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XXVII

INTELLECTUAL CAPITAL AND FIRMS' PERFORMANCES: THEORETICAL AND EMPIRICAL APPLICATIONS

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To my Brother Gabriele,

a bright light in my life

CONTENTS

INTRODUCTION: KNOWLEDGE RESOURCES AS "STRATEGIC ASSETS"

The economy has been changing quickly over the last few years, moving from an industrial economic base, where the economic growth was thought to be chiefly determined by the usage of tangible resources such land, capital and labour, to a knowledge economic base, in which the economic growth is considered to be mostly determined by the employment of knowledge resources that are able to generate value that cannot be recognised as tangible (i.e. economic value of patents, intellectual work, brands, marks, etc.) (Guthrie et al., 2007; Iazzolino and Migliano, 2014).

Regarding intellectual resources, Drucker (1998) stated: "*knowledge is the only meaningful resource today. The traditional 'factors of production' – land (i.e. natural resources), labour and capital – have not disappeared, but they have become secondary. They can be obtained, and obtained easily, provided there is knowledge. And knowledge in this new sense means knowledge as a utility, knowledge as the means to obtain social and economic results*".

Thus, nowadays, knowledge resources can be considered as the engine of each organisation; in fact, there are no doubts that successful organisations tend to be generally those that ceaselessly innovate using new technologies, skills and knowledge, rather than tangible assets such machinery or plants (Guthrie et al. 2007; Iazzolino et al., 2013a).

Alongside the theoretical considerations about the benefits generated by the usage of knowledge resources, even companies (not limited just to private or listed organisations but also public and no-profits ones) operating in several markets started recognising the importance of including these kind of resources in their strategy formulation processes, giving them a central role for generating what is generally known as "competitive advantage": the ability to use resources in a way that allows a specific firm to outperform its competitors.

Therefore, a central question arising from the field of strategic management is: Why do some organisations perform better than others? (Barney, 2001; Treece et al., 1997). The aforementioned question is founded on strategic elements characterising knowledge resources and their management. In literature, two strategic standpoints have been traced:

(i) market-based view and

(ii) resource-based view.

These two routes are theoretically differentiated on the basis of the identification of those constituents (or factors), which are able to explain the organisation's performance and that should to be taken into account in strategy formulation.

On the one hand, in the market-based view, scholars and practitioners look at external environmental factors to explain an organisation's performance and determine its strategic choices. Several theories and models, such those that carried out by Porter (1980) (Industry and competitor analysis), presented a sort of checklist featured by factors often categorised as: economic, social, political and technological as argued by Mintzberg (1994).

On the other hand, the resource-based view is founded on the idea that organisation's performance is chiefly explained by the resources portfolio owned by the specific company and its deployment (Dierickx and Cool, 1989); therefore, with this approach, knowledge is recognised as the main strategic asset (Itami and Roehl 1987; Hall 1993; Grant 1996).

In this sense, Grant (1991) stated: "*the firm's most important resources and capabilities are those which are durable, difficult to identify and understand, imperfectly transferable, not easily replicated, and in which the firm possesses a clear ownership and control [...]. The essence of strategy formulation, then, is to design a strategy that makes the most effective use of these resources and capabilities*".

Other two streams can be identified within the resource-based view: (i) static and (ii) dynamic. The first one identifies the stock of strategic relevant resources as the main contributor to the competitive advantage, as stated by Barney (1991) who argued that a sustainable competitive advantage derives from the stocks of resources and capabilities, owned by a specific organisation, which are valuable, rare, imperfectly (or hardly) imitable and not substitutable.

By contrast, the second one is mainly based on the idea that accumulating firm-specific assets is not enough to obtain a sustainable competitive advantage, since these stocks should be managed properly. Hence, organisations should learn dynamically to employ their resources effectively (Prahalad and Hamel 1990; Senge 1990; Nonaka and Takeuchi 1995). Thus, organisations should be able to develop and renew their resources by taking account of changes occurring within the environment in which they operate. This phenomenon is recognised in literature as "dynamic capability", which is the ability of appropriately adapting, integrating and reconfiguring internal and external resources, organisational skills and functional competences to meet the requirements of a changing environment (Teece et al., 1997). The environment abovementioned was described by

Clarkson (1995) as: "*the survival and continuing profitability of the corporation depends upon its ability to fulfil its economic and social purpose, which is to create and distribute wealth or value sufficient to ensure that each primary stakeholder group continues as part of the corporation stakeholder system*".

In conclusion, organisational resources can be categorised within two main streams as displayed by the following Figure 1:

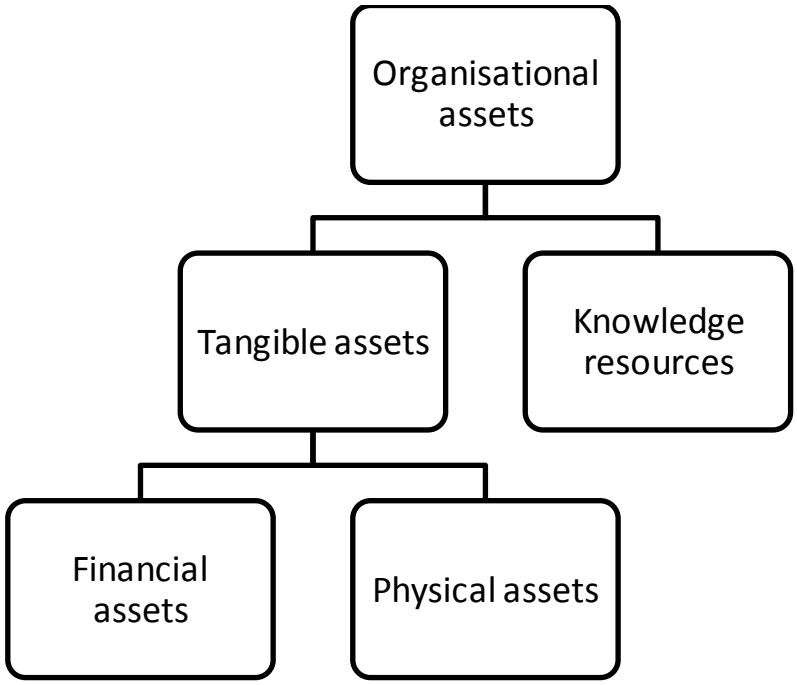

Figure 1: Organisational resources

Regarding tangible assets, the financial ones include, but are not limited to: borrowing capacity, investing and financing activities, monetary-value of assets (cash reserves, receivable balance, provisions, inventory balance) and monetary-value of liabilities (loans, accounts payable, unearned revenue), and shareholder equity; whereas the physical ones include, but are not limited to: plants, properties, equipments and inventories.

Differently from tangible assets, knowledge resources are generally divided by the literature into three main components, specifically known as elements of "Intellectual Capital" (Figure 2):

1) Human resources (or Human Capital) include experience, knowledge, intellect, behaviour, relationship, attitude and special skills of the personnel of a business entity employed in order to create economic value (Cohen and Kaimenakis, 2007; Schiuma et al., 2008). These are becoming critical resources for

organisations, particularly because they contribute to the ability to respond and adapt to a changing environment.

2) Structural resources (or Structural Capital) include non-human storehouses of knowledge in organisations (Watson and Stanworth, 2006). Structural capital is defined as a general system for solving problems and innovation (Chu et al., 2006). In other words, structural capital is made up by all those elements remaining within the organisation when its employees have left the building. Hence, these kind of resources include (a) intellectual property, owned by the organisation and protected by law, such patents, trademarks and copyrights; (b) infrastructural resources, which consist of organisational peculiarities such as processes and procedures, culture, routines, information and networking systems, etc. that are necessary to pursue organisational goals.

3) Relational resources (or Structural Capital) concern the value created through the relations between organisations and with suppliers, customers, shareholders and other institutions and/or individuals (Grasenik and Low, 2004; Chu et al., 2006). Some of these resources are not owned by the organisation, but are constituted by relationships that are significant for the organisation and require management.

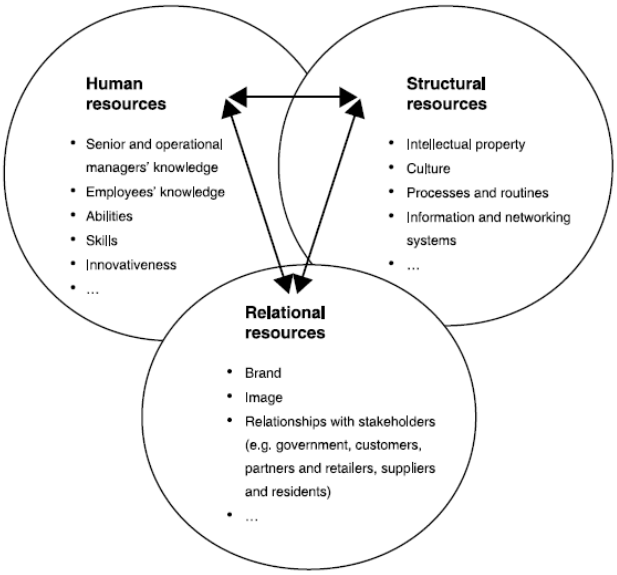

Figure 2: Intellectual Capital components (source: Ricceri, 2008)

As it has been previously said, the importance of knowledge resources has been widely recognised by scholars and practitioners, thus, during the last few years, many authors have tried to carry out frameworks to measure the linkage between Intellectual Capital (intended

as human, structural and relational capital) and firms' (organisations') performances (measured by total profits, ROE, banking income, etc.); these topics will be deeply analysed in the following chapters.

In conclusion, this thesis will be focused on several perspectives involving the Intellectual Capital and the firms' performances evaluation theories. Therefore, this work aims at investigating different standpoints, from which Intellectual Capital could be seen, further, these intellectual capital concepts will be integrated into a several empirical analyses to measure what is the impact of intellectual resources on firms' performances, these latter measured by ratios such as ROE, Cash ROCE, etc.

Summarising, the incipit of this thesis is to consider intellectual capital resources as a source of competitive advantage for every company.

In this work, it will be illustrated, in Chapter 1, the main literature regarding Intellectual Capital and firms' performances; further, some empirical approaches will be shown in the following chapters. In particular, the topics treated by this thesis are:

1. How intellectual capital could be usefully integrated in Credit Risk evaluation framework (Chapter 3);
2. How to distinguish between knowledge and capital-intensive firms by using a particular point of view of the intellectual capital (the VAIC standpoint) and, what is the impact of the intellectual capital in such kind of companies (Chapter 4);
3. What are the differences between intellectual capital (from the VAIC viewpoint) and the traditional EBIT-based measures for evaluating firms (Chapter 5);
4. How relative valuations to get the "firm value" could be integrating by adding new perspectives derived from the intellectual capital theory (Chapter 6);
5. How intellectual capital could affect firms' financial performances and market value (Chapter 7) and how firms could get a leadership position within a business space consisting of two integrated perspectives: (i) intellectual capital and (ii) firms' performances (Chapter 8);
6. To carry out the researches above mentioned both quantitative and qualitative methodologies were employed. A general description of research methodologies mainly used for the topics is in Chapter 2.

CHAPTER 1: THEORETICAL BACKGROUND ON INTELLECTUAL CAPITAL AND FIRMS' PERFORMANCES

1.1 Intellectual Capital

Within the literature, there are many definitions about what Intellectual Capital (IC) is. Generally, it could be intended as the set of intangible resources owned by an organisation, valuable from a strategic standpoint to get the "real" value of the organisation itself; further, it allows companies to obtain competitive advantage, outperforming their competitors (Del Bello and Gasperini, 2006).

The concept of IC covers a wide area of cognitive resources such skills and expertise of the employees, leadership and organisational capabilities, and even business relations.

Teece (1986) was one of the firsts authors to point out the returns (in terms of business returns) related to the management of knowledge resources. The author identified two main kinds of resources: (i) *intellectual resources*, mainly stored in the employees' minds such their know-how, experiences (single or collective) and capabilities/abilities; (ii) *intellectual assets*, which are parts of codified knowledge on which the company is the owner.

The first one who used the term "intellectual capital" was Stewart (1991). He defined it as the sum of all that every employee/person knows within a specific organisation that is able to produce a sustainable competitive advantage within a specific marketplace. Hence, intellectual capital is not a tangible asset but, conversely, is something "intangible". In fact, as stated by Stewart (1991), to create value organisations need to employ a capital chiefly based on knowledge.

As it can be immediately noted, in the intellectual capital theory, the role of people is strongly emphasised; however, Stewart (1997) argued that it is not the only concept conceived by the literature. In fact, although knowledge is generated by the people's skills and competences, it is translated internally into know-how, processes, routines, procedures, etc. and, externally into business relations with clients, suppliers, governments,

competitors, etc. Some examples of IC could be: skills and competences of employees, patents, marks, information about clients and suppliers, information systems and so on.

Edvinsson and Malone (1997) defined intellectual capital as the set of knowledge that can be converted into value. What they argued sheds light on how people's skills and competences should be converted into internal and external value. Thus, according to the authors, the intellectual capital is made up of two main components:

1. *Human capital*: the set of knowledge, competences, abilities, capabilities, values, culture, which cannot be owned by the organisation;
2. *Structural capital*: the set of organisational tools that support the productivity of workers. It can be owned and even exchanged (i.e. sold) in a market by the organisation. Further, structural capital is in turn composed of other two sub-components named as:
    a. *Customers capital*: streams of relations existing between the organisation and its customers (current or potential ones);
    b. *Organisational capital*: obtained from:
        i. *Innovation capital*: R&D processes aiming at obtaining future market opportunities;
        ii. *Process capital*: employment of technologies as tools for supporting the value creation.

The Figure 3 summarises what Edvinsson and Malone (1997) argued:

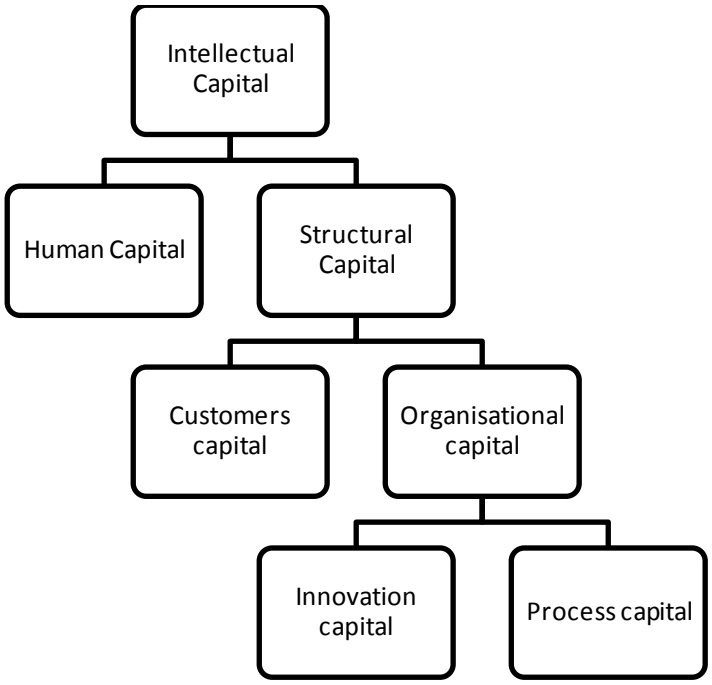

Figure 3: Intellectual Capital according to Edvinsson and Malone (1997)

Sullivan (2000) stated intellectual capital consists of (i) *human capital* and (ii) *intellectual assets* (Figure 4). The first one is made up by four elements: know-how, collective experience, capabilities and creativity. It should be considered as a resource since it is able to create value directly by a service or indirectly by generating a new intellectual resource that it could be even sold. In accordance with Edvinsson and Malone (1997), human capital is not owned by the organisation. For this reason, it is important to convert innovations obtained by the intellectual capital (particularly human capital) into intellectual assets. These latter are owned by the organisation and they are exchangeable on a specific market. Hence, intellectual assets could be intended, according to Sullivan (2000) as the tangible and codified knowledge towards which a certain organisation can exercise its property rights. Some examples of intellectual assets are generally recognised in patents, copyrights, marks, industrial and commercial secrets.

Conversely to what argued by Edvinsson and Malone (1997), Sullivan (2000) suggested that the structural capital should be intended as a factor which falls outside the intellectual capital; as a consequence, the structural capital was considered by the author as a direct or indirect support provided by the organisations to the intellectual capital.

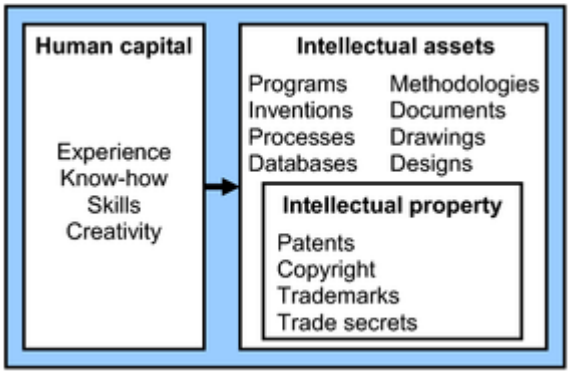

Figure 4: Intellectual Capital according to Sullivan (2000)

A noteworthy framework regarding the value of a certain organisation was provided by Swedish group Skandia. Similarly to Edvinsson and Malone (1997), the *Skandia Navigator* (Skandia, 1996) categorised the company's value in two main parts (Figure 5):

1. *Financial Capital*, divided into e.g. plants, equipments and inventories, and finance capital, e.g. cash, investments and debtors.
2. *Intellectual Capital*, sub-divided into:
    a. *Human capital*: competences, human relations and values;
    b. *Structural capital*, made up by:
        i. *Customers capital*, value brought by potential or current customers;
        ii. *Organisational capital*, which consists of:
            (1). *Culture*, organisational values and beliefs shared across the company;
            (2). *Processes*, series of actions and steps (wherein knowledge is codified) to get a final product or service;
            (3). *Innovation*, in turn divided into Intellectual property and Intangible assets in general.

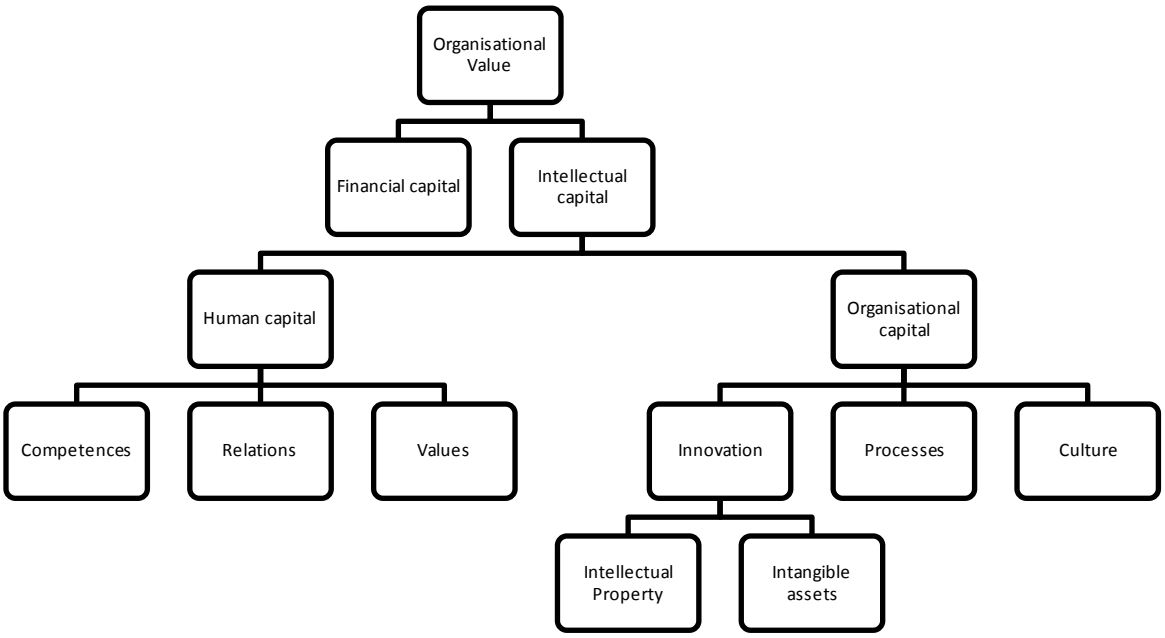

Figure 5: Organisational value according to the Skandia Navigator

Another contribution to the IC theory was provided by Roos et al. (1997) that, while maintaining the distinction between human and structural capital, suggests some variations to the Skandia Navigator as it was originally formulated. In this new study, the human capital is referred to competences (such knowledge and capabilities), attitudes (such motivation and behaviours) and intellectual agility (such innovation, imitation, adaptation, packaging), whereas the structural capital is related to relations (such customers, suppliers, shareholders, partners), organisation (intended as infrastructure, processes and culture) and a specific category named as renewal and development.

This contribution could be intended as an "enriched version" of the Skandia Navigator, which extends significantly the IC component linked to the individuals, attributing, at the same time, a great relevance to the relations established with clients, suppliers and other companies, highlighting how IC results from many interactions amidst human and structural elements aiming at creating value for the organisation. The following figure xx displays what it has just explained:

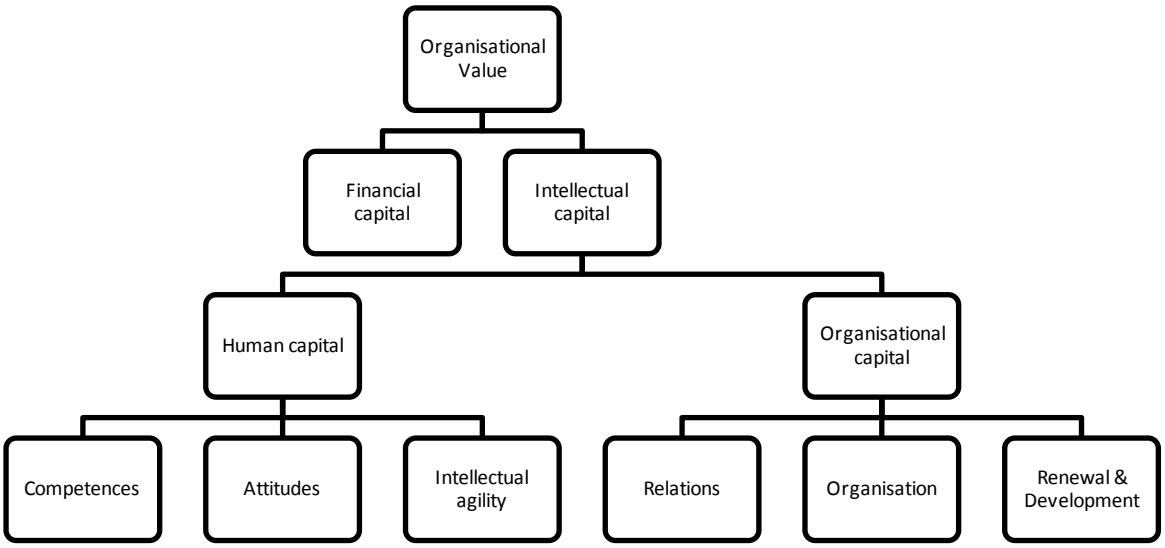

Figure 6: Organisational value according to Roos et al. (1997)

A substantial change to the Skandia Navigator schema was provided by Stewart (1998) who recognised that, analogously to what happen for human resources, customers are not owned by the organisation; thus, the customer capital was brought to the same level of the human and structural capital. This new approach generated the main three components of intellectual capital that the literature now acknowledges.

The Figure 7 shows what is globally known as Intellectual Capital:

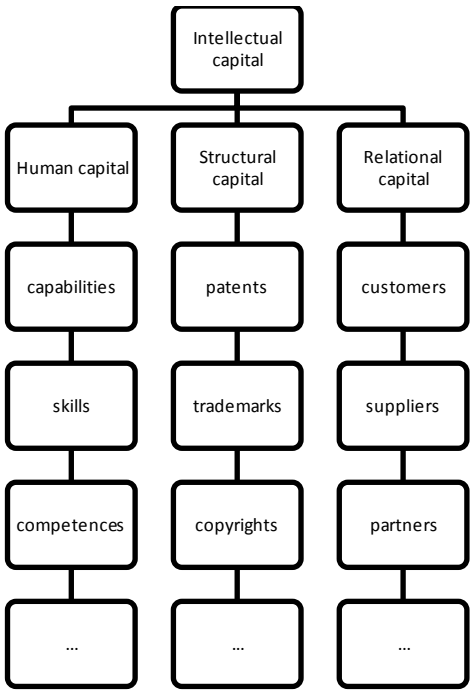

Figure 7: Intellectual Capital components

To provide a better understanding of what the Figure 7 shows, following, it will be illustrated in a non-exhaustive way the Intellectual Capital components, even recalling the study carried out by Roos et al. (1997):

1.1.1 Human Capital

As it has been mentioned previously, human capital is made up by the so called *human resources*, which are related to all those resources embodied in the individuals employed by or linked to the organisation in a way that makes it possible for the organisation to deploy these resources and reach its market goals.

Human resources are represented by the accumulated value of investments in people training, competence, and other intangible elements such those related to the people motivation. Bontis (2001) explained human capital as the combination of knowledge, skill, innovativeness, and ability of a company's individual employees to meet the task. In other terms, Stewart (1997) described human capital as the part of intellectual capital that leaves the organisation at the end of the working day.

Nonaka (2002) stated that knowledge is created and organized by the flow of information, tied on the commitment and beliefs of its holder. Thus, human capital refers to the tacit knowledge embedded in the minds of employees.

Ulrich (1998) was one of the first authors who proposed a measurable definition of human capital, which is the product of "competence" and "commitment." He defined Competence mainly considering two aspects: (1) competencies shall be aligned with business strategy; and (2) competencies have to be generated through more than one mechanism, such as buy, build, borrow, bounce, and bind (Ulrich, 1998). Further, Commitment is reflected in how employees relate to each other and feel about the organisation where they work (Ulrich, 1998). Therefore, to investigate what Ulrich (1998) called commitment, he indicated three fundamental ways: (1) reduce demands, (2) increase resources, and (3) turn demands into resources.

What the literature argued sheds light on the fact that human capital is the fundamental part of an organisation. In fact, human capital can be defined as the contribution that the single employee adds to the process of value creation. Edvinsson (1997) stated that if the intellectual capital was a tree, humans would be the lymph that allows it to grow up.

Nowadays, human capital is becoming increasingly important for every business since firms employ and trait it as a strategic asset that is able to give them the possibility to outperform their competitors. In fact, a routine work that requires few standard capabilities, does not generate any form of human capital for the organisation, due to the fact that it could be automated. Even in the case where a specific routine work cannot be automated, workers employed in it, could be easily substituted since they were hired for manual instead of knowledge-based work/job.

Several authors recognised that human capital plays a strategic role. Becker (1962) found positive relations amidst salaries, profits and human capital. Even before Becker, Simon (1947) rejected the traditional theory (a rational entrepreneur mainly oriented to the maximisation of his profits), replacing it with another one more knowledge-oriented, focused on a variety of cooperating decision makers who have limited rational capacities due to the lack of information and knowledge about the consequences of their decisions. Further, the Simon's approach emphasised the role of the so called *collective knowledge*, which results from the aggregation and integration of individuals' knowledge.

Other studies acknowledged the importance of human capital, Stewart (1997) stated it encloses "*the capabilities of the individuals required to provide solutions to customers*"; Pennings et al. (1998) and Finkelstain and Hambrick (1996) recognised the linkages between human capital and firms' performances.

Hill et al. (2001) demonstrated that accumulating human capital allows companies to establish synergies and enhance productivity and performances; whereas Davenport (2005) tied the strategic nature of human capital to the organisations' willingness to invest in it.

Some examples are displayed by the Table 1, which is founded on the study carried out by Roos et al. (1997). This table cannot be intended as complete but for illustrative purposes only, and the individual organisation will have to define the dimensions that are relevant when it comes to creation of value.

Human Capital	Potential resources
Competences	• Specific knowledge fields that encompass tacit aspects. • Specific abilities that encompass tacit aspects. • Brain power or processing capacity (IQ). • Empathy.

Human Capital	Potential resources
	• Ability to build personal networks. • Ability to participate in (maintain) personal networks. • Ability to use (leverage) personal networks
Attitudes	• Behavioral traits including social intelligence. • Motivation. • Pace - sometimes known as sense of urgency. • Endurance or perseverance.
Intellectual agility	• Ability to innovate. • Ability to imitate. • Ability to adapt.

Table 1: Human capital potential resources

1.1.2 Structural Capital

Structural capital involves certain types of resources that, as stated by Edvinsson (1997) are "*those resources that remain in the organisation when the employees have left the building but that cannot be found on the balance sheet*".

Bontis (2002) defined structural capital as the non-human storehouses of knowledge embedded within the organisational routines and processes. In other words, according to Bontis (2002) structural capital is made up by structures, systems, and other tools.

Structural capital, differently from human capital, is completely owned and controlled by the organisation; in fact, it is generally identified by the knowledge transferred from the individuals (human capital) and the relationships amidst them, to the organisational structures (such culture, processes, procedures, policies, etc.).

Therefore, structural capital regards the organisational structure that is able to support (i) human capital performance (by helping employee to reach their best performance) and (ii) the overall business performance. As demonstrated, human capital impact on structural capital, since the first one is fundamental for the overall organisational success.

However, it could be even noticed that structural capital exists independently from the human capital (i.e. organisational culture and structure); further, as stated by Roos et al.

(1997) and by Skandia (1996), both structural and human capital enable organisations to create, develop and use innovation capital.

According to several authors (Bontis et al., 2000; Bontis, 2002; Ordóñez de Pablos, 2002), structural capital consists of two main elements: (i) technological component and (ii) architectural competencies.

Bontis (2002) defined the first one as the capabilities and knowledge that are fundamental to day-to-day operations, such as tacit knowledge, design policies/rules, etc. The second element is devoted to the ability of the organisation to integrate its core competencies in several flexible and new ways to develop other competencies, i.e. problem solving strategies, new communication channels, new values, etc.

Chen et al. (2004) stated that an organisation having a strong structural capital, in terms of performances, it could create a favourable ground to use human capital proficiently and, as a consequence, to boost its customer and innovation capital.

As it has been done in Table 1 for human capital, some examples of subdivision of structural resources are listed in Table 2, even in this case, the table is not complete and it is for illustrative purposes only.

Structural Capital	Potential resources
Externally oriented	• Brands • Trademarks • Service offerings • Product concepts • Patents and other IP
Internally oriented	• Processes • Organisational structures • Systems • Information on paper • Information in databases • Software • Organisational culture

Table 2: Structural capital potential resources

1.1.3 Relational Capital

Relational capital includes all those resources concerning relationships that an organisation has with entities outside the organisational boundaries and that influence the organisation's ability to create value. Relational resources, similarly to the human ones, are not owned and controlled by the organisation. In fact, considering a specific organisation, it does not own its customer relationships but it can influence them.

Therefore, relational capital is generally defined as that component of intellectual capital embedded within all the relationships that a specific organisation establishes with its stakeholders that are able to affect its strategies (Lin, 2001; Nahapiet and Goshal, 1998). These relationships could be found in or developed from the relationships established directly by the organisation or by individuals.

The intellectual capital literature (i.e. Dyer and Nobeoka, 2000) argued that relationships with stakeholders should be considered as a necessary condition for developing the organisational business, particularly by exploiting external relationships to have access to critical resources.

Some authors (Prahalad and Ramaswamy, 2000) suggested that customers are increasingly becoming a new source of competence for the organisation because they renew the organisation knowledge base and consequently its overall competences preventing these from the obsolescence in a turbulent environment (Gibbert et al., 2002; Pantano et al., 2013).

Recalling the concept of networking relationships, it is recognised that these provide value for the market actors (e.g. individuals or organisations) by allowing them to get access to the resources hidden within such relationships (Acquaah, 2007). Other scholars such as Pfeffer and Salancik (1978) and Peng and Heath (1996) argued that networking relationships are more fruitful for organisations when they need to face a high uncertainty within the business environment where they operates.

Dyer and Nobeoka (2000) claimed that the relationships that an organisation establishes with their stakeholders (i.e. customers, suppliers, institutions, business partners, etc.) enable it to create and exploit its intellectual capital. In particular, establishing relationships with customers could means build and develop brand loyalties (Park and Luo, 2001), building relationships with suppliers could offer access to high quality raw materials and delivery services (Peng and Luo, 2000), while creating business partnerships

could attenuate the possibility of facing opportunistic behaviours (Pisano, 1989), enhance trust relationships (Kale et al., 2000) and develop new inter-firm relationships to freely exchange information, skills, know-how and competencies (Kale et al., 2000; Walker et al., 1997).

Measuring the value of relational capital is fundamental in several theoretical research fields; within the intellectual capital theory it can be measured, according to Bontis (2002) by considering it a "function of longevity, whereas in the marketing literature, it is the results of long term relationships (Hakansson and Snehota, 1995).

As done for the two aforementioned intellectual capital dimensions (human and structural capital), Table 3 displays, for illustrative purpose only, some potential resources related to the relational capital:

Relational Capital	Potential resources
Directly business related	• Customers • Suppliers • Partners • Unions • Channels to market/representatives • Sources of new knowledge (e.g., universities)
Indirectly business related	• Owners • Media • Regulatory bodies • Pressure/interest groups • Local government • National government • Educational institutions

Table 3: Relational capital potential resources

1.2 Intellectual Capital: the VAIC approach

The Value Added Intellectual Coefficient (VAIC) was developed by Pulic (2000); however, according to Pulic, Intellectual Capital (IC) is not a collection of different assets, but a set of knowledge workers.

Therefore the way for measuring knowledge work productivity becomes the main methodological concern for Pulic.

Pulic's proposal is to use the value added as an indicator of the value created by intellectual labor (knowledge workers). To Pulic, the operational tool for measuring value creation is the "Value Added" Income Statement. In fact, if properly interpreted, the Value Added Income Statement is able to measure the value creation of knowledge investments (Figure 8).

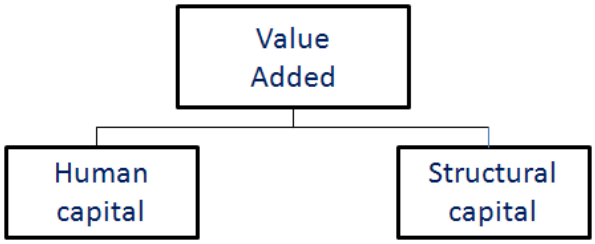

Figure 8: Pulic scheme

The term Human Capital (HC) for Pulic is not a set of characteristics (capability, skills, etc.) held by employees, as in the Skandia Navigator, but the amount of capital invested in knowledge workers (wages, salaries, training, etc).

Structural capital is the share of value added after deducting investment in human capital (HC). Clearly this is not the meaning of SC in Skandia Navigator.

Starting from the concept of Value Added, Pulic constructed the VAIC (Value Added Intellectual Coefficient) as:

VAIC = ICE + CEE

where:

- ICE = HCE + SCE (Intellectual Capital Efficiency);
- HCE = VA/HC (Human Capital Efficiency);
- SCE = SC/VA (Structural Capital Efficiency);
- CEE = VA/CE (Capital Employed Efficiency);

- CE is the book value of Capital Employed.

For a detailed analysis of Pulic's proposal see Iazzolino and Laise (2013).

In order to construct his measure of Value Creation, Pulic (2008) started from the Value Added Income Statement (Table 4):

Sales	OUT
- Costs	IN
= Value Added	VA
- Salary and wages	HC
= Structural capital (EBITDA)	SC
- Depreciation and Amortization	A + D
= Operating Profit	P

Table 4: Value Added Income Statement

This Income Statement shows that:

$$VA = HC + SC \qquad [1]$$

Pulic's proposal is enclosed into the [1].

To satisfy all stakeholders (first of all, employees and shareholders) it is necessary to create Value Added (VA) for paying the personnel wages (HC) and the gross operating profit (SC or EBITDA). Thus, the higher the VA created, the greater the possibility to satisfy the expectation of both employees (HC) and shareholders (SC).

From the [1], it is possible to obtain:

$$1 = HC/VA + SC/VA$$

By setting:

VA/HC = HCE (Human Capital Efficiency or knowledge worker productivity)

SC/VA = SCE (Structural Capital Efficiency),

it can be obtained:

$$SCE = 1 - (1/HCE) \qquad [2]$$

This is the main formula of Pulic's proposal. It links the Value Creation for shareholders (SCE) with the productivity of knowledge workers (HCE). It appears that the variable on which the Value Creation for shareholders (SCE) depends is the knowledge workers' productivity (HCE). The higher the productivity of knowledge workers (HCE) the higher

the value created for shareholders (SCE). Therefore, the condition for creating value for shareholders is:

$$SCE > 0 \Rightarrow HCE > 1 \Rightarrow VA > HC \quad [3]$$

Hence, the strategies for creating value for shareholders may be summarised as follow:

1] The main driver for creating value is the productivity of knowledge workers (HCE = VA/HC);

2] To enhance the value HCE needs to increase and this could be done by increasing VA, or by reducing HC, or by increasing VA and reducing HC at the same time.

3] Knowledge organisations, in order to increase HCE, invest in knowledge. This means adopting technologies which incorporate a high knowledge (i.e. robotics, artificial intelligence, etc.). Investments in technologies "knowledge-intensive" have two effects that increase the productivity of knowledge workers:

4] Firstly, there is a reduction of employees costs (HC) due to the investments in new technologies that allow firms to reduce the workforce (labour saving), even if the individual wages of knowledge workers increase. As a consequence, the productivity of knowledge workers grows up.

5] On the other hand, investments in new technologies "knowledge-intensive" increase the Value Added per employee and hence increase the productivity of knowledge workers.

6] The combined effect is a high growth of productivity of knowledge workers (HCE) and therefore, a high growth of shareholder value (SCE), that is the necessary condition to be able to make further investments in knowledge for iterating the cycle 1) - 6).

