexity of process of value creation from Big Data in relationship to IC management is a further additional element of originality offered . . The concept of how IC ecosystem can be designed is also introduced.

**Practical implications**: The paper proposes a framework for transforming Big Data into organizational values for IC management in the context of entrepreneurial universities, as pivotal contexts of observation that can be replicated in different fields The framework provides guidelines that can be used to help organizations who intend to embark on the emerging paradigm of Big Data for IC management for their competitive advantages.

**Keywords** Intellectual capital, Intellectual capital management, Big Data, Value Creation, Activity Theory, Ecosystems, Service Science, Service Dominant Logic.

**Introduction**

Big Data represents a key new type of economic asset that is now permeating all the areas of companies. It has become a strategic factor in organizations’ competitiveness, while it is also radically changing the world, affecting the daily lives of individuals, companies, and public institutions (Jin *et al*., 2013). Defined as “information assets characterised by such a high volume, velocity and variety to require specific technology and analytical methods for its transformation into value” (De Mauro *et al*., 2016), Big Data is coming the most promising source of differentiation and strategic positioning of the organizations in the context of the knowledge economy.

The exponential growth of available data, compounded by the Internet, social media, cloud computing and mobile devices, has generated new challenges and opportunities for many organizations (Gandomi & Haider, 2015; Hashem *et al*., 2015). There is a growing interest in businesses to understand how to capture and create value using Big Data as well as to harness its power in order to gain competitive advantage in a scenario more and more configurable as knowledge-intensive (De Mauro *et al*., 2016; LaValle *et al*., 2011).

Knowledge permeates all areas of a company both internally and externally including employee knowledge, internal structural knowledge and knowledge of the external environment (Grant, 1996). Its aggregation constitutes an organization’s Intellectual Capital (Bontis, 1998) Intellectual capital is critical to sustaining competitive advantage and is a valuable source of wealth creation. (Moustaghfir and Schiuma, 2013). According to Dumay (2016, p. 169), Intellectual Capital is intellectual material, knowledge, experience, intellectual property, information that can be put to use to create value.

Big Data and IC share a similar goal that is value creation to provide competitive advantages for organizations. Value creation is not only concerned with monetary assets, but should also include social and utility values and it is more and more interested by the interaction within organization’s ecosystem (LaValle, *et al*., 2011). This is aligned with Dumay and Garanina’s (2013, p. 21) concept of fourth stage IC research. That is switching the focus for knowledge from organization to the society as well as from a managerial to an ecosystem focus (Secundo *et al*., 2017).

Big Data discloses a huge potential for businesses and is a source of input for more effective decision-making (Zeng & Glaister, 2017), blurring boundaries between the internal and external knowledge assets that companies can leverage. Borin and Donato (2015) argue that it is strategic to create a bridge between knowledge inside the organization (human capital) and knowledge outside the organization (relational capital). Big Data has shifted the focus of IC from organizations to the ecosystems in which it operates to create knowledge on a wider scale (Dumay, 2013). Creating value is the result of managing knowledge assets, and this is reflected in both Big Data and IC (Secundo *et al*., 2016).

While there is a growing consensus on the contribution that Big Data can provide in sustaining organization into the process of IC creation and management to generate value for both society and the ecosystems in which they operate, how to transform Big Data into tangible or intangible assets that become IC is still unknown (O’Neil and Schutt, 2013; Jin *et al*., 2015). This is especially important today that there are multiple actors involved in the IC system. Each actor has different values.

Despite the importance of organizational value that is needed for IC management, very little research has been done in this area, by disclosing areas for further investigation related to the processes and meaning of value creation from Big Data (Secundo *et al*., 2017).

It full comprehension calls for the adoption of interpretative frameworks able to detect strategic actors, processes, evolutionary dynamics and goals characterizing the IC ecosystems. This makes the adoption of the frameworks based on interdisciplinary perspectives enable us to combine the rigorous of technical, economic and engineering perspectives societal and cultural aspects in order to sustain organizations, that are more and more embedded into complex networks of relationships, in the full exploitation of their knowledge as well as in the creation of sustainable value.

Framed in the above premises, the paper suggests the adoption of service centred perspective as useful lens for transforming of Big Data into value for all participating actors in an IC ecosystem. Accordingly, the paper aims to provide an answer to the following research questions: How IC organizations use the value co-creation and context to transform Big Data to useful value for the different actors involved? How does context play in the value co-creation ecosystems? How do the different actors or stakeholders interact with each other?

To achieve this, we draw on the cultural historical activity theory (Leontiev, 1978; Kuutti 1996; Uden, 2007) to underscore the importance of networks of actors, institutions, e.g., rules, social norms, resources integration, value co-creation, and the (re)formation of IC systems as activity systems.

In order to better understand IC ecosystem perspective, this paper describes a theoretical conceptual model based on service ecosystems and activity theory with the aim of supporting organizations in IC creation and management (Dumay and Garanina, 2013; Dumay, 2014).

With the aim of providing practical evidence for the study, the paper focuses on the archetype of entrepreneurial university, as multi-actor organizational context that focused on the creation and management of intangible knowledge assets emerging from an ecosystem populated by different categories of stakeholders (Zhou & Etzkowitz, 2011; Guerrero & Urbano 2012).

