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Evaluating the innovation of the Internet of Things: Empirical evidence from the intellectual capital assessment

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Empirical evidence from the intellectual capital assessment

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Abstract

Purpose – The Internet of Things (IoT) represents the network connection of people, processes, data and things. Due to the relevant position that this intelligent infrastructure is acquiring, the purpose of this paper is to investigate the effects of IoT on the companies' value, with specific reference to the intellectual capital value.

Design/methodology/approach – The methodology is based on a single case study approach with an empirical analysis which aims to analyse whether and how the introduction of the IoT' innovations influences the value of the intellectual capital owned by a company. The evaluation method used for the empirical analysis is the Economic Value Added. The application is carried out on the company "Cisco Systems Inc." by analysing the company's financial reports covering the period 2007-2014.

Findings – The paper demonstrates the impact of the innovation of IoT on intellectual capital owned by a high intensity cognitive company by determining its economic value. The results demonstrate that the introduction of projects involving the use of the IoT has increased the value of intellectual capital over the years.

Originality/value – As the IoT can guarantee efficiency, social and individual benefits, the effects of the IoT on company performance and, particularly, on intangible corporate dimensions are analysed. Hence, the paper is directed to fill the literature gap on the analysis and evaluation of the IoT' impact on intellectual capital owned by high intensity cognitive companies. The research proposes strategic advice for decision making of companies interested in new technology investments.

Keywords Innovation, Internet of Things, EVA, Intellectual capital, Cisco Systems Inc.

Paper type Research paper

1. Introduction

The paper investigates the effects Internet of Things (IoT) innovation on the intellectual capital owned by high intensity cognitive companies, through the assessment of their economic value.

In the last few years, the IoT has had an effect on education, communication, trade and the public administration (Evans, 2011). The IoT innovation represents a paradigm: an innovation that creates value. It represents a range of technologies that provide objects with intelligence, making sure that they communicate with humans or with other machines, providing a new level of interaction or information compared with

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the environment in which these objects can be found (Chandrakanth *et al.*, 2014; Debasis and Jaydip, 2011; Gubbi *et al.*, 2013; Sundmaeker *et al.*, 2010).

The technological change, which is taking place at an organisational level, the rise of knowledge workers and the increasingly demanding customers have highlighted the importance of intellectual capital in addition to physical and financial capital (Petty and Guthrie, 2000).

As the IoT can guarantee efficiency, social and individual benefits, the effects of the IoT on company performance and, particularly, on intangible corporate dimensions are analysed.

From this perspective, the objective of the paper is to evaluate how the introduction of the IoT can change the value of intellectual capital and intangible corporate dimension of a company. At the same time, the research tries to understand how the IoT can influence intellectual capital owned by a company.

The analysis is founded on the assessment of intellectual capital (human capital, relational capital and structural capital) owned by a company that has introduced the innovation of the IoT.

The first level of the research is directed to represent whether the introduction of the IoT can increase the value of intangible assets in the company system; the second level of the research aims at analysing how the IoT can influence the value of intellectual capital.

In the first level, in order to determine the economic value generated by IoT on intellectual capital, a synthetic method recognised as "Economic Value Added" (EVA) has been used. The application is carried out on the company "Cisco Systems Inc.", the worldwide leader in networking, by including its financial statement during the period 2007-2014.

The method used for the research is both qualitative and quantitative (Anderson *et al.*, 2012; Myers, 2013; Waters, 2008), by proposing to the scientific community an approach for the assessment of IoT on intellectual capital owned by high intensity cognitive companies, evaluating, at the same time, the effects on the economic value.

The research utilises a single case study approach (Eisenhardt, 1989; Merriam, 1998), in order to fill the literature gap discovering the influence of innovation of the IoT on intellectual capital.

Collected data are of a secondary nature (Yin, 2013), gathered through the use of databases, reports, news, journal articles in open sources and papers.