The sequence of effects described from 1) to 6) can be defined the "chain reaction" highlighted by Pulic's proposal.

The [2] is the main formula that encloses Pulic's message. However, there are other ways to explain the same proposal; one of these uses the Intellectual Capital Efficiency (ICE) concept.

Pulic defines ICE as:

$$ICE = HCE + SCE \quad [4]$$

The [4] provides the same information of the [2]:

The correspondence between these two formulations is shown in Table 5.

	[2]	[4]
Value Destruction	SCE < 0 ⇒HCE < 1	(SCE < 0 and HCE < 1) ⇒ICE < 1
No Value Creation	SCE = 0 ⇒HCE = 1	(SCE = 0 and HCE = 1) ⇒ICE = 1
Value Creation	SCE > 0 ⇒HCE >1	(SCE > 0 and HCE >1) ⇒ICE >1

Table 5: Correspondence between [2] and [4]

In Table 6 the characteristic values of ICE are shown:

ICE	HCE	SCE	Judgment
1	1	0	Worse performance (Much worrying: Edge of survival)
1,25	1,13	0,12	Low performance (Worrying)
1,75	1,44	0,31	Relatively good performance
2,00	1,62	0,38	Good performance
≥ 2,5	≥ 2	≥ 0,5	Successful performance

Table 6: ICE and measure of performance (elaborated from Pulic, 2008)

Pulic completes his analysis by constructing an overall efficiency indicator defined as:

$$VAIC = ICE + CEE \quad [5]$$

where:

CEE = VA/CE is the Capital Employed Efficiency;

CE = Book value of Capital Employed.

1.3 Firms' performances

Within every organisation, measuring performances is one of the most important tasks since it is fundamental for defining corporate strategies. Therefore, organisations are particularly interested in building their own performance measurement system to define an objective evaluative indicator to measure their performance outcomes. Generally, all the organisational stakeholders obtain a great amount of information deriving from many sources such as financial database, financial statements, etc. Consequently, this information could be exploited by a wide range of users; some of them are listed below:

1. *Shareholders* may want use such kind of information to make the right investment decisions, i.e. buy and sell stocks, or to evaluate similar companies.

2. *Investors*, i.e. banks or financial institutions, may be interested in this information to evaluate if a certain company will be able to pay its debts or not.
3. *Managers*, by exploiting this information might be able to evaluate and compare performances coming from different divisions or organisational functions; further, they can compare performances over certain periods to have a whole vision on how the organisation performed over that period.

As stated previously, information about financial performances can be derived from several kinds of sources, first of all, it could be gathered from the company financial statements; however, there are financial databases such Datastream (Thomson Reuters) and Amadeus (Bureau van Dijk) that can be used to harvest financial information.

Financial performances can be measured according to different ways; in this thesis, performance measures have been categorised as follow:

1. *Accounting-based performances*: indicators chiefly based on financial statements. These include traditional measures such as return on investment (ROI) and return on equity (ROE) as profitability indexes, quick and current ratios as liquidity indexes and so on.
2. *Value-based performances*: these kinds of indicators strive to measure the firm's value. Within these measurements, it is possible to distinguish the (i) direct and (ii) relative evaluation. The first one is focused on the estimation of cash flows; whereas the latter try to estimate the firm's value by comparing similar organisations.

Following, accounting and value-based performances will be explained more in detail.

1.3.1 Accounting-based performances

Accounting-based measures are typically related to variables or ratios extracted from the main financial statements, the balance sheet, the income statement and the statement of cash flows. Such kinds of measures are generally useful to evaluate the firm's economic value according to several perspectives, i.e. profitability, liquidity, growth, etc.

Therefore, evaluating performances by using accounting-based measures, which are usually described by economic-financial ratios, has been a powerful and useful tool for decision-makers such as shareholders, investors, managers, banks, etc.

Rather than measuring performances by looking at only the total amounts gathered from the financial statements (i.e. values of costs, incomes, revenues, interests, etc.), analysts prefer to use ratios to obtain robust and meaningful outcomes. Hence, the financial health of a certain organisation can be analysed by using the ratio analysis, which allow analysts to compare that organisation's financial performances with performances obtained by other organisations; as a consequence, it is possible, through the ratio analysis, to evaluate economic-financial performances across industries.

Generally, the literature on accounting and finance organises financial ratios into different classes such as liquidity, profitability, long-term solvency, asset turnover or utilisation, and so on. Liquidity ratios measures the ability of a certain organisation to pay its short-term debts; whereas, long-term solvency determine if that organisation is able to satisfy its creditors by looking at its long-term debts.

Profitability ratios give analysts and managers the possibility to evaluate the ability of an organisation to produce profits, to make it possible, these kinds of ratios takes account of sales, equity and organisational assets.

Asset turnover ratios investigate how a certain organisation is able to generate revenues by using its assets.

As it has been stated previously, financial ratios are computed by using variables commonly found on financial statements. The usage of accounting-based measures can provide the following benefits (Ross et al., 2003):

- Measuring the performance of managers for the purpose of rewards;
- Measuring the performance of departments within multi-level companies;
- Projecting the future by supplying historical information to existing or potential investors;
- Providing information to creditors and suppliers;
- Evaluating competitive positions of rivals;
- Evaluating the financial performance of acquisitions.

Furthermore, financial ratios are also used for the purpose of predicting future performance. For example, they are used as inputs for empirical studies or are used to develop models to predict financial distress or failures, within the field of credit risk assessment (Altman, 1968; Beaver, 1966; Altman and Sabato, 2007; Iazzolino et al.,

2013a). In fact, many of recent studies focused on investigating and potentially predicting bankruptcy as a means to identify characteristics (in term of financial ratios) of good or bad-performing firms and their potential values (Kumar and Ravi, 2007; Iazzolino et al., 2013a).

In literature, there are many definitions of financial ratios, a possible classification is provided below:

- *Profitability ratios*: they consist of values that take account of net income, EBIT, EBITDA. It could be noticed that these type of ratios measure, as stated before, the ability, of an organisation, to produce returns for their capital providers (i.e. shareholders, equity capital providers, investors, etc.). In fact, when there are no profits, shareholders, or generally anyone who invests within a certain organisation, could reasonably think to invest his capital in alternative investments; hence, any capital provider is interested in knowing how an organisation performs in terms of profitability. Some examples of profitability measures are: return on equity (ROE), return on investments (ROI), return on assets (ROA), cash return on capital employed (Cash ROCE), net profit margin, net asset turnover, gross profit margin, etc.
- *Activity ratios*: they are able to show how a certain organisation efficiently manages its short-term assets and liabilities such as working capital. These kinds of measures look at short-term periods, generally referred to a financial year; hence, some examples are: debtor days, creditor days, stock days, sales/net current assets, etc.
- *Liquidity ratios*: these ratios measure the ability of an organisation to transform its assets into cash. Another definition of these ratios was provided by Brealey et al. (2001) who stated that these measures evaluate how quickly a certain company is able to convert its assets into liquidity. Some examples of such kinds of ratios are: current and quick ratios.
- *Leverage ratios*: gearing or leverage ratios evaluate how an organisation is able to satisfy its financial obligations; hence, it is measured the ability of a certain company to meet the return expectations of its capital providers. Some examples are: capital gearing ratio, debt/equity ratio, interest cover, etc.

- *Growth ratios*: they try to measure how a certain organisation grows with respect to a defined period. Hence, these indexes takes account of changes occurred in total assets, operating assets, sales, total and operating expenses, etc.

Following, in the Table 7, some potential indicators for each category aforementioned are shown:

Category	Formula	Meaning
Profitability	$ROE = \frac{Net\ Income}{Equity}$	ROE measures the income available to common stockholders (residual claimants) as a percentage of the book value of their investment in the organisation. ROE is subject to the same issues as all profitability measures with respect to its numerator, net income.
	$ROI = \frac{EBIT}{CE}$	ROI measures the return available to providers of long-term capital to the organisation, including both debt and equity capital. The intention of this calculation is to examine the return available to all capital providers, so it is generally inappropriate to use net income after the effects of interest expense; in this sense, for calculating ROI, EBIT is preferred as numerator.
	$ROA = \frac{Net\ Income}{Total\ Assets}$	ROA measures the organisation's ability to use its assets to create profits (measured by net income).
	$ROS = \frac{Net\ Income}{Sales}$	ROS measures the percentage of sales retained as profits, and is also known as net profit margin. ROS is influenced by the financial structure of the organisation since net income is calculated after interest expense.
	$Cash\ ROCE = \frac{EBITDA}{CE}$	It is the percentage of EBITDA generated by the investments made by an organisation. This indicator is useful to identify companies having high growth capacities. This ratio uses EBITDA at its numerator since it is in essence, operating profit

Category	Formula	Meaning
		excluding non-cash expenses such as depreciation and amortisation (a regular provision writing down intangible assets such as goodwill), it is similar to cash flow from operating activities, ignoring the effect of changes in working capital. As a measure of financial performance, EBITDA eliminates the effects of financing and capital expenditure, and hence can indicate trends in sustainable profitability.
	$\frac{EBITDA}{Sales}$	It is a profitability index that represents the percentage of EBITDA generated by the Sales.
Activity	$Debtor\ days = \frac{Debtors * 365}{Credit\ sales}$	The value of credit sales is usually not available and it is common for sales or turnover to be used as a substitute. The debtor days ratio gives the average period of credit being taken by customers. If it is compared with a company's allowed credit period, it can give an indication of the efficiency of debtor administration.
	$Creditor\ days = \frac{Trade\ creditors * 365}{Cost\ of\ sales}$	Trade creditors should be compared with credit purchases, but as this information is not always available, cost of sales is often used instead. The creditor days ratio gives the average time taken for suppliers of goods and services to receive payment.
	$Stock\ days = \frac{Stock * 365}{Cost\ of\ sales}$	This ratio shows how long it takes for a company to turn its stocks into sales. Several other ratios can be calculated by separating the total stock figure into its component parts, i.e. raw materials, work-in-progress and finished goods. The shorter the stock days ratio, the lower the cost to the company of holding stock. The value of this ratio is very dependent on the need for stock and so will vary

Category	Formula	Meaning
		significantly depending on the nature of a company's business.
	$Fixed\ asset\ turnover = \frac{Sales}{Fixed\ assets}$	Fixed asset turnover indicates the sales being generated by the fixed asset base of a company. Like ROI, it is sensitive to the acquisition, age and valuation of fixed assets.
	$\frac{Sales}{Net\ current\ assets}$	This ratio shows the level of working capital supporting sales. Working capital must increase in line with sales if undercapitalisation is to be avoided and so this ratio can be used to forecast the level of working capital needed for a given level of sales when projecting financial statements.
Liquidity	$Current\ ratio = \frac{Current\ assets}{Current\ liabilities}$	This ratio measures a company's ability to meet its financial obligations as they fall due. It is often said that the current ratio should be around two, but what is normal will vary from industry to industry: sector averages are a better guide than a rule of thumb.
	$Quick\ ratio = \frac{Current\ assets - Stocks}{Current\ liabilities}$	It is argued that the current ratio may overstate the ability to meet financial obligations because it includes stock in the numerator. This argument has merit if it takes more than a short time to convert stock into sales, i.e. if the stock days ratio is not small. The quick ratio compares liquid current assets with short-term liabilities. While a common rule of thumb is that it should be close to one, in practice the sector average value should be used as a guide.
Leverage	$Capital\ gearing\ ratio = \frac{Long\ term\ debts * 100}{CE}$	The purpose of this ratio is to show the proportion of debt finance used by a company. When comparing calculated values to benchmarks it is

Category	Formula	Meaning
		essential to confirm that the same method of calculation is used because other definitions of this ratio are found. One alternative replaces long-term debt capital with prior charge capital, which includes preference shares as well as debt.
	$Debt/equity\ ratio = \frac{Long\ term\ debts * 100}{Share\ capital + Reserves}$	This ratio serves a similar purpose to capital gearing. A company could be said to be highly geared if its debt/equity ratio were greater than 100 per cent using book values, but again this is only a rule of thumb.
	$Interest\ cover\ ratio = \frac{EBIT}{Interest\ charges}$	Interest cover shows how many times a company can cover its current interest payments out of current profits and indicates whether servicing debt may be a problem. An interest cover of more than seven times is usually regarded as safe, and an interest cover of more than three times as acceptable. These are only rules of thumb, however, and during periods of low and stable interest rates, lower levels of interest cover may be deemed acceptable. Interest cover is a clearer indication of financial distress than either capital gearing or the debt/equity ratio, since inability to meet interest payments will lead to corporate failure no matter what the level of gearing may be.
Growth	$\Delta Sales = \frac{Sales_t - Sales_{t-1}}{Sales_{t-1}}$	Sales growth is the primary measure of growth used in the empirical studies. It measures the growth of sales considering two different time periods (generally indicated as t and t-1). It is an organisational growth measure even used by analysts to predict future growths within a specific market.

Category	Formula	Meaning
	$\Delta Employee = \frac{Employees_t - Employees_{t-1}}{Employees_{t-1}}$	Employee growth represents the change in the number of people employed by an organisation between two time periods. The growth in employees can be viewed as a proxy for several performance indicators. First, companies add employees in anticipation of, or coincident with, sales growth. Second, employee growth can indicate that the organisation is adding critical resources necessary for growth. In this regard, growth in research and development employment, representing the addition of critical knowledge, has been used as a measure of performance (Baum et al., 2000).
	$\Delta Total\ Assets = \frac{Total\ Assets_t - Total\ Assets_{t-1}}{Total\ Assets_{t-1}}$	Drucker (1954) included the ability of an organisation to continue to attract capital as a critical performance dimension. It follows that growth in total assets could be considered a measure of organisational effectiveness. As total asset growth is an intuitively attractive measure of organisational growth, examination of the information content of this variable relative to organisational financial performance is warranted.

Table 7: Examples of indicators (adapted from Carton, 2006 and Watson and Head, 2007)

1.3.2 Value-based performances

As stated by Damodaran (2005), in corporate finance there are mainly four approaches to firm evaluation according to a value-based perspective:

(i) the *Discounted Cash Flow (DCF)* method, according to which the value of an asset (or a firm) is the present value of the expected cash flows produced by the same asset (or firm) over the future;

(ii) the *Liquidation and Accounting valuation*, based on the evaluation of the existing assets of a firm, by estimating the value (or the book value) of the assets;

(iii) the *Contingent Claim valuation*, which uses option pricing models to measure the value of assets having "option" characteristics;

(iv) the *Relative Valuation* method, which estimates the value of an asset by looking at assets (or firms) that can be considered "comparables", on the basis of a common variable like earnings, cash flows, book value or sales. In this last approach the s.c. Multiples are used, that are constructed as ratios in which the numerator is the market value (Enterprise Value or Equity Value) and the denominator is a book variable like earnings, cash flows, EBITDA, etc.

1.3.2.1 Discounted Cash Flows method

Generally, within discounted cash flows (DCF) method, the value associated to any asset is estimated by discounting the expected cash flows related to that asset according to a specified discounting rate that emphasise how risky that asset is (Damodaran, 2014). Therefore, the intrinsic value characterising an asset can be estimated.

This intrinsic value can be interpreted as a function of the cash flows generated by a certain asset, and as a consequence, by its life, expected cash flows and the risk linked to the asset itself (as it has been said previously, risk or riskiness is measured by the discounting rate). Hence, according to Damodaran (2014), the value of a defined asset could be estimated by the following formula:

$$Value\ of\ Asset = \sum_{t=1}^{N} \frac{E(CF_t)}{(1+r)^t}$$

where N is the life of the asset (generally expressed in years) and r is the discount rate that reflects the riskiness of the asset. As Damodaran (2014) stated, if a firm is viewed as a portfolio of assets, the equation aforementioned can be extended to obtain the value of a firm, using, similarly to what done for an asset, cash flows to the firm over its life (expressed in years) and a discount rate that reflects the whole riskiness of the firm's assets.

Within the evaluation based on DCF method, there are two main steps: the first concerns the estimation of the *equity stake*; the second one refers to the estimation of the entire *firm value*.

Hence, the value of equity can be computed by discounting expected cash flows to equity, which are, the residual cash flows after having met all the operating expenses, tax obligations, and interest and principal payments, at the cost of equity, which is, the rate of return expected by equity investors.

$$Value\ of\ Equity = \sum_{t=1}^{N} \frac{CF\ to\ Equity_t}{(1+k_e)^t}$$

where *CF to Equity*$_t$ is intended as the expected cash flow to equity in period *t*, and k_e is the cost of equity. A special case of equity valuation is the dividend discount model, where the value of a stock is the present value of expected future dividends.

Similarly to what it has been done for the estimation of the value of an asset, the *value of the firm* is got by discounting expected cash flows to the firm, which is, residual cash flows after having met all operating expenses, taxes and reinvestment needs, but prior to have paid debts, at the weighted average cost of capital (WACC)[1].

$$Value\ of\ firm = \sum_{t=1}^{N} \frac{CF\ to\ firm_t}{(1+k_e)^t}$$

where *CF to Firm*$_t$ is defined as the expected cash flow to firm in period *t*, and *WACC* is, as previously argued, the weighted average cost of capital. Although the two approaches use different definitions of cash flow and discount rates, they will generate consistent estimations of the value of equity if the same hypotheses are applied to both approaches. Further, Damodaran (2014) stated that within the equity evaluation "*it is important to avoid mismatching cash flows and discount rates, since discounting cash flows to equity at the weighted average cost of capital will lead to an upwardly biased estimate of the value of equity, whereas discounting cash flows to the firm at the cost of equity will yield a downwardly biased estimate of the value of the firm*".

[1] $WACC = \frac{D}{D+E} * k_D * (1 - t_c) + \frac{E}{D+E} * k_e$
where, D stands for both the long-term and short-term debt of the company, while E is the company equity. k_D is the company cost of debt, t_c is the tax rate, k_E is the equity cost of capital.

1.3.2.2 Liquidation and Accounting valuation

As stated previously, within the DCF evaluations, the value of a certain asset can be estimated as the present value of its expected cash flows. This concept can be extended to evaluate an entire company by arguing that the value of its business can be interpreted as the sum of values linked to the specific assets owned by that company.

However, a company is an ongoing market entity that owns specific assets and invests for its future; this can be noticed by looking at its balance sheet (Table 8):

Assets	Liabilities
Assets in place Existing investments generate cash flows today. In other words, investments already made.	**Debt** Borrowed money
Growth Assets Expected value that will be created by future investments. In other words, investments yet to be made.	**Equity** Owner's funds

Table 8: Balance sheet (adapted from Damodaran, 2005)

As it can be noticed by looking at the balance sheet, investments that have already been made by the company are dubbed as *assets in place*, whereas investments that the company expects to make in the future are named as *growth assets*. According to Damodaran (2005), a financial balance sheet gives a good framework to emphasise the differences between evaluating a business as a "going concern" and evaluating it as a sum of its assets. In fact, when analysts make a going concern evaluation, their judgement is not only based on existing but even on expected future investments and the profitability linked to them.

On the other hand, the main focuses of an "asset-based" valuation are the assets in place and estimate the value of each asset considered separately (Damodaran, 2005). However, to what concerns companies with lucrative growth opportunities, asset-based valuations will produce lower values than "going concern" valuations (Damodaran, 2005).

In conclusion, there are two main ways to make these kinds of evaluations: (i) book value-based and (ii) liquidation valuations as they had been named by Damodaran (2005).

Book value-based valuation

The accounting literature has always tried to provide a measure representing the "real" value of a company, which can be intended as a real earnings potential and a reliable estimation of the company's assets and equity value obtained by using the profit and loss statement as well as the balance sheet. However, the treatment of historical costs has developed differently with respect to various asset classes.

The book value-based valuation starts from the assumption that a company book value can be considered as a good proxy of its market value. As a consequence, this kind of valuation could be applied to organisations having a high value of fixed assets and a restricted potential for further growth. In literature, some methods that are able to incorporate earnings into book value-based valuations have been carried out. The residual income model, chiefly founded on the dividend discount model, try to put expected dividends in relation to book value; therefore, the equity book value at the start of a defined period shall be equal to the equity book value at the start of the previous period plus net income minus all dividends paid out (Damodaran, 2005).

$$Book\ value\ of\ Equity = Book\ value\ of\ Equity_{t-1} + Net\ Income_t + Dividends_t$$

$$Value\ of\ Equity_0 = Book\ value\ of\ Equity_0 + \sum_{t=1}^{\infty} \frac{(Net\ Income_t + r_{E_t} * Book\ value\ of\ Equity_{t-1})}{(1 + r_E)^t}$$

Recently, other advancements in fair value accounting have been developed, and particularly, there were a return to the idea that the balance sheet might provide a better viewpoint of the "real" firm's value. Therefore, on the one hand, this linkage could give more useful information for every investor; on the other side, with the use of fair value accounting, it could increase the possibility of misuse and manipulation, hence, the techniques such as marking to market could only reflect what has already happened into the market itself (Damodaran, 2005; Gitman, 2006; Koller et al., 2005).

Liquidation valuation

In the case of liquidation, company's assets need to be sold in a very short time period, which could result in a discount depending on the number of potential buyers, the whole state of economy and the assets' features.

Liquidation value may be expressed as a percentage of the book value. In fact, it could be difficult to estimate liquidation value as a fraction of a discounted cash flow value mainly due to the underlying growth assumptions in "going concern" valuation.

Obviously, liquidation valuation is considered appropriate for those companies (that find themselves in financial distress) that need to dispose their assets urgently (Damodaran, 2005; Gitman, 2006; Koller et al., 2005).

Commonly to what happen for discounted cash flows methods, the basic approach is to estimate the value of an organisation by directly making investigations on it and on the assets that it owns. However, while liquidation and accounting valuations are founded on the ability of a certain firm to generate returns starting from its currently existing assets, discounted cash flows methods are more focused on company's growth opportunities (Damodaran, 2002; Koller et al., 2005).

1.3.2.3 Contingent claim valuation

Damodaran (2012) stated that in some cases, the value of an asset cannot be greater than the present value of its expected cash flows, especially when these cash flows are characterised by the contingency of a certain event, either it occurs or not.

Hence, due to the development of the option pricing model, the concept of contingency has come out in the last few years. Even though these models were initially used to estimate the value of traded options, in the last decades, they have been extended to traditional evaluations, generally known as "real" valuations. In fact, some scholars such Damodaran (2012) used the "option approach", instead of employing traditional DCF models, to estimate the value of some kinds of assets such patents or undeveloped reserves.

As a consequence, Damodaran (2012) argued "*a contingent claim or option pays off only under certain contingencies - if the value of the underlying asset exceeds a pre-specified value for a call option, or is less than a pre-specified value for a put option*". In the last decades, much work has been done, by many scholars and practitioners, in carrying out models that are able to evaluate options, and these option pricing models can be used to evaluate any kind of assets that have option-like features. The following diagram (Figure 9) illustrates the payoffs on call and put options as a function of the value of the underlying asset:

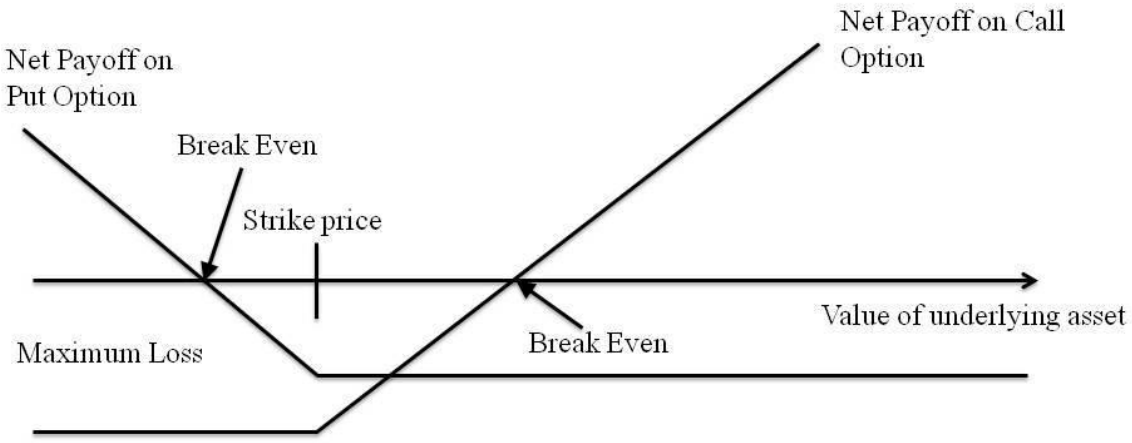

Figure 9: Payoff diagram on Call and Put options (adapted from Damodaran, 2012)

According to the theory (Black and Scholes, 1972), an option can be evaluated by considering the following variables: (i) the current value, (ii) the variance in value of the underlying asset, (iii) the strike price, (iv) the time to expiration of the option and (v) the riskless interest rate.

Thus, an asset can be evaluated as an option if the payoffs are a function of the value of an underlying asset. According to Damodaran (2012):

- a specific asset can be evaluated as a *call option* if the payoff is contingent on the value of the asset exceeding a pre-specified level.
- a specific asset can be evaluated as a *put option* if the payoff increases as the value of the underlying asset drops below a pre-specified level.

The first categorisation of options, according to Damodaran (2012) is based on whether the underlying asset is:

1. a *financial asset*, i.e. options listed on a specific derivatives exchange market, other financial assets such stocks and bonds;
2. a *real asset*, such as commodities, real estate or even investment projects. Such options are often called "*real options*".

A second and overlapping categorisation, according to Damodaran (2012) is based on whether the underlying asset is:

1. *traded*: assets that are traded (exchanged) on a market. Generally, options on traded assets can be evaluated easier that options on non-traded assets since the necessary inputs for the evaluation can be gathered from financial markets.

2. *Non-traded*: options on non-traded assets are much more difficult to be evaluated since there are no market inputs available on the underlying asset.

According to the literature, there are some kinds of assets that can be considered as an option since they share several option features. Some examples of these assets are:

1. Equity, which could be viewed as a call option where the value of the debt represents its strike price and its term is the option's life.
2. Patents, which could be evaluated as a call option on organisation's products/projects, where the strike price is represented by the investments made into the development of the products/projects to which a patent is related, and the option's life is the time of expiration of that patent.

Considering the latter case, patents, it is possible to show a similarity with the definition of call option, as it has been argued previously, remembering that a call option gives the right, but not the obligation, to buy the underlying activity at a predefined date or within a predefined date at an agreed price, called strike price (Iazzolino and Migliano, 2015). If a firm has a patent, it will exercise the patent right only if the positive flows (that will arise from the product commercialization) will be greater than the negative flows needed to develop the product. If the estimated flows arising from the product commercialization will be less than the costs that the firm has to develop and commercialize the product, the management will not exercise the patent right. The patent can be considered like a call option, in which the underlying is the product. The payoff of the patent is the following:

$$Payoff\ of\ the\ patent = \begin{cases} V - X & if\ V > X \\ 0 & if\ V \leq X \end{cases}$$

where:

X = present value of negative cash flows for developing and selling product

V = present value of positive cash flows from sales

The payoff of the patent is the same of the payoff of a call option (Figure 9): if the expected discounted cash flows from selling the product are not more than the negative flows to produce the product, the enterprise doesn't exercise the right, while the enterprise will exercise the right on the other case.

Briefly, the strike price is represented by the costs to develop and distribute the product, while the value of the underlying is represented by the discounted cash flows from the product.

1.3.2.4 Relative valuation

In discounted cash flow valuation, the main goal is to find the value of specific assets, given their cash flow, growth and risk features. In relative valuation, the objective is to value assets, based upon how similar assets are currently priced in the market.

Focusing on the last mentioned approach, the main advantage is related to ease of use (Antonios et al., 2012) and for this reason it is used by many analysts who mention measures such as Price Earnings ratio (P/E) and EBITDA multiples within firms' reports (Asquith et al., 2005); but in some cases, multiple analysis includes implementation problems mainly due to the fact that although industry, product, size, and measures of risk are matched, it is almost impossible to find two, or more firms with exactly the same performances (Penman, 2005).

As it can be noticed that there are two main kinds of Multiples in the literature (Nissim, 2013; Loughran and Wellman, 2011; Damodaran, 2012; Mînjnă, 2009):

- Enterprise Multiples (EMs), based more on the use of the Enterprise Value and measures like EBITDA, EBIT and Sales (i.e. EV/EBITDA, EV/EBIT, EV/Sales).
- Price Multiples (PMs), based more on the use of the stock price (i.e. P/E, P/BV, P/CE);

Thus, by using Multiples, the estimated intrinsic value of an asset, but also of a firm (focus of this work) belonging to a specific industry at the end of a specified time period can be computed (Curteau et al., 2006; Mînjnă, 2009). The determinants of Multiples are: growth, risk and cash flow generating potential (Damodaran, 2005); thus, it is reasonable to think that a firm with higher growth, low risk and greater cash flow generating potential should be trading at higher multiples than a firm with lower growth, higher risk and lower cash flow generating potential.

Underlying the multiple theory there are two main hypotheses, as claimed by Nissim (2013): the first one is that the value is proportional to the fundamental used (i.e. earnings, cash flows, revenues, etc.) and the latter is related to the fact that firms selected should belong to the same industry or have similar characteristics (i.e. size, leverage, expected growth) to be considered as "comparable".

Several authors have studied the valuation accuracy by using Multiples: Nassim (2013), Sehgal and Pandey (2010), Armstrong et al. (2011), Courteau et al. (2006), Antonios et al.

(2011), Mînjnă (2009) examined the accuracy of relative valuations for different sectors using multiples based on price as a proxy of intrinsic value. Bhojraj and Lee (2002) developed a framework for selecting comparable firms in market-based research and equity evaluation by using as a first step a so-called "warranted multiples" based on systematic variations in growth, profitability and cost of capital; and a second step by generating a list of "peer" firms having the closest warranted multiple.

Loughran and Wellman (2011) investigated the relationship between Enterprise Multiples (based on EBITDA) and the average stock returns; the authors interpreted Enterprise Multiples (EMs) as a proxy of the discount rate highlighting that firms with low EMs values appear to have higher discount rates and hence higher stock returns than firms with high EMs values.

Following, it will be provided a better explanation about the categories of multiples cited beforehand.

First of all, Enterprise Multiples (EMs) are those that support the valuation of the target company enterprise value (EV) looking at the EV of comparable companies. The main assumption underlying EMs is that if a sample of comparable companies is evaluated by the market a certain number (n) of times a given balance sheet parameter, the target company, if really comparable, can be valued the same way, i.e., the same number n of times the same given balance sheet parameter:

$$EM_i = \frac{EV_i}{parameter_i}$$

Among the EV multiples, there are those with a wider diffusion and application, such as the EV/EBITDA, the EV/EBIT, the EV/FCFF, the EV/sales, and the EV/CE. Table 9 displays the multiples that have just been mentioned and a brief explanation for each of them.

Enterprise Multiples	Meaning
EV/EBITDA	The EV/EBITDA is the ratio between the EV of a company and its EBITDA. In economic terms, it represents the number of years the EBITDA should be multiplied by to obtain the company enterprise value. It is one of the most commonly used EV multiples when dealing with industrial companies. The EBITDA is the first approximation of the company cash flows but is not a good choice for companies for which outsourcing is relevant because of the overvaluation of the

Enterprise Multiples	Meaning
	EBITDA.
EV/EBIT	It is the ratio between the EV of a company and its EBIT. It represents the number of years the EBIT should be multiplied by to obtain the enterprise value. The EBIT focuses on the operating management, but it does not consider the different choices made by companies regarding depreciation and amortization.
EV/FCFF	The EV/FCFF is the ratio between the EV of a company and its FCFF. It represents the number of years the FCFF should be multiplied by to obtain the enterprise value.
EV/Sales	The EV/sales is the ratio between the EV of a company and its sales. It represents the number of years the sales should be multiplied by to obtain the enterprise value.
EV/CE	The EV/CE is the ratio between the EV of a company and its capital employed. Because it compares the EV with its balance sheet asset value, it runs the risk that the balance sheet data may not be representative of the asset market value. It is often used for companies that operate in the luxury segment.

Table 9: Examples of Enterprise Multiples

In companies with negative EBITDA, EBIT, or FCFF, the previously described multiples (EV/EBITDA, EV/EBIT and EV/FCFF) become senseless; as a consequence, EV/Sales could be considered the first choice when a company has positive sales. However, it has the serious disadvantage of not taking the company's profitability into consideration.

Although the list of EV multiples could be quite long and can become increasingly longer, it is not possible to state which one is the best since it can depend on different industries[2], different business models, and different value drivers. It takes a great deal of practice to determine the best alternative to calculate the EV of a company. The multiple that can express the value of the company in the most complete way must be determined on a case-by-case basis.

The other category of multiples aforementioned, Price Multiples (PMs), allows analysts to directly evaluate the company equity value. The price multiples have the market capitalisation of the company or equivalently its stock price as a numerator. The market capitalisation of the company is given by the price of the stock on the official exchange

[2] To have a better idea about multiples used in specific industries see: http://valuationacademy.com/industry-specific-multiples/

multiplied by the number of outstanding shares. Similarly to the EV multiples, the process to estimate the target company equity value comes from the estimation of the comparable companies' (i) multiple values:

$$PM_i = \frac{E_i}{parameter_i}$$

Amidst price multiples, the P/E, the P/FCFE, and the P/BV are the most commonly used; however, they are not the only ones belonging to this category. Table 10 displays the multiples that have just been mentioned and a brief explanation for each of them.

Price Multiples	Meaning
P/E	The P/E is the ratio between the market capitalization of a company and its earnings or, equally, the ratio between the price of the stock and the EPS (the ratio between earnings and the number of outstanding shares). It represents the number of years the EPS should be multiplied by to obtain the company market capitalization (the stock price). It is one of the multiples that can always be computed (for listed companies), as it is easy to calculate and understand. However, the earnings of a company suffer from depreciation and amortization policies, its financial structure, and the profit or loss of discontinued operations.
P/FCFE	The P/FCFE, the ratio between the market capitalization of a company and its FCFE, represents the number of years the FCFE should be multiplied by to obtain the company market capitalization.
P/BV	The P/BV is the ratio between the equity market value (i.e., the market capitalization) of a company and its equity book value. It represents the equity value of a company in relation to its book value. It is often used for banks and real estate companies and less so in the industrial sector. In fact, for a lot of companies, the equity book value (assets and debts) is not the best indicator of the company value.

Table 10: Examples of Price Multiples

1.3.2.5 Economic Value Added (EVA)

Stewart (1990, 1991) proposed the Economic Value Added (EVA) as a tool for evaluating firms' performances that was able to reflect only incremental values added to a firm after considering cost of capital. According to Stewart (1991), EVA is a financial performance measure that highlights the true profit of a company. EVA is made up of three main

components: NOPAT (Net Operating Profit After Taxes), WACC (Weighted Average Cost of Capital) and Capital Employed (K). Thus, when a company generates returns (NOPAT) that exceed the cost of invested capital (including debts and equity) it means that the firm value is enhanced (Stewart, 1994; Lee and Kim, 2009). Compared to the other measures of performance (ROE, ROA, etc.) that are based only on the notions of accounting profits, EVA acquires a new meaning because it takes into account the cost of invested capital (Kyriazis and Anastassis, 2007) as shown in the following formulation:

$$EVA = NOPAT - (WACC * K)$$

where:

- NOPAT = Net Operating Profit After Taxes
- K = CE = Capital Employed

As can be noticed, EVA is an EBIT-based measure; in fact, NOPAT is calculated starting from EBIT, hence, it is able to evaluate firms' performances from a shareholders' point of view (El Mir and Seboui, 2008).

1.4 Intellectual Capital and firms' performances evaluation

As it has been stated in the previous sections, Intellectual Capital (IC) has been widely studied by many academics and practitioners who have recognised its great importance within the context of firms' performance evaluation (Alipour, 2012; Youndt et al., 2004; Stewart, 1997; Thurow, 1999; Petty and Guthrie, 2000; Bontis, 2001). Even though there are a lot of definitions of IC, as stated previously in this work, one of the most accepted divides it into three main components: (i) Human Capital, (ii) Structural Capital, and (iii) Relational Capital (Hsu and Sabherwal, 2011; Iazzolino et al., 2013a). Summarising, the first one includes experience, knowledge, intellect, behaviour, relationship, attitude and special skills of the personnel (Cohen and Kaimenakis, 2007; Schiuma et al., 2008). Structural Capital is devoted to non-human storehouses of knowledge in organizations; it can be defined as a general system for solving problem and innovation (Chu et al., 2006). The last one concerns the value created through the relations between organizations and with suppliers, customers, shareholders and other institutions and/or individuals (Grasenik and Low, 2004; Chu et al., 2006).

Many approaches have been advanced in the last few years across several industries: Chen et al. (2005), Phusavat et al. (2011), Tan et al. (2007), Wang (2011), Alipour (2012), Maditinos et al. (2011), Joshi et al. (2013) developed frameworks to examine the relationship between IC, using VAIC components (Pulic, 2000; Iazzolino and Laise, 2013), and firms' performances (generally measured taking into account profitability and market-based indicators). Particularly:

- Chen et al. (2005) analysed the relationship between corporate value creation efficiency and firms' market-to-book value ratios, and explored the relation between intellectual capital and firms' current as well as future financial performance. The authors used VAIC components as an efficiency measure of capital employed and intellectual capital. Regarding the performance standpoint, to measure the corporate value Chen et al. (2005) used the market-to-book value (M/B); whereas to evaluate the financial performances of the companies analysed, they used ROE, ROA, Sales growth and Employee productivity (pre-tax Income - No. Employees). The authors found that intellectual capital has a positive impact on firms' market value and financial performance, and it may be an indicator for predicting future financial performance. Further, the authors found investors may place different value on the three components of value creation efficiency (physical capital, human capital, and structural capital). Finally, they found R&D expenditures (neglected by the VAIC) may capture additional information on structural capital (measured by the SCE, according to what stated by the Pulic's framework) and has a positive effect on firm value and profitability.
- Tan et al. (2007) used the VAIC framework to investigate the relationship between intellectual capital (as intended by Pulic) and financial performances. These latter were measured by using ROE, EPS (Earning per share) and ASR (annual share returns). In particular, the authors found that IC and company performance are positively related; IC is correlated to future company performance (measured by the ratios beforehand mentioned); the rate of growth of a company's IC (computed as the year-on-year growth rate of CEE, HCE and SCE) is positively related to the company's performance; and the contribution of IC to company performance differs by industry; in fact Tan et al. (2007) harvested 150 firms listed on Singapore Stock Exchange operating in: multi-industry, manufacturing, commerce, transports, finance, construction, properties, hotels/restaurants, services and others.