The full comprehension of processes to promote resource integration and alignment of objectives towards a shared co-creation by heterogeneous actors involved in a same (eco) systems as well as of the elements characterizing the different dimensions of IC (Human Capital, Structural Capital, and Relational Capital) through the perspective of service dominant logic can allow ud to overcome the limits anchored to Goods-Dominant Logic that has been used till now by demonstrating it to be unable to capture the dynamics required by the context of observation (Polese, *et al*., 2016).

By leveraging on two consolidated and interdisciplinary approaches, such as Service Ecosystems and Activity Theory, the paper aims to provide a conceptual contribution at the advancement of debate on IC and Big Data.

The paper begins with a background in IC, in section 2. Section 3 presents a review of the literature on Big Data and value co-creation from service science. A brief overview of Activity Theory is given in section 4. Section 5 presents the framework for transforming stakeholders’ Big Data to values for IC management. Section 6 concludes with main evidences and suggestions for further research.

**2. Background of Intellectual Capital (IC)**

The world economy has recently experienced a transition from an industrial configuration, based on the intensive usage of tangible assets, to knowledge-based perspective, resulting from the intensive usage of the knowledge (Foray & Lundvall, 1998; Romano *et al*., 2014). This means creating wealth by developing and managing intangible assets, and this is commonly known as IC (Dumay & Garanina, 2013). Despite there this not being a precise convergence on its definition (Moustaghfir and Schiuma, 2013; Secundo *et al*., 2017), the IC arises as a multi-faced issue characterized by intangibility and oriented to the creation of value in its larger definition (Dumay, 2016).

IC grew out of accounting and centres on identifying and measuring the knowledge assets of the organization (Stewart, 1997).

Stewart (1997) defined 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]”. According to Marr *et al*. (2004), IC as the combination of intangible resources and activities allows an organization to gain competitive advantage, by transforming a bundle of material, financial and human resources in a system capable of creating stakeholder value and organizational innovation. As a dynamic system of intangible, knowledge-based resources and activities capable of creating value for the stakeholders (European Commission, 2006), IC allows organizations to be competitive according to the principles of resource-based theory of the firms (Wernerfelt, 1984).

IC consists of three components: human capital, structural capital and relational capital (Bontis, 1998; Veltri *et al*., 2014). As argued by Secundo *et al*., (2017) the value of IC as competitive asset not only resides in the sum of the elements that make up the whole, but in the interconnections between them as well as into the activities that allows us to identify, measure, disclose, and report the organizational knowledge (Edvinsson, 2013; Lerro & Schiuma, 2013; Secundo & Elia, 2014). Several stages of research can be identified in the debate on IC (Dumay and Garanina, 2013; Secundo *et al*., 2017). In the last two decades this has been featured in large numbers of scientific contributions. According to Dumay and Garanina (2013), we are currently into the fourth stage of research on IC.

This fourth stage is characterized by the aim to create a bridge between knowledge inside the organization, known as human capital, and knowledge outside the organization, known as relational capital (Borin & Donato, 2015). In the fourth stage, the challenges for scholars and practitioners in the field of IC is to bring together 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 (Secundo, *et al*., 2016). This approach is the result of an evolutionary process related to the comprehension and management of IC issues, from the age of awareness and understanding (first stage), to the age of strategic thinking on IC (second stage), followed by the age of the technology based and managerial orientation (third stage). The fourth stage is on the shifts from the focus on IC from the single organization to the ecosystems as scalable representation of national, regional or local context, in which organizations are embedded and where knowledge could be created and developed on a wider scale (Secundo *et al*., 2017).

The perspective on value creation remains crucial in the debate on IC. In this fourth stage value should be produced in terms of utility, social capital and sustainability (Dumay, 2016). The authors concur with Dumay, (2016) that organizations should provide sustainable value in society. Today many organizations affect the everyday lives of the society in which they operate and in the meantime the ecosystem in which they are participating will influence their capacity for creating and managing IC assets. This is made more challengeable by reason of the huge amount of data generated within the ecosystem as well as of complexity of the relationships that organizations can experience. Therefore, to understand how organizations can create value from their IC is crucial, as well as leveraging on Big Data to create and effectively manage their IC.

**3. Creating Value from Big Data**

The fourth stage of research on IC has highlighted the emergence of ecosystems as complex contexts to be observed and managed for driving the processes of value creation from IC (Dumay, 2016). This is because in such ecosystems a plurality of actors can interact with organizations and offer potential contributions for the creation of IC in all its components. In making evanescent the boundaries of organizations, such a community of stakeholders will assume a valuable dimension by reason of the huge amount of data that can be generated. It is in this perspective that Big Data become critical in the debate on the fourth stage of IC as a crucial asset with a huge potential for value creation (Secundo, et al., 2017).

Defined as “techniques and technologies that make handling data at extreme scale affordable”*,* Big Data is not only technology but also people with the appropriate analysis skills that makes dealing with extreme scale affordable. Advanced tools, software, and systems are required to capture, store, manage, and analyze the data sets, all in a timeframe that preserves the intrinsic value of the data. Three main dimensions such as volume, velocity, and variety (Laney, 2001; McAfee and Brynjolfsson, 2012) have been defined as useful lens for Big Data.

Three more Vs are used to define and differentiate consumer Big Data from large-scale data sets: variability, veracity and value (Ebner, *et al*., 2014; Lycett, 2013). The question of value creation from Big Data becomes important because of the increasing amounts of data available.