The paper has the following structure. After the introduction, Section 2 provides the literature review related to IoT innovation and the relationship between innovation and intellectual capital. Section 3 describes the research method. Section 4 proposes the findings through the application of the EVA method and the analysis of Cisco Systems Inc. Section 5 defines the conclusions and limitations of the study, providing insights for future research.

Therefore, the research questions are as follows:

RQ1. Does the introduction of the Internet of Things affect the value of intellectual capital?

RQ2. How does the Internet of Things increase the value of intellectual capital in high intensity cognitive companies?

2. Literature review

2.1 Innovations of the IoT

Innovation is a complex social process; companies innovate for so many reasons since there are different drivers that push them to innovate (Egbu, 2004).

Over the last few years, the companies have focused on innovative services since they create continuous value for the economies (Kim *et al.*, 2012).

Several classifications of innovation have been provided. Schumpeter (1934) defines five main types of innovation that may arise: product innovation; production process innovation; innovation in organisation; new market behaviour; and new raw materials. Some authors (Dewar and Dutton, 1986) have suggested a second definition based on the intensity of innovative change, therefore classifying them in radical innovation, the creation of a new product replacing all of the old characteristics, and incremental innovation, improvements or adaptations to existing solutions.

Others (Kim *et al.*, 2012), have classified innovation, especially innovation of digital content services, linking the concept of divergence and convergence (Freeman and Hagedoorn, 1995; Jenkins, 2001; Nordmann, 2004), of existing services into new creative services with the concept of incremental innovation, or use and set up of an existing single service applying to other content or platforms to develop new services, and recombinative innovation, involving the combination of multiple sources of existing services to create new services.

The IoT could be considered, at the same time, incremental and recombinative innovation because it utilises service and technical characteristics of pre-existing products in order to create new services and products which are more dynamic and efficient than existing ones.

The IoT is a new vision that has quickly increased its importance in the modern telecommunication field (Atzori *et al.*, 2010).

The IoT represents a paradigm: an innovation that creates value affecting the competitive essentials, making functionalities and services, that before were not imaginable. Some authors (Andersson and Mattsson, 2015) assert that it represents one of the most promising innovations and it is important to know as much as possible about what the technical opportunities are to innovate, because the IoT could involve great change in the commercial and social field.

Ashton (2009) asserts that it represents the foundation of a digital economy, the digital society and the grounds for the future of the economy based on knowledge (Foray, 2004; Zanda, 2012) and innovative companies.

The use of analysis and algorithms has increased efficiency, productivity and almost deleting the marginal costs of production and sharing of several products and services (Rifkin, 2014).

The IoT connects the planet via a network (Trequattrini *et al.*, 2012; Vermesan and Friess, 2014), distributed on a global level, across different sectors of industry and trade.

The IoT European Research Cluster (2013) defines it as a dynamic infrastructure, a global network with self-configuration functions based on standard and inter-operable protocols of communication where physical and virtual "things" have an identity, attributes and virtual personalities; they use intelligent interfaces and are perfectly integrated in the information network (Vermesan *et al.*, 2011; Sundmaeker *et al.*, 2010).

The IoT innovation covers many application fields, sometimes in combination, such as security, tracking and tracing, payment, health, remote control and maintenance and measurement (Andersson and Mattsson, 2015).

In the last few years, the IoT has had an effect on education, communication, trade and the public administration (Evans, 2011). It represents a paradigm: an innovation that creates value, a range of technologies that provide objects with intelligence, making sure that they communicate with humans or with other machines, providing a

new level of interaction or information compared with the environment in which these objects can be found (Chandrakanth *et al.*, 2014; Debasis and Jaydip, 2011; Gubbi *et al.*, 2013; Sundmaeker *et al.*, 2010).

Due to the importance of the phenomenon, several scholars have analysed it from different points of view including the investment opportunities perspective for companies (Griffith, 2014), expansion of communication (Capriotti and Pardo Kuklinski, 2012; Echterhoff, 2013), optimisation of energy consumption (Singh and Yiu, 2011), implications for marketing (Benady, 2014; Cristóbal-Fransi *et al.*, 2014), implications for logistics (Pye, 2014; Yu *et al.*, 2015); the source of innovation that this new infrastructure represents (Wright and Bell, 2003; Yuksekkaya *et al.*, 2006).