- Phusavat et al. (2011), similarly to what studied by Chen et al. (2005) investigated the impact of intellectual capital, measured by using VAIC components, on manufacturing firms' performances, computed by referring to ROE, ROA, Sales growth and Employee productivity. Findings showed that intellectual capital positively and significantly affects manufacturing firms' performances. In fact, it impacted all four performance indicators under study. In addition, the authors found that human capital is significantly related to the employee productivity.
- Wang (2011) carried out a study in which VAIC components were used as intellectual capital measures and, operating cash flow (OCASH), ROA and market capitalisation (MC) were employed to measure respectively: economic, financial and stock market performances. Results showed that the VAIC is positively related to ROA and MC. Furthermore, innovation variables such as research and development (R&D) expenditure (measured as percentage of Sales) are more accurate than structural capital (as intended by the Pulic's framework) in measuring intellectual capital.
- Maditinos et al. (2011) examined the impact of intellectual capital on firms' market value and financial performances. In particular, the authors used the VAIC components to evaluate the intellectual capital efficiency; whereas they adopted market-to-book value to measure the market value of each firm (belonging to a sample of 96 Greek companies), and ROE, ROA and Sales growth to evaluate firms' performances. Although many hypotheses of the study were rejected, the authors found a significant relationship between human capital efficiency (HCE) and financial performances.
- Alipour (2012) analysed the relationship between intellectual capital, measured by the VAIC components, and financial performances of 39 insurance companies. To measure financial performances, the author employed ROA as dependent variable of his multiple regression model, and firm size, financial leverage (total liabilities/total assets) and ROE as control variables. Findings displayed a significant positive linkage between VAIC components and the company's profitability.
- Joshi (2013) carried out a study aiming at examining the intellectual capital performances of the Australian Financial Sector. In particular, the author investigated both the relationships existing amidst the IC components (VAIC

components) and those subsisting between IC and financial performances (measured by ROA). The study revealed that VAIC, used to measure intellectual capital performances, had a significant relation with human costs and the value addition made by the Australian banks. All Australian-owned banks had relatively higher human capital efficiency (HCE) than capital employed efficiency (CEE) and structural capital efficiency (SCE). In this study, the author found that the relationship between ROA and VAIC was not significant, thus it means that, according to Joshi (2013), VAIC has no impact on the profitability of Australian Financial Sector companies.

Other studies which do not use Pulic's scheme were developed by:

- Guo et al. (2012) who provided a framework in which the relationship between intellectual capital (in particular R&D expenditures) and financial performance of listed biotech firms are analysed. The authors found a positive linkage between R&D expenditure and patents although the increase in these latter did not improve significantly the accounting performances, measured by cash flows from operating activities, 1-year stock returns and ROA. Further, findings showed that the quality of human capital, evaluated by salary, cash bonus and stock option for CEO and Vice Presidents (VPs), can affect positively technological innovations and financial performances.

- Murthy and Mouritsen (2011) discussed how Intellectual Capital is related to human, organizational, relational and financial capital using a case study of a firm that invests in Intellectual Capital. In their work, the authors stated that the positive relationship between intellectual and financial capital is difficult to be proved in practice. In fact, according to Murthy and Mouritsen (2011), financial capital is not only an effect but also an important input, even because the development of intellectual capital takes place through the firm's budgeting processes.

- F-Jardón and Martos (2009) developed a framework for wood Argentine companies by using items related both to the three IC dimensions, Human, Structural and Relational Capital, and firms' performances, measured by: output, cash flows, profit, yield, market value, equity, competitive advantage, professionalism of the employees, productivity, reduction of costs, transference of new technologies and modernisation of the facility innovation capacities. In particular, the authors found that the only IC dimension directly affecting financial

performance is Structural Capital; whereas the other dimensions exert an indirect effect through Structural Capital.

- Li and Wu (2004) used IC indicators such employee skills, R&D and advertisement expenses to measure the relationship between IC and firms' performances (measured by total profits). Results showed a positive relationship between intellectual capital and firms' performances, particularly structural capital.
- Mention and Bontis (2013) studied the gap existing among IC components and business performance (industry leadership, future outlook, net profit, liquidity ratio, ROE, banking income, cost-income ratio, overall response to competition, success rate in new product/service launches, and overall business performance and success) within banks of Luxemburg and Belgium. Results indicated that human capital contributes both directly and indirectly to business performance in the banking sector. Surprisingly, relational capital has been evidenced to negatively moderate the effect of structural capital on performance.
- Alwert et al. (2009) investigated how Intellectual Capital Reports (IC Report) of SMEs affect the evaluation behaviour of analysts. The authors argued that IC Reports allow a more homogeneous rating assessment to be implemented. Adding intellectual capital reports to the classic set of annual report and audit certificate contributes to more homogenous results in the rating of credit worthiness of organisations and to more homogenous results in the assessment of the future development of organisations. Findings indicated that IC reports help to reduce risks for banks as they allow a more homogenous evaluation of the company.

Table 11 shows a summary containing the applications and the approaches used in the articles previously cited:

Authors	**Approach**
Chen et al. (2005), Phusavat et al. (2011), Tan et al. (2007), Wang (2011), Alipour (2012), Maditinos et al. (2011), Joshi et al. (2013), Iazzolino et al. (2013b); Iazzolino and Laise (2013)	**VAIC and measure of performances mainly related to profitability and market indexes**
Guo et al. (2012), Murthy and Mouritsen (2011), F-Jardón and Martos (2009), Li and	**IC components (human, structural and relational capital) and firms'**

Authors	Approach
Wu (2004), Mention and Bontis (2013), Alwert et al. (2009)	**performance evaluation indexes (profitability, market, productivity)**

Table 11: Summary of IC and firms' performances evaluation approaches

In conclusion, Intellectual Capital should be considered by scholars and practitioners to get a better, deeper and clearer firm performance evaluation (Alwert et al., 2009; F-Jardón and Martos, 2009; Iazzolino et al., 2013a; 2013b).

CHAPTER 2: METHODOLOGIES TO DESIGN RESEARCHES

2.1 Introduction to research methodologies

Research commonly refers to a search for knowledge, thus, it can be defined initially as a scientific and systematic search for pertinent information on a specific topic. In fact, research is what it could be dubbed as the "art of scientific investigation".

The Advanced Learner's Dictionary of Current English (1952) specified the meaning of research as "*a careful investigation or inquiry specially through search for new facts in any branch of knowledge*".

Redman and Mory (1923) defined research as a "*systematised effort to gain new knowledge*". Some people consider research as a movement from the known to the unknown. It is actually a process of discovery. Humans have always had the vital instinct of inquisitiveness that makes possible to discover and figure out what we all call "unknown".

Inquisitiveness can be recognised as the mother of all knowledge and method, which humans employ for obtaining the knowledge of whatever they do not know; finally, inquisitiveness can be translated into research.

Research is an academic activity and as such the term should be used in a technical sense. Slesinger and Stephenson (1930) in the Encyclopaedia of Social Sciences defined research as "*the manipulation of things, concepts or symbols for the purpose of generalising to extend, correct or verify knowledge, whether that knowledge aids in construction of theory or in the practice of an art*".

Thus, research is intended as an original contribution that allows the existing stock of knowledge to advance. It means to pursue the truth with the help of study, observation, comparison and experiment. In short, the search for knowledge through objective and systematic method of finding solution to a problem is research.

Hence, when facing a research study it is important to select approaches, strategies and methods to investigate properly a certain field of research under settled hypotheses. Thus, it is necessary to design research, by making epistemologically coherent choices on whatever element constituting the research itself.

Designing research is similar, in some ways, to the organisational design; thus, paraphrasing the Taylorism's formula, similarly to what happens for managerial studies, it does not exist a "one best way" to carry out a research. Hence, it is necessary to opt for choices and decisions founded on many variables such as ideas and epistemological beliefs of the researcher, which will impact on the results achievable at the end. (Saunders et al., 2007).

Some basic types of research are briefly described as follows:

(i) *Descriptive vs. Analytical*: the first kind of researches aims at shedding light on the state of the art as it is at present; thus, these include surveys and fact-finding enquiries of different types. Generally, in social science and business researches works belonging to descriptive research are also named as Ex-post facto studies. The main characteristic of this method is that researchers have no control over variables; in fact, they can only report what has happened or what is happening. Ex-post facto studies also include attempts by researchers to discover causes even when they cannot control the variables. The methods of research utilised in descriptive research are survey methods of all kinds, including comparative and correlation methods. In analytical research, by contrast, researchers have to use facts or information already available, and analyse these to make critical evaluations.

(ii) *Applied vs. Fundamental*: applied research aims at finding a solution for an immediate problem facing a society or an industrial/business organisation, whereas fundamental research is mainly concerned with generalisations and with the formulation of a theory. Researches related to some natural phenomenon or to pure mathematics are examples of fundamental research. Similarly, even other studies concerning human behaviour carried on with a view to make generalisations about human behaviour, are also examples of fundamental research. On the other hand, researches aimed at finding certain conclusions (i.e. a solution) facing a concrete social or business issue is an example of applied research. In this sense, researches that aim to identify social, economic or political trends that may affect a particular institution or the copy research (research to find out whether certain communications will be read and understood) or the marketing research or evaluation research are examples of applied research. Thus, the central purpose of applied research is to discover a

solution for some practical problem; whereas basic research is directed towards finding information that has a broad base of applications and thus, adds to the already existing organised body of scientific knowledge.

(iii) *Quantitative vs. Qualitative*: Quantitative research is founded on the measurement of quantity or amount. It is applicable to phenomena that can be expressed quantitatively. On the other hand, Qualitative research concerns with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind. For instance, qualitative research is generally used to investigate human behaviours. This type of research aims at discovering the underlying motives and desires, and they are usually carried out by using interviews. Some other techniques for conducting such kind of researches are: word association tests, sentence completion tests, story completion tests and similar other projective techniques. Attitude or opinion research i.e., research designed to find out how people feel or what they think about a particular subject or institution is also qualitative research. Qualitative research is particularly important in behavioural sciences where the aim is to discover the underlying motives of human behaviour. Through such research it is possible to analyse various factors which motivate people to behave in a particular manner or which make people like or dislike a particular thing. It may be stated, however, that to apply qualitative research in practice is relatively a difficult job and therefore, while doing such research, one should seek guidance from experimental psychologists.

(iv) *Conceptual vs. Empirical*: Conceptual researches are linked to some abstract idea(s) or theory. It is often used by philosophers and thinkers to conduct researches aiming at discovering concepts or at reinterpreting existing ones. On the other hand, empirical research relies on experience or observation alone. Thus, it is a data-based research, coming up with conclusions, which are capable of being verified by observations or experiments. These researches are often dubbed as experimental type of research. In such studies, it is necessary to get at facts firsthand, at their source, and actively to go about doing certain things to stimulate the production of desired information. Hence, such researches are chiefly based on hypotheses and the researcher must prove or disprove them. To prove/disprove hypotheses, the researcher sets up experimental designs aiming at obtaining final experimental results. Therefore,

such researches are characterised by the experimenter's control over the variables under study and his deliberate manipulation of one of them to study its effects. Empirical research is appropriate when proof is sought that certain variables affect other variables in some way. Evidence gathered through experiments or empirical studies is today considered to be the most powerful support possible for a given hypothesis.

(v) *Some Other Types of Research*: All other kinds of research are considered as variations of one or more of the above stated approaches, based on either the purpose of research, or the time required accomplishing research, on the environment in which research is carried out, or on the basis of some other similar factor. Form a time standpoint, it is reasonable to think that researches could be distinguished either as one-time or longitudinal researches. In the former case, the research is confined to a single time-period, whereas in the latter case the research is carried on over several time-periods. Further, research can be classified as field-setting research or laboratory research or simulation research, depending upon the environment in which it is to be carried out. Research can as well be understood as clinical or diagnostic research. Such research follows case study methods or in-depth approaches to reach the basic causal relations. Such studies usually go deep into the causes of things or events that interest the researcher, using very small samples and very deep probing data gathering devices. The research may be exploratory or it may be formalised. The main goal of exploratory research is to develop hypotheses rather than their testing, whereas formalised research studies are those with substantial structure and with specific hypotheses to be tested. Historical research is that which utilises historical sources like documents, remains, etc. to study events or ideas regarding the past, including the philosophy of persons and groups at any remote time. Researches can also be categorised as conclusion-oriented and decision-oriented. While doing conclusion-oriented research, a researcher is free to pick up a problem, redesign the enquiry as he proceeds and is prepared to conceptualise as he wishes. Decision-oriented research is always for the need of a decision maker and the researcher in this case is not free to embark upon research according to his own inclination. Operations research is an example of decision oriented research since it is a

scientific method of providing executive departments with a quantitative basis for decisions regarding operations under their control.

In the following paragraphs of this work some research methods will be explained; however, a specific research might not belong to only one but even more categories aforementioned.

Within this thesis, some quantitative methodologies, amidst those beforehand described, were employed to investigate relationships amongst objects (i.e. intellectual capital and firms' performances indicators); as a consequence, those ones described in the paragraph 2.2 seemed to be more appropriate to get robust results, hence, correlation, simple as well as multiple regressions were applied in Chapter 4, Chapter 5 and Chapter 7. In Chapter 3, it was taken advantage of MDA (multiple discriminant analysis) models to classify firms within a credit scoring context.

However, within this work, even empirical and customised methodologies were built up and applied. Particularly, in Chapter 6 and Chapter 8, methodologies were devised by taking account of the literature regarding respectively multiples and general approaches developed to evaluate linkages between intellectual capital and firms' performances.

2.2 Measures of relationships

2.2.1 Correlation

In literature, there are several approaches aiming at discovering relationships amongst variables; these methods could be distinguished according to the answers given to the following questions:

1. Is there an association or a relation between two (or more) variables? If a relation exists, what is its degree?
2. Is there any cause-effect relation between two (or more) variables in case of bivariate/multivariate population? If a cause-effect relation exists, what is its degree? What is its direction?

Correlation methods aim at answering to the first question; whereas, regression analyses try to reply to the second one.

Starting from the first mentioned techniques, correlation amongst variables, in case of bivariate populations, can be founded by applying:

1. Cross tabulation;
2. Spearman's coefficient;
3. Pearson's coefficient.

When facing multivariate populations, correlation amongst variables can be computed according to:

(i) Coefficient of multiple correlation;

(ii) Coefficient of partial correlation.

Cross tabulation might be used when datasets are presented according to a nominal form; therefore, each variable can be classified into two or more categories and then cross-classified into sub-categories.

Interactions amongst variables (assuming we have two variables) can be:

- *Symmetrical*: the two variables vary together; however, it is assumed that neither variable is due to the other one.
- *Reciprocal:* the two variables affect each other.
- *Asymmetrical*: one variable, called independent, affects another one, named dependent.

The procedure of cross classification starts with a table that indicates whether a relationship amidst variables exists or not. This kind of analysis can be further elaborated when a third factor is included in the cross classification. Hence, it could be found a relationship in which a certain factor, say X, seems to affect another one, say Y, when a third factor, say Z, is held constant.

The correlation found by using this approach is not generally considered as a reliable form of calculating statistical correlations, accordingly, researchers prefer to use other methods when analysing ordinal, interval or ratio data.

The *Spearman's coefficient* is particularly useful when seeking correlation between two variables in case of ordinal data where ranks are given to the different values of the variables involved in the analysis. The major goal of the Spearman's coefficient is to investigate the extent to which two given sets of ranking are similar or dissimilar; the coefficient is computed as follow:

$$Spearman's\ coefficient = 1 - \left[\frac{6\sum_i {d_i}^2}{n(n^2-1)}\right]$$

Where:

- d_i = difference between ranks of i-th pair of the two variables;
- n = number of pairs of observations.

The *Pearson's coefficient* is perhaps the most known method of investigating correlation between two variables. This coefficient take account of the assumptions listed below:

1. There is a linear relationship between the two variables;
2. One variable depends to the other one;
3. Variables are distributed according a normal distribution.

The Pearson's coefficient may be computed as follow:

$$Pearson's\ coefficient(r) = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{n\sigma_X\sigma_Y}$$

Where:

- X_i = i-th value of X variable
- X = mean of X
- Yi = i-th value of Y variable
- Y = Mean of Y
- n = number of pairs of observations of X and Y
- σ_X = Standard deviation of X
- σ_Y = Standard deviation of Y

The Pearson's coefficient (r) can assume three different values: (i) positive ($0 < r < +1$); (ii) negative ($-1 < r < 0$); neutral ($r = 0$). Positive values should be interpreted as positive correlation between the two variables (it means that changes in both variables take the same direction, i.e., if one the value of a variable increases, the value of the other one increase too). Negative values of r, should be interpreted as negative correlation between the two variables (it means that changes in the variables go towards opposite directions, i.e., if the value of a variable increases, the value of the other one decreases). Neutral

values of r, indicate that there is no correlation between the two variables. Values of r close to +1 or -1 should be interpreted as strong positive or negative relationships respectively.

Obviously, to say that a correlation exists, it is necessary to measure its "statistical significance" or simply its "significance"; this latter can be computed as follow:

Suppose r_{xy} is the correlation between two variables, x and y. Considering n couple (x, y) where x and y are both independent and distributed according to a Gaussian. Thus,

$$t = \frac{r_{xy}}{\sqrt{1 - {r_{xy}}^2}}\sqrt{n-2} = t_{n-2}$$

t_{n-2} is the t-student[3] having two degrees of freedom.

The correlation test (significance α):

- If $|t| > t_{\alpha/2}$ ⇒ null hypothesis is rejected ⇒ r_{xy} is significantly ≠ 0;
- If $|t| \leq t_{\alpha/2}$ ⇒ null hypothesis is accepted ⇒ r_{xy} is significantly ≠ 0;

As a consequence:

- $P(t_{n-1} \geq t_{\alpha/2}) = \alpha/2$ or
- $P(|t_{n-1}| \leq t_{\alpha/2}) = \alpha$

Where α is the level of significance.

2.2.2 Simple regression analysis

Regression analysis aims at determining if a significant statistical relationship between two or more variables exists. Simple regression admits only two variables: one is "dependent" whereas the other one is "independent"; in particular, the dependent variable behaves according to the values assumed by the independent one.

Thus, regression can establish if there is a way to which an independent variable, X, can affect a dependent variable, Y. This relationship is mathematically expressed by:

$$\hat{Y} = a + bX$$

where the symbol $\hat{Y}$ is the estimated value of Y for a given value of X.

[3] The t-test aims at identifying if the average value of a certain distribution deviates significantly from a certain reference value.

The equation aforementioned is generally known as *regression equation* and can be graphically identified by the so-called "regression line". The equation highlights the relationship between X and Y, accordingly, it means that every change in X is able to produce change of b in Y; changes can be either positive (direct relationship) or negative (inverse relationship).

A method that is able to determine the best fitting straight line between the dependent and independent variables is the least-square method, which is following illustrated:

Firstly, we need to determine:

$$\sum {x_i}^2 = \sum {X_i}^2 - n\bar{X}^2$$

$$\sum {y_i}^2 = \sum {Y_i}^2 - n\bar{Y}^2$$

$$\sum x_i y_i = \sum X_i Y_i - n\bar{X}\bar{Y}$$

Then

$$b = \frac{\sum x_i y_i}{\sum {x_i}^2}$$

These measures define both parameters a and b which will give the best possible fit through the variables X and Y and the value of r that can be computed as follow:

$$r = \frac{b\sqrt{\sum {x_i}^2}}{\sqrt{\sum {y_i}^2}}$$

Therefore, regression analysis aims at depicting relationships amidst variables and it could be used successfully for prediction purposes. In fact, through this method, it is possible to predict the values of a variable, given the values of another one from which it depends.

2.2.3 Multiple regression and correlation

Multiple regression aims at finding relationships amongst more than one dependent and one independent variable. The regression equation is similar to that previously displayed for the simple regression case with exception of the right-side of the equation itself. Thus, the equation can be expressed as follow:

$$\hat{Y} = a + b_1 X_1 + b_2 X_2 + \cdots + b_n X_n$$

where X_1, X_2, …, X_n are the independent variables and Y is the dependent variable, and the constants a, b_1, b_2, …, b_n should be found

When having two independent variables, these following equations[4] shall be solved:

$$\sum Y_i = na + b_1 \sum X_{1i} + b_2 \sum X_{2i}$$

$$\sum X_{1i} Y_i = a \sum X_{1i} + b_1 \sum {X_{1i}}^2 + b_2 \sum X_{1i} X_{2i}$$

$$\sum X_{2i} Y_i = a \sum X_{2i} + b_1 \sum X_{1i} X_{2i} + b_2 \sum {X_{2i}}^2$$

However, in multiple regression analysis, the coefficients a, b_1, …, b_n can become less reliable when a high degree of correlation is found amongst the independent variables; this problem, is generally recognised as multi-collinearity, thus, when carrying out this kind of analysis, researchers should take account of it when selecting independent variables to not distort the prediction of the dependent variable.

When having more than one independent variable, it is possible to make a difference between the collective effect of the independent variables and the single effect of each of them taken separately. In case of two independent variables, the collective effect is given by the coefficient of multiple correlation,

$$R_{y*x_1x_2} = \sqrt{\frac{b_1 \sum Y_i X_{1i} - n\bar{Y}\bar{X_1} + b_2 \sum Y_i X_{2i} - n\bar{Y}\bar{X_2}}{\sum {Y_i}^2 - nY^2}}$$

where b_1 and b_2 are the regression coefficients.

2.2.4 Partial correlation

Partial correlation aims at measuring possible relationships between two variables, considering them separately; in such way, effects of other variables are excluded. In other words, partial correlation measures the relationship between a dependent and an independent variable assuming that the others are held constant. In case of having two variables, their partial correlation can be computed as follow:

$$r_{yx_1*x_2} = \frac{R_{y*x_1x_2} - {r_{yx_2}}^2}{1 - {r_{yx_2}}^2}$$

[4] It can be noticed that the number of equations strictly depends on the number of independent variables involved into the regression analysis; i.e. in case of n variables, n + 1 equations shall be solved.

It measures the variation of the dependent variable (named Y) that is not explained by X_2; accordingly, it investigates the impact of X_1 on Y.

Similarly, the following equation measures the effect of X_2 on Y; as it can be noticed, X_1 and X_2 have been simply interchanged.

$$r_{yx_2*x_1} = \frac{R_{y*x_1x_2} - {r_{yx_1}}^2}{1 - {r_{yx_1}}^2}$$

Partial correlation coefficients aforementioned are generally recognised as "first order coefficients" when one variable is held constant; whereas they are dubbed as "n order coefficients" when n variables are held constant.

2.3 Measures of classification

2.3.1 Multiple Discrimininant Analysis (MDA)

Multiple Discriminant Analysis (MDA) is particularly useful for researchers when they need to classify a dependent variable, which cannot be directly measured, on the basis of its features, into two or more groups.

Accordingly, the main goal of this kind of analysis is to predict the possibility that a certain entity belongs to a defined group on the basis of several "predictors".

By using MDA, researchers may classify objects, entities, individuals and so on, into two or more classes, according to a set of independent variables, named, as before mentioned, predictors.

This analysis should not to be confused with regression analysis. In fact, the latter one is not suitable in the cases above mentioned because the dependent variable cannot be scaled into an interval. Thus, MDA is deemed suitable when facing non-metric variables need to be classified into two or more groups, considering their relations with independent variables that, by contrast, shall be metric.

MDA is even able to predict an object's likelihood of belonging to a certain group with respect to the several independent variables involved into the analysis.

Considering the case of having two groups of objects that need to be created by taking account of *n* independent variables, the MDA equation can be modeled as follow:

$$z_i = b_0 + b_1 X_{1i} + b_2 X_{2i} + \cdots + b_n X_{ni}$$

Where:

- X_{ji} = the i-th individual's value of the j-th independent variable;
- b_j = the discriminant coefficient of the j-th variable; they indicate the importance of the j-th independent variable to discriminate amongst several groups (or classes). Thus, such coefficients allow researchers to establish which variables should be considered to discriminate objects in a certain context.
- z_i = the i-th individual's discriminant score;
- $z_{crit.}$ = the critical value for the discriminant score (cut-off point).

The classification procedure in such case would be:

1. If $z_i > z_{crit}$, object *i* is deemed to belong to the Group I;
2. If $z_i < z_{crit}$, object *i* is classified into the Group II.

As previously stated, MDA can even predict an object's likelihood of belonging to a certain group; hence, z_i can be transformed into such probability.

A practical literature example of MDA application concerns the credit risk assessment for bankruptcy predictions (mentioned within the accounting-based valuations in chapter 1). This particular kind of multivariate models applied to predict bankruptcy, among which the first contribution was given by Altman (1968), is based on the concept that the identification of the point of possible insolvency (cut-off) depends on the weighting of different indicators, selected within the set of the most significant financial risk indicators.

Many versions of Altman's model have been developed (Eisenbeis, 1977; Grice and Ingram, 2001) and a very large debate has been carried out. Altman (2000) uses MDA and a model he called ZETA (Z) (Altman et al., 1977) to evaluate characteristics of business failures in order to specify and quantify the variables which are effective indicators and predictors of corporate distress. Another combination of quantifiable financial indicators of firm performance and additional variables are described in Altman (2002). Altman and Sabato (2007) developed a new model (using a logit technique) for predicting default in Small and Medium Enterprises (SMEs). The discriminant function has been defined in different ways, by changing the selected indicators and their weights.

MDA was used in many studies to develop credit scoring models for loan evaluation purpose. Thus, Reichert et al. (1983) examined the theoretical requirements of the MDA model in the context of realistic lending situations and described the extent of bias when

these theoretical assumptions are not fully met. Taffer and Tisshaw (1977) developed a bankruptcy prediction model using linear discriminant analysis (LDA), which is a synonym of MDA (it is a linear application of MDA), based on UK manufacturing companies; in particular, they analysed a sample of 46 failed firms matched by 46 non-failed manufacturing companies. Therefore, in order to discriminate these set of firms, they investigated 80 different ratios and then they defined four variables: profit after tax to current liabilities, current assets to current liabilities, current liabilities to total assets, and no-credit interval. The latter variable measures the time for which the firm could finance its continuing operations from its immediate assets if all other sources of finance were cut off. Kwansa and Parsa (1991) and Gu (2002) carried out analyses on bankruptcy into restaurant industry. The first mentioned authors have developed an event approach for identifying events into the failure process of the restaurant companies. This model is not a prediction model, but it is an explanatory model. Hence, this model do not discriminate between two or more classes but it compares the groups (failed and non-failed firms) basing on the characteristics common to failing firms, which are absent in the non-failing set. Instead, the model developed by Gu (2002) may be considered as a prediction model (with a 92-percent accuracy rate 1 year prior to bankruptcy); this MDA model was constructed starting from the analysis of 12 financial ratios, commonly used into previous works regarding business failure prediction such Gardiner et al. (1996) who conducted similar analyses on hospital sector. They carried out discriminant models, separately for both non-profit and proprietary hospitals; hence, they developed MDA models containing variables linked to the main aspects of financial health: liquidity, solvency/leverage, profitability, and efficiency/activity.

2.3.2 Artificial Neural Networks (ANNs)

In the last few years, Artificial Neural Networks (ANNs) appeared to be useful in solving several issues arising from research fields such as mathematics, physics, biology, economy, etc. thanks to the ability of learning either with or without “supervisor”.

Although neural networks have analytical processes mainly based on the “black-box” principle, thus they are not perfectly transparent to those who use them due to the fact that they do not reveal the “way of thinking” a specific solution, their efficiency on certain research fields is undeniable.

Synthetically, ANNs could be intended as a system able to process information in a non-programmed way. Neural networks, as we mentioned previously, are able both to learn something from certain provided examples and behave as a "black-box" tool, therefore, the way of processing information is not explicated. In this sense, it is possible to consider ANNs as inspired to the way of human brain processes information. Hence, it is possible to consider the two following fundamental aspects:

- Knowledge is acquired by the network from a *training process*;
- The intensity of connections amongst neurons, generally known as synaptic weights, are used to store knowledge.

Within a neural network, the main element is represented by the artificial neurons that try to work like biological ones. The following Figure 10 shows how a generic neuron works:

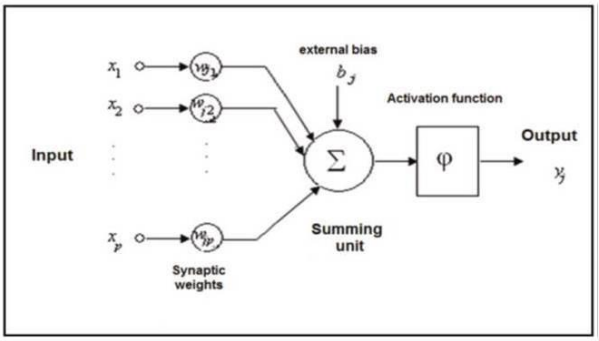

Figure 10: Generic non-linear neuron (adapted from Gorunescu, 2011)

An artificial neuron, intended as a single element, has a certain number of p real input x_i, weighted by elements w_i, summed and passed through an activation function φ to produce a defined output, depending from a threshold T.

Like a nervous system, a neural network is made up of a large number of tightly interconnected neurons that work parallel to solve a specific problem (generally, a classification problem). Therefore, a neuron should be viewed as a base object of a neural network rather than a single component that works independently from the others.

Thus, within a neural network, a generic real input x_i reaching the input of the synapsis i, connected to the neuron j, is multiplied by the synaptic weight w_{ij}. In this mathematical model, the input (scalar) x_i represents the activity level of other neurons, which they are connected to the neuron i and modeled according to the weight w_{ij} that is the strength of an interconnection between two neurons (i and j). Furthermore, for each neuron (identified by j), a threshold T_j is established. Neural networks contain also a constant (fictitious), which

is an external input b_j, generally dubbed as external bias (external influence) having the effect of increasing or decreasing the net activation input (either it is positive or negative).

By the summing unit, it is computed a weighted sum among the input of the net; if it overcome the threshold T_{ij}, it will be elaborated by the activation function in order to produce the output.

Mathematically, it is possible to describe how a specific neuron j works as following:

$$u_j = \sum_{i=1}^{p} w_{ji} * x_i = \boldsymbol{w}_j * \boldsymbol{x}^T$$

where $\mathbf{x} = (x_1, x_2, \ldots, x_p)$ is the input vector, $\mathbf{w} = (w_{j1}, w_{j2}, \ldots, w_{jp})$ is the synaptic weight vector and u_j is the linear combination due to the input $\mathbf{x}$.

The activation of a neuron is:

$$y_j = \varphi\left(u_j + b_j\right) = \begin{cases} h_j, u_j + b_j \geq T_j \\ 0, u_j + b_j < T_j \end{cases}$$

where b_j is the external influence (bias), φ is the activation function and y_j is the output signal of the neuron j.

After having briefly described the basic principles on which neural networks are based, following, some kinds of net will be shown. As stated previously, the main elements of a neural network are:

- inputs, gathered from the application environment,
- the "hidden" layer, which contains the neurons placed between inputs and outputs and that they make "black-box" computations and,
- outputs, which summarise the network responses.

All the neurons (input, hidden and outputs) should be interconnected to each other to become fully functional. ANNs architectures refer to the topological organisation of the neurons (number of neurons, number of hidden layers, structure of the layers, direction of signals and reciprocity). The way of operating is related to the nature of the activity during the information processing (dynamic or static for each new input). At the end, the learning paradigm concerns the way by which the net acquires knowledge from the training set.

The main ANN architectures are showed as following:

Feedback: there is a feedback loop by which the output affects the input and vice versa (Figure 11):

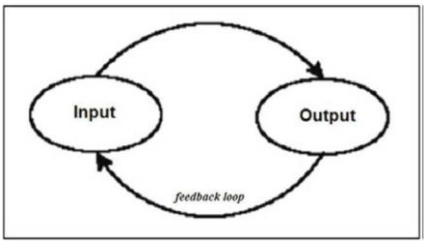

Figure 11: Feedback net (adapted from Gornuescu, 2011)

- *Feed-forward:* it is a net in which the signal goes from input towards output neurons eventually passing from those ones placed in one or more hidden layers. These nets have the property by which the outputs can be expressed by using deterministic functions of the inputs.

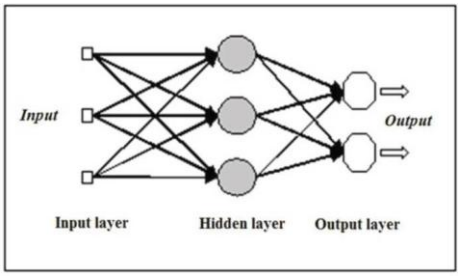

Figure 12: Feed-forward net (adapted from Gorunescu, 2011)

- *Recurrent feed-forward:* it is a feed-forward net having at least one feedback loop between two neurons. It could be considered as a hybrid network that uses the concepts illustrated in feedback and feed-forward nets.

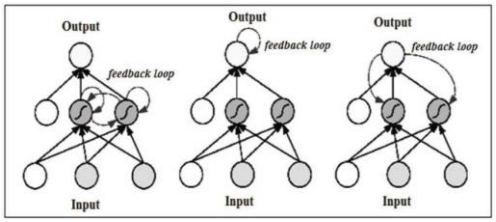

Figure 13: Recurrent feed-forward net (adapted from Gorunescu, 2011)

As it has been argued previously, net topology and learning paradigm, by which the ANN acquires knowledge from a dataset, are put alongside. Schematically, the environment stimulates the network, thus, ANN receives inputs from the environment, the system parameters receive certain values as reaction to these stimuli, and then NN responds to its

external environment with its new configuration. Since there are several methods to set net parameters, there are some different learning methods [5], as stated by Haykin (1999):

- *Error-based learning*: it is based on a control mechanism that evaluates differences existing between the effective response (real) and that one comes from the net. Technically, the net weights are adapted according to the errors made by the output neurons;
- *Memory-based learning*: it uses the explicit data memorization;
- *Hebbian learning*: it is founded on neurobiological considerations (in honour of Hebb's postulate);
- *Competitive learning*: it is based on a competition amongst neurons (i.e. only a neuron, dubbed as winner, from a given interaction within a given layer, will be activated in a specified moment);
- *Boltzmann learning*: it is based on ideas derived from statistical mechanisms.

Further, learning could be "supervised" or "unsupervised" [6]; in the first case, are presented to the network for learning, the parameters optimisation being performed based on the error measurement, given by the difference between the network output and the expected response (supervisor's response). In the other case, only inputs are used, thus, any parameter adjustment is done without considering the support activity of a supervisor.

2.3.3 Support Vector Machines (SVMs)

A particular class of feed-forward nets are represented by the so-called Support Vector Machines (SVMs) that are mainly used when classifying objects and non-linear regressions.

From the previous paragraph, it is possible to derive the following dilemma: in spite of a simply and efficient algorithm, neural networks (featured by an input and a output layers) are limited by the fact that they are able to take just "linear" decisions; in fact, they can classify objects characterised by the "linear separability" property.

[5] These learning methods may be found detailed in Gorunescu (2011)
[6] Other details on supervised and unsupervised methods may be found in Gorunescu (2011)

Multi-layer nets, which have one or more hidden layers, are characterised by a strong classification power but, unfortunately, they cannot be easily trained in every case, due to a multitude of local minima and a high dimension of the weight space.

To solve the dilemma aforementioned, SVMs can be applied mainly due to their efficient learning algorithm that allow them to model, at the same time, both linearly and not linearly separable solutions.

Without going into details, given a set of not linearly separable objects, the basic idea of SVMs is to map them within a space in which a linear classifier can be used. In this sense, it is necessary to transform the initial space of solutions (not linear) into a new one that is linear (a space in which equivalent solutions to the ones belonging to the initial space can be found). This is possible by applying the so-called "kernel trick"[7]

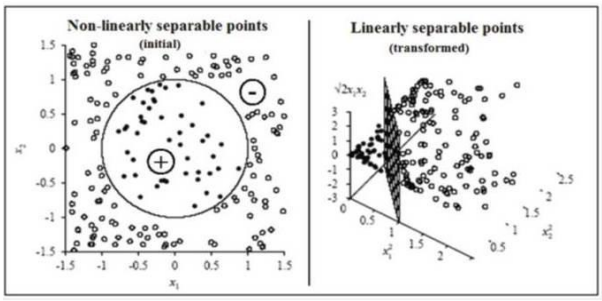

Figure 14: Kernel trick paradigm (Gorunescu, 2011)

To better figure out the SVM classifier it is convenient to start from the Figure 14. It shows in its left part a two-dimensional space of inputs in which an object is described by $\mathbf{x} = (x_1,x_2)$. Hence, there are two classes of objects:

- *Positive objects*, which are located within a circumference $x_1^2 + x_2^2 = 1$;
- *Negative objects*, which are located outside the beforehand mentioned circumference.

As it can be easily noticed, there is not linear separability between the two object sets; in fact, the separability is circular (described by a circumference). However, the same situation might be mapped on a three-dimensional space (instead of two-dimensional one), passing from a *x*-space to a *z*-space by applying a function $z = g(x)$ as following characterised:

- $z_1 = g(x) = x_1^2$;
- $z_2 = g(x) = x_2^2$;

[7] Details on kernel trick may be found in Gorunescu (2011)

- $z_3 = g(x) = \sqrt{2}\, x_1 x_2$;

By observing the right part of the Figure 14, it is possible to note that the transformed objects are linearly separable.