Big Data is revolutionizing all aspects of our lives ranging from enterprises to consumers, from science to government (Jagadish, *et al*., 2014).

The challenge for organizations is to derive meaningful insights from available data to create value. This involves the collection of data from direct and indirect, structured and unstructured sources, analyzing and synthesizing it to derive meaningful information and values. Once this is achieved it must be converted into a useful knowledge base, storing it and finally delivering it to end users. The abundance of data generated by the organization through the interaction with multiple users getting into contact with each other highlights the relevance of the ecosystem perspective in the development of the research on value creation from an IC perspective in this study.

From the economic perspective, Big Data offer much potential, including creation and storage of more transactional data in digital form; more accurate and detailed performance information; tailored products or services by ever-narrower segmentation of customers; making information transparent and usable at much higher frequency; development of the next generation of products and services (Aho & Uden 2014).

In addition, Big Data can also provide potential benefits to productivity, user involvement and customer satisfaction for companies. Companies or countries will expect to optimise costs, increase revenues, and make organizational processes more efficient when adopting a Big Data approach (Manyika *et al*., 2011).

According to Secundo *et al*., (2017), Big Data can from the social perspective, create the basis for a more equal and inclusive society. Big Data can be used as powerful instrument for creating advanced solutions in many fields of human, political, economic and social applications (Boyd & Crawford, 2012). It also gives organizations and nations the potential to solve challenges in science, education, the environment and medicine that create societal value and widespread wellness (Fredriksson, 2015; Ohlhorst, 2012). Big Data can enhance decision making in both economic and social terms with the support of advanced, automated data analytics algorithms. (Fredriksson, 2015). Therefore, the debate on value creation from Big Data is consistent with the adoption of an ecosystem perspective instead of the organizational one and this highlights the relevance of this issue in the research on IC management.

Resources are important for the performance and competitiveness of a company. According to Erevelles *et al*., (2015), there are several important resources in the context of Big Data, Firstly, physical capital resources include software or a platform that a firm uses to collect, store, or analyze Big Data. Companies must establish a platform that is capable of storing and analyzing large amounts (volume) of data continuously flowing in real time (velocity) from many different sources (variety) (Davenport *et al*., 2012). Secondly, human capital resources include the insight of data scientists and strategists who know how to capture information from consumer activities, as well as manage and extract insights from Big Data. Thirdly, organizational capital resources include an organizational structure that enables the firm to transform insights into action. Firms may need to alter organization and business processes to act on the insights from Big Data (Viaene, 2013).

Firms must constantly update and reconfigure resources by responding to changes in the external environment to develop a sustainable competitive advantage (Kozlenkova *et al*., 2014; Lin & Wu, 2014). A firm must be able to have skills and knowledge embedded within the organization to alter existing resources and create new value to respond to change (dynamic capability; Kozlenkova *et al*., 2014). A firm using novel consumer insight extracted from Big Data to understand unmet consumer needs enhances dynamic capability.

Zeng & Glaister’s (2017) research reveals that the data itself does not automatically generate value for customers. It is what a firm does that leads to value creation both internally within the firm and externally across the extended-data network. Data scientists alone do not maximize value creation from Big Data. Rather, value creation is closely associated with a collective process that transmits relevant knowledge across the firm. According to these authors, there are four capabilities organizations need internally for harnessing Big Data to create value: data democratization, data contextualization, data experimentation and data execution.

The value of Big Data actually lies in the analytics. Data analytics (DA) is the science of examining raw [data](http://searchdatamanagement.techtarget.com/definition/data) with the purpose of drawing conclusions about that information (De Mauro *et al*., 2016). It is used in many industries to allow companies and organization to make better business decisions and in the sciences to verify or disprove existing models or theories. The activities performed in data analytics require coordinating processes, people, and technology internally within a company and externally from partners and vendors to produce analysis that answers business questions, makes recommendations based on mathematically and statistically rigorous methods, and informs successful business activities across many functions from sales to marketing to management. Data analytics can help a business in many ways. The two goals for the highest and best usage of analytics are to create value by 1) generating profitable revenue, and 2) reducing cost (Aho & Uden 2014).

As we know Big Data is not good for organizations unless it can create value for them. The transformative potential of Big Data lies in treating data as an asset. Extracting the most value out of data assets requires a data driven business strategy, a value-framework for data, assessing, valuating, realizing, complying, securing, and sustaining the value of data. Value creation is the most important part of Big Data management. Value creation is closely associated with a collective process that transmits relevant knowledge across the firm. How do we make sure that we have captured all the values of the different stakeholders involved? It is the authors’ belief that we need to turn to co-creation of value from service science to help us.

**3.1. Co-creation of value from service science**

To switch the focus for knowledge from organization to society: from a managerial to an ecosystem focus (Secundo *et al* 2017), it is imperative that we turn to service ecosystems from service science. This is because value creation is typically the joint integration of resources by the multiple actors associated with an exchange (Vargo and Lusch, 2008). It is the authors’ belief that the principles of service ecosystems can shed light to how 4th IC ecosystems can be designed.