The next section will provide an analysis of the connection between innovation and intellectual capital.

2.2 Innovation and intellectual capital

Innovation represents the greatest source of competitive advantage and is an essential requirement for the success of the organisation and its survival (Del Giudice *et al.*, 2010; Egbu, 2004). The economic value of innovation often is retrieved in the idea that has generated it or in the knowledge connected to it (Chesbrough *et al.*, 2006).

In the last few years, the conception has emerged that modern economies are moving their interest towards modern services and technologies (Stewart, 1997; Sveiby, 1997; Petty and Guthrie, 2000; Cuganesan, 2005). In these economies, information and knowledge are seen as the main drivers for the creation of value and competitive advantage (Del Giudice *et al.*, 2013; Prahalad and Hamel, 1990).

The main key sources for a sustainable competitive advantage and for the survival of companies based on knowledge and high technology are the knowledge, because it represents a resource, and innovation technology, as it represents the dynamic capacity of the company (Martín-de Castro, 2015).

The technological change, which is taking place at an organisational level, the rise of knowledge workers and increasingly demanding customers have highlighted the importance of intellectual capital rather than physical and financial capital (Petty and Guthrie, 2000).

Intellectual capital represents a set of knowledge available to a company; it can be defined as capital or intellectual assets of a company (Stewart, 1997; Nahapiet and Ghoshal, 1998). It represents knowledge that can be converted into profit (Harrison and Sullivan, 2000). It can be identified by three components: human capital (Becker, 1964; Edvinsson and Malone, 1997), relational capital (Prahalad and Ramaswamy, 2000; Martin de Castro *et al.*, 2011) and structural capital (Bontis, 1998).

It is important to analyse how innovations can influence intellectual capital components.

Human capital represents a set of knowledge, skills and capacities acquired during the life of an individual and aimed at achieving company objectives.

Relational capital represents a range of relations that the company creates with customers, with employees and with the community, or with the external environment. It identifies the relational system of the company supported by elements such as image, company reputation and trust.

Structural capital can be defined as a range of all coded knowledge and non-coded knowledge owned by the company. Its essence could be attributed to knowledge embedded within the routines of an organisation and could be identified by analysing the organisation, the process and the innovation produced (Bontis, 1998).

Over the years several models have been proposed, aimed at explaining the nature of intellectual capital, the relations that connect it with the company and its role in the creation of value (Baum *et al.*, 2000; Lev, 2001; Mouritsen *et al.*, 2001)

Many scholars (Brooking, 1996; Edvinsson, 2000; Roos *et al.*, 1997; Stewart, 1997) argued that human capital of a company represents the most relevant intangible asset, especially in terms of innovation. Stewart (1997) considers tacit knowledge (Polanyi, 1997) owned by an individual as the "source of innovation". Roos *et al.* (1997) suggest that it is a mix of skills (skills and education), attitude and intellectual agility. Whatever its components may be, only tacit knowledge of an individual represents a valuable asset to an organisation.

With the introduction of innovation in the company system, the need arises for highly qualified and specialised professional skills. It has created the need of professional figures able to elaborate on the data received and transform it into information.

Under relational capital analysis, the use of infrastructures with integrated video-communication and a high rate of efficiency in relations, improves relations with customers. Considering the latter as important elements of company positioning in the market (Smith and Saint-Onge, 1996), relations will be guaranteed in a much shorter amount of time compared with the traditional ones, increasing the value of relational capital.

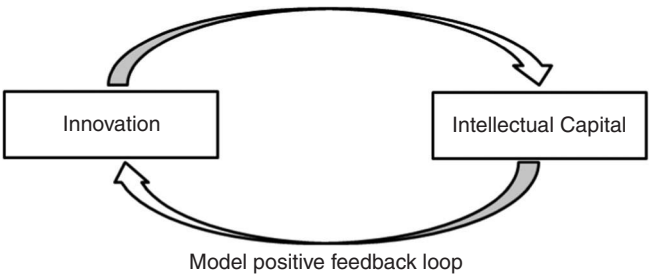
New technologies, such as sensors and network technology can change business processes, interactions of consumers and company management (Chui *et al.*, 2010).