By projecting the three-dimensional space on the first two axes, it is possible to obtain a detailed image of the method (Figure 15) in which it is possible to note a linear separator. The closest points to the linear separator are dubbed as *support vectors*, which are points that determine the linear separation of input objects.

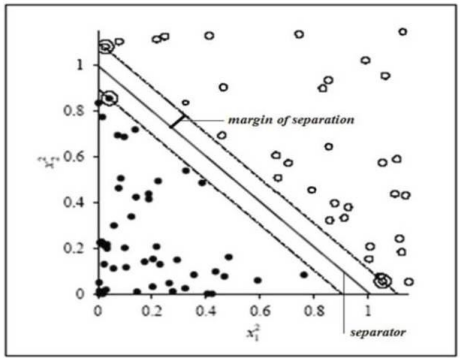

Figure 15: Linear separation obtained by kernel trick (Gorunescu, 2011)

The margin of separation that it can be noticed by the figure measures the distance between the linear separator (a hyper plan) and the closest objects (support vectors).

Generalising, the SMVs concept lies on the fact that an initial space of inputs can be mapped on a space large enough where not linearly separable objects become linearly separable.

SVMs (commonly called kernel machines, of which SVMs are part of) tries to discover the optimal linear separator (i.e. that one is able to maximise the distance between positive and negative objects), which has a certain degree of robustness in the classification of new objects.

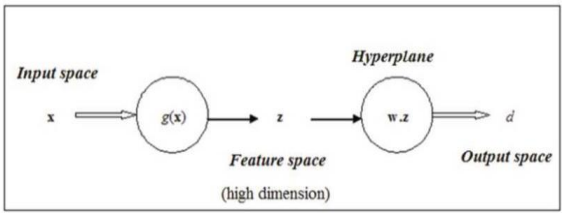

Figure 16: SVMs/kernel machines (Gorunescu, 2011)

The Figure 16 displays how SVMs work; they are essentially based on two steps[8]:

[8] Further details may be found in Gorunescu (2011)

1. Mapping the initial space *x* (with not linearly separable objects) into a new space large enough *z*;
2. Building an optimal separation hyper plan for the space *z* defined in the first step.

2.3.4 Data Envelopment Analysis (DEA)

The Data Envelopment Analysis approach was developed by Charnes et al. (1978) and it is recognised as a non-parametric method for evaluating the efficiency of certain units, generally dubbed as "decision-making units" (DMUs).

As it has been stated, DEA is based on the DMU concept that follows these two definition of efficiency (Cooper et al., 2011):

1. **Full Efficiency**: it is reached by any DMU if and only if there are neither inputs nor outputs that can be improved without worsening some other inputs or outputs;
2. **Relative Efficiency**: A DMU is to be rated as fully efficient with respect to available evidences if and only if the performances of other DMUs does not show that some of its inputs or outputs can be improved without worsening some of its other inputs or outputs. This type of efficiency is usually known as "technical efficiency" in the economic field.

DEA concerns two general approaches:

1. ***CCR model***: based on *constant returns to scale*;
2. ***BCC model***: which introduced an additional variable is able to account of *variable returns to scale* effect.

The first aforementioned model, the CCR, was created by Charnes, Cooper and Rhodes (1978) from which its name was derived. It takes account of:

- CRS: constant returns to scale;
- Relative efficiency;
- It is constrained by the fact that all numerical variables shall be positive;
- Both all inputs and outputs are attributed both to a single virtual input (expressed as a weighted sum of the other inputs) and a single output (expressed as a weighted sum of the other outputs).

Therefore, it is assumed that there are *n* DMUs that need to be evaluated; each of them uses a certain amount of *m* inputs to produce *s* outputs. Particularly, the DMU_j receives

amount x_{ij} of input i and produces amount y_{rj} of output r. It is also assumed that $x_{ij} > 0$ and $y_{rj} > 0$ and that each DMU has, at least, one positive input and one positive output value.

This fractional programming model determines both the inputs and outputs weights that are able to maximise the following ratio:

$$max\, h_o = \frac{\sum_r u_r y_{ro}}{\sum_i v_i x_{io}}$$

Where v_i and u_r are, reciprocally, the weights associated to inputs, x_{io}, and outputs, y_{ro}, which are the observed input and output values related to the DMU_o, which is the DMU to be evaluated. This ratio is the objective function, which can be less or equal than or to 1; further, weights shall be positive. Following, the fractional programming model is displayed:

$$max\, h_o = \frac{\sum_r u_r y_{ro}}{\sum_i v_i x_{io}}$$

Subjected to:

$$\frac{\sum_r u_r y_{rj}}{\sum_i v_i x_{ij}} \leq 1 \text{ for } j = 1, \ldots, n$$

$$v_i, u_r \geq 0 \text{ for all } i \text{ and } j$$

Since it is a fractional programming model, to be solved, it should be converted into a linear programming one. Hence, to convert the original model, it is sufficient to normalise the denominator by assigning an arbitrary value, as an example, 1. By adding a constraint $\sum_{i=1}^{m} v_i x_{io} = 1$ it is possible to obtain the following CCR input-oriented model in which the variables (u, v) are transformed into (μ, v):

CCR input-oriented model (multipliers-based method)

$$\max z = \sum_{r=1}^{s} \mu_r y_{ro}$$

Subjected to:

$$\sum_{r=1}^{s} \mu_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0$$

$$\sum_{i=1}^{m} v_i x_{io} = 1$$

$$\mu_r, v_i \geq 0$$

The dual problem[9] is defined as follow:

$$\theta^* = \min \theta$$

Subjected to:

$$\sum_{j=1}^{n} x_{ij}\lambda_j \leq \theta x_{io} \quad i = 1,\ldots,m$$

$$\sum_{j=1}^{n} y_{rj}\lambda_j \leq y_{ro} \quad r = 1,\ldots,s$$

$$\lambda_j \geq 0 \quad j = 1,\ldots,n$$

Even a output-oriented CCR model can be defined, formulation is displayed as follow:

$$\min q = \sum_{i=1}^{m} v_i x_{io}$$

Subjected to:

$$\sum_{i=1}^{m} v_i x_{ij} - \sum_{r=1}^{s} \mu_r y_{rj} \geq 0$$

$$\sum_{r=1}^{s} \mu_r y_{ro} = 1$$

$$\mu_r, v_i \geq \varepsilon > 0$$

The models aforementioned produces the so-called "efficiency frontier", showed in Figure 17. All efficient DMUs (points) lie on this frontier; therefore, inefficient DMUs should be made more efficient by projecting them onto the efficiency frontier, as displayed in the Figure 17.

[9] For further details about the dual formulation of CCR see Cooper et al. (2011)

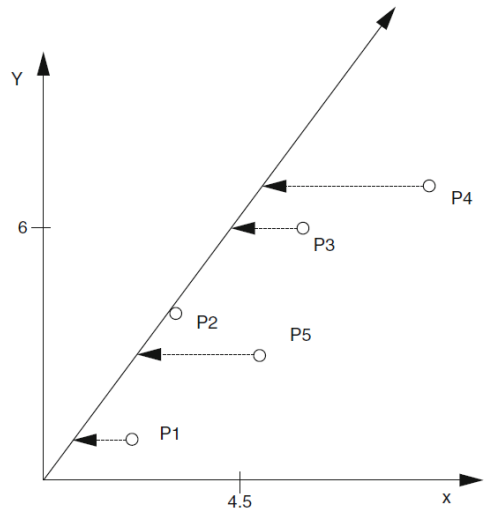

Figure 17: CCR efficiency frontier (Cooper et al., 2011)

BCC model

While the CCR model assumes that there are constant returns to scale, BCC does not make the same consideration. It should be noticed that in many practical cases, the CRS (constant returns to scale) assumption is not verified and, to carry out the analysis it is necessary to know the scale characterising the units, or to know the dimension of the inputs and outputs for which inefficiency become a direct consequence of the scale itself.

The BCC model is featured by variable returns to scale (VRS), therefore, it takes into account the possibility that the objective function can vary according to either increasing or decreasing returns.

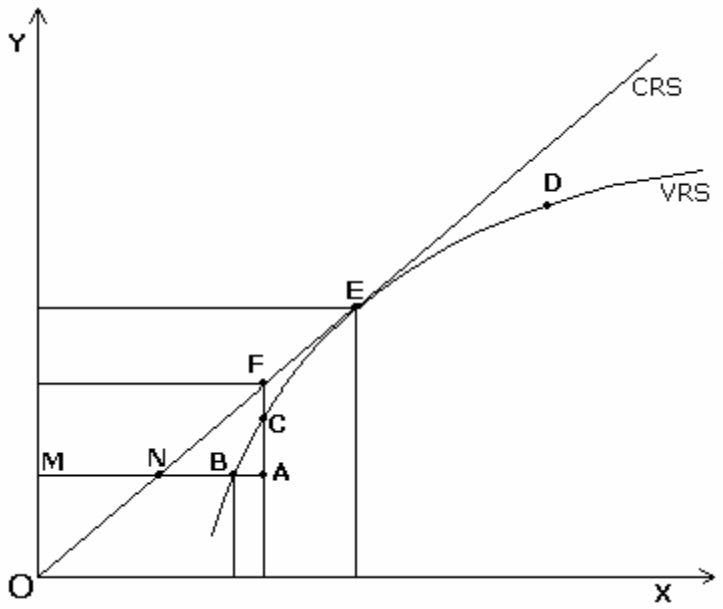

Figure 18: VRS vs CRS (Ray, 2004)

The Figure 18 shows both VRS and CRS. The curve BED represents a VRS function, whereas the other one is the efficiency frontier characterised by CRS. By observing the graph, it could be said that the point (DMU) A does not belong to any efficiency frontiers (neither VRS nor CRS). Analogously to the CCR model, we should compare the point A with the C one, in case of output-oriented approach; whereas, in case of input-oriented approach we should compare A with B. Therefore, the efficiency of A can be measured as:

- ${E_I}^A = \frac{x_B}{x_A}$;
- ${E_O}^A = \frac{y_C}{y_A}$;

By comparing the models and their efficiency frontiers respectively, it can be noted that on the straight line CRS, the average productivity ($AP_J = {y_j}/{x_j}$ when we have only one input and one output) is constant; whereas, on the curve VRS, it vary on each point.

The point E is one that has the highest productivity and, as it can be easily noticed, it is the tangent point between the curve VRS and the straight line CRS; this point is commonly dubbed as "most productive scale size" (MPSS). The average productivity of MPSS is equal to the average productivity of the CRS efficiency frontier. The overall efficiency of A can be obtained by comparing this unit with E or N (DMUs having the same productivity since they are on CRS frontier).

The scale efficiency for each point belonging to the efficiency frontier is the ratio between the average productivity in that point and the average productivity of MPSS. Hence, the scale efficiency of the DMU_A can be computed as $\frac{x_B}{x_A}$, which is the horizontal distance between CRS and VRS frontiers.

At the end, it can be noticed that the product between overall efficiency and scale efficiency is what is named as technical efficiency:

$$\frac{x_N}{x_A} \times \frac{x_B}{x_N} = \frac{x_B}{x_A}$$

These concepts cannot be easily applied to complex contexts, where a lot of inputs and outputs should be taken into account, since the unfeasibility of determining a common set of weights that can be accepted by every DMU when pondering variables. Therefore, it is necessary to develop a model that is able to evaluate the technical efficiency in a multi-input and output situation by correcting the error generated by the CCR approach of

attributing to the technical inefficiency of a single DMU possible disadvantages that might be caused by the economies of scale.

This model is called BCC, it is similar to the CCR one, it satisfies all DEA hypotheses but it has a convexity constraint ($\sum \lambda$) with which VRS are admitted.

CHAPTER 3: EVALUATING INTELLECTUAL CAPITAL FOR SUPPORTING CREDIT RISK ASSESSMENT[10]

Abstract

The aim of this work is to propose a new methodology for credit risk assessment, by considering not only financial indicators, but also variables concerning the Intellectual Capital (IC) of the firm. Two credit scoring models based on Multi Discriminant Analysis (MDA) have been developed: (i) a model which takes into account only financial data and (ii) a model which takes into account also Intellectual Capital variables, divided in the three traditional dimensions, Human, Structural and Relational Capital. The two models have been applied on a sample of large firms and the obtained results have been compared. The study highlights that the model which integrates IC and financial variables is more accurate than the model developed using only financial data. Intellectual Capital reduces, and in some cases eliminates, both type I and type II errors. The result shows the importance of taking into account some aspects of intangible assets into the credit risk evaluation. Intellectual Capital variables can help to provide a better understanding of the firm's value (financial and intangible).

3.1 Introduction

Many economists consider the current financial crisis as the most severe since 1929. One of the reasons that have led to the financial crisis is a lack of ability in credit risk assessment. Therefore, during the last few years, the evaluation of credit risk has become essential for many scholars and practitioners (Abdou et al., 2008).

The definition and quantification of credit risk is very complex. In the literature, there are many approaches which attempt to measure credit risk (Iazzolino and Fortino, 2012). In general, credit risk evaluation is based on financial data, obtainable through financial reports. As in Alwert et al. (2009), financial data is not sufficient to assess risk, because in

[10] This work was the incipit of: Iazzolino, G., Migliano, G., Gregorace, E. (2013) "Evaluating intellectual capital for supporting credit risk assessment: an empirical study", *Investment Management and Financial Innovations*, Vol. 10, No. 2, pp. 44-54.

an organization there are intangible assets and other resources. Financial reports are not able to cover intangible information, which can generate information asymmetry, whereby the managers of the firm know the true value of the firm but outside investors do not. Intellectual Capital reports are useful to provide higher transparency in order to explain the hidden value of an organization (Edvinsson and Malone, 1997). Intellectual Capital can help to better understand the role of intangible assets in credit risk analysis (Guimon, 2005).

The aim of the chapter is to propose a new model for credit risk assessment, in which the variables related to Intellectual Capital are included into a Multi Discriminant Analysis (MDA) model, together with financial variables. MDA is a statistical approach commonly used to find effective linear transformations in particular contexts. Furthermore, it is a simple and very useful tool (as demonstrated by results in literature) for separating, in a data space, two classes of objects having the following characteristics: (i) the average distance between the objects within the class is the smallest and (ii) the average distance between the classes is the largest. The following sections describe the research methodology, the dataset, the empirical research, results and discussions. Further, in the last part of the chapter, conclusions and future works are presented.

3.2 Research Methodology

The Research is based on an experimental study design, in order to figure out a new framework in which Intellectual Capital variables are included within a credit scoring model. In our methodology, Intellectual Capital is divided in three dimensions: Human Capital, Structural Capital and Relational Capital (Edvinsonn, 1997). As in Alwert et al. (2009), Intellectual Capital can help to better understand economic evaluations; therefore, we have used Intellectual Capital-based indicators within our credit scoring model. We propose a model for credit risk evaluation in which the traditional financial ratios are integrated by indicators based on Intellectual Capital.

3.2.1 Selected financial indicators

By considering the indicators proposed in Z-score models (Altman, 1968; Altman and Hotchkiss, 2005; Altman and Sabato, 2007), we selected five financial ratios belonging to the following categories (see also Table 7):

- *Solvency*: these ratios are able to assess a company's ability to meet its long term obligations and explain how the company has been financed (debt or equity). In this category we have, for example, the Debt ratio and the Leverage ratio;
- *Liquidity*: are used to determine whether a company is able to pay off its short term debt obligations. They are: Quick ratio and Current ratio;
- *Profitability*: they depend not only on the margins generated, but also on the assets, i.e. ROE, ROI, etc.
- *Interest Coverage*: are used to determine how easily a company can pay interest on outstanding debt. There are the EBIT/Interest expenses and the EBITDA/Interest expenses.
- *Efficiency*: they are the different kind of income and include Net Income, EBIT, EBITDA, also in percentage on Sales. The five selected ratios are the following:

1. $\frac{Short\ term\ debt}{Equity\ book\ value}$
2. $\frac{Cash}{Total\ Assets}$
3. $\frac{EBITDA}{Total\ Assets}$
4. $\frac{Retained\ earnings}{Total\ Assets}$
5. $\frac{EBITDA}{Interest\ expenses}$

3.2.2 Selected Intellectual Capital indicators

Ten indexes based on the concept of Intellectual Capital have been selected. They are grouped in three categories, describing the main three components of IC:

1. Human Capital;
2. Structural Capital;
3. Relational Capital.

Human Capital is composed by three indicators: (i) Employee satisfaction, that regards personnel motivation; (ii) Personnel training, that regards the activities that the firm finalizes to the professional growth of employees; (iii) Educational level, which is related to the educational qualification of employees.

For Structural Capital four indicators have been selected: (i) Investments in R&D, that are linked to investments the company claims for innovations (product, process, organizational, business innovations); (ii) Organizational processes, regarding organizational and business process; (iii) Information systems, related to the applications of information systems to obtain greater efficiency; (iv) Intellectual property, i.e. patents, trademarks, etc..

Relational Capital is made up of three indicators: (i) Customer relationships, that regard relationships firm has with its customers; (ii) Relationships with research centres and universities; (iii) Relationships with other partners, i.e. other firms, institutions, other groups, etc. The IC-based indicators are shown in Figure 19.

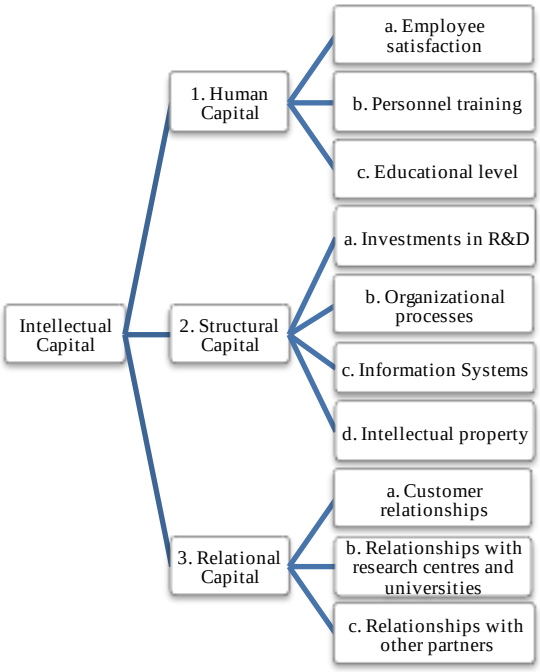

Figure 19: Intellectual Capital indicators

3.2.3 Methodology steps

This chapter proposes to integrate variables concerning Intellectual Capital and Financial factors into a single model. Our research methodology has been conducted according to the following steps:

1. The MDA (Multi-Discriminant Analysis) model, using financial indexes only, has been applied (Model 1):

$$Z = \mu_1 X_1 + \mu_2 X_2 + \mu_3 X_3 + \mu_4 X_4 + \mu_5 X_5 \quad (1)$$

where:

$X1 = \frac{Shorttermdebt}{Equitybookvalue}$; $X2 = \frac{Cash}{TotalAssets}$; $X3 = \frac{EBITDA}{TotalAssets}$; $X4 = \frac{Retainedearnings}{TotalAssets}$; $X5 = \frac{EBITDA}{Interestexpenses}$

2. The MDA model, using also Intellectual Capital variables, together with financial indexes, has been applied (Model 2):

$$Z = \mu_1 X_1 + \mu_2 X_2 + \mu_3 X_3 + \mu_4 X_4 + \mu_5 X_5 + \mu_6 X_6 + \mu_7 X_7 + \mu_8 X_8 \quad (2)$$

where:

$X1 = \frac{Shorttermdebt}{Equitybookvalue}$; $X2 = \frac{Cash}{TotalAssets}$; $X3 = \frac{EBITDA}{TotalAssets}$; $X4 = \frac{Retainedearnings}{TotalAssets}$; $X5 = \frac{EBITDA}{Interestexpenses}$

and:

X6 = Human Capital indicator; X7 = Structural Capital indicator; X8 = Relational Capital indicator

3. A comparison between the application of the MDA model using financial indicators only (Model 1) and the application of MDA model using both Intellectual Capital variables and financial ratios (Model 2) has been carried out.

3.3 Dataset

Data were extracted from the AMADEUS Bureau van Dijk Database. We have selected a sample of 44 Italian very large firms, with the following characteristics:

- Operating Revenues ≥ 100MLN Euro (140 MLN USD);
- OR Total Assets ≥ 200 MLN Euro (280 MLN USD);
- OR Employees ≥ 1000;
- OR Listed.

We selected firms belonging to NACE Rev. 2 sector (from 10 to 33) (Manufacturing sector) and NACE Rev. 2 sector (58, 60, 61, 62, 63, Quaternary sector). We selected 100 firms for the first sector (Manufacturing) and 100 firms belonging to the latter

(Quaternary). Then, we analyzed the reports, containing financial and non-financial information, of the 200 firms.

After evaluating the reports, 40 firms (20 for each of the two sectors) have been chosen, on the basis of the level of disclosure concerning Intellectual Capital within the reports. The more the level of disclosure (and then the abundance and completeness of information on Intellectual Capital), the more the firm has been included in the sample. A firm has been entered in the sample if it can be obtained enough information from its report to make it possible to assign a score to the IC-based indicators, as defined in Figure 19. Regarding the way of assigning the score see next section. Furthermore, we have considered for the analysis an additional sample of default firms, composed by 4 firms[11]. Table XX displays manufacturing, quaternary sector and default firms respectively.

Manufacturing Firms	***Quaternary sector firms***	***Default firms***
Saras	Engineering	sitindustrie
ERG	Zambon	ElsagDatamat
Italcementi	Tiscali	TexFer
Parmalat	Snai	Comau
Danieli	Telecom Italia	
Indesit	Wind	
DeLonghi	IKF	
Piaggio	NoemaLife	
Campari	Newron	
Brembo	TasGroup	
Geox	MolMed	
Tod's	Reply	
Carraro	Bee Team	
Recordati	Exprivia	
SOL	Buongiorno	
Natuzzi	ComData	
IMA	Fullsix	
LaDoria	MutuiOnline	
Interpump	AccentureItalia	
IRCE	H3G	

Table 12: Sample

Firms that we have selected have been divided according to their Operating Revenue as shown in Figure 20.

[11] This choice is based on the Italian failure rate that is the 4%, as confirmed by AMADEUS and the Cerved Group report (2010) (then we should have been 2 firms). Two additional *default* firms have been selected in order to better understand the model behaviour, given the low extention of the sample. Then the overall considered *default* firms are four.

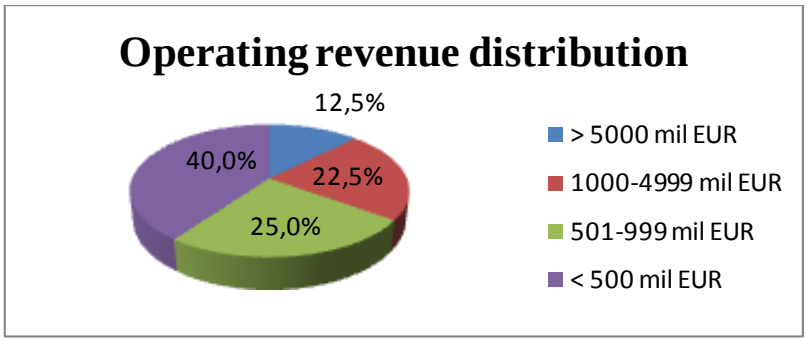

Figure 20: Operating Revenue distribution

3.4 Empirical research: the application of the models

In order to develop our credit scoring model, we have calculated the values of financial and IC variables for the sample. Other researches have been carried out that assign a score to the intellectual capital variables (Mangena et al., 2010).

As regard the evaluation of IC variables, we have to say that it is very difficult to calculate them objectively. A score has been assigned to the IC disclosure on the basis of a subjective assessment. Every item in the fig. 1 has been evaluated through a score from 1 to 5 (1 = low, 5 = top) and the items were grouped into the three main components of Intellectual Capital: Human, Structural and Relational Capital. A weighted average value has been calculated for obtaining a score for each of the three components (the detailed values are shown in the Appendix of Iazzolino et al, 2013a). Table 13 and Table 14 show the overall financial and IC indicators calculated for non-default (Table 13) and default firms (Table 14).Firms are considered non-default or default on the basis of the classification provided by AMADEUS.

	Financial indexes					IC variables		
Firm Name	**X_1**	**X_2**	**X_3**	**X_4**	**X_5**	**X_6**	**X_7**	**X_8**
Saras	1,70	0,02	0,05	0,02	4,0	9	6	10
ERG	0,90	0,24	0,03	0,008	2,59	9	9	12
Italcementi	0,35	0,05	0,08	0,019	4,76	10	12	9
Parmalat	0,20	0,16	0,10	0,06	19,85	7	7,5	8
Danieli	2,57	0,28	0,084	0,04	5,76	8	8,25	6
Indesit	2,12	0,09	0,13	0,04	8,55	6	11,25	11
DeLonghi	0,76	0,12	0,13	0,058	9,71	9	6,75	6
Piaggio	1,35	0,10	0,127	0,03	5,55	12	9	11
Campari	0,29	0,097	0,113	0,059	7,18	3	6	7
Brembo	1,15	0,078	0,18	0,079	15,13	9	8,25	8
Geox	0,42	0,18	0,21	0,093	26,62	8	9,75	6
Tod's	0,23	0,18	0,20	0,12	114,5	5	9	9
Carraro	4,98	0,059	0,067	-0,014	-1,32	5	7,5	8
Recordati	0,31	0,16	0,20	0,12	47,53	12	9,75	9
SOL	0,39	0,049	0,18	0,049	16,00	9	9,75	7
Natuzzi	0,33	0,12	0,04	-0,021	45,77	9	9,75	8
IMA	3,18	0,17	0,09	0,029	7,48	9	8,25	9
LaDoria	1,27	0,027	0,11	0,04	5,39	5	4,5	8

Interpump	0,77	0,19	0,10	0,03	2,68	5	5,25	3
IRCE	1,053	0,016	0,10	0,034	6,09	4	6,75	3
Engineering	1,28	0,086	0,15	0,089	29,59	14	11,25	12
Zambon	0,39	0,16	0,15	0,079	25,32	13	12,75	13
Tiscali	2,73	0,028	0,18	-0,066	4,67	7	9,75	9
Snai	1,61	0,014	0,077	-0,042	1,92	6	8,25	9
Telecom Italia	0,56	0,061	0,13	0,04	2,80	12	14,25	12
Wind	1,74	0,028	0,160	-0,017	2,54	8	9,75	9
IKF	4,21	0,002	0,009	0	0,49	8	7,5	8
NoemaLife	2,07	0,11	0,11	0,015	6,10	9	11,25	13
Newron	0,32	0,21	-0,87	0,089	-4,40	9	10,5	10
TasGroup	0,72	0,050	0,037	0,015	0,71	9	10,5	11
MolMed	0,093	0,49	-0,22	-0,23	-51,04	10	12	9
Reply	1,10	0,13	0,13	0,056	27,38	11	12	10
Bee Team	1,43	0,029	0,073	0,0073	5,50	10	10,5	9
Exprivia	1,062	0,04	0,087	0,028	7,75	14	12	10
Buongiorno	0,69	0,10	0,108	0,032	13,42	9	8,25	6
ComData	8,91	0,12	0,044	-0,073	1,91	11	8,25	9
Fullsix	2,205	0,46	0,015	-0,016	1,018	9	6,75	8
MutuiOnline	0,29	0,23	0,52	0,342	88,03	7	9,75	7
AccentureItalia	10,62	0,026	0,10	0,050	102,77	12	11,25	11
H3G	0,40	0,023	0,075	0,0206	7,76	6	9	8

Table 13: Financial and IC's indicators for non-default firms

	Financial indexes					**IC variables**		
Firm Name	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
sitindustrie	5,53	0,015	-0,056	-0,14	-1,29	5	4,5	3
ElsagDatamat	7,60	0,019	-0,10	-0,10	-5,43	6	5,25	5
Texfer	80,60	0,004	-0,064	-0,17	-2,51	4	4,5	5
Comau	2,92	0,0001	-0,041	-0,05	-0,60	4	5,25	3

Table 14: Financial and IC's indicators for default firms

3.4.1 Application of the models: Model 1

The μ coefficients referred to the sample for the first model (Model 1, with only financial data) have been calculated. In Table 15 the results are exhibited.

μ	**Value**
μ_1	-0,763
μ_2	8,954
μ_3	3,647
μ_4	23,827
μ_5	-0,016

Table 15: μ coefficients for model 1

The detailed computations of μ coefficients for Model 1 could be found on the full paper Iazzolino et al. (2013a). The resulting model is the following:

Model 1: $Z_i = -0{,}763X_{1i} + 8{,}954X_{2i} + 3{,}647X_{3i} + 23{,}827X_{4i} - 0{,}016X_{5i}$

where Z_i is the score of firm i.

3.4.2 Application of the models: Model 2

Similarly to the first model, theμ coefficients for Model 2 (including 8 variables, among which three are referred to Intellectual Capital) have been calculated. In tab. 6 the results are illustrated.

μ	Value
μ_1	-0,760
μ_2	11,470
μ_3	6,392
μ_4	29,689
μ_5	-0,038
μ_6	-0,154
μ_7	0,401
μ_8	1,100

Table 16: μ coefficients for model 2

In the full paper Iazzolino et al. (2013a), detailed calculations of μ coefficients have explained for Model 2.The resulting model is the following:

$$Model\ 2: \quad Z_i = -0{,}760X_{1i} + 11{,}470X_{2i} + 6{,}392X_{3i} + 29{,}689X_{4i} - 0{,}038X_{5i} - 0{,}154X_{6i} + 0{,}401X_{7i} + 1{,}100X_{8i}$$

where Z_i is the score of firm i.

3.5 Results and Discussions

3.5.1 Results for Model 1

In order to verify the reliability of the model and to understand model's discriminatory ability, we have determined the critical value, named cut-off point (Z_c):

$$Z_c = \frac{(Z'_1 + Z'_2)}{2}$$

where: Z'_1 is the average value of Z_i for non-default firms of the selected sample and Z'_2 is the average value of Z_i for default firms of the selected sample. If a firm is below the cut-off point, it is considered abnormal (default firm). For Model 1, $Z_c = -3{,}686$. Then, it has been compared the classification obtained through our model with the classification provided by the AMADEUS Database (considered to be reliable); differences between the two classifications have been considered as errors of our model. The models (model 1 and model 2), based on Multi Discriminant Analysis (MDA) are able to classify non-default and default firms and furthermore they provide the Probability of Default (PD), defined as follows (Resti and Sironi, 2008):

$$PD = P(B|x_i) = \frac{1}{1 + \frac{1-\pi_B}{\pi_B} * e^{z_i - \alpha}}$$

where:

- $P(B|x_i)$ is the probability of belonging to group B (default firms), given a vector x_i of independent variables (financial and/or IC indicators);
- $\pi_B$is the default probability defined "a priori", a measure of the "average quality" of the loan portfolio of the bank depending on the general market;
- α is the cut-off point.
- z_i is the score of the generic firm i.

The calculated score and the PD, together with the errors, are shown in Table 17 and in tab. Table 18.

Number	Firm Name	Score (Zi)	PD	Error
1	**Saras**	-0,46458	0,1990%	No
2	**ERG**	1,795057	0,0208%	No
3	**Italcementi**	0,945496	0,0487%	No
4	**Parmalat**	2,819934	0,0075%	No
5	**Danieli**	1,802045	0,0207%	No
6	**Indesit**	0,597848	0,0689%	No
7	**DeLonghi**	2,263812	0,0130%	No
8	**Piaggio**	0,971801	0,0474%	No
9	**Campari**	2,354792	0,0119%	No
10	**Brembo**	2,133111	0,0148%	No
11	**Geox**	3,883528	0,0026%	No
12	**Tod's**	3,315637	0,0045%	No
13	**Carraro**	-3,349	3,4451%	No
14	**Recordati**	4,093894	0,0021%	No
15	**SOL**	1,750164	0,0218%	No
16	**Natuzzi**	-0,24713	0,1602%	No
17	**IMA**	0,076769	0,1159%	No
18	**LaDoria**	0,581902	0,0700%	No
19	**Interpump**	2,433962	0,0110%	No
20	**IRCE**	0,43948	0,0807%	No
21	**Engineering**	2,021454	0,0166%	No
22	**Zambon**	3,221097	0,0050%	No
23	**Tiscali**	-2,80775	2,0344%	No
24	**Snai**	-1,85112	0,7915%	No
25	**Telecom Italia**	1,522774	0,0273%	No
26	**Wind**	-0,95564	0,3248%	No
27	**IKF**	-3,17075	2,8989%	No
28	**NoemaLife**	0,131156	0,1098%	No
29	**Newron**	0,711066	0,0615%	No
30	**TasGroup**	0,399701	0,0840%	No
31	**MolMed**	-1,26592	0,4424%	No
32	**Reply**	1,811029	0,0205%	No
33	**Bee Team**	-0,47944	0,2020%	No
34	**Exprivia**	0,431642	0,0813%	No
35	**Buongiorno**	1,35725	0,0322%	No
36	**ComData**	-7,32108	65,4508%	Type II error
37	**Fullsix**	2,114933	0,0151%	No

38	**MutuiOnline**	10,54492	0,0000%	No
39	**AccentureItalia**	-7,93978	77,8616%	Type II error
40	**H3G**	0,547805	0,0724%	No

Table 17: Results for non-default firms

Numero	Nome impresa	Score (Zi)	PD	Error
41	**sitindustrie**	-7,68808	73,2222%	No
42	**ElsagDatamat**	-8,41704	85,0036%	No
43	**TexFer**	-65,8252	100,0000%	No
44	**Comau**	-3,58722	4,3316%	Type I error

Table 18: Results for default firms

As regard the non-default firms, by this analysis it can be seen that there are two incorrect evaluations: Com Data and Accenture Italia. These two firms are considered non-default by AMADEUS Database, but our model gives them a low score, below the cut-off (and a high PD).This is a "type II" error (non-default firms classified as default). In this case the percentage for the error is 5% (2 firms out of 40).

As regard the default firms, there is one incorrect evaluation: Comau, a default firm (by AMADEUS) but classified as non default by our model (score upon the cut-off). This is a "type I" error. The percentage for the error is 25% (1 firm out of 4).

3.5.2 Results for Model 2

We have verified the reliability of the second model. The cut-off point, i.e. the discriminatory value between default and non-default firms, is $Z_c = 4{,}877$. Results of the application of Model 2 for non-default firms are shown in the following tables.

Number	Firm Name	Score (Zi)	PD	Error
1	**Saras**	11,80547	0,0049%	No
2	**ERG**	17,92179	0,0000%	No
3	**Italcementi**	14,50626	0,0003%	No
4	**Parmalat**	14,1659	0,0005%	No
5	**Danieli**	11,55439	0,0063%	No
6	**Indesit**	16,97072	0,0000%	No
7	**DeLonghi**	10,99588	0,0110%	No
8	**Piaggio**	15,49562	0,0001%	No
9	**Campari**	12,74479	0,0019%	No
10	**Brembo**	13,68697	0,0007%	No
11	**Geox**	14,16882	0,0005%	No
12	**Tod's**	15,2919	0,0001%	No
13	**Carraro**	7,983543	0,2232%	No
14	**Recordati**	16,6888	0,0000%	No
15	**SOL**	12,55193	0,0023%	No
16	**Natuzzi**	10,37954	0,0204%	No
17	**IMA**	12,62764	0,0022%	No
18	**LaDoria**	10,93018	0,0117%	No
19	**Interpump**	8,021082	0,2150%	No
20	**IRCE**	6,227942	1,2782%	No
21	**Engineering**	18,10484	0,0000%	No
22	**Zambon**	21,38751	0,0000%	No
23	**Tiscali**	10,0256	0,0290%	No

24	**Snai**	10,40007	0,0200%	No
25	**Telecom Italia**	19,2862	0,0000%	No
26	**Wind**	11,97935	0,0041%	No
27	**IKF**	7,438866	0,3842%	No
28	**NoemaLife**	18,11951	0,0000%	No
29	**Newron**	13,29579	0,0011%	No
30	**TasGroup**	15,63311	0,0001%	No
31	**MolMed**	12,27766	0,0031%	No
32	**Reply**	16,38419	0,0001%	No
33	**Bee Team**	12,29278	0,0030%	No
34	**Exprivia**	14,43096	0,0004%	No
35	**Buongiorno**	10,33637	0,0213%	No
36	**ComData**	4,178652	9,1324%	Type II error
37	**Fullsix**	13,33103	0,0011%	No
38	**MutuiOnline**	23,17395	0,0000%	No
39	**AccentureItalia**	5,238282	3,3660%	No
40	**H3G**	12,25042	0,0031%	No

Table 19: Results for non-default firms Model 2

Number	Firm Name	Score (Zi)	PD	Error
41	**sitindustrie**	-4,26437	99,7861%	No
42	**ElsagDatamat**	-2,44095	98,6901%	No
43	**TexFer**	-60,0315	100,0000%	No
44	**Comau**	0,8125	74,4326%	No

Table 20: Results for default firms, Model 2

As regard the non-default firms, it can be seen that there is one incorrect evaluation: Com Data. This firm is considered non-default by AMADEUS Database, but our model gives it a low score, below the cut-off (and a high PD). This is a "type II" error. In this case the percentage for the error is 2,5% (1 firm out of 40). As regard the default firms, there are no incorrect evaluations. Then there are no "type I" errors. The percentage of this error is 0%. Through model 2, (including extra variables "IC-based"), the error is halved or dissolved.

3.5.3 Comparison between Model 1 and Model 2

Two matrixes can be constructed for better showing results of Model 1 and Model 2. On the axes we have the Real Situation, as provided by AMADEUS, and the Obtained Situation, as obtained by the application of our models.