According to Spohrer *et al*. (2008), Service science centres on the study of value co-creation within and among service systems—dynamic and adaptive webs of exchange composed of interactions among people, organizations, and technology. Maglio *et al*. (2010, p. 1) argue that service science is the “systematic search for principles and approaches that can help understand and improve all kinds of value co creation. According to Lusch and Vargo (2014, p. 161) service ecosystems are “relatively self-contained, self-adjusting system[s] of resource-integrating actors connected by shared institutional logics and mutual value creation through service exchange. Service-ecosystems view centres on the collaborative creation of value (i.e., value co-creation), the integration of dynamic resources, and the institutions that influence, and are influenced by, interactions among multiple actors (Vargo & Lusch, 2011). Organizations are increasingly co-creating value by forming service ecosystems where they engage in exchange of services (Lusch and Nambisan 2015).

According Vargo and Lusch (2004, pg 2), “service is that the application of specialised competences, such as knowledge and skills, through deeds, processes and performances for the benefit of another entity or the entity itself”. Maglio, & Lim (2016) *defined service* as value creation that occurs within systems of interacting economic actors. Service is the process of doing something for and with another party. The purpose of economic exchange in service is service provision for (and in conjunction with) another party in order to obtain reciprocal service – that is, service is exchanged for service. Although goods are involved in the process, they are appliances for service provision – they are conveyors of competencies. The key to effective service lies in arranging the capabilities among multiple actors or stakeholders so they can create the most value together (Maglio *et al*., 2009).

Service-dominant (S-D) logic was introduced by Vargo and Lusch (2004, 2008) to reframe ‘service’ as a concept that transcends and unifies ‘goods’ and ‘services’. The new notion of service, the service dominant logic (SDL), views service as being about resources, exchange and human action (Spohrer *et al.,* 2008). S-D logic starts from the notion that service is the basis of any exchange and all socioeconomic actors are service providers. Resources are integrated in value co-creation of multiple actors, i.e., producers, customers, users, suppliers, and wider networks, which are nested in institutional arrangements (Lusch and Vargo, 2014).

To summarize, an S-D logic, or service-ecosystem perspective, is grounded on five axioms (Vargo & Lusch, 2016, p. 18):

Axiom 1: Service is the fundamental basis of exchange.

Axiom 2: Value is co-created by multiple actors, always including the beneficiary.

Axiom 3: All social and economic actors are resource integrators.

Axiom 4: Value is always uniquely and phenomenologically determined by the beneficiary.

Axiom 5: Value co-creation is coordinated through actor-generated institutions and institutional arrangements.

According to Akaka & Alden (2010), from service-ecosystem view, value-in-exchange is only a nominal representation of value. The "real value" or value-in-use (Smith, 1776) is derived and determined through the integration and application of resources. A service ecosystem perspective provides insight into the dynamic nature of IC by suggesting that value is always derived and evaluated by the customer (Vargo & Lusch, 2008). Exchange in a service-ecosystem perspective is embedded in social interactions and the resource integration practices of multiple actors (Korkman *et al*., 2010). Thus resource integration is a central practice in value co-creation (Vargo & Akaka, 2012). Also because exchange and resource integration are embedded within a variety of contexts, value creation is influenced by interactions that take place outside of dyadic transactions, including external stakeholders.

According to researchers, in the service-ecosystem view, value co-creation is not only influenced by the use of firm-specific resources, management or firm characteristics, but also by contextual factors, such as networks of relationships, social structure, and cultures (Chandler & Vargo, 2011; Akaka, *et al*., 2015). Together these different layers offer a view of organizations that includes multiple levels of interaction, namely micro-, meso-, and macro. These levels are relative to each other (i.e., not fixed) and an analytical meta-layer reveals the relationship among the nested levels that enables researchers to understand the connections among different levels of interaction and how the ecosystem evolves over time (Kaartemo, *et al* 2017)

We concur with Lusch and others (2010) that the service ecosystem perspective provides an important venue for understanding how actors interact with other actors as they co-create value for themselves and for others by integrating available resource for the IC ecosystems.

According to Chandler and Vargo (2011), the creation of value depends on social context made of interconnected relationship. The “social context implies norms and values that exert a profound influence on both the service exchange and the value co-creation process” (Edvardsson *et al*. 2011, p. 239).

Value co-creation is a multidimensional concept. It is a joint activity consisting of simpler joint collaborative actions. The following dimensions from Karpen *et al*. (2012) can be used in the micro level of IC ecosystem interactions. To understand value co-creation we should commence with investigating the actions of the different actors engage in the interactions, with the goal of generating value for at least one of the participants.

These actions include: Individualizing joint actions; Relating joint action; negotiating joint actions; Norm joint actions; Developmental joint actions and Concerted joint actions

Besides the joint collaborative actions between actors in IC ecosystem interaction, it is also necessary to consider the value co-creation antecedents for IC value co-creation.

Many models have been developed by researchers for the co-creation of value for service science. For this paper, we would adopt the TADERT Model of co-creation (Uden & Naaranoja, 2010). The TADERT model consists of the following dimensions as enabling processes impacting on the value co-creation:

1. Trust, as feeling occurring at individual level (identification-based and knowledge-based trust); socially with the convincement on similar intensions and goals (indentification-based trust); organizational and interpersonal level.
2. **A**ccess, to make available knowledge, tools and expertise that can help users in constructing their own experience outcomes;
3. **D**ialogue, to encourage not only knowledge sharing, but also gives individuals more opportunity to interject their view into the value creation process.
4. **E**nvisioning, to involve the creation of a vision that is tangible enough that all players understand how it will affect them: a vision that is clear enough that it can be expressed concisely at every level of an organization, and that has tactical and strategic implications for short and long-term futures.
5. **R**isk, to be aware about the risks associated to the openness, the cooperation and collaboration for organizational goals
6. **T**ransparency, to operate with respect and to inspire individuals to participate effectively in co-creation and engender trust between institutions and individuals.