The structural capital belongs to the organisation and it may be reproduced and made available to each individual. The definition of structural capital could be related to property rights: technologies, inventions, data, publications and procedures may be patented, covered by copyright or protected by laws on company secrets (Stewart, 1997).

The development of highly modern procedures has resulted in the need for greater protection, therefore resulting in an increase in the number of patents and consequently the value of structural capital.

Having investigated how knowledge, and therefore the intellectual capital, affects the innovation, and how innovation can influence intellectual capital components, it could be argued that their relationship is governed by a positive feedback loop mechanism, since the two components influence each other (Figure 1).

As far we know, nobody has investigated how the IoT could support companies to increase the value of intellectual capital. Our research aimed to clarify the link between these two aspects (Figure 2).



Source: Our elaboration

Figure 1.
Link between innovation and intellectual capital

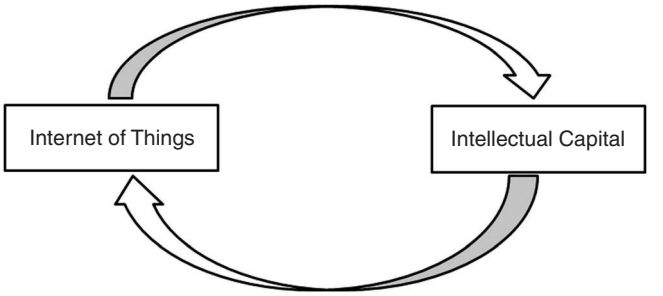


Figure 2.
Goal of our research

Source: Our elaboration

From this perspective, having defined what kind of innovation the IoT represents and the relationship between innovation and intellectual capital in literature, in the next section, the research attempts to understand whether and how innovation of the IoT influences the intellectual capital.

3. Research approach

The research is based on a qualitative and quantitative method (Anderson *et al.*, 2012; Myers, 2013; Waters, 2008), with two levels of analysis.

The first level of the paper is based on an empirical analysis in order to investigate whether the introduction of the IoT has increased both the value of intangible assets and the financial value of Cisco Systems Inc. company, the worldwide leader in networking.

In order to assess intangible performance of the company, the analysis follows the application of a synthetic method based on EVA, by including data retrieved from financial statements of Cisco Systems Inc. covering the period from 2007 to 2014.

The research utilises a single case study approach (Eisenhardt, 1989; Merriam, 1998), in order to fill the existing literature gap covering the influence of the IoT on intellectual capital of a company.

Specifically, the EVA (Grant, 2003) is a measuring instrument of company performance through the evaluation of an investment.

The EVA can be considered an indicator of intellectual capital because it measures the over income, or income generated over the income market. The traditional understanding concept of the EVA method is related to the discounting of a company over income in terms of goodwill.

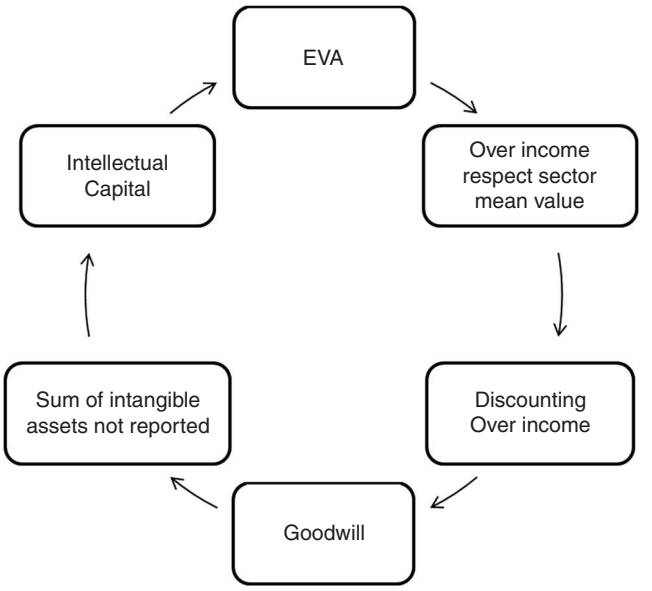
Therefore, goodwill may be considered as the sum of intangible assets not accounted that can be explained through the intellectual capital paradigm (Figure 3).