Obtained situation

Real Situation	**Non-Default**	**Default**	**Total**	**Percentage error**
Non-Default	38	**2**	40	5% (Type II)
Default	**1**	3	4	25% (Type I)

Table 21: Matrix for Model 1

Obtained situation

Real Situation	**Non-Default**	**Default**	**Total**	**Percentage error**
Non-Default	39	**1**	40	2,5% (Type II)
Default	**0**	4	4	0% (Type I)

Table 22: Matrix for Model 2

The first aspect that it could be seen by comparing the two models is the reduction of errors: by applying Model 1, two non-default firms have been classified as default and one default firm has been classified as non-default, whereas in Model 2 only one non default firm has been classified as default and no default firms have been classified incorrectly. Then in Model 2 there are no Type I errors, while Type II errors have been halved. This result highlights the importance that Intellectual Capital evaluation can have in supporting credit risk analysis. Financial indicators are the basic data, very important in credit risk analysis, but, comparing the two models, we can say that for a better understanding, it could be useful to evaluate non-financial data. In our case the non-financial variables are "IC-based". Model 2, which integrates financial and Intellectual Capital variables, clears Type I errors. A particular case is ComData that has been classified incorrectly by both models; but while in Model 1 PD is 65%, in Model 2 PD is 9%. Despite the not correct evaluation, by considering also Intellectual Capital variables, the PD of ComData has decreased significantly.

3.6 Conclusions and further works

Risk evaluation has become essential for organisations in general (Iazzolino et al., 2013; Pantano et al., 2013). In this historical period, characterized by a severe financial crisis, credit risk assessment emerges as one of the most important risk evaluation areas. Therefore, in this study we have applied two models based on Multi Discriminant Analysis (MDA); one of these uses only financial data, whereas the second model includes also Intellectual Capital variables. The results shown that Intellectual Capital reduces, and in some cases deletes, both type I and type II errors. Hence, Intellectual Capital variables, that we have integrated into a MDA scoring model, could help to provide a better understanding of firm's value (financial and intangible value) (Alwert et al., 2009; Guimon, 2005). Therefore, our study shows that in order to have a better evaluation of credit risk, it is possible to integrate financial data with Intellectual Capital variables. Our study proposed:

- an MDA model that uses financial data only;
- a second MDA model which integrates Intellectual Capital variables within the model, together with the financial variables.

This study highlights that the model which integrates IC and financial variables is more accurate than the model developed using only financial data. This result shows the importance of taking into account some aspects of intangible assets into the credit risk evaluation.

Credit scoring models should be based on the integration of financial and non-financial data. In this study we considered Intellectual Capital variables, which can help financial analysts to better classify default and non-default firms. This result can allow financial institutes or banks to support decision making and to better evaluate the financial position of a firm.

Further researches could be focused on: (i) the use of other sophisticated techniques, such as SVM, neural nets, other credit scoring models; (ii) the enlargement of the sample; and (iii) the analysis on different industrial sectors.

CHAPTER 4: CAPITAL EFFICIENCY AND MARKET VALUE IN KNOWLEDGE AND CAPITAL INTENSIVE FIRMS[12]

Abstract

The increasing gap between Market and Book value allowed us to understand that firms' value is based not only on physical but also on intangible assets. Intellectual Capital resources are very important, especially in Knowledge-Intensive, but also in Capital-Intensive industries. In literature, there are few proposals of criteria that are able to distinguish if a sector has to be considered as Knowledge-Intensive or Capital-Intensive. The main aims of this work are: (1) to propose a methodology based on the Value Added components, starting from Pulic's point of view (Pulic, 1998; 2000; 2008), which is able to discriminate between Knowledge-Intensive and Capital-Intensive industries; (2) to investigate the relationship between Intellectual Capital Efficiency and Market Value (and between Physical Capital Efficiency and Market Value) for firms belonging to both Knowledge and Capital Intensive sectors. In order to measure the Intellectual Capital Efficiency and the Physical Capital Efficiency, two new indicators are proposed, based on an extension of the definition proposed by Pulic (1998; 2000; 2008).

4.1 Introduction

In the knowledge economy context, firm's value cannot be evaluated only by the book value; for estimating the value of an enterprise it is necessary to take into account many different criteria (Iazzolino et al., 2012).

Many scholars studied the asymmetry between the market and the book value: one of the main elements that influence firms' Market Value is the Intellectual Capital (Edvinsson, 1997, Sveiby, 1997 and Lynn, 1998). Therefore, it has become interesting to study the relationship between Intellectual Capital and Market Value both in Capital Intensive and

[12] This work was the incipit of: Iazzolino, G., Migliano, G., Forgione, R, Girimonte, M. (2013) "Capital Efficiency and Market Value in Knowledge and Capital Intensive Firms: an empirical study", *Investment Management and Financial Innovations*, Vol. 10, No. 2, pp. 147-157.

Knowledge Intensive Firms, also in order to highlight the differences among the two sectors.

In this age, Intellectual Capital often "replaces" traditional resources as land, capital and work (Sveiby, 1997; Bontis, 1999; O'Donnell et al., 2006). The actual accounting systems are able to show only physical assets without considering intangibles.

The aim of the chapter is threefold: (i) starting from Pulic's point of view (Pulic, 1998; 2000; 2008), we propose a methodology based on the Value Added components that is able to discriminate between Knowledge-Intensive and Capital-Intensive industries; (ii) we propose two new indicators useful for measuring the Intellectual Capital and the Physical Capital Efficiency, extending the definition proposed by Pulic (1998; 2000; 2008); (iii) we analyze the relationship between Intellectual Capital Efficiency and Market Value (and between Physical Capital Efficiency and Market Value) for firms belonging to both Knowledge and Capital Intensive sectors.

4.2 Methodology of research

As stated previously, the aim of the chapter is threefold: (i) at first, starting from Pulic's point of view (Pulic, 1998; 2000; 2008), we propose a methodology based on the Value Added components that is able to discriminate between Knowledge-Intensive Firms (KIFs) and Capital-Intensive Firms (CIFs); (ii) secondly, we propose two new indicators useful for measuring the Intellectual Capital Efficiency (ICE) and the Physical Capital Efficiency (PCE), extending the definition proposed by Pulic (1998; 2000; 2008); (iii) third, we analyze the relationship between ICE and Market Value (and between PCE and Market Value) for both KIFs and CIFs.

4.2.1 A criterion to discriminate between Knowledge-Intensive Firms (KIFs) and Capital-Intensive Firms (CIFs)

In order to make a distinction between Knowledge-Intensive Firms and Capital-Intensive Firms (and then also between Knowledge-Intensive industries and Capital-Intensive industries) we refer to the concept of Value Added and its components. One of the major contributes of Pulic (1998, 2000, 2008) is to use the concept of Value Added to measure the performances of a knowledge-based organisation. By extending Pulic's work, we

propose to consider also the other components of Value Added rather than Human Capital (HC), which allow us to study not only the Intellectual Capital Efficiency (ICE) but also the Physical Capital Efficiency (PCE).

Value Added is made up of several sub-components that contribute in a different way to value creation. According to the formulation based on factors of production, Value Added could be written as:

$$VA = \text{Cost of employees} + \text{Depreciation and Amortization} + \text{Interests expenses} + \text{Taxation} + \text{Net Income}$$

where:

VA = Value Added

Furthermore, in this formula Depreciation and Amortization is considered as a whole component. We have partitioned Depreciation and Amortization into three components, as shown in Figure 21.

Depreciations and Amortization (D/A) are divided into: Tangible, Intangible and Others. Tangible Amortizations regard Physical Capital (physical assets) such as plants, machineries, etc.; Intangible Amortizations are linked to Intellectual Capital; Other Amortizations regard other funds/provisions.

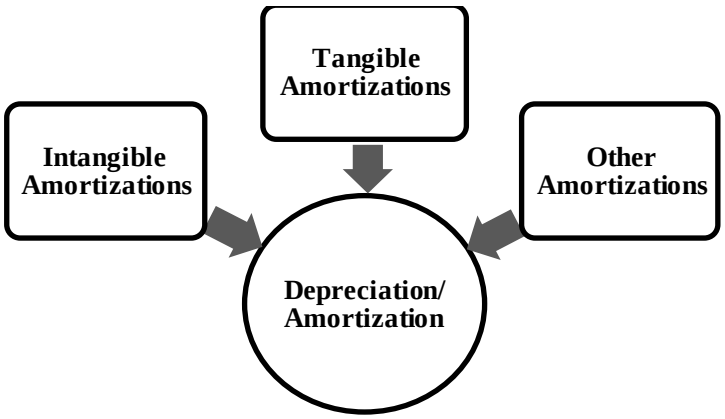

Figure 21: Composition of Depreciations and Amortizations

The overall decomposition of Value Added is illustrated in Table 23.

Components	Types of Capital	%
Cost of Employees (HC)	Human Capital (Intellectual Capital)	%
Depreciation/Amortization Intangible Amortizations (IA) Tangible Amortizations (TA)	 Intellectual Capital Physical Capital	%
Interest expenses	Financial Capital	%
Taxation	"External" Capital (Government)	%
Net Income	Financial Capital	%
VALUE ADDED (VA)		100%

Table 23: Value Added and its components

In literature there are no methodologies to classify KIFs and CIFs. We propose a classification of firms based on the weight of Value Added components, emphasizing: (i) Cost of employees and Intangible Amortization for KIFs; and (ii) Tangible Amortization for CIFs. In particular, a KIF is characterized by a high weight of Human capital (Cost of Employees) and Intangible Amortization on Value Added; whereas, a CIF is identified by a high weight of Tangible Amortization on Value Added.

These two possible rules could be formalized as follow:

Considering a specific Sector i:

$$\text{Sector}_i \in \text{KIF} \underset{\text{iff}}{\Leftrightarrow} \begin{cases} \dfrac{\text{HC}_i}{\text{VA}_i} \geq \text{Median}\left(\dfrac{\text{HC}_{\text{all sectors}}}{\text{VA}_{\text{all sectors}}}\right) \\ \text{AND} \\ \dfrac{\text{HC}_i}{\text{VA}_i} \geq \dfrac{\text{TA}_i}{\text{VA}_i} \end{cases}$$

where i = 1,.., n

Considering a specific Sector i:

$$\text{Sector}_i \in \text{CIF} \underset{\text{iff}}{\Leftrightarrow} \left\{ \frac{\text{TA}_i}{\text{VA}_i} \geq \text{Median} \ \frac{\text{TA}_{\text{all sectors}}}{\text{VA}_{\text{all sectors}}} \right\}$$

where i = 1,.., n

4.2.2 Two new indicators for measuring IC Efficiency and Physical Capital Efficiency

Afterwards the classification, we propose some efficiency indicators for Intellectual and Physical Capital. Pulic (1998, 2000, 2008) proposed VA/HC as efficiency indicator of Intellectual Capital, in fact he used it to measure the knowledge workers' productivity. HC

is the amount of investments in human resources, thus VA/HC is an efficiency indicator of human capital. As a matter of fact, if VA/HC is high, it means that the firm is making the best use of its employees.

Therefore, this indicator shows how new value is created for each monetary unit invested in human capital.

The efficiency indicators that we use into our analysis are:

1. $\frac{\text{VA}}{\text{Cost of employees}}$: efficiency of Human capital (Intellectual Capital) (already proposed by Pulic);
2. $\frac{\text{VA}}{\text{Intangible Amortizations}}$: efficiency of Intangible assets (Intellectual Capital);
3. $\frac{\text{VA}}{\text{Tangible Amortizations}}$: efficiency of Physical Capital;

4.2.3 Analysis of the relationship between IC Efficiency and Market Value (and between Physical Capital Efficiency and Market Value)

The third aim of our research is to investigate the relationship between IC Efficiency and Market Value (and between Physical Capital Efficiency and Market Value) in: (i) KIFs and (ii) CIFs.

In order to achieve this goal the following hypotheses have been tested:

H1: In Knowledge Intensive industries, Intellectual Capital Efficiency (average value in the time range 2005-2009) positively influences Market Value (average value in 2009-2011).

H2: In Capital Intensive industries, Physical Capital Efficiency (average value in the time range 2005-2009) positively influences Market Value (average value in 2009-2011).

H3: In Knowledge Intensive industries, Intellectual Capital Efficiency (average value in the time range 2002-2009) positively influences Market Value (average value in 2009-2011).

H4: In Capital Intensive industries, Physical Capital Efficiency (average value in the time range 2002-2009) positively influences Market Value (average value in 2009-2011).

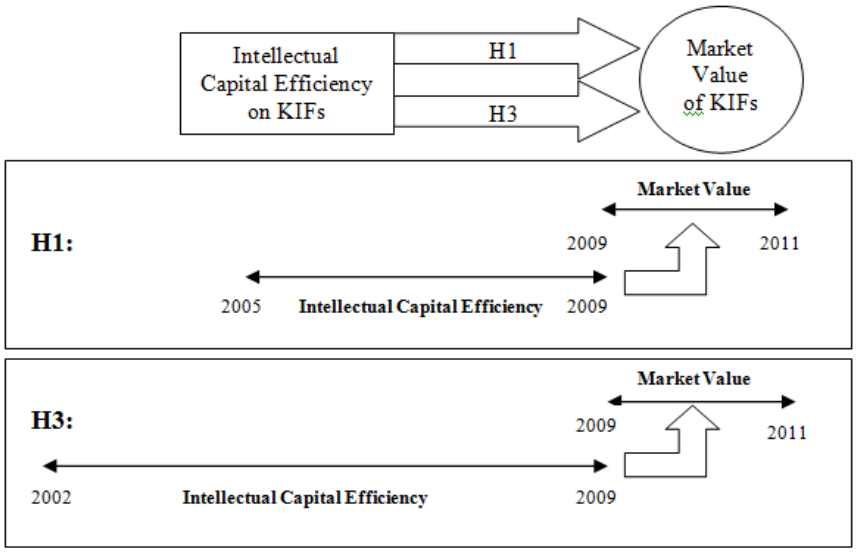

Figure 22: Hypotheses 1 and 3

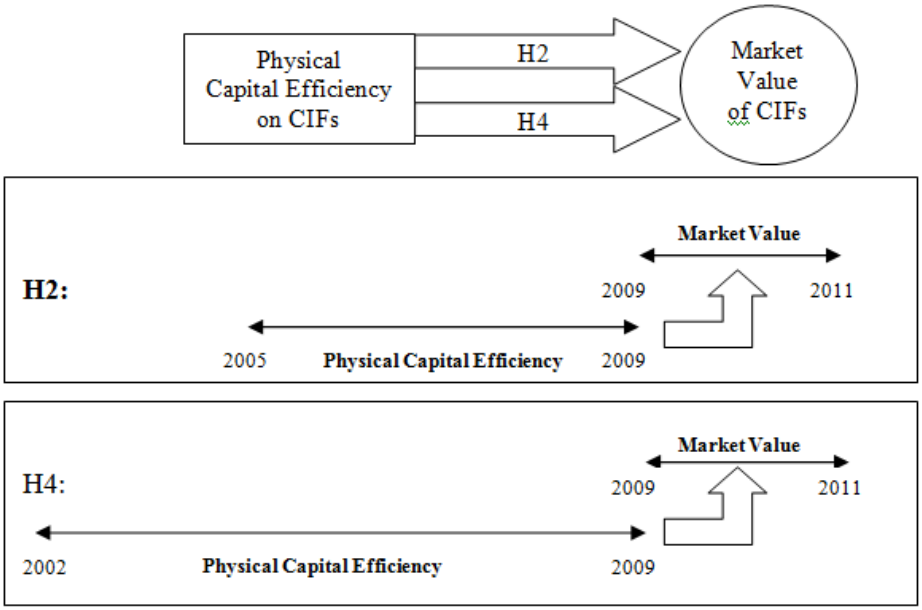

Figure 23: Hypotheses 2 and 4

These hypotheses are based on the following considerations: investments in Intangibles provide benefits in a long time horizon. Investments regarding Intellectual Capital consider expenditures on patents and marks but also in human resources and organisation development. Thus, it is reasonable to assume that in order to return from these expenditures it will be necessary a long time period. We have considered two wide times ranges: the first from 2005 to 2009 and the second from 2002 to 2009. Similarly we have considered the Physical Capital Efficiency (PCE) and then hypotheses 2 and 4.

4.3 Analysis

4.3.1 Dataset

Data were extracted from the AMADEUS Bureau Van Dijk database. In particular, we have selected six industries:

- Computer programming and consultancy;
- Manufacture of chemicals;
- Manufacture of basic metals;
- Travel agency and tour operator reservation service;
- Advertising and market research;
- Manufacture of paper.

Initially, we analysed 2,280 Italian SMEs belonging to the above mentioned sectors; subsequently, the sample was reduced, by considering the data availability from 2002 to 2011. A wide number of firms were removed, due to the presence of null value or unavailable data. Furthermore, abnormal observations or outliers have been removed, in order to improve both indexes of symmetry and kurtosis and then to guarantee a higher effectiveness of multiple linear regressions.

Therefore, the final sample was made up of 534 firms, as shown in Table 24:

Sectors	No. of firms
Computer programming and consultancy	**58**
Manufacture of chemicals	**25**
Manufacture of basic metals	**20**
Travel agency and tour operator reservation service	**105**
Advertising and market research	**170**
Manufacture of paper	**156**
TOTAL	**534**

Table 24: The Sample

4.3.2 Knowledge and Capital Intensive industries

In order to distinguish knowledge and Capital Intensive sectors we have carried out the analysis of the industries; the percentage of the Value Added components for each firm has been calculated. Afterwards the average value for each sector has been considered. Average values for every sector are shown in Table 25:

	Computer programming and consultancy	Travel agency	Advertising and market research	Manufacture of chemicals	Manufacture of basic metals	Manufacture of papers
Cost of employees	**70%**	**58%**	**46%**	**41%**	**40%**	**41%**
Tangible Amortizations	**3%**	**2%**	**1%**	**11%**	**10%**	**12%**
Intangible Amortizations	**9%**	**8%**	**4%**	**8%**	**5%**	**7%**
Other Amortizations	2%	3%	1%	3%	2%	3%
Total Depreciation and Amortization	14%	13%	6%	22%	17%	22%
Interest expenses	2%	4%	4%	6%	9%	6%
Taxations	7%	13%	1%	5%	2%	5%
Net Income	6%	12%	34%	26%	31%	26%
Value Added	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 25: Percentage of Value Added components for each industry

Observing the percentage of each component of Value Added it could be obtained a possible sectors classification for distinguishing between Knowledge and Capital Intensive industries. Therefore, we have adopted the rules cited beforehand in the methodology for establishing which firms could be classified as KIF or CIF.

Results are shown below (Table 26):

	Computer programming and consultancy	Travel agency	Advertising and market research	Manufacture of chemicals	Manufacture of basic metals	Manufacture of papers
Cost of employees	**70%**	**58%**	**46%**	**41%**	**40%**	**41%**
Tangible Amortizations (TA)	**3%**	**2%**	**1%**	**11%**	**10%**	**12%**
Intangible Amortizations (IA)	**9%**	**8%**	**4%**	**8%**	**5%**	**7%**
Median HC/VA	44%	44%	44%	44%	44%	44%
Median TA/VA	7%	7%	7%	7%	7%	7%
Rules calculus	70% > 44% and 9% > 3%	58% > 44% and 7% > 2%	46% > 44% and 4% > 1%	11% > 8%	10% > 5%	12 % > 7%
Sector classification	**Knowledge-Intensive**	**Knowledge-Intensive**	**Knowledge-Intensive**	**Capital-Intensive**	**Capital-Intensive**	**Capital-Intensive**

Table 26: Classification of industries

In Tab. 5 the resulting classification is reported:

Knowledge Intensive	Capital Intensive
Computer programming and consultancy	Manufacture of chemicals
Advertising and market research	Manufacture of basic metals
Travel Agency	Manufacture of paper

Table 27: Knowledge and Capital Intensive sectors

4.4 The impact of Intellectual and Physical Capital on Market Value

It has been carried out a multiple linear regression analysis that allowed us to evaluate the impact of Intellectual and Physical Capital on firm's Market Value. To build solid regression models we have considered not only the cost of employees and depreciation and amortization, but all components of Value Added. Before proceeding with the multiple linear regressions, a correlation analysis has been carried out (by IBM SPSS Statistics), for each sector, among the independent variables used into the models. For assessing the impact of Intellectual and Physical Capital on firm's Market Value, we have developed four multiple regression models:

Model 1 (Hypoteses H1 and H2)

1.1)

$$FCFO_{2009-2011} = \beta_0 + \beta_1 * \frac{VA_{2005-2009}}{Cost\ of\ employees_{2005-2009}} + \beta_2 * \frac{VA_{2005-2009}}{Intangibles\ amortizations_{2005-2009}} + \beta_3 * \frac{VA_{2005-2009}}{Tangibles\ amortizations_{2005-2009}} + \beta_4 * \frac{VA_{2005-2009}}{Others\ amortizations_{2005-2009}} + \beta_5 * \frac{VA_{2005-2009}}{Taxations_{2005-2009}} + \beta_6 * \frac{VA_{2005-2009}}{Interest\ expenses_{2005-2009}} + \beta_7 * \frac{VA_{2005-2009}}{Net\ Income_{2005-2009}} + \varepsilon;$$

1.2)

$$FCFO/Sales_{2009-2011} = \beta_0 + \beta_1 * \frac{VA_{2005-2009}}{Cost\ of\ employees_{2005-2009}} + \beta_2 * \frac{VA_{2005-2009}}{Intangibles\ amortizations_{2005-2009}} + \beta_3 * \frac{VA_{2005-2009}}{Tangibles\ amortizations_{2005-2009}} + \beta_4 * \frac{VA_{2005-2009}}{Others\ amortizations_{2005-2009}} + \beta_5 * \frac{VA_{2005-2009}}{Taxations_{2005-2009}} + \beta_6 * \frac{VA_{2005-2009}}{Interest\ expenses_{2005-2009}} + \beta_7 * \frac{VA_{2005-2009}}{Net\ Income_{2005-2009}} + \varepsilon$$

Model 2 (Hypoteses H3 and H4)

2.1)

$$FCFO_{2009-2011} = \beta_0 + \beta_1 * \frac{VA_{2002-2009}}{Cost\ of\ employees_{2002-2009}} + \beta_2 * \frac{VA_{2002-2009}}{Intangibles\ amortizations_{2002-2009}} + \beta_3 * \frac{VA_{2002-2009}}{Tangibles\ amortizations_{2002-2009}} + \beta_4 * \frac{VA_{2002-2009}}{Others\ amortizations_{2002-2009}} + \beta_5 * \frac{VA_{2002-2009}}{Taxations_{2002-2009}} + \beta_6 * \frac{VA_{2002-2009}}{Interest\ expenses_{2002-2009}} + \beta_7 * \frac{VA_{2002-2009}}{Net\ Income_{2002-2009}} + \varepsilon;$$

2.2)

$$FCFO/Sales_{2009-2011} = \beta_0 + \beta_1 * \frac{VA_{2002-2009}}{Cost\ of\ employees_{2002-2009}} + \beta_2 * \frac{VA_{2002-2009}}{Intangibles\ amortizations_{2002-2009}} + \beta_3 * \frac{VA_{2002-2009}}{Tangibles\ amortizations_{2002-2009}} + \beta_4 * \frac{VA_{2002-2009}}{Others\ amortizations_{2002-2009}} + \beta_5 * \frac{VA_{2002-2009}}{Taxations_{2002-2009}} + \beta_6 * \frac{VA_{2002-2009}}{Interest\ expenses_{2002-2009}} + \beta_7 * \frac{VA_{2002-2009}}{Net\ Income_{2002-2009}} + \varepsilon$$

The regression models have been developed using the average of dependent and independent variables in order to take into account the value of variables for the years considered.

Firms included in the sample are not listed on a stock market; thus we have used a "proxy" of Market Value because this is not available for non-listed firms: FCFO (Free Cash Flow from Operations). It could be used as a proxy of firm's Market Value as FCFO is the basic item for calculating the Market Value, according to the financial method for evaluating firm market value. FCFO is calculated as follow:

$$\boldsymbol{FCFO = EBITDA - \Delta Working\ Capital - \Delta Gross\ Fixed\ Assets - \Delta Operating\ Taxations}$$

where:

FCFO = Free Cash Flow from Operations

EBITDA = Earnings Before Interest, Taxes, Depreciation and Amortization

The other dependent variable considered in our analysis is FCFO/Sales. It allowed us to take into account the dimensional factors of firms.

The independent variables of models concern the efficiency of the Value Added components, as written previously. In particular, we consider VA/Cost of employees (or VA/HC), and VA/Intangible Amortizations, as indicators of Intellectual Capital efficiency, whereas VA/Tangible Amortizations, as indicators of Physical Capital efficiency.

Model 1 (Data from 2005 to 2009)

This model has been developed to test hypotheses H1 and H2; hence, independent variables have been drawn by the average of efficiency indicators mentioned beforehand considering the period 2005-2009, while the average firm's Market Value from 2009 to 2011 was measured through FCFO and FCFO/Sales (dependent variables). Results of the application of Model 1 are shown in Table 28:

	Model 1			
	Independent variables: average of ratios 2005-2009			
	Dependent variable: FCFO/Sales (Average)		Dependent variable: FCFO (Average)	
Sectors	**R^2**	**F**	**R^2**	**F**
Computer programming and consultancy	0,3	2,01*	0,27	1,72
Travel agency and tour operator reservation services	0,97	97,93***	0,68	5,31**
Advertising and market research	0,71	4,35**	0,58	2,41*
Manufacture of paper	0,17	2,74**	0,28	5,24***
Manufacture of chemicals	0,16	4,46*	0,53	25,48***
Manufacture of basic metals	0,18	4,51***	0,06	1,45
*significance level of 10%; **significance level of 5%; ***significance level of 1%				

Table 28: Application of the Model 1 (1.1 and 1.2)

In order to test the hypotheses, we have observed the t-tests (shown in Table 29 and Table 30). Through the β coefficient and its significance it can be possible to identify which sectors satisfy H1 and H2.

	TRAVEL			PAPER			ADVERTISING			COMPUTER			METAL			CHEMICAL		
Model 1 Dependent variable: FCFO (Average) 2009-2011	Beta	t	Beta	t	Sig.	Sig.	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.
(Constant)			-2,414	,018	-,144	,885		2,511	,027		-2,695	,011		-3,092	,002		-,144	,885
VA / Taxation	-,183	,102	1,036	,303	-11,976	,000	-,110	-,551	,592	,196	1,209	,236	,136	1,614	,109	-,718	-11,976	,000
VA / Net Income	0.28*	,153	1,598	,114	,163	,871	-,133	-,558	,587	,050	,322	,750	,058	,723	,471	,009	,163	,871
VA / HC	0.30*	0,18*	1,752	,083	-,701	,484	-,790***	-3,775	,003	0.592**	2,950	,006	0,18**	2,182	,031	,043	-,701	,484
VA / Interest expenses	-0.39**	,072	,657	,513	2,719	,007	-,017	-,090	,930	-,159	-1,035	,309	,048	,575	,566	,151	2,719	,007
VA / Intangible Amortizations	0.28*	,127	1,117	,267	,087	,931	-,033	-,164	,873	-,351	-1,695	,100	,023	,288	,774	,005	,087	,931
VA / Tangible Amortizations	,080	0,244**	2,540	,013	,754	,452	-,076	-,296	,772	,137	,843	,405	,120	1,448	,150	,042	,754	,452
VA / Other Amortizations (AVERAGE)	-,005	,104	1,096	,276	,208	,835	-,031	-,155	,879	0.29*	1,701	,099	,005	,067	,947	,011	,208	,835

* significance level of 10%; ** significance level of 5%; *** significance level of 1%

Table 29: Model 1.1: independent variables 2005-2009

	TRAVEL			PAPER			ADVERTISING			COMPUTER			METAL			CHEMICAL		
Model 1 Dependent variable: FCFO/ Sales (Average) 2009-2011	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.
(Constant)		-1,539	,142		-2,414	,018		3,238	,007		-2,776	,009		-2,947	,004		-,122	,903
VA / Taxation	-,022	-,495	,627	,102	1,036	,303	-,125	-,742	,472	,207	1,305	,201	,284	3,589	,000	-,411	-5,141	,000
VA / Net Income	0.98***	24,398	,000	,153	1,598	,114	-,068	-,337	,742	-,001	-,006	,995	,060	,795	,428	,013	,182	,856
VA / HC	0.11**	2,607	,018	0.18*	1,752	,083	-,818***	-4,609	,001	,518	2,643	,013	,204	2,568	,011	-,048	-,598	,551
VA / Interest expenses	-,054	-1,292	,214	,072	,657	,513	-,067	-,407	,691	-,267	-1,775	,085	,022	,281	,779	,031	,425	,671
VA / Intangible Amortizations	0.18***	4,685	,000	,127	1,117	,267	-,234	-1,351	,202	-,197	-,970	,339	-,035	-,460	,647	,009	,123	,902
VA / Tangible Amortizations	-,046	-1,159	,262	0.24**	2,540	,013	-,108	-,500	,626	,119	,744	,462	,017	,223	,824	,045	,603	,547
VA / Other Amortizations	-,014	-,353	,729	,104	1,096	,276	-,012	-,070	,946	,307	1,795	,082	-,242	-3,172	,002	,014	,192	,848

* significance level of 10%; ** significance level of 5%; *** significance level of 1%

Table 30: Model 1.2: independent variables 2005-2009

Model 2 (2.1 and 2.2)

Model 2 was developed to test H3 and H4; thus, independent variables have been drawn by the average of efficiency indicators as done in model 1 considering the period from 2002 to 2009 as time horizon, while the average firm's Market Value from 2009 to 2011 was measured through FCFO and FCFO/Sales (dependent variables). The following Tab. 9 shows the results of the application of this model:

	Model 2			
	Independent variables: average of ratios from 2002-2009			
	Dependent variable: FCFO/Sales (Average)		Dependent variable: FCFO (Average)	
Sectors	**R^2**	**F**	**R^2**	**F**
Computer programming and consultancy	0,17	1,53	0,01	0,07
Travel agency and tour operator reservation services	0,24	0,79	0,65	4,45**
Advertising and market research	0,77	5,97**	0,64	3,17**
Manufacture of paper	0,17	2,74**	0,26	4,71***
Manufacture of chemicals	0,19	0,44	0,11	2,35**
Manufacture of basic metals	0,08	1,89	0,10	2,35**
*significance level of 10%; **significance level of 5%; ***significance level of 1%				

Table 31: Application of the Model 2

As done for the previous model, t-tests have been observed in order to test both hypotheses H3 and H4. Results are shown in Table 32 and Table 33.

Model 2 Dependent variable: FCFO (Average) 2009-2011	PAPER			ADVERTISING			TRAVEL			COMPUTER			METAL			CHEMICAL		
	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.
(Constant)		-1,629	,107		3,280	,007		-0,56	0,583		,919	,363		-2,896	0,004		3,628	0
VA / Taxation	-,093	-1,027	,307	-,138	-,766	,458	-0,13	-0,655	0,522	,043	,295	,769	0.16**	1,991	0,048	-0,101	-1,087	0,279
VA / Net Income	,007	,069	,945	-,091	-,502	,625	0,025	0,137	0,893	,010	,067	,947	0.17**	2,233	0,027	-0,034	-0,41	0,682
VA / HC	0,235**	2,352	,021	-,864	-4,447	,001	0,267	1,556	0,138	-,093	-,624	,536	0.14*	1,81	0,072	-0,286	-3,258	0,001
VA / Interest expenses	-,053	-,519	,605	,031	,169	,868	-0.44**	-2,273	0,036	,046	,315	,754	0,012	0,147	0,883	-0,046	-0,532	0,595
VA / Intangible Amortizations	,369	3,476	,001	,049	,262	,798	0.32*	2,039	0,057	,028	,102	,919	0,023	0,287	0,775	0,008	0,09	0,928
VA / Tangible Amortizations	,001	,015	,988	-,093	-,495	,630	0,229	1,353	0,194	-,042	-,151	,881	0.16**	2,018	0,045	-0,177	-2,055	0,042
VA / Other Amortizations	,016	,181	,857	,027	,154	,880	-0,06	-0,383	0,707	,000	-,003	,998	0,017	0,212	0,832	-0,129	-1,518	0,131
* significance level of 10%; ** significance level of 5%; *** significance level of 1%																		

Table 32: Model 2.1: independent variables 2002-2009

Model 2 Dependent variable: FCFO/Sales (Average) 2009-2011	PAPER			ADVERTISING			TRAVEL			COMPUTER			METAL			CHEMICAL		
	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.
(Constant)		-1,344	,182		4,330	,001		-,875	,394		,561	,578		-1,476	,142		-1,905	,059
VA / Taxation	-,126	-1,314	,192	-,138	-,963	,354	,500	1,715	,105	0.24*	1,769	,083	,107	1,348	,180	,075	,948	,344
VA / Net Income	,038	,374	,709	-,026	-,183	,858	,214	,793	,439	-,031	-,240	,811	,039	,493	,623	-,005	-,060	,952
VA / HC	,114	1,070	,288	-,859	-5,542	,000	,117	,467	,647	-,167	-1,225	,226	,111	1,378	,170	,089	1,088	,278
VA / Interest expenses	,022	,206	,837	-,017	-,116	,910	-,471	-1,674	,113	,201	1,523	,134	-,027	-,333	,740	,026	,324	,746
VA / Intangible Amortizations	,166	1,472	,144	-,180	-1,218	,247	,228	,983	,340	,386	1,519	,135	-,210	-2,618	,010	-,001	-,013	,990
VA / Tangible Amortizations	0.25**	2,570	,012	-,090	-,602	,558	,207	,833	,416	-,374	-1,458	,151	,110	1,371	,172	,067	,859	,392
VA / Other Amortizations	,096	1,008	,316	,015	,106	,918	-,106	-,456	,654	,101	,776	,441	-,041	-,525	,600	,010	,130	,897
* significance level of 10%; ** significance level of 5%; *** significance level of 1%																		

Table 33: Model 2.2: independent variables 2002-2009

4.5 Discussions

4.5.1 KIFs and CIFs

Results demonstrate that, in general, the HC% value (percentage on VA) is the highest in each sector with respect to the other VA components. However, considering the different sectors, Knowledge Intensive Firms (KIFs) have a higher value of HC% than the Capital Intensive Firms (CIFs). Furthermore, KIFs have a value of Intangible amortization (%) higher than Tangible amortization. As a matter of fact, in Knowledge Intensive industries there is a greater use of intellectual resources and consequently there are no many tangible assets. Through the results, it could be noted that, in the Computer programming and consultancy sector, there are the greatest values of HC% and Intangible amortizations %. In fact, in this industry there are companies that base their business on an intensive usage of their staff competences. In CIFs there are higher values of tangible than intangible amortization, due to the use of expensive production plants. As it can be noticed, there are intangible assets also in Capital Intensive sectors but they are lower than tangible assets in CIFs and higher than tangible assets in KIFs.

The validity of these criteria is guaranteed by the objectivity of the assessment, since financial data were used.

4.5.2 Model 1 (1.1 and 1.2)

In model 1, the analyses considering the FCFO as dependent variable point out that H2 is never satisfied in any Capital Intensive industries. The results prove that there are no significant relationships among FCFO and the efficiency of Physical Capital. Due to the fact that t-value is lower than the critical threshold, it can be said that the ratio VA/Tangible Amortizations is not significant for determining the firm's Market Value (measured by FCFO).

The Hypothesis H1 (considering the same variables) is satisfied into Travel Agency sector (Table 29) in which the Intellectual Capital Efficiency ratios are significant for determining firm's Market Value (FCFO).

In contrast, measuring firm's Market Value by FCFO/Sales, the hypotheses previously mentioned find a more empirical confirmation. Therefore, H1 is satisfied for two

Knowledge Intensive sectors: Computer programming consultancy and Travel agency (Table 30). In Capital Intensive sectors, H2 is satisfied only in Manufacture of paper. Some observations could be made by comparing a Capital Intensive with a Knowledge Intensive sector (Table 30).

As described in Table 30, the efficiency of intangible capital measured by VA/Intangible Amortization is a significant predictor of the Market Value for Travel agency, whereas the same ratio is not a good predictor for Manufacture of paper. Furthermore, the efficiency of intangible capital has greater influence on Market Value in Knowledge Intensive than in Capital Intensive sectors; whereas the efficiency of Physical Capital influences the Market Value only in Capital Intensive sectors. Furthermore, in Advertising and market research sector, there is a great influence of the efficiency of human capital on the Market Value (represented by both FCFO/Sales and FCFO), as shown in Table 29 and Table 30.

4.5.3 Model 2 (2.1 and 2.2)

First of all, considering FCFO/Sales as dependent variable, the hypothesis H3 is never satisfied; thus, there are no empirical evidences that intangible capital efficiency influences firm's Market Value in Knowledge Intensive sectors. Using the same dependent variable, hypothesis H4 is verified only in Manufacture of paper, as VA/Tangible Amortizations is significant in this sector as shown in Table 33.

Secondly, using FCFO as dependent variable, H3 is verified only in Travel agency sector; whereas H4 is confirmed in Manufacture of basic metals. Therefore, comparing these two sectors it could be noticed some aspects (Table 32):

- in Travel agency sector the efficiency of intangible capital is higher than in Manufacture of basic metals;
- in Knowledge Intensive sectors (such as Travel agency) the efficiency of intangible capital has significant influence on Market Value; whereas,
- in Manufacture of basic metals, efficiency of Physical Capital is more significant than in Knowledge Intensive sectors (Travel agency) and it has a meaningful influence on Market Value.

4.6 Conclusions

The incipit of this study is that Intellectual Capital Efficiency positive influences firms' Market Value. However, the impact of Intellectual Capital could be different in relation to the sectors in which it is taken into account. Thus, Intellectual Capital may be essential into Knowledge Intensive industries, as KIFs (Knowledge Intensive Firms) base their business on Intellectual Capital rather than Physical Capital resources. Despite the Intellectual Capital is also present into Capital Intensive sectors, CIFs (Capital Intensive Firms) use more Physical than Intellectual Capital resources.