In order to address the co-creation of value for IC, it is necessary to ask the following questions:

* What type of value does the organization intend to create, how, for whom and why?
* What is the organization’s notion of value?
* What process is used for value creation?
* What actions and activities the value creation process entails, for whom the organization aims to create value and why?

It is the authors’ belief that Cultural Historical Activity Theory (AT) can be used a theoretical lens to help us transform Big Data to value creation for IC management.

**4. An overview of activity theory (AT)**

Activity Theory is a philosophical and cross-disciplinary framework for studying different forms of human practices as development processes, both individual and at social levels interlinked at the same time (Kuutti 1996). It originated as a cultural and historical psychology by Vygotsky (1978) and Leontiev (1978). It incorporates the notions of intentionality, mediation, history, collaboration and development (Nardi, 1996).

The unit of analysis is the entire activity (Uden, 2007). Activity theory has been used as analytical tool for many different subjects. These include: human–computer interaction (Kuutti, 1996), information systems (Bødker, 1991), interface design (Bødker, 1991), communities of practice (Engeström, 1993), education (Engeström, 1987), etc. Activity Theory provides researchers with both a methodological framework, and the practical tools with which to apply it. It enables researchers to consider the tensions, contradictions and different motives which may be brought to bear within a given context.

Engeström (1987) depicts an activity system with six components (See Figure 1), each of which holds cultural and historical dimensions. Activity theory sees activity systems as being in essence dynamic, undergoing a process of change and development. Activity systems are collective human constructions that are not reducible to discrete individual actions (Leontiev, 1979). The driving force behind that dynamic is contradiction. Contradiction is the continual breakdown and temporary resolution of inner relations within the system.

Activity is always directed towards an object, satisfying a need that constitutes the overall motive of the activity. The object of an activity is always associated with a motive. Individual activity is always collective. The *‘Object’* component portrays the purposeful or *objective* nature of human activity that allows individuals to control their own motives and behaviour through the manipulation of tools. The objective of an activity therefore forms the basis for distinguishing the various sub-activities that may exist within the main activity system. (Mwanza, 2000).

The subject of an activity system is known as the actor. This is the person, or group of people whose perspective is the focus of the analysis e.g. a professor or a group of students. The object transformed into outcomes with the help of mediating artifacts, known as *Tools*. Tools can be physical or psychological. A "tool" can be anything which is used in the transformation process, including both material tools and tools for thinking; "*Community* consists of the people who share with the subject an interest in and involvement with the same object. Relations between the subject and the community are mediated by the last two components: a) the *rules* that regulate the subject’s actions toward an object, and relations with other participants in the activity; and b) the *division of labour*, understood as what is being done by whom toward the object, including both the relatively horizontal division of tasks and the vertical division of power, positions, access to resources, and rewards (Engeström, 1987). Finally, *Rules* refers to the explicit and implicit regulations, norms, and conventions that constrain the actions and interactions within the activity system (Uden, 2007). Rules and the division of labour define how participants are expected to behave and who is expected to do what in the achievement of the object of an activity system. An activity is embedded within a surrounding system; for example teaching is embedded into the activity system of a university, which is in turn embedded into the activity system of the country. Within these embedded systems, the cultural life of the university (or other setting) is developed and maintained.

In AT, context and content (activity) cannot be separated. Context arises from and is sustained by the activity itself. Leontiev (1979) argues that human activity is formed not from within the individual but as a result of interaction with the external environment. The ‘social conditions carry in themselves motives and goals of the individuals forming it’ (Leontiev (1979)



**Figure 1: Basic structure of an activity**

Central to activity theory is that activities are basic units of analysis: Individual actions should be situated in context, which constitutes the activity as a unit of analysis (Kuutti, 1996). Activities are not given or static, but instead dynamic unities. The components of an activity system keep changing and developing. Hence, each activity has its own history and development. The analysis of AT is to consider the systemic whole of an activity, not just its separate components. This makes possible the analysis of a multitude of relations within an activity system, both at a particular point in time, and as it evolves over time.

According to Kuutti (1996), activities have three hierarchical levels: activity, action and operation, which can be individual or cooperative. They can be considered as corresponding to motive, goal and conditions. An activity (global) may be achieved through a variety of actions. The same action may be used as contribution to different activities. Similarly, operators may contribute to a variety of actions (See Figure 2).



**Figure 2: The three levels of activity**

The subject and object of an activity are in a reciprocal relationship with each other. The subject transforms the object. Conversely, the properties of the object penetrate into the subject and transform him or her. This is called internalization (Uden, 2007). Activities in activity theory can be understood only in their psychological, cultural, and institutional contexts, not in isolation Engeström 2001).

*Networks of activity systems*

Activity theory also includes activity systems interacting with other activity systems. The analytical focus consequently shifted from activity system to the network of interacting systems of activity (Engeström and Kerusuo, 2007). Networks of activity systems partially share the motive of activity and object of attention (Figure 3). The partially shared object represents the focus of attention and the motive of activity amongst two or more interconnected activity systems (Yamazumi, 2009). This means that collective activity in networked activity systems embeds mutual needs and shares the envisioning of potential benefits. The network of interacting activity systems multiplies multi-voicedness (Engeström, 2001). Significant transformations occur in interconnected systems of activity.