The application is carried out on the company Cisco Systems Inc., a leading multinational in the supply of networking devices. The formula applied for the evaluation is the following:

$$\mathrm{EVA} = \mathrm{NOPAT} - (\mathrm{WACC} \times \mathrm{IC})$$

where NOPAT is the net operating profit after tax; WACC the average cost considered of the loan sources; IC the capital investment in the activity.

NOPAT has been calculated by deducting the value of interest income from net income and adding the value of interest expense.



Source: Our elaboration

Figure 3.
The connection between EVA and intellectual capital

The value of WACC has been calculated according to the following formula:

$$\mathrm{WACC} = K \times \left[\mathrm{E}/(D+E)\right] + Y \times \left[\mathrm{D}/(D+E)\right]$$

where K is the cost of equity; E the equity; D the financial debts; Y the ratio between interest expense and financial debts.

IC has been calculated by taking into consideration the value of operating activities calculated adding the value of equity and the value of medium-/long-term debts.

The value of the cost of equity has been calculated according to the following formula:

$$i = i_1 + i_2$$

where i_1 is the risk free rate; i_2 the premium risk.

Its value has been hypothesised as equal for every year investigated in the empirical evaluation and it has been calculated by using the value of the components (i_1; i_2) in 2013.

The other components have been established for the years 2007-2014 considering the non-GAAP financial report for each year considered.

The second step of the research aims to investigate how the IoT can influence intellectual capital by proposing the analysis of information related to the projects undertaken by the company Cisco Systems Inc. in order to verify if the IoT could affect the intellectual capital of Cisco Systems Inc.

Data collecting has been carried out using the following sources (Yin, 2013):

- financial statement of the company Cisco Systems Inc. for the years 2007-2014 from the website: cisco.com;
- value of the β of the company from the Datastream Thomson Reuters database;

- value of the risk free rate and of the premium risk from the Damodaran website (http://pages.stern.nyu.edu/); and
- projects and actions of the company Cisco Systems Inc. that include the use of the IoT from the company's website (www.cisco.com).

Overall, the research sources are of secondary nature (documents, reports, news, journal articles in open sources, scientific papers and books, databases).

4. Findings and discussion

Cisco Systems Inc. (Cisco) is a leading company in the IT field. It has shaped the future of the internet in order to create infrastructures and opportunities for clients, employees, investors and partners of the ecosystem and it has become a worldwide networking leader, changing the way in which people communicate and collaborate.

For 30 years its vision has focused on how to help and change the way in which the world operates. The strategy aims at solving the most important business challenges of its clients by providing intelligent networks and technological architectures built on integrated products, services and software platforms.

Several studies have analysed this company from different points of view, for example demonstrating how the company built a powerful new business capability (Capron, 2013) and investigating management development (Direction, 2015).

In the first level of the analysis the application of EVA method (Table I) is carried out, in order to define if there is an increase of company immaterial components due to the use of the IoT.

The result of the application shows the increase of the EVA value from 2011 to 2014 (Figure 4).