In literature there are few applications which try to classify KIFs and CIFs but they are confused. Hence, we have proposed a classification based on the efficiencies mentioned above.

Starting from Pulic's point of view (Pulic, 1998; 2000; 2008), we decomposed the VA according to the formulation based on factors of production; afterwards, starting from whole value of depreciations and amortizations we have placed side by side the efficiency of Human Capital with efficiency of intangible assets (VA/Intangible amortizations) for Intellectual Capital measurement; whereas we have defined the efficiency of tangible assets for measuring Physical Capital.

Subsequently, we have tested the hypotheses described into the methodology of research in order to investigate the existing relationships between IC and Market Value within Knowledge and Capital Intensive sectors.

In this study, we have considered FCFO as a proxy of Market Value because in our sample there are no listed firms; although FCFO takes into account only what happens within a company, not considering exogenous factors which could affect firm's value.

In conclusion, the main aims of this study are:

1. Providing an objective Knowledge and Capital Intensive sectors classification based on VA components;
2. Investigating the relationships among Intellectual Capital (IC) and Market Value (MV) within Knowledge and Capital Intensive industries.

Further researches could regard analyses that take into account a wider sample of firms especially for Knowledge Intensive sectors. Furthermore it will be considered a larger set of sectors (both knowledge and Capital Intensive).

CHAPTER 5: VALUE CREATION BY DIFFERENT PERSPECTIVES[13]

Abstract

This chapter proposes a comparison between VAIC and one of the most important performance evaluation methods, the Economic Value Added (EVA), starting from a re-interpretation of the Value Added Intellectual Coefficient (VAIC). The empirical data were gathered from AMADEUS Bureau van Dijk and consist of 2596 companies operating in northern Italy, from six different economic sectors, observed for the year 2011. A correlation analysis was carried out in order to highlight whether there is a relationship between the two concepts of VAIC and EVA. Results show that EVA and VAIC have no significant relationships; as a matter of fact, EVA is based on financial theory, whereas VAIC is focalised on the assessment of Intellectual Capital Efficiency (ICE). Managers could be misled due to the fact that they often make decisions by taking into account only financial indicators such as EBIT, EVA, etc. (Pulic, 2008). Although methods like EVA have improved modern accounting systems, they do not take into account information linked to ICE. Therefore, these two perspectives can be useful in a context in which firms' performances are measured through multi-criteria methodologies (i.e. Balanced Scorecard). Our proposal describes the differences between VAIC and EVA considering these two concepts as not contrasting. In fact, in order to better measure firms' performances, it could be useful to consider VAIC and EVA as an integrated vision in order to develop multi-criteria evaluation systems rather than consider them separately.

5.1 Introduction

In the last few years the set of tools for measuring firms' performance has increased a lot. In this context, two of the most important innovations regard the methods that are able to measure value creation: (i) the Economic Value Added (EVA) (Stewart, 1990; 1991) and (ii) the Value Added Intellectual Coefficient (VAIC) (Pulic, 2000).

[13] This work was presented by Giuseppe Migliano at the 8th International Forum on Knowledge Asset Dynamics, Zagreb 12-14 June 2013, and then selected, as "high quality paper", to be published on *Measuring Business Excellence*.
This work was the incipit of: Iazzolino, G., Laise, D., Migliano, G. (2014) "Measuring Value Creation: VAIC and EVA", *Measuring Business Excellence*, Vol. 18, No. 1, pp. 8-21.

On the one hand, EVA is a useful tool for firms' performances measurement that, combined with other indicators, allows analysts to better investigate the financial performances of a specific company.

On the other hand, VAIC refers to a different perspective of "value added". In particular, EVA measures the Value Added from the shareholder's perspective, whereas VAIC is a measure of Value Added from the stakeholder's point of view.

Thus, these two different perspectives lead to a variety of tools used for measuring firms' performances. EVA can be calculated starting from all Income Statement configurations (e.g. from Cost of Goods Sold). Instead, to calculate VAIC it is necessary to start from the Value Added Income Statement.

This difference is imposed by the fact that only the Value Added Income Statement considers the creation and the distribution of the Value Added from the stakeholders' perspective (first of all, employees and shareholders). This viewpoint become important especially when the performances of Knowledge Organisations, in which the role of human resources and people satisfaction are particularly relevant for the success of these firms, are measured; in fact, in a knowledge organisation both shareholders and knowledge workers must be satisfied; the latter in particular have to be motivated and incentivised.

This work, starting from the main studies of Pulic (1998, 2000, 2008), is organised as follows: in the first section the main aspects of Pulic's proposal are recovered with reference to the existing literature; in the second section the characteristics of the measures introduced by Pulic will be discussed in more detail; in the third section, other ways proposed by Pulic for measuring the value creation are described; in the fourth section, the concept of Economic Value Added (EVA) is described; in the fifth section it is shown the empirical application regarding the comparison between VAIC and EVA; in the sixth section, the results are discussed; the last section is dedicated to conclusions.

The main aim of this empirical investigation is to highlight the lack of linear correlation between the traditional measures of performance (EVA) and the one introduced by Pulic through the VAIC. In other words, the empirical study has the aim of showing that VAIC, not being correlated with EVA, can represent a criterion that provides different information for measuring firms' performances compared with EVA.

The criticism that Pulic levelled at EBIT will be extended, thus, it will be shown that EVA "is in no correlation to value added (VAIC) … and it does not indicate the capability of companies in value creation" [Pulic, 2008:10].

5.2 VAIC and EVA: theoretical inequality

As can be noticed by looking at the paragraph 1.3.2.5, EVA is an EBIT-based measure; in fact, NOPAT is calculated starting from EBIT, hence, it is able to evaluate firms' performances from a shareholders' point of view (El Mir and Seboui, 2008).

Despite the EVA being widely recognised in firms' performances evaluation, Pulic (2008) argues that the EBIT-based measures could create an "accounting illusion"; as a matter of fact, EVA has not a conceptual linkage to VAIC. Conceptually, EVA is based on the values of NOPAT and Capital Employed; whereas VAIC is related to the Value Added Income Statement, therefore, the Value Added is completely different from the EVA components; as stated previously, EVA is an economic profit, as demonstrated by the use of NOPAT and Capital Employed into the formulation. The VAIC formulation uses the concept of Value Added that is a measure of the work productivity; thus, the meaning is quite different from the EVA.

EVA and VAIC seem to have the same goal: value creation, but they measure two different aspects of firms' performances: (i) EVA measures firms' performances from the shareholders' point of view; whereas (ii) VAIC measures firms' performances from the stakeholders' point of view. Pulic (2008) noticed that EBIT-based measures do not evaluate clearly the performances of firms; thus, the authors will try to prove empirically that there are no linear correlations between EVA and VAIC.

5.3 VAIC and EVA: the empirical study

As already stated, VAIC and EVA do not have the same meaning. In fact, EVA is based on financial theory, whereas VAIC is focalized on the assessment of Intellectual Capital Efficiency (ICE). In this section, the authors prove empirically, based on a sample of Italian firms, that there is no linear correlation between the two concepts of VAIC and EVA.

5.3.1 Dataset

Data were extracted from the AMADEUS Bureau van Dijk database. A sample of 2596 companies operating in northern Italy was selected. The industries involved in the analysis are: Manufacture of paper, Manufacture of chemicals, Manufacture of basic metals,

Computer programming and consultancy, Advertising and market research, Travel agency and tour operator reservation. The data extracted refer to the year 2011, as it is the last year for which all the necessary values are available.

Table 34 shows the sample description:

Sectors	NACE Rev. 2 Division	No. of firms
Manufacture of paper	17	**243**
Manufacture of chemicals	20	**451**
Manufacture of basic metals	24	**406**
Computer programming and consultancy	62	**782**
Advertising and market research	73	**525**
Travel agency, tour operator reservation service	79	**189**
TOTAL		**2596**

Table 34: Sample description

5.3.2 Correlation Analysis

In order to verify and identify the possible linear correlation between VAIC and EVA, the authors carried out a correlation analysis for each industry previously mentioned. Therefore, some descriptive statistics have been calculated for each sector, following the NACE Rev. 2 division: mean, standard deviation and number of firms belonging to a specific industry (Table 35).

	VAIC		EVA	
Sectors	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**
Manufacture of paper	2,503	7,519	-882,912	2210,505
Manufacture of chemicals	-6,623	241,335	-2789,508	30759,234
Manufacture of basic metals	4,547	37,884	-2200,296	8835,528
Computer programming and consultancy	5,594	42,034	-438,884	5452,745
Advertising and market research	8,374	67,306	-521,857	4654,505
Travel agency, tour operator reservation service	0,6140	68,118	-230,779	545,366

Table 35: Descriptive statistics of all sectors

Afterwards, the authors developed a correlation analysis (for each sector), highlighting the Pearson and the two-tailed significance coefficient for identifying the possible relations between VAIC and EVA. The authors conducted the analysis by considering the values of VAIC and EVA (for each firm involved) obtained for the year 2011.

VAIC was calculated according to this formulation (Pulic, 2000):

$$\text{VAIC} = \frac{\text{VA}}{\text{HC}} + \frac{\text{SC}}{\text{VA}} + \frac{\text{VA}}{\text{CE}}$$

where:

- VA = Value Added

- HC = Human Capital = Cost of employees
- SC = Structural Capital = (VA - HC)/VA
- CE = Capital Employed = Total Shareholders' funds + Long term debts + Loans

EVA has been calculated as defined previously:

$$\mathrm{EVA} = \mathrm{NOPAT} - (\mathrm{WACC} * \mathrm{K})$$

The following explains the way in which the data for the correlation analysis, in the Manufacturing of Paper industry, were obtained. For the other sectors a similar analysis was conducted.

The data were collected for 243 companies for the year 2011. For these companies VAIC and EVA were calculated as follow (Table 36 and Table 37):

FIRMS	VA/HC	SC/VA	VA/CE	VAIC
1	$(VA/HC)_1$	$(SC/VA)_1$	$(VA/CE)_1$	$VAIC_1 = (VA/HC)_1 + (SC/VA)_1 + (VA/CE)_1$
2	$(VA/HC)_2$	$(SC/VA)_2$	$(VA/CE)_2$	$VAIC_2 = (VA/HC)_2 + (SC/VA)_2 + (VA/CE)_2$
3	$(VA/HC)_3$	$(SC/VA)_3$	$(VA/CE)_3$	$VAIC_3 = (VA/HC)_3 + (SC/VA)_3 + (VA/CE)_3$
…	…	…	…	…
i	$(VA/HC)_i$	$(SC/VA)_i$	$(VA/CE)_i$	$VAIC_i = (VA/HC)_i + (SC/VA)_i + (VA/CE)_i$
…	…	…	…	…
243	$(VA/HC)_{243}$	$(SC/VA)_{243}$	$(VA/CE)_{243}$	$VAIC_{243} = (VA/HC)_{243} + (SC/VA)_{243} + (VA/CE)_{243}$

Table 36: VAIC computation

FIRMS	NOPAT	WACC	K = CE	EVA
1	$NOPAT_1$	$WACC_1$	K_1	$EVA_1 = NOPAT_1 - (WACC_1 * K_1)$
2	$NOPAT_2$	$WACC_2$	K_2	$EVA_2 = NOPAT_2 - (WACC_2 * K_2)$
3	$NOPAT_3$	$WACC_3$	K_3	$EVA_3 = NOPAT_3 - (WACC_3 * K_3)$
…	…	…	…	…
i	$NOPAT_i$	$WACC_i$	K_i	$EVA_i = NOPAT_i - (WACC_i * K_i)$
…	…	…	…	…
243	$NOPAT_{243}$	$WACC_{243}$	K_{243}	$EVA_{243} = NOPAT_{243} - (WACC_{243} * K_{243})$

Table 37: EVA computation

Afterwards, the authors tested the existence of linear correlation between VAIC and EVA under this (null) hypothesis:

H0 : The variables VAIC and EVA do not have a linear relationship (in the data of the sample).

The result is shown in Table 38:

Sector	Pearson	Significance	Comment
Manufacture of paper	0,026	0,681	No significance
Manufacture of chemicals	-0,002	0,964	No significance
Manufacture of basic metals	0,014	0,778	No significance
Computer programming and consultancy	0,006	0,875	No significance
Advertising and market research	0,011	0,798	No significance
Travel agency, tour operator reservation service	0,001	0,985	No significance

Table 38: Results of correlation analysis

As can be noticed, the analysis shows that there is no linear correlation between VAIC and EVA in all sectors; in fact, all the correlation analyses appear to be not significant (as demonstrated by two-tailed significance coefficient).

5.4 Discussions

As demonstrated by the empirical framework, VAIC and EVA are two different concepts. Despite VAIC and EVA seeming to have the same goal (measure the value creation) they measure two different aspects of firms' performances. In fact, EVA is defined as:

$$\mathrm{EVA} = \mathrm{NOPAT} - (\mathrm{WACC} * \mathrm{K})$$

NOPAT is linked to the EBIT, therefore as a consequence EVA is an EBIT-based measure of performance. The three components of EVA are linked to the shareholders; hence, it measures the firm's performance based on the shareholders' point of view and it has no significant relations with Intellectual Capital.

VAIC measures the value creation from another point of view, considering explicitly the stakeholders and the Intellectual Capital. VAIC is calculated as follow:

$$\mathrm{VAIC} = \frac{\mathrm{VA}}{\mathrm{HC}} + \frac{\mathrm{SC}}{\mathrm{VA}} + \frac{\mathrm{VA}}{\mathrm{CE}}$$

The main strong point of Pulic was to recover the notion of Value Added, as intended in the Value Added Income Statement. This point of view can be considered as a bridge between Intellectual Capital and firms' performances evaluation.

Hence, on the one hand, EVA is a financial performance evaluation method for calculating an economic additional profit that a corporation can generate compared with the economic "normal" profit of a specific sector. Therefore, this concept covers the shareholders' point of view and it may be part of the financial perspective of the firm performance.

On the other hand, VAIC, starting from the Value Added Income Statement, is a useful tool for measuring value creation, especially in organisations in which the presence of knowledge workers is prevalent; therefore, VAIC could be considered as a coefficient that can usefully belong to the learning and growth perspective of firm performance. Furthermore, VAIC takes account of the stakeholders' point of view and this is the main difference with the EBIT-based method.

Therefore, these two perspectives could be integrated into a multi-criteria vision (similar to Balanced Scorecard, Intangible Assets Monitor, etc.); in fact, EVA and VAIC have two completely different meanings, but they are not rivals; therefore, they could be integrated for obtaining a more comprehensive firms' performance evaluation taking account of financial and learning and growth perspective.

In Figure 24 the two main perspectives for firm performance evaluation are shown:

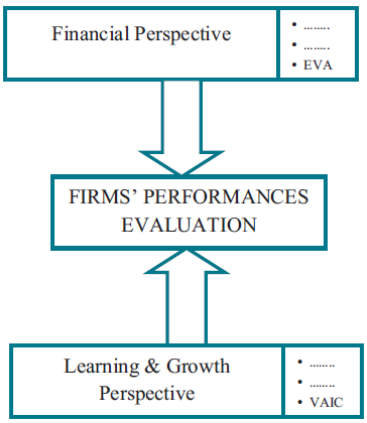

Figure 24: Firms' performances evaluation perspectives

5.5 Conclusions

The authors investigated the relationship between VAIC and EVA in order to highlight two different perspectives of firms' performances. The analyses show that there is no linear correlation between these two measures of performances.

The authors have verified that EVA and VAIC refer to the Value Creation but the first is linked to a shareholders' point of view, whereas the latter is linked to stakeholders' viewpoint. Hence, these two visions can be integrated within a multi-criteria dashboard

such as BSC (Balanced Scorecard); in fact, VAIC is a measure that usefully complements the existing ones and for this reason can be included, as an innovative indicator of Intellectual Capital efficiency; whereas EVA is a measure of economic profits. Thus, the VAIC concept can be included in the Learning and Growth perspective; whereas the EVA can be considered as part of the financial perspective, using terms linked to the Balanced Scorecard (BSC) (Kaplan and Norton, 1996).

In consolidating the multi-criteria idea, it can be observed that EBIT-based measures alone are not sufficient to highlight all the aspects of firms' performances; in fact, Pulic (2008) demonstrated that a high ROA does not mean that there will be a high HCE; hence, the same consideration could be made using EVA.

In the end, this work shows that EVA and VAIC are two non-rival concepts because VAIC measures a dimension of performance that is not considered by other traditional measures. Therefore VAIC is a measure that usefully complements the existing ones and for this reason can be included, as an innovative indicator of Intellectual Capital efficiency, in the multi-criteria dashboards such as the BSC, the Skandia Navigator and the Intangible Asset Monitor. In fact, the study confirms that the correct way of intending the performance measurement is a multidimensional point of view. According to Pulic's mono-criteria vision of firm performance measurement, the traditional EBIT-based measures say nothing on value creation for stakeholders and then have to be totally replaced by those based on Value Added. The authors sustain instead that, if you adopt a multi-criteria measure point of view, VAIC can be maintained as a specific criterion that captures only one aspect of the multidimensional reality.

The bridge created by Pulic between the notion of Value Added and that of value creation in a Knowledge Economy context constitutes the principal strong point of his proposal. He argues successfully that in the Knowledge Organizations there is no need to modify the accounting principles to consider the existence of Knowledge Workers. The "Value Added" Income Statement, correctly interpreted, allows the productivity of knowledge workers and the creation of new value generated from them to be measured. For a detailed analysis of the concept of VAIC (Value Added Intellectual Coefficient) see Iazzolino and Laise (2013).

The main strong point of Pulic was to recover the notion of Value Added. The VAIC provides a cumulative measure of the changes in value added produced by efficiency gains related to the use of both physical/financial capital and intellectual capital.

CHAPTER 6: EVALUATING A FIRM USING NEW RELATIVE MEASURES[14]

Abstract

This chapter proposes a new multiple, based on intellectual capital, as a new tool for relative valuation of a firm. The intellectual capital multiple (ICM), also disaggregated in three multiples, based on the intellectual capital components (human, structural and relational capital), can be added to the traditional financial-based multiples (e.g., price/earnings, EV/EBITDA, EV/sales, etc.) to improve the techniques of valuation based on the so-called comparables. An empirical analysis on a sample of firms listed in the Italian Stock Exchange has been carried out to validate the new method, by comparing the intellectual capital-based multiples with the traditional financial-based enterprise multiples. Findings show that, especially in certain sectors mainly characterised by a high use of intellectual capital resources (software and telecommunications), ICMs can be considered as valid and reliable. The ICMs can lead researchers and practitioners towards discovering a new 'intangible' valuation tool to be placed alongside 'tangible' valuation methods.

6.1 Introduction

The economy has been changing quickly during the last decades due to the increasingly use of intellectual resources that lead modern firms to achieve competitive advantage in a context characterised by many threats (technological, financial, etc.) (Hsu and Sabherwal, 2011; Kamukama et al., 2011).

Therefore, knowledge and know-how created by employees, relationships with suppliers and customers, new forms of organisational structure, information technology systems and processes are the most important assets that create value for firms, changing their market evaluation and creating a gap between market and book value (Li and Wu, 2004; F-Jardon and Martos, 2009; Edvinsson and Malone, 1997; Sveiby, 1997; Lynn, 1998).

[14] This work was the incipit of: Iazzolino, Migliano, G. (2014) "The Intellectual Capital Multiple: a new tool for Relative Valuation of a firm – Theoretical presentation and empirical application to Italian Companies", *International Journal of Intelligent Enterprise*, Vol. 2, No. 2/3, pp. 142-168.

The starting point of this chapter is to integrate financial and intellectual capital measures in order to provide a new tool for evaluating firms; as a matter of fact, the inclusion of intellectual capital variables into the evaluation of firms can lead analysts towards more homogeneous evaluations (Alwert et al., 2009).

Hence, the main goal of this study is to develop a new firm evaluation tool based on Multiples' theory (Relative Valuation) that allows analysts to compare firms not only on the basis of their financial performances but also on their Intellectual Capital indicators. The main aim of this research is to develop and propose a new Intellectual Capital Multiple (ICM) that can be considered valid within the industries taken into consideration.

The authors evaluated the effectiveness of the ICMs by comparing them with the traditional Enterprise Multiples (EV/EBITDA and EV/Sales) . The results are interesting, in particular for companies belonging to the "new market" that is characterised by a high use of knowledge resources.

The study is organised as follows: in Section 2 a theoretical background, about (i) Relative Valuation methods (Multiples) and (ii) Intellectual Capital and performances, is presented; Section 3 is devoted to the research framework; Section 4 describes the empirical analysis and discussion; in Section 5 the conclusions are reported; Section 6 describes limitations and future research.

6.2 Research design issue

This section is devoted to describe the methodology used for calculating and testing the new Intellectual Capital Multiple (ICM) starting from data gathered from the reports of the selected firms. Therefore, the authors propose a research framework following the steps listed below:

1. Firms' sample selection;
2. Calculation of the Intellectual Capital indicators (Intellectual Capital Investments – ICI);
3. Calculation of the Intellectual Capital Multiples (ICMs);
4. Calculation of the "traditional" Enterprise Multiples (EMs);
5. Reliability test of the ICMs, by comparing them with the traditional Enterprise Multiples.

6.2.1 Firms' sample selection (Dataset)

Data were gathered from the Italian Stock Market ("Borsa Italiana"). A sample of 21 firms belonging to service industries, such as Software and computer services, Support services, Consumer services, Telecommunications, Public utilities, Other services, were selected. The period 2009-2011 was considered (then a total of 63 financial reports were analysed). These industries belong to the "quaternary" sector that is characterised by a high use of knowledge resources (Wood, 2009; Muller and Doloreux, 2009).

The selected sample (Table 39) is made up of firms that are similar in terms of "fundamentals" (particularly Sales, EBITDA, ROE) (Damodaran, 2005).

Firm's name	Industry
Buongiorno	Software and computer services
Engineering	Software and computer services
Exprivia	Software and computer services
Mediacontech	Software and computer services
Noemalife	Software and computer services
Reply	Software and computer services
Tas group	Software and computer services
Txt E-solutions	Software and computer services
Acsm Agam	Support services
Biancamano	Support services
Eems	Support services
Sadi servizi industriali	Support services
Servizi Italia	Support services
Basic net	Consumer services
Fullsix	Consumer services
Acotel Group	Telecommunications
Tiscali	Telecommunications
Iren	Public utilities
Kinexia	Public utilities
Cobra	Other services
Mutui on line	Other services

Table 39: Firms' sample

6.2.2 Calculation of Intellectual Capital Investments (ICI)

The first step of this work was related to the study of the firms' financial reports (containing Balance sheet, Income Statement and notes about corporate actions) in order to gather data about the Intellectual Capital Investments (ICI) referring to the years 2009-2011.

Considering also the work carried out by Guthrie and Petty (2000), the authors of this study developed a framework to evaluate the Intellectual Capital Investments (ICI) as shown in Table 40:

INTELLECTUAL CAPITAL INVESTMENTS EVALUATION FRAMEWORK				
Firm: (Firm's name)				
1. Human Capital Investments (HCI)				
	2009	**2010**	**2011**	**Mean Value**
Cost of Employees (€) (**CEmp**)				
Investments in development plans (i.e. training, career development, etc.) (€) (**T**)				
Stock Option plans (€) (**SO**)				
TOTAL HCI (€) = CEmp + T + SO				
2. Structural Capital Investments (SCI)				
	2009	**2010**	**2011**	**Mean Value**
R&D expenses (€) (**R&D**)				
Software development (€) (**Sw**)				
Costs of patents and marks registration (€) (**P**)				
Costs of licensing agreements (€) (**L**)				
TOTAL SCI (€) = R&D + Sw + P + L				
3. Relational Capital investments (RCI)				
	2009	**2010**	**2011**	**Mean Value**
Marketing costs (€) (**M**)				
Investments in customer service/assistance (both in house and outsourcing) (€) (**CS**)				
Investments in business and research collaborations (with business partners, research centres and Universities) (€) (**BR**)				
TOTAL RCI (€) = M + CS + BR				
INTELLECTUAL CAPITAL INVESTMENTS (ICI)				
	2009	**2010**	**2011**	**Mean Value**
TOTAL ICI (€)= HCI + SCI + RCI				

Table 40: ICI evaluation framework

6.2.3 Calculation of the Intellectual Capital Multiples (ICMs)

Four Intellectual Capital Multiples (ICMs) were defined according to the following rule that ensure the consistency of the multiples defined:

Although valuating firms through relative valuations could seem easy, in order to use Multiples wisely it is fundamental to define and measure them consistently and uniformly across the firms being compared (Damodaran, 2012). Thus, it is reasonable to presume, as an example, that if the numerator of a multiple ratio is referred to the Equity (i.e. stocks' price or market value of Equity), also the denominator of the same ratio should be referred to the Equity (i.e. earnings or book value); whereas if the numerator is related to the firm as a whole (i.e. Enterprise Value), also the denominator of the same ratio should be linked to the firm as a whole (i.e. EBITDA). Starting from this assumption, the ICMs were carried

out, having: (i) as numerator the Enterprise Value (EV) (calculated as: Market Capitalisation at fiscal yearend date + Preferred Stock + Minority Interest + Total Debt minus cash, and hence referred to the firm as a whole) and (ii) as denominator the Intellectual Capital Investments components (HCI, SCI and RCI) also defined for the company as a whole. Furthermore, an overall Intellectual Capital Multiple (ICM) was calculated: EV/ICI. Figure 25 summarises the proposed Intellectual Capital Multiples (ICMs).

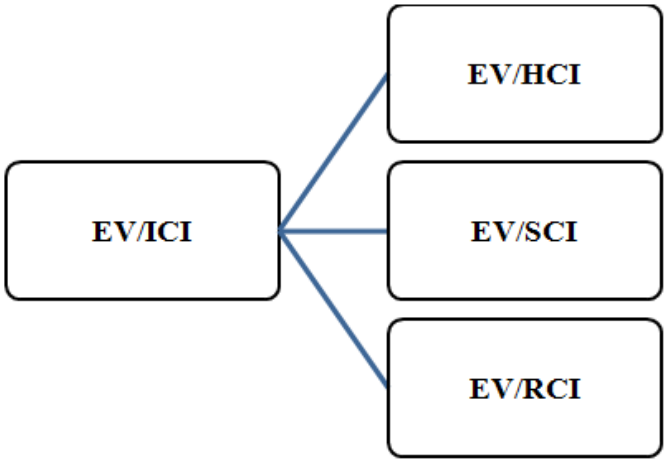

Figure 25: The proposed Intellectual Capital Multiples (ICMs)

To summarise, EV/ICI is the overall Intellectual Capital Multiple (ICM), based on the total value of the Intellectual Capital Investments (ICI). Three further Intellectual Capital Multiples, based on the three components of the ICI (Human Capital Investments – HCI, Structural Capital Investments – SCI, Relational Capital Investments – RCI), are defined: (i) EV/HCI, (ii) EV/SCI, (iii) EV/RCI. The following equation summarises the definition of the ICMs (for explanation of symbols see Table 40):

1. $\frac{\mathrm{EV}}{\mathrm{HCI}} = \frac{\mathrm{EV}}{\mathrm{CEmp} + \mathrm{T} + \mathrm{SO}}$
2. $\frac{\mathrm{EV}}{\mathrm{SCI}} = \frac{\mathrm{EV}}{\mathrm{R}andD + Sw + P + L}$
3. $\frac{\mathrm{EV}}{\mathrm{RCI}} = \frac{\mathrm{EV}}{\mathrm{M+CS+BR}}$
4. $\mathrm{ICI} = \mathrm{HCI} + \mathrm{SCI} + \mathrm{RCI}$
5. $\frac{\mathrm{EV}}{\mathrm{ICI}} = \frac{\mathrm{EV}}{\mathrm{HCI+SCI+RCI}}$

6.2.4 Calculation of the traditional Enterprise Multiples (EMs)

The step concerned the calculation of the "traditional" Enterprise Multiples (EMs) for each firm (by using Thomson Reuters Datastream) and in particular, two multiples have been chosen: (i) EV/EBITDA and (ii) EV/Sales. The first one relates the total market value of the firm (EV) to the cash flow generated by the current operations (EBITDA) and it is considered useful for three main reasons, as stated by Damodaran (2002): first of all, there are far fewer firms with negative EBITDA than there are firms with negative earnings per share; secondly, Depreciations and Amortizations (and as a consequence their calculations) do not affect the EBITDA; thirdly, this multiple can be compared easily across firms with different financial leverage.

The second multiple divides the EV by revenues generated by the sales and it is judged more accurate than price-to-sales valuation by analysts; in fact, the EV/Sales ratio (considered as an extension of price-to-sales multiple) takes into account not only the market capitalisation but also the amount of debt of the company. Price-to-sales index may lead to misleading conclusions when it is compared across firms in a sector with different degrees of leverage, thus, as claimed by Damodaran (2012) this multiple may be internally inconsistent.

6.2.5 Reliability test

The last stage of the work is devoted to testing whether the ICMs might be considered reliable across the sample industries analysed. For that reason, the authors investigated two hypotheses (H1 and H2):

H1: an ICM may be considered reliable if its variability does not exceed a defined threshold with respect to the maximum theoretical variability value, for every year taken into account

H2: an ICM with a variability higher than the defined threshold is assumed to be reliable if its standard deviation is lower than that of the traditional enterprise multiple with which it is compared

In order to summarise the hypotheses above introduced, a useful flow chart (Figure 26) was carried out:

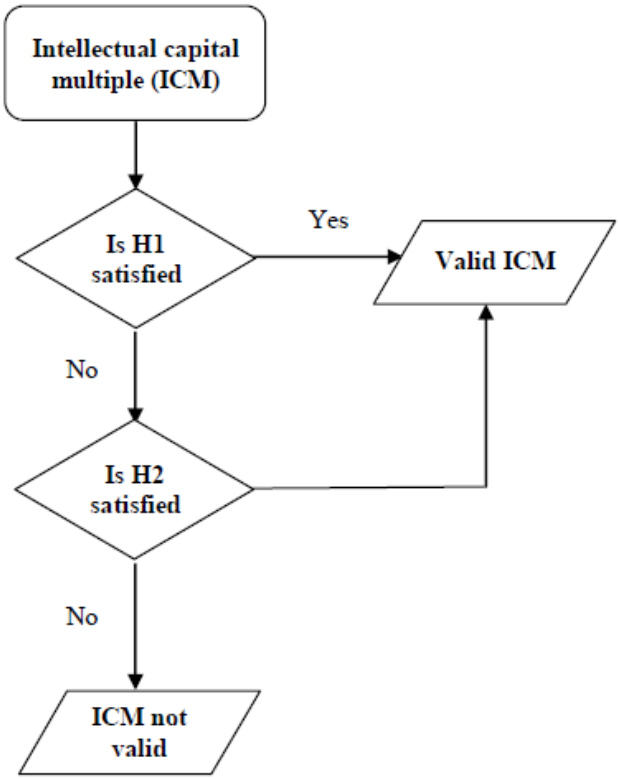

Figure 26: Hypotheses flow chart

6.3 Empirical tests and discussions

As stated in the methodology, the first step was to gather information about the Intellectual Capital Investments (ICI) and its components. Figure 27 summarises the overall percentage of Human Capital Investments (HCI), Structural Capital Investments (SCI) and Relational Capital Investments (RCI) on the total amount of Intellectual Capital Investments (ICI), for every year considered.

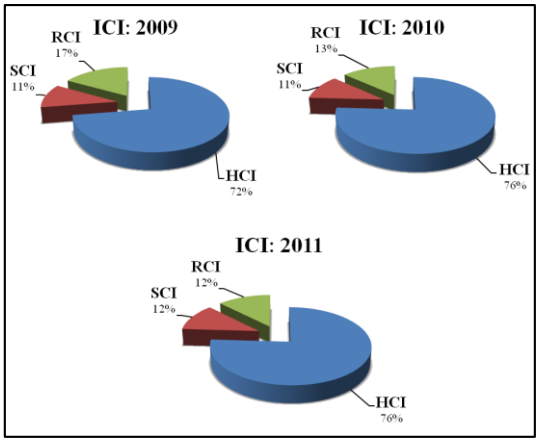

Figure 27: Intellectual Capital Investments for the sample as a whole

It is noteworthy that, from 2009 to 2011, Human Capital Investments (HCI) are always the highest and they increased from 2009 to 2010 (72-76%) remaining stable in 2011 (76%); whereas it can be noticed that Structural Capital Investments (SCI) are almost stable across the three years (11-12%); Relational Capital Investments (RCI) had a slight decrease trend from 2009 to 2011 (especially from 2009 to 2010; 17-13%).

Afterwards, in order to verify the two hypotheses H1 and H2 and hence follow the steps of the methodology previously explained, the Intellectual Capital Multiples (ICMs) and the Enterprise Multiples (EMs) were calculated for each firm (for further details see Iazzolino and Migliano, 2014)

In order to verify the two hypotheses of this research, it was necessary to normalise data (ICMs and EMs values) for obtaining more comparable patterns. The authors, in this sense, used the min-max normalisation technique, which is considered one of the simplest approaches for scaling data in a defined range of values ([0, 10] in our case). Min-max normalisation is best suited for the case where the bounds (maximum and minimum value) of the score produced by a matcher are known (Jain et al., 2005).

The min-max formula is shown below:

$$\boldsymbol{y'm} = \frac{\boldsymbol{ym-min}}{\boldsymbol{max-min}} (\boldsymbol{max'} - \boldsymbol{min'}) + \boldsymbol{min'} \qquad [1]$$

where, taking account of a series y:

- y'm is the value that we would obtain;
- ym is the pattern m where m = 1,.., M;
- min is the minimum value in the series of values;
- max is the maximum value in the series of values;
- max' is the maximum value of the predetermined range (that we would get);
- min' is the minimum value of the predetermined range (that we would get).