**Figure 3 Two interacting activity systems partially sharing an object of attention**

(Engeström, 2001, p. 136)

According to Engeström (2001), the object of activity is “a moving target, not reducible to conscious short term goals’ (p.136). This means that there is a demand for joint and collective work that should be established between different set of stakeholders, governed by rules and divisions of labour, to determine the new object of interacting activity systems.

Based on the work of Engeström (1987), Virkkunnen and Kuutti (2000) argued that an analysis of an activity system typically begins with the identification of one central activity which is the focal point of holistic investigation surrounded by other interrelated activities that support the central activity) as shown in Figure 4.



**Figure 4: A Central Activity and Interconnected Activities**

(adapted from Engeström 1999).

**4.1 Advantages of AT for managing Big Data for IC management**

Activity theory can support the co-creation of value from Big Data in an IC perspective by offering a range of benefits. Firstly, it takes account of complexity in IC ecosystem design. Secondly, it takes a holistic systemic view (and multiple systemic). Thirdly, it is activity based, socially constructed. Fourthly, it is developmental as instability in the system created change and expansive learning. Fifthly, learning and development are promoted in an activity system by contradictions and discontinuities between conflicting areas of the activity system. Identifying these contradictions enables reflection and reconstruction of the situation, and proposed new activity that can be transformative. When activity systems interact together, new elements from each may be introduced, creating a secondary contradiction within the system. These benefits provide an ideal theoretical framework to understand how IC Big Data ecosystems can be designed and managed. Finally, activity theory can be used to create a bridge between knowledge inside the organization, known as human capital, and knowledge outside the organization, known as relational capital by shifting the focus of IC from the organization to the eco-systems where knowledge could be created on a wider scale helping with the fulfilment of fourth stage of IC research

**5. Conceptual framework for Big Data in IC Management**

This section describes the theoretical conceptual framework to transform the stakeholders’ Big Data for intellectual capital management using the principles from activity theory and service science. To do this we would use the entrepreneurial university as an example to show how the different stakeholders belonging to different internal partners and external partners between different universities . This allows us to illustrate how the framework can be used to cope with the organizational context characterized by knowledge-intensive and multi-stakeholders dynamicsUsing service ecosystem concepts and activity theory. to transform Big Data into values for the different stakeholders in an IC system. The Entrepreneurial University is used to show that universities to day is a highly complex organisation concerning not only with teaching , learning and research , but innovation and enterprising. Universities today are more and more configurable as multi-actor organizational contexts embedded into complex ecosystems of relationship with different categories of stakeholders (Zhou & Etzkowitz, 2011; Guerrero & Urbano 2012). The use of entrepreneurial universities is in our study aimed to provide a concrete context where we can demonstrate the inter and intra relationshios bw=etween the internal and external parteners involved in the complex IC ecosystem

In this section we describe how AT can be used to help with Big Data for IC management with the aim to comprehend how the plurality of actors operating in the ecosystem of an entrepreneurial university, can be considered as multiple activity systems to address the various components of the IC Big Data framework of what, who, how and why.

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).

**5.1 An activity theory framework for IC management**

A collective activity system is taken as the unit of analysis using Engeström’s activity diagram. The study began by interpreting the various components of the activity triangle (Figure 2) in terms of the situation being examined. This involves following the 8 steps to build up the various components of the activity triangle representation for the activity diagram.

*1. Identify the Object or Objective of activity*

- Why is this activity taking place?

This is concerned with the *why component* of the Secundo *et al*., (2017) Conceptual framework. It *describes* the main motivations and objectives addressing the use of Big Data into the strategies and practices of IC management in the entrepreneurial university.It uses the object-orientedness principle of activity theory. It is important to clarify the motives and goals of the activity system. The object identified for our entrepreneurial university is social engagement and regional development.

*2. Identify the Activity of interest to be investigated*

- What sort of activity am I interested in?

What are the activities, goals and sub goals to be supported by the IC environment?

What is it you want to achieve? Is it reduced cost? Better management of risk? Improved customer experience?

Identify the activity that will create value.

There are several activities that can be investigated for our university example such as:

* Entrepreneurial competence development;
* Technology transfer and innovation:
* Social engagement and regional development.

The activity chosen for this study is Social engagement and regional development.

*3. Identify the Subjects in this activity*

- Who are involved in carrying out this activity?

‘Who’ refers to the different stakeholders that contribute to the creation, sharing, and processing of Big Data in a value network that supports the effective implementation of IC practice (Secundo *et al*., 2017). This requirement calls for the use of an activity system from AT where local and distributed assets and expertise are coordinated to achieve a collective object. The stakeholders in the entrepreneurial university are any one that has a stake in the university including University board (technical, administrative and auxiliary staff) etc. This is the actors/human capital of the university. Organizational value cannot be created on its own. It emerges through joint collaboration between the different stakeholders bringing together their assets, competences, and specificities. This requires the co-creation of value and the interaction of activity systems in an IC ecosystem.

4. *Tools* mediating the activity

- By what means are the subjects carrying out this activity?

Tools include physical and psychological tools, language, software, signs and data. Data would be considered as the tool used to extract value for IC management of the university.

What are the physical tools used to perform the activity? What are the psychological tools used? (Methods, procedures, techniques, languages etc)?