Years	2007	2008	2009	2010	2011	2012	2013	2014
NOPAT (mn $)	7.659	8.761	7.457	9.426	9.020	9.963	10.795	10.556
WACC	0.053	0.050	0.046	0.050	0.047	0.047	0.049	0.043
Invested capital (mn $)	39.972	44.827	54.473	61.897	69.589	74.028	79.195	85.325
EVA (mn $)	*5.540*	*6.520*	*4.951*	*6.331*	*5.749*	*6.484*	*6.914*	*6.887*

Table I.
EVA application

Source: Our elaboration

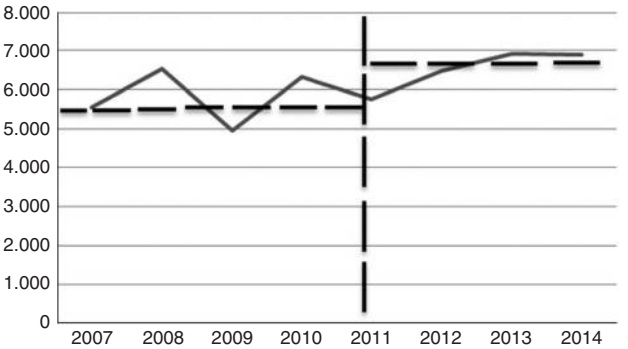


Figure 4.
EVA trend

Source: Our elaboration

The gap between the EVA average value in the years before the introduction of IoT in Cisco Systems Inc. (2007-2010) and the successive years (2011-2014) show an increase in value in the last period.

Over the years, there has been an increase in the value of the immaterial component owned by the company, and consequently in the value of intellectual capital.

Cisco IBSG estimates that the IoT arose between 2008 and 2009; in 2011, the IoT represented a reality to Cisco, as demonstrated by the initiatives such as Cisco Planetary Skin, Smart Grid and Intelligent Vehicles (Evans, 2011).

These results are useful for demonstrating that IoT would have increased the value immaterial value of the company, registered as an increase in the value of EVA mainly in 2013, as shown by the findings of the second part of the research, Cisco have increased IoT projects.

As far we know, nobody has investigated how the IoT could support companies to increase the value of intellectual capital or of own knowledge, however authors (Chahal and Bakshi, 2015) have analysed the role that innovation has had on intellectual capital and the relationship between intellectual capital and competitive advantage. They assert that innovation has a role of mediating variable and organisational learning and in particular moderating variables in intellectual capital and competitive advantage relationship. Moreover, some authors (Bharati *et al.*, 2015; Roblek *et al.*, 2013) have analysed the role that innovations, such as social media, have had on the value of intellectual capital and their role in knowledge-based companies, such Cisco. They demonstrate the increasingly important role of social media in the value added chain in knowledge-based industries (Roblek *et al.*, 2013) and that social media affects structural capital and cognitive capital directly, it only affects relational capital indirectly through structural and cognitive capital (Bharati *et al.*, 2015).

The second level of the research is aimed at analysing how the IoT could impact the intellectual capital of Cisco Systems Inc., investigating projects undertaken in recent years.

John Chambers, CEO of Cisco Systems Inc., asserts that the IoT is increasing the connection of people and things to a level that was initially unimaginable (available at: www.techeconomy.it). The speed of adoption of the market objects is increasing due to a growth in analyses and cloud computing, an increase in the inter-connectivity of machines and intelligent personal devices.

It is important as the majority of companies concentrate on how to acquire products on the market much quicker, adapting to norm-related requirements, increasing efficiency and, most importantly, to continue innovation.

The opportunities offered by the IoT exceed the challenges. The connection of devices, machines and things allows for the dynamic creation, analysis and communication of intelligence data, an increase in operating efficiency and the strengthening of new and improved models.

Cisco's Internet Business Solutions Group predicts some 25 billion devices will be connected by 2015, and 50 billion by 2020 (Cisco, 2011).

In the last few years the company has proposed a new unit called IoT Group and has started new initiatives with further investments in the creation of an ecosystem for the IoT. Such initiatives support the objective of helping customers to connect whatever they have which is still not connected. With the emergence of complex procedures, Cisco has considered the IoT Group, or a new business unit that brings together some company teams already working in adjacent fields, with the objective of developing solutions that offer clients the possibility of connecting the various and diverse data sources, machines and people. The Group will concentrate on the development of vertical business solutions

that connect the flows initially not connected between them from sensors in the network, devices and objects, in order to enable the IoT, transforming the business processes into operative dynamic and intelligent, data-guided and modern processes.