Subsequently, the Multiples[15] (both intellectual capital and enterprise based) were clustered (i) by sector; and (ii) by sales within the sectors. After that, the Standard Deviation (SD), and consequently the dispersion from the mean, were calculated in order to evaluate the variability of each ICM; obviously, the maximum possible value for SD is

[15] Scaled data may be found in Iazzolino and Migliano (2014)

5, owing to the fact that after the data normalisation a range between 0 (minimum value) and 10 (maximum value) was obtained. Results are displayed following:

Industry name	year	Mean EV/HCI	VARIANCE EV/HCI	SD EV/HCI	Dispersion (%)	Mean EV/SCI	VARIANCE EV/SCI	SD EV/SCI	Dispersion (%)	Mean EV/RCI	VARIANCE EV/RCI	SD EV/RCI	Dispersion (%)	Mean EV/ICI	VARIANCE EV/ICI	SD EV/ICI	Dispersion (%)
Software and computer services	2009	1.270	0.406	0.637	12.737%	0.295	0.059	0.243	4.855%	0.921	1.559	1.249	24.971%	1.780	0.763	0.873	17.468%
Software and computer services	2010	0.451	0.079	0.281	5.614%	0.272	0.048	0.219	4.372%	0.809	2.038	1.428	28.554%	0.738	0.242	0.492	9.844%
Software and computer services	2011	0.921	0.523	0.723	14.463%	5.447	0.011	0.106	2.116%	2.346	12.936	3.957	71.933%	0.877	0.373	0.611	12.220%
Support services	2009	3.972	3.996	1.999	39.981%	3.000	17.396	4.171	83.418%	3.103	16.209	4.026	80.520%	6.321	9.898	3.146	62.922%
Support services	2010	1.466	1.054	1.027	20.535%	3.582	20.442	4.521	90.425%	2.536	17.740	4.212	84.237%	2.733	3.082	1.756	35.111%
Support services	2011	2.513	2.834	1.683	33.669%	3.775	24.931	4.993	99.863%	1.683	2.771	1.665	33.292%	2.816	2.852	1.689	33.777%
Consumer services	2009	0.618	0.764	0.874	17.486%	0.999	1.996	1.413	28.253%	0.022	0.001	0.031	0.615%	0.780	1.217	1.103	22.063%
Consumer services	2010	3.469	22.785	4.773	95.467%	0.275	0.095	0.308	6.156%	0.051	0.003	0.055	1.102%	1.538	4.023	2.006	40.114%
Consumer services	2011	6.192	29.036	5.338	107.769%	0.342	0.202	0.449	8.893%	0.216	0.001	0.036	0.729%	2.370	0.080	0.283	5.563%
Telecommunications	2009	7.239	0.121	0.348	6.969%	0.451	0.149	0.386	7.728%	0.104	0.003	0.054	1.072%	5.148	0.298	0.546	10.926%
Telecommunications	2010	3.257	0.055	0.235	4.709%	0.355	0.012	0.108	2.161%	0.072	0.004	0.063	1.264%	2.996	1.791	1.338	26.764%
Telecommunications	2011	3.701	2.934	1.713	34.260%	0.170	0.010	0.100	1.993%	0.171	0.009	0.093	1.869%	2.404	0.987	0.993	19.869%
Public utilities	2009	5.001	50.024	7.073	141.456%	0.011	0.000	0.015	0.297%	0.066	0.009	0.093	1.865%	1.035	2.142	1.464	29.272%
Public utilities	2010	7.932	8.568	2.927	58.542%	0.446	0.337	0.581	11.612%	1.380	2.482	1.575	31.508%	6.574	23.512	4.849	96.979%
Public utilities	2011	9.366	0.282	0.531	10.626%	0.182	0.059	0.243	4.853%	4.412	24.217	4.921	98.421%	6.028	31.588	5.620	112.407%
Other services	2009	4.634	16.405	4.050	81.006%	1.598	4.276	2.068	41.357%	0.178	0.007	0.082	1.640%	5.634	22.451	4.738	94.765%
Other services	2010	2.711	8.621	2.936	58.722%	1.478	3.965	1.991	39.822%	0.087	0.003	0.055	1.105%	3.509	14.155	3.762	75.246%
Other services	2011	2.909	8.671	2.495	58.895%	0.577	0.580	0.761	15.226%	0.199	0.010	0.101	2.026%	0.199	0.010	0.101	2.026%

Table 41: SD and Dispersion clustered by sectors

Industries	year	Mean EV/HCI	VAR EV/HCI	SD EV/HCI	Dispersion (%)	Mean EV/SCI	VARIANCE EV/SCI	SD EV/SCI	Dispersion (%)	Mean EV/RCI	VARIANCE EV/RCI	SD EV/RCI	Dispersion (%)	Mean EV/ICI	VARIANCE EV/ICI	SD EV/ICI	Dispersion (%)
Software and computer services																	
Sales > 200 millions €	2009	1.022	0.494	0.703	14.063%	0.301	0.045	0.211	4.228%	0.470	0.577	0.759	15.188%	1.164	0.142	0.377	7.537%
Sales < 100 millions €	2009	1.419	0.388	0.623	12.464%	0.291	0.081	0.284	5.683%	1.191	2.195	1.482	29.634%	2.150	0.809	0.899	17.986%
Sales > 200 millions €	2010	0.381	0.087	0.296	5.910%	0.328	0.038	0.195	3.903%	0.478	0.642	0.801	16.021%	0.472	0.109	0.330	6.605%
Sales < 100 millions €	2010	0.493	0.088	0.297	5.945%	0.239	0.061	0.247	4.934%	1.008	3.115	1.765	35.297%	0.897	0.285	0.533	10.668%
Sales > 200 millions €	2011	0.910	0.829	0.911	18.215%	0.204	0.012	0.112	2.235%	1.925	10.473	3.236	64.724%	0.598	0.122	0.349	6.891%
Sales < 100 millions €	2011	0.928	0.500	0.707	14.145%	0.125	0.010	0.102	2.040%	2.598	17.190	4.146	82.921%	1.044	0.499	0.706	14.129%
Support services																	
Sales > 200 millions €	2009	3.637	6.143	2.478	49.569%	0.387	0.056	0.236	4.729%	1.544	2.318	1.523	30.451%	5.241	9.860	3.140	62.802%
100 millions € < Sales < 200 millions €	2009	4.195	4.734	2.176	43.514%	4.741	23.391	4.836	96.728%	4.142	27.209	5.216	104.325%	7.041	12.921	3.595	71.891%
Sales > 200 millions €	2010	1.564	3.293	1.815	36.293%	0.492	0.195	0.441	8.824%	0.652	0.372	0.610	12.195%	2.588	7.979	2.825	56.494%
100 millions € < Sales < 200 millions €	2010	1.401	0.446	0.668	13.356%	5.642	24.874	4.987	99.747%	3.792	29.379	5.420	108.404%	2.829	2.140	1.463	29.256%
Sales > 200 millions €	2011	2.703	9.848	3.138	62.763%	0.185	0.030	0.174	3.485%	1.995	3.291	1.814	36.282%	2.710	8.683	2.947	58.934%
100 millions € < Sales < 200 millions €	2011	2.386	0.684	0.827	16.535%	6.168	28.371	5.326	106.529%	1.475	3.734	1.932	38.649%	2.887	1.344	1.159	23.188%
Telecommunications													0.000%				
Sales > 100 millions €	2009	7.239	0.121	0.348	6.969%	0.451	0.149	0.386	7.728%	0.104	0.003	0.054	1.072%	5.148	0.298	0.546	10.926%
Sales > 100 millions €	2010	3.257	0.055	0.235	4.709%	0.355	0.012	0.108	2.161%	0.072	0.004	0.063	1.264%	2.996	1.791	1.338	26.764%
Sales > 100 millions €	2011	3.701	2.934	1.713	34.260%	0.170	0.010	0.100	1.993%	0.171	0.009	0.093	1.869%	2.044	0.987	0.993	19.869%
Other sectors																	
Sales > 50 millions €	2009	4.634	16.405	4.050	81.006%	1.598	4.276	2.068	41.357%	0.178	0.007	0.082	1.640%	5.634	22.451	4.738	94.765%
Sales > 50 millions €	2010	2.711	8.621	2.936	58.622%	1.478	3.965	1.991	39.822%	0.087	0.003	0.055	1.105%	3.509	14.155	3.762	75.246%
Sales > 50 millions €	2011	2.909	8.671	2.945	58.895%	0.577	0.380	0.761	15.226%	0.199	0.010	0.101	2.026%	0.199	0.010	0.101	2.203%

Table 42: SD and Dispersion clustered by sales within sectors

At the end of the evaluation process, the authors provided the assessment about the reliability of each Intellectual Capital Multiple (ICM) according to what stated in H1 and H2 for every industry included in the sample; Table 43 summarises the final results:

Industry	ICM	Validity 2009	Validity 2010	Validity 2011
Software and computer services	EV/HCI	YES	YES	YES
Software and computer services	EV/SCI	YES	YES	YES
Software and computer services	EV/RCI	YES	YES	NO
Software and computer services	EV/ICI	YES	YES	YES
Support services	EV/HCI	NO	YES	NO
Support services	EV/SCI	NO	NO	NO
Support services	EV/RCI	NO	NO	NO
Support services	EV/ICI	NO	NO	NO
Consumer services	EV/HCI	YES	NO	NO
Consumer services	EV/SCI	YES	YES	YES
Consumer services	EV/RCI	YES	YES	YES
Consumer services	EV/ICI	YES	NO	YES
Telecommunications	EV/HCI	YES	YES	NO
Telecommunications	EV/SCI	YES	YES	YES
Telecommunications	EV/RCI	YES	YES	YES
Telecommunications	EV/ICI	YES	YES	YES
Public utilities	EV/HCI	NO	NO	YES
Public utilities	EV/SCI	YES	YES	YES
Public utilities	EV/RCI	YES	NO	NO
Public utilities	EV/ICI	YES	NO	NO
Other services	EV/HCI	NO	YES	YES
Other services	EV/SCI	NO	NO	YES
Other services	EV/RCI	YES	YES	YES
Other services	EV/ICI	NO	YES	YES

Table 43: ICMs' Validity

It is noteworthy that, within the Software and computer services and Telecommunication industries, the ICMs, according to H1 and H2, can be considered as valid in all three years of the analysis with the exception of EV/RCI (for Software and computer services) and EV/HCI (for Telecommunications) in 2011.

Afterwards, the authors compared the valid ICMs, regarding the two sectors mentioned beforehand, with the EV/EBITDA by using the mean rate of the dispersion in all three years (Table 44):

Industry	ICMs	Mean Dispersion (%) ICMs	Mean Dispersion (%) EV/EBITDA	Difference (%) (Absolute value)
Software and computer services	EV/HCI	10.938	10.110	0.828
	EV/SCI	3.781	10.110	6.329
	EV/ICI	13.177	10.110	3.067
Telecommunications	EV/SCI	3.961	14.280	10.319
	EV/RCI	1.400	14.280	12.880
	EV/ICI	19.186	14.280	4.906

Table 44: Difference between valid ICMs and EV/EBITDA

Findings, in Table 41, Table 42 and Table 43, show that Software and computer services and Telecommunications have the most valid ICMs in all the three years considered by the

analysis; Table 44 displays that with regard to the first mentioned sector, EV/HCI is the closest to the EV/EBITDA; this means that it is possible to consider EV/HCI as the most reliable multiple. This result can be justified also by other theories in which Human Capital has been considered as one of the most important intangible resources able to provide success to the firm in terms of performances and Market Value (Gamerschlag, 2013; Sáenz, 2005). Moreover, in this sector, also EV/SCI and EV/ICI are valid in the time range considered; it means that Intellectual Capital resources importance has been increasing rapidly in the last few years within knowledge-intensive industries, replacing the resources based on traditional factors of production (Iazzolino et al., 2013b).

In the Telecommunications industry, a critical role is played by the Structural capital, due to the increasing investments in R&D, which are becoming essentials especially in terms of new technologies (Yang and Olfman, 2006; Lestage et al., 2013; Lam and Shiu, 2010).

In the analysis based on clustering by sales within sectors, the same general trend is observed. In the Software and computer service industry the ICMs are stable and valid for the three years considered. In particular this result is true for large firms (Sales > 200 MLN€) and for Multiples EV/HCI, EV/SCI, EV/ICI. A similar situation can be seen for the Telecommunications Sector.

The obtained results demonstrate that Intellectual Capital is an important driver of firm value, especially in some kinds of industry. Furthermore, the obtained results, with respect to the three Intellectual Capital components, are aligned with the "classical" approaches of measurement of intangibles, in particular with the multidimensional methodologies: Skandia Navigator (Edvinsson, Malone, 1997), Intangible Asset Monitor (Sveiby, 1997), and, before, the Balanced Scorecard (Kaplan and Norton, 1992).

Such models arose with the objective of identifying and evaluating intangibles in their different dimensions. Within them, Human Capital assumes a special significance.

Skandia Navigator put human resources at the centre of the model. They are the heart of the firm and are able to interact with all other firm areas. The model concentrates particularly on the Learning and Growth perspective of the Balanced Scorecard.

Also the Intangible Asset Monitor is based on the idea, in common with the other two methodologies, that the main sources of competitive advantage are people, upon which firm performance depends. Human capital knowledge is difficult to encode and therefore it can never become entirely an asset of the enterprise.

Human Capital has been studied by many authors, such as Sveiby (2002; 2007). From those studies it emerges that, in knowledge-based firms, the effectiveness of knowledge work is highly influenced by the collaborative climate and the human capital in general. Grimaldi et al. (2013a; 2013b) conducted researches centered on the role of Intellectual Capital (especially human capital) for explaining both the value creation and the innovation processes.

Summarising, before our work, past studies about firm performance evaluation (with respect to the Multiples theory) had not taken into account the Intellectual Capital perspective, instead they focused their attention on financial-based measures only. Those kinds of measure (chiefly based on financial indexes) did not take account of the economic development that has been occurring for the last few decades, which led competitive markets (especially those characterized by a high use of knowledge resources) to move from the industrial logic to the knowledge-based logic. Even though Intellectual Capital cannot be accepted as a necessary and sufficient condition to evaluate firms and industries, it should be acknowledged as a "high-impact" feature for the growth of knowledge-based sectors, as proved by the analysis carried out in this study.

In this sense, the basic philosophy of multidimensional models is that non-financial measures have to be considered as a complement to financial measures. Firm Value should be determined by both.

This is exactly what our approach is proposing in this work: Intellectual Capital Multiples can be effectively integrated with traditional Multiples, in order to provide a contribution to the overall evaluation process.

6.4 Conclusions

This work extends the studies regarding the Multiples theory (Damodaran, 2005; 2012; Nassim, 2013; Brahmana and Hooy, 2011; Sehgal and Pandey, 2010; Armstrong et al., 2011; Curteau et al., 2006; Antonios et al., 2011; Mînjnă, 2009) and the Intellectual Capital in the context of the firm performance evaluation (Mention and Bontis, 2013; Alwert et al., 2009; F-Jardón and Martos, 2009) and provides new approaches considering not only financial-based but also knowledge-based measures in a multi-criteria perspective (Iazzolino et al., 2012).

In this work, the authors demonstrated how Intellectual Capital could be taken into account to forecast and discover the Firm Value by integrating it within the Multiples' theory that in the past was more focused on financial aspects. In this sense, it has been proven that analysts should take into consideration intellectual capital factors to obtain a clearer understanding of the firm value, especially for firms operating within industries characterised by a high use of intangible resources (in this study Software and Telecommunication sectors, in which ICMs are considered as valid after having been compared to EMs).

Therefore, the main aim of this work was to identify a new tool for evaluating firms and defining new Intellectual Capital Multiples (ICMs) which allows analysts to better understand the knowledge's perspective of a company.

In this study, the authors identified three main ratios based on Enterprise Value and Intellectual Capital components in order to compare firms not only with traditional enterprise multiples but also on the basis of intellectual resources. After that, it is possible to notice that ICMs cannot be considered reliable for every sector but they reveal a high efficiency within the evaluation of certain knowledge-based industries such as Software and computer services and Telecommunications.

Despite the limitations described in the next section, this study provides a valuable contribution regarding two different perspectives (IC and financial-based) within the context of firm evaluation, highlighting that in certain sectors, featured by a high use of Intellectual resources, ICMs can be considered as valid and reliable.

Practically, analysts could place ICMs alongside EMs in order to obtain a deeper understanding of the "real value" of certain companies, thereby avoiding misconceptions due to the lack of consideration of intellectual resources that are becoming essential to compete in knowledge-based industries and on which managers should be aware.

6.5 Limitations and future research

Although this study provides an original contribution in the topic of the knowledge-based firm evaluation, it contains some limitations. They are mainly related to the following elements:

- Enterprise Multiples (EMs), and Multiples in general, use results-based measures (EBITDA, Earnings, etc.), i.e. measures of output, in their definition (at the

denominator of the Multiples); whereas Intellectual Capital Multiples (ICMs) use investment-based measures, i.e. measures of input, in their definition (at the denominator of the Multiples). It has to be considered that the Value of the Firm is more reasonable linked to results (performance) than investments. In this sense, a measure of the Intellectual Capital performance could be considered for better defining the Intellectual Capital Multiples;

- The sample size considered in this study is not so high. It could be increased to obtain stronger results in further works;
- The representative indicators for Intellectual Capital could be enlarged, considering other indicators.

Therefore the future agenda concerning this research is made up at first of activities that try to resolve the above-mentioned limitations and to improve the quality and reliability of the proposed methodology:

- A measure of performance for investment in Intellectual Capital will be tentatively defined, starting from the variables already proposed or considering other key-variables that can be obtained from financial reports of firms;
- A wider sample of firms will be considered: other stock markets from other countries will be studied, other industries will be included and a larger time range will be considered in order to strengthen the results of research;
- The Intellectual Capital indicators will be further investigated in order to select the ones that are able to better represent the attitude of the firm towards investment in intangibles.

CHAPTER 7: INTELLECTUAL CAPITAL AND ITS MARKET IMPACT

Abstract

This work aims at advancing knowledge about the relationship among Intellectual Capital (IC), firms' performances and market value by investigating 10-year data gathered from a sample of companies listed on the Euronext Stock Exchange. With respect to IC, firms' performances and market value variables, an exploratory study was designed to: (i) highlight linkages amidst the IC components and (ii) prove the consistence of the ties amongst IC, financial performance and firm's value variables. Findings highlighted that: (i) Structural Capital (SC) and Relational Capital (RC) impacted directly on firms' performances and that (ii) only SC, within a certain time horizon, had significant effects on firms' market value. This study could be useful for scholars, who aims at deepening knowledge about the linkage between IC and financials, and for practitioners, to figure out how investments in Intellectual Capital should be addressed to get better financial performances and a higher market value.

7.1 Introduction

During the last decades, the modern Economy has been changing quickly due to the increasingly usage of knowledge-based resources that have revolutionised the way of competing in new marketplaces chiefly characterised by many threats (i.e. technological, financial, etc.) (Hsu and Sabherwal, 2011; Kamukama et al., 2011).

Following these new market changes, firm's market value cannot be evaluated taking account only by using tangible resources but also by adding the "intangible value" (Iazzolino et al., 2013a). To date, knowledge-based resources, represented by the Intellectual Capital resources, often "replaces" the traditional ones: land, capital and work (Stewart, 1997; Sveiby, 1997; Bontis, 1999; Bounfour and Edvinsson, 2005; O'Donnell et al., 2006).

Many authors have focused their attention on the asymmetry between the market and the book value stating that one of the main elements that influence firms' market value is the

Intellectual Capital (Edvinsson, 1997; Sveiby, 1997; and Lynn, 1998); therefore, it has become interesting to study the relationship between it and Market Value.

By looking the past literature, results of different analysis shed light on the fact that there is a "hidden value" that, though it cannot be easily gathered observing only financial statements, it is able to create competitive advantage, particularly in new dynamic markets (Chen et al., 2005; Edvinsson and Malone, 1997; Lev and Zarowin, 1999; Yang and Lin, 2009; Iazzolino et al., 2013a).

Thus, the wide acceptance of the Intellectual Capital as a source of competitive advantage leaded many authors to carry out methodologies that strove to measure this "hidden value", recognising the fact that the traditional accounting and financial measures are not able to show it (Campisi and Costa, 2008; Nazari and Herremans, 2007) representing only a (tangible) part of the "real" firm value. According to Firer and Williams (2003) and Chen et al. (2005), if a market is considered as efficient, investors ascribe a higher value to the firms (obviously operating in that market) having a high value of Intellectual Capital resources.

This work aims to investigate the relationship amidst the Intellectual Capital, firms' performances and market value by measuring separately the effects of:

1. Intellectual Capital investments on firms' financial performances;
2. Intellectual Capital investments on market value;
3. firms' financial performances on market value;

Thus, the study is organised as follow: in its first part, literature regarding the Intellectual Capital (IC) is examined in order to constitute the conceptual base to define the IC-variables to be used during the analysis; in the subsequent part, the research framework, results and discussions are displayed; finally some conclusions and future works are presented.

7.2 Research Framework

Given the objective of investigating the relationship amongst Intellectual Capital (IC), firms' performances and market value (MV), this framework, using 10-year data[16] about

[16] The choice of using 10-year data is justified by the expected effects of Intellectual Capital Investments; as a matter of fact, it is presumable to think that they have impact only considering a medium/long time horizon. Another consideration

45 companies listed on Euronext market stock exchange (Euronext 100), starts from the calculation of Intellectual Capital and financial-based variables to verify the following hypotheses:

Hp. A: There is a relationship (in terms of correlation) amongst the three IC components (HC, SC, RC);

- Hp. A.a: There is a relationship between HC and SC;
- Hp. A.b: There is a relationship between SC and RC;
- Hp. A.c: There is a relationship between HC and RC;

Subsequently, the research moves forward to examine the relationships underlying Intellectual Capital Investments (ICI) and firms' performances according to the hypotheses below displayed:

Hp. 1: The ICI made during the period 2003-2007 positively affect firms' performances over the period 2008-2012;

- Hp. 1.a: The Human Capital Investments (HCI) made during the period 2003-2007 positively affect firms' performances over the period 2008-2012;
- Hp. 1.b: The Structural Capital Investments (SCI) made during the period 2003-2007 positively affect firms' performances over the period 2008-2012;
- Hp. 1.c: The Relational Capital Investments (RCI) made during the period 2003-2007 positively affect firms' performances over the period 2008-2012;

To what concern the relationship between IC and firm's value, the research follows these hypotheses:

Hp. 2: The ICI made during the period 2003-2007 positively affect firm's value over the period 2008-2012;

- *Hp. 2.a: The Human Capital Investments (HCI) made during the period 2003-2007 positively affect firm's value over the period 2008-2012;*
- *Hp. 2.b: The Structural Capital Investments (SCI) made during the period 2003-2007 positively affect firm's value over the period 2008-2012;*

is related to the fact that the Intellectual Capital Investments are initially accounted as costs by firms; thus the revenues generated by them cannot be expected in a short period.

- *Hp. 2.c: The Relational Capital Investments (RCI) made during the period 2003-2007 positively affect firm's value over the period 2008-2012;*

The hypotheses H3 and H4 are similar to H1 and H2 with the only difference of considering a longer period for ICI (2003-2009 instead of 2003-2007); thus, they are:

Hp. 3: The ICI made during the period 2003-2009 positively affect firms' performances over the period 2010-2012;

- *Hp. 3.a: The Human Capital Investments (HCI) made during the period 2003-2009 positively affect firms' performances over the period 2010-2012;*
- *Hp. 3.b: The Structural Capital Investments (SCI) made during the period 2003-2009 positively affect firms' performances over the period 2010-2012;*
- *Hp. 3.c: The Relational Capital Investments (RCI) made during the period 2003-2009 positively affect firms' performances over the period 2010-2012;*

Hp. 4: The ICI made during the period 2003-2009 positively affect firm's value over the period 2010-2012;

- *Hp. 4.a: The Human Capital Investments (HCI) made during the period 2003-2009 positively affect firm's value over the period 2010-2012;*
- *Hp. 4.b: The Structural Capital Investments (SCI) made during the period 2003-2009 positively affect firm's value over the period 2010-2012;*
- *Hp. 4.c: The Relational Capital Investments (RCI) made during the period 2003-2009 positively affect firm's value over the period 2010-2012;*

After having explored separately the effects of the ICI on both firms' performances and firm's value, the next step consists of seeking a possible relationship between the overall performance and the value of a firm. Therefore, the following hypotheses have been defined (Hp. 5 and Hp. 6):

Hp. 5: firms' performances obtained during the period 2008-2012 positively affect firm's value considering the same time horizon;

Hp. 6: firms' performances obtained during the period 2008-2012 positively affect firm's value considering the same time horizon;

The framework containing the hypotheses above mentioned is showed by the Figure 28 below:

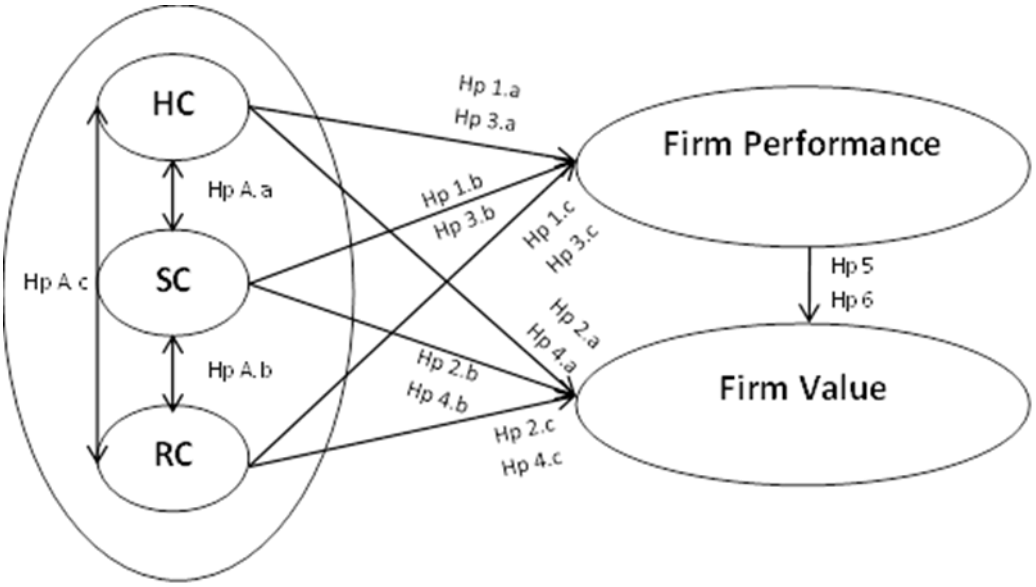

Figure 28: Conceptual Research Framework

7.3 The empirical analysis

7.3.1 Dataset

The sample used in this research is made up of 45 firms listed on Euronext stock exchange. In a first step, the choice was based on the value of the stock market index Euronext 100 that represents the 100 titles having the highest capitalisation and most actively negotiated on Euronext[17]. Ten-year Data (from 2003 to 2012) have been harvested from Thomson Reuters DATASTREAM database.

Table 45 describes the sample as a whole:

Idustry: ***Energy and Chemicals Industry (13 firms)***				
Shell	Total	EDF	Schneider Electric	ASML Holding
Galp Energia	Sanofi	Air Liquide	Essilor	Legrande
Veolia Environment	DSM	Solvay		
Idustry: ***Consumer Goods and Retail Industry (10 firms)***				
Ab_Inbev	Heineken	L'Oréal	Unilever	Danone
Kering	Carrefour	Ahold Kon.	Jéronimo Martins	Pernod Ricard
Industry: ***ICT (7 firms)***				
Philips	France Télécom S.A.	Vivendi	Dassault Systèmes	Iliad

[17] Concerning the first step, some firms had to be deleted due to the lack of data (also due to the fact that exists an absence of tools able to measure and report the Intellectual Capital within the traditional financial statements) for the period of which this research takes account; furthermore, some companies do not disclose reports about Intellectual Capital to not reveal strategic information that could favor their competitors.

KPN	Gemalto			
Industry: *Engineering and Aerospace and Defense (11 firms)*				
EADS	Bureau Veritas	Vinci	Saint-Gobain S.A.	Lafarge
Renault	ArcelorMittal	Michelin	Technip	STM
Vallourec				
Industry: *Services Marketing (4 firms)*				
Publicis Groupe	Sodexo Alliance	Accor	JC Decaux	

Table 45: The Sample

7.3.2 Variables

In order to discover the relationships underlying IC, firms' performances and firm's value, seven variables have been defined by the authors, according to the literature regarding Intellectual Capital and firms' performance evaluation (Guo et al., 2012; Murthy and Mouritsen, 2011, F-Jardón and Martos, 2009; Li and Wu, 2004; Mention and Bontis, 2013).

In particular, the variables chosen are described in Table 46:

Macro-variable	Variable	Description
Human Capital	*Cost of Employees / No. Employees*	It is the average cost of personnel consisting of salaries paid to the employees including benefits and contributes of them. High values of this index means there is higher staff remuneration than that of the market due either to nature of contracts or to the prevalence of high-skilled employees.
	Training Hours / No. Employees	It represents the number of training hours for each employee. It could be interpreted as the commitment of an organisation to invest in human capital by defining training courses aiming at raising employees' productivity and creativity.
Structural Capital	*Intangible Assets / Total Assets*	It is the percentage of the intangible assets available in a certain organisation. Intangibles are made up of resources often classified as Intellectual Property Resources like patents, marks, copyrights, brands, etc. A high value of this ratio means there is a high Structural Capital within an organisation.
	R&D / Sales	It represents the quantity of Sales invested in R&D activities. This ratio depends not only by the willingness of an organisation to invest in R&D but also by the industry in which an organisation operates and by the technological advancement of that sector (i.e. pharmaceutical companies generally have a higher value for this ratio due to the high technological advancements in the sector in which they compete).
	R&D / No. Employees	It is the expression of the R&D cost associated to each employee. This ratio makes possible to evaluate the impact of R&D activities on a single employee, assuming that each of them is involved in that those activities.
Relational Capital	*Sales / No. Employees*	It is the percentage of Sales generated by each employee; thus it is a sort of productivity index of each employee.
	Universities and other Partnerships	It is a binary indicator (Yes/Not). It represents the existence of relationships amidst organisations, universities, research centres, etc. These relationships aim both at enhancing the capacity of innovating of an organisation and solving environmental issues.
Firm Performance	*EBITDA / Sales*	It is a profitability index that represents the percentage of EBITDA generated by the Sales.
	Cash ROCE = EBITDA / Capital Employed[18]	It is the percentage of EBITDA generated by the investments made by an organisation. This indicator is useful to identify companies having high growth capacities.

[18] Capital Employed = Total Assets – Current Liabilities

Macro-variable	Variable	Description
Firm Value	*Market to Book ratio = MV / BV*	It is used to investigate the gap existing between MV, calculated as share price * number of shares, and the BV (net book value of assets – net book value of liabilities). The concept underlying this ratio is that the gap between MV and BV is due to the "real" value of intangible resources.
	EV / EBITDA	It is a market multiple referring to the incomes. It represents the Enterprise Value (Equity + Debts) generated by the companies operating margins/incomes.

Table 46: Variables description

7.3.3 The computational analysis

To what concerns the analysis carried out to investigate the hypotheses above displayed (in the section 3), the first step was related to the quantification of all variables (both belonging to IC and financial measures); afterwards, the obtained results showed that variables had different measure units; thus in this sense, the authors proceeded to a standardisation (in a range [1; 10]) of them according to the min-max criterion[19].

After having standardised the variables values, the following step was devoted to the computation of two approaches:

Correlation analysis, to highlight linkages amidst IC variables (*Hp. A.a, Hp. A.b, Hp. A.c*);

Linear regression, to prove the consistence of the ties amongst IC, financial performance and firm's value variables.

Linear regressions needed to take account of different time horizons (according the hypotheses), thus, in a first instance, they had been based on two general formulations and then they were particularised to scan each hypothesis; therefore, here the authors present the two basic regression equations:

[19] Min-max normalisation is best suited for the case where the bounds (maximum and minimum value) of the score produced by a matcher are known (Jain et al., 2005). The min-max formula is shown below:

$$y'm = \frac{ym - min}{max - min}(max' - min') + min'$$

where, taking account of a series y:
y'm is the value that we would obtain;
ym is the pattern m where m = 1,.., M;
min is the minimum value in the series of values;
max is the maximum value in the series of values;
max' is the maximum value of the predetermined range (that we would get);
min' is the minimum value of the predetermined range (that we would get).

Equation 1:

$$Firm\ Performance = \beta0 + \beta1 * \frac{\text{Cost Of Employees}}{\text{NE}} + \beta2 * \frac{\text{Training Hours}}{\text{NE}} + \beta3 * \frac{\text{Intangible Assets}}{\text{Total Assets}} + \beta4 * \frac{R\&D}{\text{NE}} + \beta5 * \frac{R\&D}{\text{Sales}} + \beta6 * \frac{\text{Sales}}{\text{NE}} + \beta7 * \text{University}\&Environmental\ Partnership + \varepsilon$$

Equation 2:

$$Firm\ Value = \beta0 + \beta1 * \frac{\text{Cost Of Employees}}{\text{NE}} + \beta2 * \frac{\text{Training Hours}}{\text{NE}} + \beta3 * \frac{\text{Intangible Assets}}{\text{Total Assets}} + \beta4 * \frac{R\&D}{\text{NE}} + \beta5 * \frac{R\&D}{\text{Sales}} + \beta6 * \frac{\text{Sales}}{\text{NE}} + \beta7 * \text{University}\&Environmental\ Partnership + \varepsilon$$

Dependent and independent variables have been computed by their average values over the period considered in the particularized models.

Here, the models that take account of the different time horizons are showed:

Model 1.1

$$\boldsymbol{EBITDA/Sales_{avg2008\text{-}2012}} = \beta0 + \beta1 * \frac{Cost\ Of\ Employees}{NE}_{\text{avg 2003-2007}} + \beta2 * \frac{Training\ Hours}{NE}_{\text{avg 2003-2007}} + \beta3 * \frac{Intangible\ Assets}{Total\ Assets}_{\text{avg 2003-2007}} + \beta4 * \frac{RandD}{NE}_{\text{avg 2003-2007}} + \beta5 * \frac{RandD}{Sales}_{\text{avg 2003-2007}} + \beta6 * \frac{Sales}{NE}_{\text{avg 2003-2007}} + \beta7 * UniversityandEnvironmental\ Partnership_{\text{avg 2003-2007}} + \varepsilon$$

Model 1.2

$$\boldsymbol{Cash\ Roce_{avg2008\text{-}2012}} = \beta0 + \beta1 * \frac{Cost\ Of\ Employees}{NE}_{\text{avg 2003-2007}} + \beta2 * \frac{Training\ Hours}{NE}_{\text{avg 2003-2007}} + \beta3 * \frac{Intangible\ Assets}{Total\ Assets}_{\text{avg 2003-2007}} + \beta4 * \frac{RandD}{NE}_{\text{avg 2003-2007}} + \beta5 * \frac{RandD}{Sales}_{\text{avg 2003-2007}} + \beta6 * \frac{Sales}{NE}_{\text{avg 2003-2007}} + \beta7 * UniversityandEnvironmental\ Partnership_{\text{avg 2003-2007}} + \varepsilon$$

Model 2.1

$$\boldsymbol{MV/BV}_{\boldsymbol{avg2008\text{-}2012}} = \beta 0 + \beta 1 * \frac{Cost\ Of\ Employees}{NE}_{\text{avg 2003-2007}} + \beta 2 * \frac{Training\ Hours}{NE}_{\text{avg 2003-2007}} + \beta 3 * \frac{Intangible\ Assets}{Total\ Assets}_{\text{avg 2003-2007}} + \beta 4 * \frac{RandD}{NE}_{\text{avg 2003-2007}} + \beta 5 * \frac{RandD}{Sales}_{\text{avg 2003-2007}} + \beta 6 * \frac{Sales}{NE}_{\text{avg 2003-2007}} + \beta 7 * UniversityandEnvironmental\ Partnership_{\text{avg 2003-2007}} + \varepsilon$$

Model 2.2

$$\boldsymbol{EV/EBITDA}_{\boldsymbol{avg2008\text{-}2012}} = \beta 0 + \beta 1 * \frac{Cost\ Of\ Employees}{NE}_{\text{avg 2003-2007}} + \beta 2 * \frac{Training\ Hours}{NE}_{\text{avg 2003-2007}} + \beta 3 * \frac{Intangible\ Assets}{Total\ Assets}_{\text{avg 2003-2007}} + \beta 4 * \frac{RandD}{NE}_{\text{avg 2003-2007}} + \beta 5 * \frac{RandD}{Sales}_{\text{avg 2003-2007}} + \beta 6 * \frac{Sales}{NE}_{\text{avg 2003-2007}} + \beta 7 * UniversityandEnvironmental\ Partnership_{\text{avg 2003-2007}} + \varepsilon$$

Model 3.1

$$\boldsymbol{EBITDA/Sales}_{\boldsymbol{avg2010\text{-}2012}} = \beta 0 + \beta 1 * \frac{Cost\ Of\ Employees}{NE}_{\text{avg 2003-2009}} + \beta 2 * \frac{Training\ Hours}{NE}_{\text{avg 2003-2009}} + \beta 3 * \frac{Intangible\ Assets}{Total\ Assets}_{\text{avg 2003-2009}} + \beta 4 * \frac{RandD}{NE}_{\text{avg 2003-2009}} + \beta 5 * \frac{RandD}{Sales}_{\text{avg 2003-2009}} + \beta 6 * \frac{Sales}{NE}_{\text{avg 2003-2009}} + \beta 7 * UniversityandEnvironmental\ Partnership_{\text{avg 2003-2009}} + \varepsilon$$

Model 3.2

$$\boldsymbol{Cash\ ROCE}_{\boldsymbol{avg2010\text{-}2012}} = \beta 0 + \beta 1 * \frac{Cost\ Of\ Employees}{NE}_{\text{avg 2003-2009}} + \beta 2 * \frac{Training\ Hours}{NE}_{\text{avg 2003-2009}} + \beta 3 * \frac{Intangible\ Assets}{Total\ Assets}_{\text{avg 2003-2009}} + \beta 4 * \frac{RandD}{NE}_{\text{avg 2003-2009}} + \beta 5 * \frac{RandD}{Sales}_{\text{avg 2003-2009}} + \beta 6 * \frac{Sales}{NE}_{\text{avg 2003-2009}} + \beta 7 * UniversityandEnvironmental\ Partnership_{\text{avg 2003-2009}} + \varepsilon$$

Model 4.1

$$\boldsymbol{MV/BV}_{\boldsymbol{avg2010\text{-}2012}} = \beta 0 + \beta 1 * \frac{Cost\ Of\ Employees}{NE}_{\text{avg2003-2009}} + \beta 2 * \frac{Training\ Hours}{NE}_{\text{avg2003-2009}} + \beta 3 * \frac{Intangible\ Assets}{Total\ Assets}_{\text{avg2003-2009}} + \beta 4 * \frac{RandD}{NE}_{\text{avg2003-2009}} + \beta 5 * \frac{RandD}{Sales}_{\text{avg2003-2009}} + \beta 6 * \frac{Sales}{NE}_{\text{avg2003-2009}} + \beta 7 * UniversityandEnvironmental\ Partnership_{\text{avg 2003-2009}} + \varepsilon$$

Model 4.2

$$EV/EBITDA_{avg2010\text{-}2012} = \beta 0 + \beta 1 * \frac{Cost\ Of\ Employees}{NE}_{avg2003\text{-}2009} + \beta 2 * \frac{Training\ Hours}{NE}_{avg2003\text{-}2009} + \beta 3 * \frac{Intangible\ Assets}{Total\ Assets}_{avg2003\text{-}2009} + \beta 4 * \frac{RandD}{NE}_{avg2003\text{-}2009} + \beta 5 * \frac{RandD}{Sales}_{avg2003\text{-}2009} + \beta 6 * \frac{Sales}{NE}_{avg2003\text{-}2009} + \beta 7 * UniversityandEnvironmental\ Partnership_{avg2003\text{-}2009} + \varepsilon$$

To consider also the hypotheses *Hp. 5* and *Hp. 6* related to the possible existing linkage between firm's value and firms' performances; other two regressions models have been formulated; in both models the authors treated firm's value variables as dependents and firms' performance ones as independents. Even in this case, variables have been computed according their average values over the different time horizons.