What kind of data will provide useful values from the University board (technical, administrative and auxiliary staff), collaborators to increase human capital?

What kind of data will provide useful values from students and student associations, other universities, research institutions, companies, financial investors, government and institutions? Crowd is used here to represents all the human capital forms belonging to the university’s networks and impacted by the value creation process of the university to consolidate relational capital.

What kind of data will provide useful values from physical and virtual infrastructures, machines and tools to improve structural capital?

5. *Community* in which activity is conducted

- What is the environment in which this activity is carried out?

This includes anyone who has a connection with the university, such as students and student associations, other universities, research institutions, companies, financial investors, government and institutions. It represents all the human capital forms belonging to the university’s networks and impacted by the value creation process of the university.

6. *Rules* and regulations mediating the activity

- Are there any cultural norms, rules or regulations governing the performance of this activity? This is related to the structural capital of the organization consist of all non-human knowledge repositories in the organization which include procedures, guidelines, routines etc.

What formal or informal rules or laws guide the activities in which people engage? Who is doing what and why?

This includes the procedures, approaches and managerial practices useful to identify and retrieve data, store and filter data collected, data processing and interpretation of analysis performed in order to deliver punctual feedback and insights for the organizations’ value creation.

7. *Division of labour* mediating the activity

- Who is responsible for what, when carrying out this activity and how are the roles organised?

How are tasks organised among the members of the group working toward the object?

Having identified all the actors or stakeholders that affect, or are affected by, a specific process, project or organization, it is necessary to identify who is doing what and why. No activity can be done by a single actor; Organizational value emerges through joint collaborative endeavours, precisely where these different stakeholders bring together their assets, competences, and specificities.

8. What is the desired *Outcome* from carrying out this activity?

This is concerned with what is the intended outcome for carrying the activity? What is the deliverable we want to have? What question we try to answer ? What is the value of solving the problem? What will you do with the insights? The outcome is IC management.

Using the above guidelines help us to answer questions in relation to the situation being examined. The guidelines also help to identify areas to be focused on during the investigation and also in deciding on what data are needed for what and why during the analysis.

The activity diagram produced is shown in Figure 5.

**Tools** (Big Data, HC, SC, RC)

**Subject** (University board)

**Rules** Structural capital

**Community**

(Students, other universities, research institutes, companies, etc.)

**Division of labour**

(Teaching, Research, Start-ups, Degrees, Placements, Projects.)

**Out**c**ome**

Social engagement and regional development.

**Object**

Transformation

**Figure 5: Activity diagram for social engagement and regional development.**

**5.2 How the activity is carried out?**

Lastly, the ‘how’ component describes the organizational procedures, approaches and managerial practices that are useful in creating value from data for the society. It is important to shift perspective from a knowledge economy to a socio-economic context. This means creating value beyond organizational wealth and into wider society to align with Dumay and Garanina’s (2013) concept of the fourth stage IC research. This fits in well with the principles of activity systems. This section describes how the activity of social engagement and regional development is carried out.

The principle of the hierarchical structure of activity theory is used. To carry out the Social engagement and regional development, it is important to break the activity into different actions such as R&D network development. The R&D network development actions deals with 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 action includes the aspects aimed to evaluate at which extent the institution is open to exchanges with the international scientific and industrial community; and the social engagement in the community to address to what extend the university is involved within the community through the setting up of events for engaging citizens.

Relational capital is the value of an organization’s relationships with the people and businesses with whom it trades, such as its Customers, Suppliers and Partners. However, relational capital is highly intangible in nature to capture. By using activity system as lens to analyse relationship, it is possible to build up the ecosystem that IC 4th stage is currently pursuing.

Relationships between activity systems are the tenet of activity theory. It is possible to have some typical relations between one activity and its neighbours in the Entrepreneurial University. Figure 6 shows the Central Activity and Interconnected Activities of the entrepreneurial university. In this diagram there is a central activity and four others, although there could be more. The instrument-producing activity creates the tools to be used by the central activity. For example, the Big Data committee may produce data sets that are used by the central activity. Similarly, the rule-producing activity could produce rules or guidelines that govern how members of the group should act when conducting the central activity and so on.

For the entrepreneurial university social engagement and regional development activity, a historically evolving collective activity system, seen in its network relations to other activity systems, is crucial. Each institution needs to examine the dynamic structure of its internal activity and, as far as possible, align it with that of the others. This is because any activity system is “always a community of multiple points of view, traditions and histories (Engeström p. 136).

To achieve social engagement and regional development activity, the entrepreneurial university would seek to establish formal academic links with overseas institutions - through, for example, arrangements for international students to undertake programmes jointly run by partner universities, the exchange of teaching and academic staff, and the setting up of collaborative research projects.

With regard to the exchange of academic staff between intercultural organizations, an AT framework could be applied to analyse, separately and then comparatively, the ways in which the division of labour in the two communities affects intra- and inter-institutional interaction. What are the ascribed roles for, and hierarchies of, academic staff, and what are the implications of these vertical and horizontal divisions – for example, in terms of teaching versus research, or in the nature of research supervision, or the peer review of academic quality? What expectations, resources and facilities are made available for research and publication? What social and financial distinctions are made between academic and other staff? What are the formal and informal (i.e. actual) power relationships? What similarities and differences are perceived in the general and specific division of labour? What impact do these findings have on the relationship between academics in one community of practice with those in the partner institution?