The development of dynamics has therefore resulted in the emergence of different professional skills capable of collaborating with adjacent fields and capable of elaborating the data received in order to make information available.

In 2013, during the event "Internet of Things World Forum", the company presented the IoT Initiative, formed to accelerate the creation and adoption in the market of innovation in the IoT area, contributing to the development of the start-up ecosystem active in this field, training of technological partnerships and research in an academic environment by focusing attention on security, sensors, analytics instruments in real time and applications.

This offers new approaches to the management and storage of data and new levels of operating efficiency, increased safety and security, new business opportunities, and in particular, a better decision-making process (Lombardi *et al.*, 2014).

By optimising the acquisition and elaboration system of data, the impact of the IoT on management of company data and consequently on the structural capital value of the company, can be seen. By increasing relations, there is a reduction in feedback time, resulting in a reduction in procedure times and the elaboration of data. Furthermore, with highly modern procedures the need arises for greater protection, therefore resulting in an increase in the number of patents, that at present exceeds 14,000.

Also the use of new architectures and software, such as the introduction of the Cisco Collaboration, allows the enhancement of interoperability, compatibility and openness to any device or application to make use of core collaboration services enabled by flexible models of implementation in place, as with the Software as a Service (SaaS) model or a hybrid approach.

Analysing the results of the analysis and asserting that the capital structure could be identified by the organisation, the process and the innovation produced (Bontis, 1998), it is possible to argue that the IoT affects it, not only because it is recognised as an innovation that creates value but also because it affects the decision-making processes by making them quick and more efficient. In this perspective, if the introduction of the IoT allows the company to improve the systems and procedures, it could have a reduction in transaction times, procedural innovativeness and access to information for codification into knowledge. By improving these systems, the company allows employees to take advantage of their skills, allowing the human capital, and consequently overall intellectual capital, to reach the fullest potential, and creating a competitive advantage for the company (Bontis, 1998; Nahapiet and Ghoshal, 1998).

Cisco's objective through the introduction of the IoT is the creation of an integrated network. Companies must face growing challenges in order to meet customers, supplies and regulation requirements at a much faster pace. In order to satisfy these challenges, companies must become much more agile, stand up before their competitors and rapidly answer to market and technology changes. Cisco defines a possible solution that allows for an efficient answer to these requirements through the creation of an IoT platform (through the infrastructure and applications) that may help companies to face such challenges and make organisations much more modern, efficient and competitive.

The introduction of the IoT has therefore influenced relations between customers and companies as it allows the company to create relationships much faster compared with traditional ones. Customer-related information is also gained much faster compared with before, resulting in a close relationship.

As far as Cisco is concerned, customers are an integral part of the company, so much so as to create long-term partnerships and work with them to identify their requirements and provide solutions that support their success.

As regards the relational capital, by the analysis carried out, the concept of the IoT could be connected at the concept of Service Dominant (SD) Logic (Vargo and Lusch, 2008). In this perspective the IoT, as a SDL, based on the concept of value co-creation for companies, allows people to communicate and interact better, creating a network and always consider the customer as a co-creator of value (Trequattrini and Russo, 2009).

As highlighted in the empirical analysis, the introduction of the IoT for Cisco Systems Inc. has involved relevant effects on the intellectual capital owned by the company.