Figure 7 illustrates how interacting activities span intra- and inter-organizational relationships of our entrepreneurial university.

Subject Producing Activity

(Human Capital)

Central Activity

Division of Labour

(HC, SC, RC)

Object

Tools Producing Activity

(Structural Capital)

Rule Producing Activity

(Structural Capital)

Object Activity

(Big Data, IC Activity)

Tools

**Figure 6: Central Activity and Interconnected Activities of the entrepreneurial university**

The AT Big Data framework for IC helps to bridge the gap between knowledge inside the organization (human capital) and knowledge outside the organization (relational capital). This aligns with the fourth stage IC research (Dumay and Garanina, 2013) which is now reaching its cusp (Dumay, 2016). It provides guidelines that will help IC strategic management to transform Big Data into organizational values using activity theory and co-creation of value from service science. Activity systems analysis provides a new method to extract meaningful information from massive and complex qualitative data sets and to conceptualize how real world phenomena are embedded within the situation that is being examined. Activity theory allows us to analyze the situation in its entirety. The multiple activity systems help us to identify the relationships between one activity and another to draw out systemic implications to be aligned with the IC Ecosystem.

Subject University A Boards

(Human Capital)

Community

Division of Labour

Object

Tools

Rules

Subject

Rules

Object

Div of Labour

Community

Tools

**Figure 7: Inter-activity Relationships for University**

1. **Discussions and Conclusion**

Big Data is now an asset that can create a significant competitive advantage and drive innovation, increase competitiveness, and create social impact. It is now regarded as a **primary asset** for all sectors, organizations, countries and regions.Mastering the creation of Value from Big Data will impact the competitiveness of organizations and will result in economic growth and jobs.

The transformative potential of Big Data lies in treating data as an asset. Extracting the most value out of data assets requires a data driven business strategy, a value-framework for data, assessing, valuating, realizing, complying, securing, and sustaining the value of data.

This paper has showed how it is possible to strategically manage IC to capture the distinctive role of all the stakeholders’ involved in IC management. The main categories of organization’s stakeholders within the ecosystem are the users and customers, suppliers and partners, employees, competitors, institutions and public players, and the external environment. Organizational value emerges through joint collaborative endeavours, where these different stakeholders bring together their assets, competences and specificities.

The use of activity systems showed that local and distributed assets and expertise are coordinated to achieve a collective object. By using activity theory to investigate human activity puts the study into the social and cultural context of the community whilst paying attention to the mediating aspects of that activity through the tool, rules and division of labour components.

The framework for managing Big Data for IC helps also to bridge the gap between knowledge inside the organization (human capital) and knowledge outside the organization (relational capital) using AT. It helps to shift IC’s research focus from organizations onto ecosystems, and to view intangible asset creation and management as a multi-directional process.

By Focusing on entrepreneurial universities, as consolidated archetype of universities operating in a complex environment populated by a large community of stakeholders involved presents us a challengeable process of value creation, the conceptual framework presents in the paper shows how the entrepreneurial university as an activity system in which the tangible and intellectual assets are coordinated towards the use of Big Data for IC management. The use of AT also provides the management of IC to include both internal and external stakeholders of the region/ecosystem where the university is located. The framework integrates the three components of IC (human, structural and relational capital) in the activity system identifying those that are useful for strategically managing IC for an entrepreneurial university.

The approach provides us the opportunity of adopting an innovative frameworks characterized by interdisciplinary perspectives resulting from the intersection of technical, economic and engineering , societal and cultural perspectives. It offers a new contribution to the advancement of the research in the field of IC based on the theoretical concepts from Activity Theory and value co-creation from Service Science**.**

The underlying assumption behind the framework is to consider IC management as a

collection of activity systems in which the tangible and intellectual assets are coordinated towards the achievement of strategic goals.

The conceptual framework harnesses the collectively principle of AT to co-create values for the multiple stakeholders inside the university network. The approach fits in well with the concept of an IC ecosystem where there is relationship between internal and external organizations by using AT. This is because Relationships between activities systems are the tenet of activity theory, that has been used in this paper to analyse and illuminate collaborative activity across institutional boundaries. It also allows us to have a philosophical framework for understanding collective human work activities as embedded within a social practice. By applying AT, we are able to have networks of interacting systems of activity shifting the focus of IC from the organization to the eco-systems where knowledge could be created on a wider scale helping with the fulfilment of fourth stage of IC research.

The framework also offers a contribution at the evolutionary stage on IC management as highlighted by Dumay (2016) in terms of fourth stage as well as it is coherent with the multidimensional perspectives of study of Big Data in an IC management perspective depicted by Secundo *et al*., (2017) in terms of what, who, how and why.

As Big Data is new to IC research, it is the authors’ desire that this paper throw some insights into how Big Data has the potential to transform IC management.The conceptual framework developed provides us a strategic approach to transform the stakeholders’ Big Data into organizational values for Intellectual Capital managementaccording to individual perspective (university level) and collective perspective (society and regional level).

Limitations of the study include the necessity to further validate the framework and its application in the context of entrepreneurial universities with experts, university administration, professors and students and with the community characterising the human capital of a university. Future research is needed to experiment the framework in real‐life settings by involving universities, organizations, government and research centres in the design of experimental scenarios, also with the aim to identify common and distinctive patterns.

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