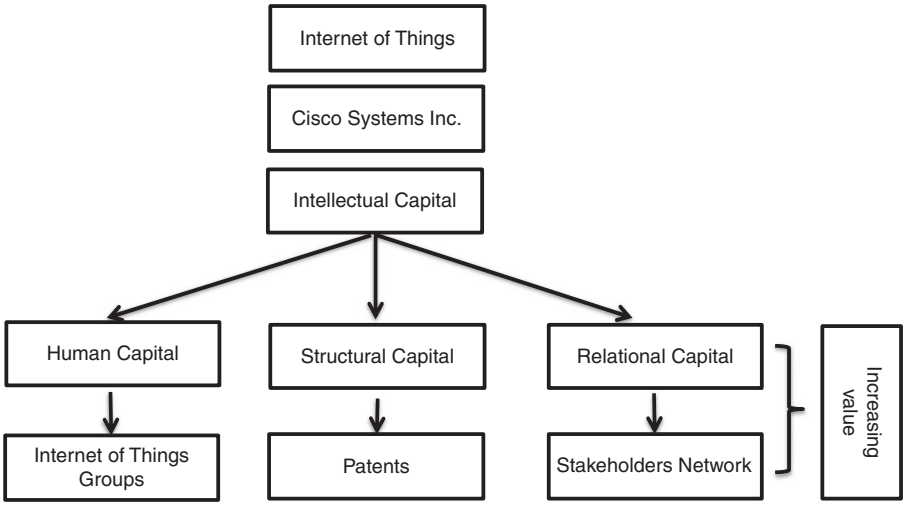
In this way, the increasing value of intellectual capital is retrieved in the following three elements (Figure 5):

- the establishment of new IoT Groups composed of knowledge workers employed with the Cisco (human capital);
- the growing number of patents recorded and used by the company for the improvement of its products and services (structural capital); and
- the enhancement of the Cisco network in the world originated by the relationships with stakeholders such as clients, suppliers, universities and so on (relational capital).

In the light of this evidence, we can affirm that the IoT has been an essential incentive improving the value of the intellectual capital.

5. Conclusions, limitations and future researches

This paper sought to gain an understanding as to whether and how the introduction of the IoT innovation influences the value of the intellectual capital owned by company. It tries to connect the technological aspects which affect the high-intensity company



Source: Our elaboration

Figure 5.
The new conceptual model of Cisco (internet of things-intellectual capital)

with high with the economic aspects. The paper demonstrates the importance of the introduction of the IoT in high intensity cognitive companies.

In particular it analysis the innovative aspects of the IoT (Atzori *et al.*, 2010; Andersson and Mattsson, 2015) and tries to understand how the innovation (Roos *et al.*, 1997; Smith and Saint-Onge, 1996; Stewart, 1997) impacts on intellectual capital.

In order to fill the literature gap related to the investigation of whether and how the IoT affects the intellectual capital an analysis was carried out of the case of the company "Cisco Systems Inc.".

The results demonstrate that the introduction of projects involving the use of the IoT has increased the value of intellectual capital over the years (particularly in the year 2013), through the application of the method of EVA.

By analysing the findings related to "Cisco Systems Inc.", it is possible to assert that the use of the IoT supports the development of intellectual capital.

It could be consider a component that provides a relevant contribution to the growth of intellectual capital value, but is not the only factor for growth of a company's immaterial component.

Moreover, considering the period of crisis that has affected the economy, the IoT innovation could be considered a key strategic component in the development of Cisco products and projects.

This result provides strategic advice for decision making in high intensity cognitive companies interested in new technology investments. The investment could lead to an increase in both the intellectual capital value and the economic value of the company.

Companies, based on investment in IoT innovation, should reconsider their business models by identifying new opportunities for value creation, since this new technology affects the value of immaterial components.

The limits of the paper are as follows: the use of a single case study does not make it possible to generalise the findings; the empirical analysis is carried out for a limited number of years and the period of time taken into consideration could be influenced by an adverse financial situation which could be identified by the increase or decrease of NOPAT and the increase of invested capital; the increase of the EVA value is only due to the introduction of the IoT.

The IoT is still an emerging phenomenon and further studies are required to investigate these relationships over a longer period of time.

Therefore, future research will be oriented to extend the time period on which to carry out the evaluation and to investigate the analysis in other high intensity cognitive companies in order to validate and generalise the findings.

This paper is the result of a group effort of analysis and reflection, A.M. authored the "Literature review" section, G.R. the "Introduction" section, B.C. the "Research approach" and "Findings and discussion" sections, and A.P. the "Conclusions, limitations and future researches" section. All authors read and approved the final manuscript.

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