Model 5.1:

$$MV/BV_{avg2008\text{-}2012} = \beta 0 + \beta 1 * EBITDA/Sales_{avg2008\text{-}2012} + \beta 2 * Cash\ ROCE_{avg2008\text{-}2012} + \varepsilon$$

Model 5.2:

$$EV/EBITDA_{avg2008\text{-}2012} = \beta 0 + \beta 1 * EBITDA/Sales_{avg2008\text{-}2012} + \beta 2 * Cash\ ROCE_{avg2008\text{-}2012} + \varepsilon$$

Model 6.1:

$$MV/BV_{avg2010\text{-}2012} = \beta 0 + \beta 1 * EBITDA/Sales_{avg2010\text{-}2012} + \beta 2 * Cash\ ROCE_{avg2010\text{-}2012} + \varepsilon$$

Model 6.2:

$$EV/EBITDA_{avg2010\text{-}2012} = \beta 0 + \beta 1 * EBITDA/Sales_{avg2010\text{-}2012} + \beta 2 * Cash\ ROCE_{avg2010\text{-}2012} + \varepsilon$$

7.3.3.1 Correlation Analysis

As it has been argued previously, in the first instance, the authors carried out a correlation analysis (considering the different time horizons) to start measuring the kind and the intensity of the relationships amidst the variables showed by Table 46. To conduct this analysis it has been used the Pearson coefficient calculated by IBM SPSS Statistics; results are following showed (Table 47):

Correlation Analysis												
		CostofEmployees/NE	***TrainingHours/NE***	***IATA***	***R&D/Sales***	***R&D/NE***	***Sales/NE***	***UniversityPartnership***	***MV/BV***	***EV/EBITDA***	***EBITDA/SALES***	***CashROCE***
CostofEmployees/NE	Pearson	1	,109	-,256	,128	,599**	,379*	-,292	-,085	,279	,181	,115
	Sig. (2-tails)		,561	,093	,458	,000	,011	,054	,582	,066	,240	,457
	N	44	31	44	36	36	44	44	44	44	44	44
TrainingHours/NE	Pearson	,109	1	-,178	-,159	,045	,117	-,283	-,247	-,077	,127	,277
	Sig. (2-tails)	,561		,330	,429	,825	,525	,117	,173	,676	,488	,126
	N	31	32	32	27	27	32	32	32	32	32	32
IATA	Pearson	-,256	-,178	1	,177	-,199	-,396**	,012	,137	-,219	,350*	-,043
	Sig. (2-tails)	,093	,330		,295	,238	,007	,938	,370	,148	,018	,777
	N	44	32	45	37	37	45	45	45	45	45	45
R&D/Sales	Pearson	,128	-,159	,177	1	,123	-,116	-,255	,042	,068	,440**	-,140
	Sig. (2-tails)	,458	,429	,295		,469	,493	,127	,805	,689	,006	,408
	N	36	27	37	37	37	37	37	37	37	37	37
R&D/NE	Pearson	,599**	,045	-,199	,123	1	-,010	-,275	,220	,665**	,040	-,040
	Sig. (2-tails)	,000	,825	,238	,469		,955	,100	,190	,000	,812	,813
	N	36	27	37	37	37	37	37	37	37	37	37
Sales/NE	Pearson	,379*	,117	-,396**	-,116	-,010	1	,141	-,047	,049	-,078	,259
	Sig. (2-tails)	,011	,525	,007	,493	,955		,354	,759	,747	,612	,085

	N	44	32	45	37	37	45	45	45	45	45	45
UniversityPartnership	Pearson	-,292	-,283	,012	-,255	-,275	,141	1	-,309*	-,128	-,282	-,291
	Sig. (2-tails)	,054	,117	,938	,127	,100	,354		,039	,403	,060	,053
	N	44	32	45	37	37	45	45	45	45	45	45
MV/BV	Pearson	-,085	-,247	,137	,042	,220	-,047	-,309*	1	,244	,182	,591**
	Sig. (2-tails)	,582	,173	,370	,805	,190	,759	,039		,106	,231	,000
	N	44	32	45	37	37	45	45	45	45	45	45
EV/EBITDA	Pearson	,279	-,077	-,219	,068	,665**	,049	-,128	,244	1	,042	,020
	Sig. (2-tails)	,066	,676	,148	,689	,000	,747	,403	,106		,783	,894
	N	44	32	45	37	37	45	45	45	45	45	45
EBITDA/SALES	Pearson	,181	,127	,350*	,440**	,040	-,078	-,282	,182	,042	1	,206
	Sig. (2-tails)	,240	,488	,018	,006	,812	,612	,060	,231	,783		,176
	N	44	32	45	37	37	45	45	45	45	45	45
CashROCE	Pearson	,115	,277	-,043	-,140	-,040	,259	-,291	,591**	,020	,206	1
	Sig. (2-tails)	,457	,126	,777	,408	,813	,085	,053	,000	,894	,176	
	N	44	32	45	37	37	45	45	45	45	45	45
****correlation is significant at the level 0,05 (2-tails)***												
***** correlation is significant at the level 0,01 (2-tails)***												

Table 47: Correlation Analysis considering the periods 2003-2007 (independent variables) and 2008-2012 (dependent variables)

Table 47 highlights a significant correlation (ρ = 0,599) between the average cost of personnel and *R&D/NE*, this means that for a firm the greater the investments made in R&D the higher the qualification of its employees, consequently, cost of personnel is higher. This association results coherent with the *Hp A.a*.

To what concerns the *Hp. A.c*, it is verified by the positive correlation (ρ = 0,379) between the average cost of personnel and the average revenue (Sales) per employee.

By contrast, the *Hp A.b*, related to the possible relation between *Intangible Assets/Total Assets* (*IATA*) and *Sales/NE* has not been verified as demonstrated by the negative correlation (ρ = -0,396). Furthermore, another negative correlation (ρ = -0,309) has been identified in the relationship between *University and Environmental Partnership* and *MV/BV*. This finding seems to contrast what it was stated by the *Hp 2.c* (investing in Relational Capital could result in a better firm evaluation within the stock market); however, such considerations are investigated deeply through the regression analysis.

Regarding the possible relations involving Structural Capital, it has been noticed a positive correlation (ρ = 0,665) between *R&D/NE* and *EV/EBITDA*. Observing the relationships amongst independent and dependent variables referring to the firm performance, it has been found that *EBITDA/Sales* has positive relations both with *Intangible Assets /Total Assets* and *R&D/Sales* respectively ρ = 0,350 and ρ = 0,440. Such correlations are inclined to prove the *Hp 1.b* (positive affections provided by Structural Capital Investments on Firm Performance).

Concerning the relationships amidst firms' performances and firm's value, *Hp 5* is partially verified; in fact, correlation analysis show a positive linkage (ρ = 0,591) between *MV/BV* and *Cash ROCE*, which would demonstrate (partially) the hypothesis beforehand mentioned.

In conclusion, insights emerged from the correlation analysis (referring to the periods 2003-2007 for independent variables and 2008-2012 for dependent ones) highlighted a link amongst intangible resources belonging to the Structural Capital both with firms' performance and firm's value variables.

In the same way, in order to investigate the hypotheses *Hp. 3*, *Hp. 4*, and *Hp. 6*, a correlation analysis using values obtained for the periods 2003-2009 for independent variables and 2010-2012 for dependent ones have been carried out and results are summarised in Table 48 as follow:

Correlation analysis												
		CostofEmployees /NE	***Training Hours/NE***	***IATA***	***R&D/Sales***	***R&D/NE***	***Sales/NE***	***UniversityPartnership***	***MV/BV***	***EV/EBITDA***	***EBITDA/ SALES***	***CashROCE***
CostofEmployees/NE	Pearson	1	,162	-,283	-,270	,612**	,409**	-,248	-,089	-,297	,167	,157
	Sig. (2-tails)		,385	,063	,106	,000	,006	,104	,566	,050	,277	,307
	N	44	31	44	37	36	44	44	44	44	44	44
TrainingHours/ NE	Pearson	,162	1	-,252	-,112	,089	,154	-,192	-,311	-,380*	,072	,258
	Sig. (2-tails)	,385		,164	,577	,667	,400	,293	,084	,032	,695	,154
	N	31	32	32	27	26	32	32	32	32	32	32
IATA	Pearson	-,283	-,252	1	,100	-,175	-,411**	-,100	,149	,186	,299*	-,132
	Sig. (2-tails)	,063	,164		,551	,302	,005	,513	,330	,221	,046	,387
	N	44	32	45	38	37	45	45	45	45	45	45
R&D/Sales	Pearson	-,270	-,112	,100	1	,181	-,126	,247	,018	,056	,051	-,079
	Sig. (2-tails)	,106	,577	,551		,285	,450	,135	,916	,739	,762	,639
	N	37	27	38	38	37	38	38	38	38	38	38
R&D/NE	Pearson	,612**	,089	-,175	,181	1	-,012	-,263	,299	,011	,113	,210
	Sig. (2-tails)	,000	,667	,302	,285		,944	,116	,072	,947	,505	,211
	N	36	26	37	37	37	37	37	37	37	37	37
Sales/NE	Pearson	,409**	,154	-,411**	-,126	-,012	1	,154	-,098	-,223	-,077	,258
	Sig. (2-tails)	,006	,400	,005	,450	,944		,312	,521	,142	,614	,087
	N	44	32	45	38	37	45	45	45	45	45	45
UniversityPartnership	Pearson	-,248	-,192	-,100	,247	-,263	,154	1	-,388**	,039	-,371*	-,335*
	Sig. (2-tails)	,104	,293	,513	,135	,116	,312		,008	,798	,012	,024
	N	44	32	45	38	37	45	45	45	45	45	45
MV/BV	Pearson	-,089	-,311	,149	,018	,299	-,098	-,388**	1	,313*	,111	,609**
	Sig. (2-tails)	,566	,084	,330	,916	,072	,521	,008		,036	,469	,000

	N	44	32	45	38	37	45	45	45	45	45	45
EV/EBITDA	Pearson	-,297	-,380*	,186	,056	,011	-,223	,039	,313*	1	-,090	-,330*
	Sig. (2-tails)	,050	,032	,221	,739	,947	,142	,798	,036		,555	,027
	N	44	32	45	38	37	45	45	45	45	45	45
EBITDA/SALES	Pearson	,167	,072	,299*	,051	,113	-,077	-,371*	,111	-,090	1	,184
	Sig. (2-tails)	,277	,695	,046	,762	,505	,614	,012	,469	,555		,225
	N	44	32	45	38	37	45	45	45	45	45	45
CashROCE	Pearson	,157	,258	-,132	-,079	,210	,258	-,335*	,609**	-,330*	,184	1
	Sig. (2-tails)	,307	,154	,387	,639	,211	,087	,024	,000	,027	,225	
	N	44	32	45	38	37	45	45	45	45	45	45
****correlation is significant at the level 0,05 (2-tails)***												
***** correlation is significant at the level 0,01 (2-tails)***												

Table 48: Correlation Analysis considering the periods 2003-2009 (independent variables) and 2010-2012 (dependent variables)

As it can be noticed, the correlation analysis almost produced the same results previously found even considering an extended time horizon for the independent variables. Insights show that *Cost of Employees/NE* is positively correlated both with *R&D/NE* (ρ = 0,612) and *Sales/NE* (ρ = 0,409); furthermore, there is a positive relation between *Intangible Assets/Total Assets* and *Sales/NE* (ρ = 0,411) and a negative correlation between *University and Environmental Partnership* and *MV/BV* (ρ = -0,388). Another negative relation involves *Training Hours/NE* and *EV/EBITDA* (ρ = -0,380); this tends to contrast the hypothesis claiming that an increase of Human Capital positively affect the firm's value (*Hp. 4.a*).

The *Hp. 3.b* seems to be verified by the positive correlation coefficient (ρ = 0,299) between *Intangible Assets/Total Assets* and *EBITDA/Sales*. By contrast, it has been registered that *University and Environmental Partnership* is negatively related to both *EBITDA/Sales* (ρ = -0,371) and *Cash ROCE* (ρ = -0,335); these insights could reject the *Hp. 3.c*; thus, these are deeply explored by using regression analyses.

As in the first correlation analysis (Table 47), it could be concluded that the hypothesis claiming that there are positive affections of the Structural Capital both on firms' performance and firm's value have been confirmed; consequently, from a strategic perspective, these relations emphasise the increasing tendency of investing in R&D and empowering the Intellectual Property (IP) by the firms taken into account.

Similarly to what happened to *Hp. 5*, *Hp. 6* seems to be partially verified as demonstrated by the correlation coefficient (ρ = 0,591) between *MV/BV I* and *Cash ROCE*.

7.3.3.2 Regression Analysis

Results coming from the correlation analysis allowed the authors to highlight the existence of linkages among ICI and dependent variables (firms' performances and firm's value) beforehand defined. The next step concerned into testing the hypotheses by using multiple linear regression models (displayed in the section 4.3) implemented by IBM SPSS Statistics v21.

The following table (Table 49) displays a summary of the regression analyses conducted in this work, which are related to the hypotheses beforehand mentioned in the research framework:

Model	Dependent Variable	R^2	Significant variables	BETA	Sig.
Model 1.1	EBITDA/Sales	0,600	IATA	0,376	0,038
			R&D/Sales	0,468	0,017
Model 1.2	Cash ROCE	0,489	Sales/NE	0,721	0,005
Model 2.1	MV/BV	0,279	-	-	-
Model 2.2	EV/EBITDA	0,677	R&D/NE	0,840	0,000
Model 3.1	EBITDA/Sales	0,804	IATA	0,241	0,056
			R&D/Sales	0,771	0,000
Model 3.2	Cash ROCE	0,474	Sales/NE	0,57	0,022
Model 4.1	MV/BV	0,513	Training Hours/NE	-0,415	0,045
			R&D/NE	0,423	0,092
Model 4.2	EV/EBITDA	0,653	Cost of Employees/NE	-0,475	0,051
			Training Hours/NE	-0,472	0,010
			University Partnerships	-0,525	0,007
Model 5.1	MV/BV	0,354	Cash ROCE	0,578	0,000
Model 5.2	EV/EBITDA	0,002	-	-	-
Model 6.1	MV/BV	0,371	Cash ROCE	0,609	0,000
Model 6.2	EV/EBITDA	0,110	Cash ROCE	-0,325	0,034

Table 49: Summarised results of the regression analyses

Paying attention to the table above, in the model 1.1, *R&D/Sales* and *Intangible Assets/Total Assets (IATA)* are significant predictors. Such results confirm positive relations previously emerged from the correlation analysis and, as a consequence, the hypothesis arguing that Structural Capital positively affects Firm Performance. The model 1.1 has a $R^2 = 0,600$; in this sense, it is able to explain the 60% of the variability of the *EBITDA/Sales* (dependent variable).

Within the model 1.2 shows that the variable *Sales/NE* is statistically significant in determining *Cash ROCE* ($\beta = 0,721$ and Sig. = 0,005). Further, this model has a $R^2 = 0,489$. Thus, this model identifies a relation between Relational Capital and Firm Performance.

To what concern the model 2.1, R2 = 0,279; thus, this could be considered as a confirmation of what it has been found previously with the correlation analysis (there were no correlations between IC and market value). By observing the output showed in Table 49, it can be noted that there are no significant predictors for *MV/BV*, hence, this model does not verify the hypotheses Hp 2.a, Hp 2.b, Hp 2.c.

In the model 2.2, *R&D/NE* (belonging to the Structural Capital) is the only significant predictor ($\beta = 0,840$) for the *EV/EBITDA*. This can be considered as a confirmation of the

relation previously observed in the correlation analysis; further, the model has a good adaptation to the data according to what it has been stated by the R2 = 0,677.

Summarising the results just exposed, it could be argued that the Structural Capital is the IC component able to affect, to a greater extent, both firm's value and firms' performances. Furthermore, a positive relation between Relational Capital and *Cash ROCE*. In conclusion, the hypotheses Hp. 1.b, 1.c and 2.b are confirmed partially.

In order to have a better understanding of the relations amidst the variables defined in the Table 46, it has been verified if the regression analysis, considering at the same moment an extended time horizon for the independent variables (2003-2009) and a reduced timeframe for the independent ones (2010-2012)[20].

By modifying the two time horizons (for independent and dependent variables), it can be noticed that the model 3.1 is featured by a better adaptation to the data, as demonstrated by a higher R2 compared with the model 1.1. Furthermore, the regression analysis confirmed the Hp. 3.b (related to the relations between SC and firms' performances), which means that *R&D/Sales* is a good predictor if *EBITDA/Sales* is considered as dependent variable.

By investigating the results deriving from the model 3.2, it can be observed that the R2 is almost the same to that of the model 1.2; thus, even in this case, a positive affection of the RC upon firms' performances appears to be proved. As a matter of fact, *Sales/NE* has a significant positive impact on *Cash ROCE*.

Moving towards the model 4.1, it is possible to note that there is a negative relationship between HC and *MV/BV*, particularly considering Training Hours/NE. Thus, the Hp. 4.a has been not verified; whereas to what concern the Hp. 4.b it can be argued that there is a positive relation between *R&D/NE* and *MV/BV*.

The model 4.2 confirmed what it has just been said in the model 4.1, adding another negative relation between RC (University Partnership) and firm's market value (*EV/EBITDA*); thus, the hypotheses Hp. 4.a and 4.c has been partially denied.

The last step of this analysis was to verify the hypotheses 5 and 6, related to a possible relation between firms' performances and firm's market value.

Models 5.1 and 6.1 showed a significant positive linkage between *Cash ROCE* and *MV/BV*; this means that either considering the first timeframe (2008-2012) or the second one (2010-2012); whereas no relations have been found in the model 5.2.

[20] Models: 3.1, 3.2, 4.1, 4.2

Concerning the model 6.2, it has been discovered a negative link between *Cash ROCE* and *EV/EBITDA* within the period 2010-2012; this could means that in a short period *Cash ROCE* could impact negatively upon market value indicators (particularly on *EV/EBITDA*); whereas if a long period is considered, a positive impact can be found; thus, in conclusion, this kind of relation should be investigated looking at longer periods than shorter ones.

7.4 Discussions

The empirical analysis carried out in this work highlighted a positive impact, although it is limited, of the IC upon firms' performances and market value. Thus, an internal correlation amongst the IC components has emerged within both periods 2003-2007 and 2003-2009; it can be displayed as follow (Figure 29):

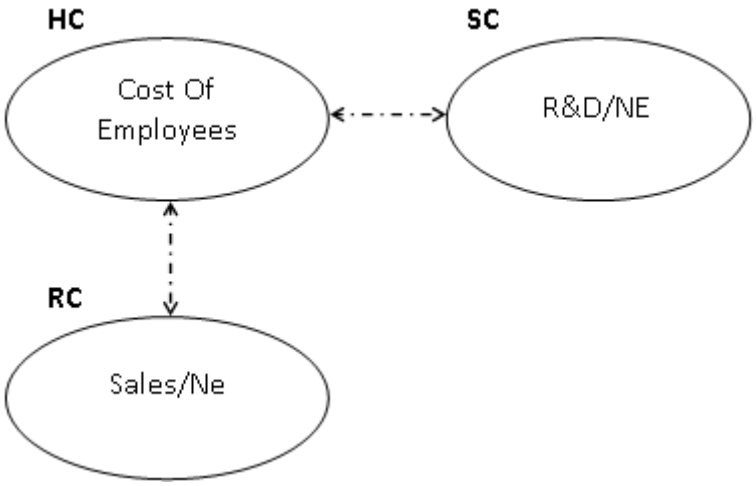

Figure 29: Internal correlation amid IC components

Figure 29 highlights which indicators among those defined in this study (Table 46) and belonging to HC, SC and RC, have had a reciprocal impact to each other. However, no positive relations have been detected between SC and RC as hypothesised by the Hp. A.b.

To what concern the relation amid IC and firms' performances, results have demonstrated that, SC and RC respectively are the IC components able to impact mostly on firms' performances.

It is noteworthy that R&D investments are particularly relevant as confirmed also by the study carried out by Chen et al. (2000), who showed as R&D expenses have positive effects on firm profitability and market value and, further, these allow analysts to acquire information about structural assets. In addition, this study confirms the relations found within the Bank industry by Cabrita and Bontis (2008) who argued that HC has a positive

impact on SC, RC and that these two latter IC components affect positively firms' performances.

Furthermore, it has been observed that the value of *MV/BV*, considering the first timeframe (2008-2012 for the dependent variables), was not influenced by the IC investments. However, in the second period (2010-2012 for the dependent variables) the same indicator (*MV/BV*) was affected negatively by the investments in HC and RC; thus, the empirical analysis does not support what the authors have previously hypothesised. Considering *EV/EBITDA* as indicator of firm's market value, the analysis showed a lack of direct linkages between it and IC with the exception of SC, which affected positively *EV/EBITDA*, verifying what hypothesised partially (Hp. 4.b).

A reason that could explain this result may lie into the fact that Intellectual Capital investments, initially, could not have high positive impact on market value, despite a positive relation with SC has been found. In fact, when an organisation decide to make an investment like these mentioned, it increases its costs (i.e. Cost of employees); consequently, market value could not grow in the periods immediately following those investments. Further, firm's market value does not depend only by the financial context but also by the market expectations. In fact, as demonstrated by Matidinos et al. (2011), market expectations have radically changed starting from 2008, in which many firms viewed their market value decreasing, despite they had improved their financial results. Therefore, changes occurred into market are chiefly linked to external factors rather than only IC and financial investments.

Summarising, in the following Table 50, the results concerning the verification of the hypotheses have been reported:

Hypothesis	***IC component***	***Influenced index (Firms' performances and market value)***
Hp. 1.a	Cost of Employees	-
	Training Hours/NE	-
Hp. 1.b	IATA	**EBITDA/Sales**
	R&D/NE	-
	R&D/Sales	**EBITDA/Sales**
Hp. 1.c	Sales/NE	**Cash ROCE**
	University and Environmental Partnership	-
Hp. 2.a	Cost of Employees	-
	Training Hours/NE	-
Hp. 2.b	IATA	**EV/EBITDA**
	R&D/NE	-

Hypothesis	*IC component*	*Influenced index (Firms' performances and market value)*
	R&D/Sales	-
Hp. 2.c	Sales/NE	
	University and Environmental Partnership	-
Hp. 3.a	Cost of Employees	-
	Training Hours/NE	-
Hp. 3.b	IATA	-
	R&D/NE	-
	R&D/Sales	**EBITDA/Sales**
Hp. 3.c	Sales/NE	**Cash ROCE**
	University and Environmental Partnership	-
Hp. 4.a	Cost of Employees	-
	Training Hours/NE	-
Hp. 4.b	IATA	-
	R&D/NE	-
	R&D/Sales	-
Hp. 4.c	Sales/NE	-
	University and Environmental Partnership	-

Table 50: Hypotheses verification

As it can be seen by the Table 50 above and the two figures below (Figure 30 and Figure 31), correlations and regressions analyses verified not all the hypotheses made by IC literature. As beforehand mentioned, Intellectual Capital investments could not affect positively market value and/or firms' performances immediately, despite positive relationships have been discovered.

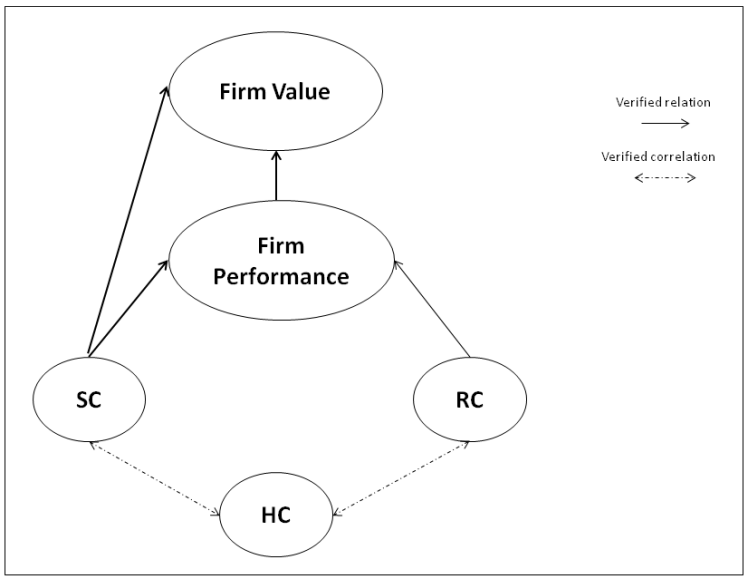

Figure 30: Verified relations and correlations in the first timeframe

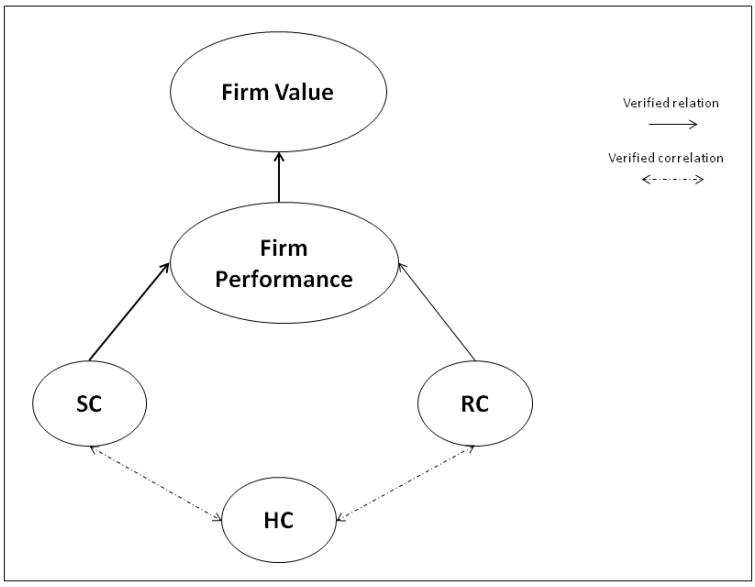

Figure 31: Verified relations and correlations in the second timeframe

Figure 30 and Figure 31 shed lights on the reciprocal influence amid the three IC components by passing through the Human Capital. Furthermore, it could be noticed that only SC and RC affected directly firms' performances; this does not mean that HC does not affect financial performances but just that it does not affect them directly. Several studies such as Bontis (1998), Bontis et al. (2000); Cabrita and Bontis (2008) stated that Human Capital affects performances indirectly by acting chiefly on Relational and Structural Capital. As a matter of fact, human capital has always been defined as the ability to address knowledge in several business contexts such as procedures and processes (Calabrese, 2012; Calabrese and Scoglio, 2012).

It is noteworthy that firms' performances could be considered as a linkage between IC components and firm value; in fact, only in the first timeframe considered by this work there has been found a direct connection between SC and firm value. As just argued could mean that Intellectual Capital may have influence on firm value through an indirect relation passing from firms' performances; thus, it is reasonable to suppose that Intellectual Capital helps to improve firms' performances and as a consequence of it, even market value could be enhanced.

This latter linkage has been verified by the assessed relation between *Cash ROCE* and *MV/BV*, which confirms that market value could be enhanced if a company got a good operating margin (EBITDA) in relation to its investments (Capital Employed). Figure 32 displays as it has just said:

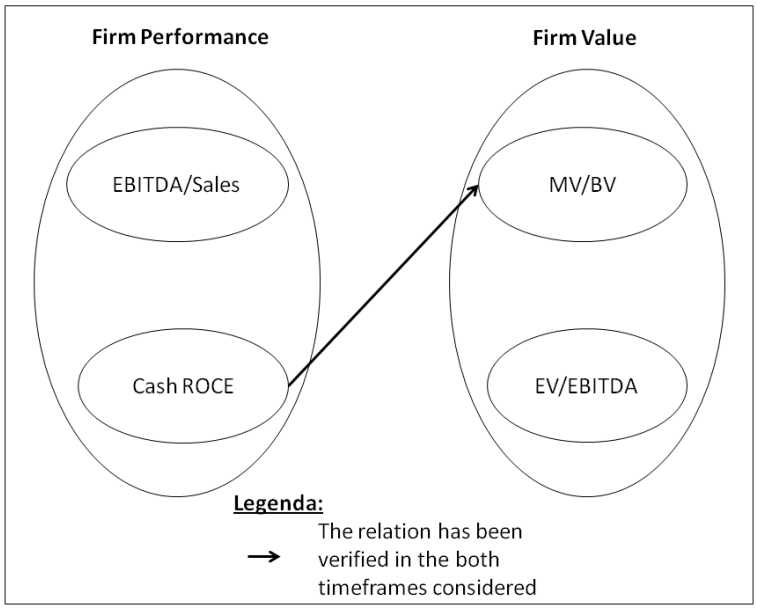

Figure 32: Relation between firms' performances and market value

As it can be noted, the analysis carried out, shows a positive impact of the *Cash ROCE* on the market; this suggests that if a firm achieves, year by year, a greater return for each monetary unit invested (consequently translated as an increase of its *Cash ROCE*), then it is more likely to be better evaluated by the market (with a higher market value).

7.5 Conclusions and future researches

This study drew up two kinds of analyses, correlation and regression respectively, to investigate relationships among IC components, firms' performances and market value, harvesting a sample of companies listed on Euronext 100 from Thomson Reuters DATASTREAM database.

The idea of this work was based on the consideration that the Intellectual Capital is a fundamental asset to get competitive advantage and therefore to compete globally in every market.

The main benefit emerging from this research was to highlight relations among IC, firms' performances and market value; this could be useful, on the one hand, for scholars, to advance knowledge about the linkage between Intellectual Capital and Financial theories; on the other hand, for practitioners, to figure out how investments in Intellectual Capital should be addressed to get better financial performances and a greater market value.

Despite these benefits, some research limitations are listed below:

- It should be considered a larger sample; in fact, such results are referred to only 45 firms (despite finding data is not easy, due to the fact that there is not any standard way to disclose IC data);
- In this research, the authors analysed data by using tools like correlation and linear regression; however, there could be non-linear relations, which cannot be investigated through linear regression.

Therefore, further studies could be carried out taking account of these limitations and then, they should consider a larger sample and also indicators not included in this analysis such as marketing expenses, investments plans in human capital (i.e. investment plans for employees), customer service expenses, customer satisfaction indexes, etc., which can be obtained by examining reporting documents drawn up by firms.

It should be investigated which factors are able to influence the Structural Capital, in order to provide guidelines to the firms and increase their value. Furthermore, other qualitative methodologies and tools to evaluate Intellectual Capital, based i.e. on surveys, need to be developed to get over limitations linked to financial statements data.

In conclusion, it could be argued that this research sheds light on implications that Intellectual Capital components could have on the process of value creation: a firm should pay more attention to the development of its Intellectual Assets as well as to its reporting system to have a clearer vision of its intangible assets on which it should be focused to get competitive advantage in this knowledge era.

CHAPTER 8: A NEW BUSINESS PERFORMANCE SPACE WHERE POSITIONING COMPANIES

Abstract

This research was designed to shed light on what is the role played by Intellectual Capital within firms for the achievement of a leadership positions. Therefore it was examined how Euronex 100 listed companies could be acknowledged amidst market leaders according to two main perspectives: (i) Intellectual Capital commitment and (ii) Financial/market performances. An exploratory study design, involving 10-year data about 45 firms listed on Euronext 100, was carried out. Firstly, firms were classified according to their intellectual capital commitment and their financial performances; then, it was developed a new tool, the Positioning Matrix, which aims at positioning firms into a business space according to the two dimensions by which they were classified in a first instance. Finally, the authors analysed all the changes that the sample firms experienced all over the ten years taken account in this study. This study showed how companies can get the market leadership by using strategies based on their intellectual capital commitment. Particularly, it was empirically found that Intellectual Capital should be considered by every firm, as a necessary, but not sufficient condition to be recognised amongst the market leaders. The main limitation of this study is that it is based on an empirical standpoint; therefore, it could be interesting to verify the findings by using quantitative approaches. Since there are no standard ways to disclose intellectual capital information, some companies have been excluded from the analyses, thus, another limitation is related to the sample that should be enlarged to obtain stronger results. The main benefit of this work is to help practitioners to understand how intellectual capital could contribute to get a better position within the market in which they operate; however, it could be useful even for academics to advance knowledge about the linkage existing between intellectual capital and financial theories, which can be seen as two different but integrated perspectives of firms' performances.

8.1 Introduction

During the last decades, the modern Economy has been experiencing turbulent changes due to the increasingly usage of knowledge-based resources that have revolutionised the way of competing in new marketplaces chiefly characterised by many threats (i.e. technological, financial, etc.) (Hsu and Sabherwal, 2011; Kamukama et al., 2011).

Following these new market changes, firm's market value cannot be evaluated taking account only tangible resources but also by adding the "intangible value" (Iazzolino et al., 2013a). To date, knowledge-based resources, represented by the Intellectual Capital resources, often "replaces" the traditional ones: land, capital and work (Stewart, 1997; Sveiby, 1997; Bontis, 1999; Bounfour and Edvinsson, 2005; O'Donnell et al., 2006).

Although the crucial role of Intellectual Capital have been recognised by both scholars and practitioners as one of the most important ingredient for the firms' growth, companies need to face issues linked to the Intellectual Capital Management mainly due to the difficulty of measuring it (Andrikopoulos, 2005; Kim et al., 2009; Nazari and Herremans, 2007). Hence, many authors have focused their attention on the asymmetry between the market and the book value stating that one of the main elements that influence firms' market value is the Intellectual Capital (Edvinsson, 1997; Sveiby, 1997; and Lynn, 1998); therefore, it has become interesting to study the relationship between it and Market Value.

By looking the past literature, results of different analysis shed lights on the fact that there is a "hidden value" that, though it cannot be easily gathered observing only both the balance sheet and the income statement, it is able to create competitive advantage, particularly for new dynamic markets (Chen et al., 2005; Edvinsson and Malone, 1997; Lev and Radhakrishnan, 2003; Lev and Zarowin, 1999; Lev, 2001; Ruta, 2009; Yang and Lin , 2009; Iazzolino et al., 2013a).

Thus, the wide acceptance of the Intellectual Capital as a source of competitive advantage leaded many authors to carry out methodologies that strove to measure this "hidden value", recognising the fact that the traditional accounting and financial measures are not able to show it (Campisi and Costa, 2008; Nazari and Herremans, 2007) representing only a (tangible) part of the "real" firm value. According to Firer and Williams (2003) and Chen et al. (2005), if a market is considered as efficient, investors ascribe a higher value to the firms (obviously operating in that market) having a high value of Intellectual Capital resources.

To conclude, this work aims to investigate how the Intellectual Capital helps firms to get the financial/market performance leadership by (i) harvesting 10-years data (from 2003 to 2012) on a sample made up by 45 companies listed on the Euronext stock exchange and (ii) developing a new tool for positioning these firms according to two main perspectives:

1. Intellectual Capital;
2. Financial/market performances.

8.2 Research design methodology

Given the objective of investigating how firms' performances could be re-interpreted by looking at two main perspectives, (i) intellectual capital and (ii) financial performances respectively (Iazzolino et al., 2014), an exploratory study design based on Euronext listed firms has been carried out by the authors. The main hypothesis on which this study was based is showed below:

Hp. *High Intellectual Capital investments will lead companies to get the market leadership.*

To verify what it has just been stated, the authors split the general hypothesis in the two following ones:

Hp.1 *Firms with relatively low financial performances can get the market leadership only if their Intellectual Capital commitment is sufficiently good.*

Hp. 2 *Firms with relatively good financial performances will get the market leadership only by investing in Intellectual Capital.*

8.2.1 Dataset

The sample used in this research is made up of 45 firms listed on Euronext stock exchange. In a first step, the choice was based on the value of the stock market index Euronext 100, which represents the 100 titles having the highest capitalisation and most actively negotiated on Euronext[21]. Therefore, ten-year Data (from 2003 to 2012) have been harvested from the Thomson Reuters DATASTREAM database and firms' reports.

[21] Concerning the first step, some firms had to be deleted due to the lack of data (also due to the fact that exists an absence of tools able to measure and report the Intellectual Capital within the traditional financial statements) for the

Therefore, the sample (shown in Table 51) consists of 45 firms belonging to six different industries as follow:

1. *Energy and Chemicals Industry (11 firms);*
2. *Consumer Goods and Retail Industry (11 firms);*
3. *Information and Communication Technology (5 firms);*
4. *Engineering and Aerospace and Defense (9 firms);*
5. *Services marketing (2 firms);*
6. *Financial services (7 firms).*

Industry: *Energy and Chemicals Industry*				
Shell	Total	EDF	Schneider Electric	ASML Holding
Galp Energia	Sanofi	Air Liquide	Essilor	Legrande
AkzoNobel				
Industry: *Consumer Goods and Retail Industry*				
Ab_Inbev	Heineken	L'Oréal	Unilever	Danone
Kering	Carrefour	Ahold Kon.	Jéronimo Martins	Pernod Ricard
LVMH				
Industry: *ICT*				
Philips	France Télécom S.A.	Vivendi	Dassault Systèmes	Iliad
Industry: *Engineering and Aerospace and Defense*				
EADS	Bureau Veritas	Vinci	Saint-Gobain S.A.	Lafarge
Renault	ArcelorMittal	Michelin	Technip	
Industry: *General services and Marketing*				
Publicis Groupe	Sodexo Alliance			
Industry: *Financial services*				
AXA	BNP Paribas	Crédit Agricole S.A.	ING Group	KBC
Société Générale				

Table 51: The Sample

8.2.2 Variables description

In order to discover how Intellectual Capital can help companies to get the market leadership, thirteen variables have been defined by the authors according to the literature linked to Intellectual Capital and firms' performance evaluation (Guo et al., 2012; Murthy

period of which this research takes account; furthermore, some companies do not disclose reports about Intellectual Capital to not reveal strategic information that could favor their competitors.

and Mouritsen, 2011; F-Jardón and Martos, 2009; Li and Wu, 2004; Mention and Bontis, 2013; Gosh and Wu, 2007; Vergauwen et al., 2007; Haslam et al., 2013).

In particular, the variables chosen are described in Table 52:

Macro-variable	Variable	Description
Human Capital	*R&D / No. Employees*	It is the expression of the R&D cost associated to each employee. This ratio makes possible to evaluate the impact of R&D activities on a single employee, assuming that each of them is involved in that those activities.
	Labour cost / Sales	It shows the percentage of sales invested in Human Capital. It could be interpreted as the company interest in investing in its employees.
	Intangible Assets / No. Employees	It is the expression of Intangible Assets associated to each employee. This ratio makes possible to evaluate how investments in Intangibles impact on a single employee.
Structural Capital	*Intangible Assets / Total Assets*	It is the percentage of the intangible assets available in a certain organisation. Intangibles are made up of resources often classified as Intellectual Property Resources like patents, marks, copyrights, brands, etc. A high value of this ratio means there is a high Structural Capital within an organisation.
	R&D / Sales	It represents the quantity of Sales invested in R&D activities (percentage of Sales invested in R&D). This ratio depends not only by the will of an organisation to invest in R&D but also by the industry in which an organisation operates and by the technological advancement of that sector (i.e. pharmaceutical companies generally have a higher value for this ratio due to the high technological advancements in the sector in which they compete). Thus, there is a linkage between R&D and economic growth in spite of problems arisen for evaluating it.
Relational Capital	*Marketing and Distribution expenses / Sales*	It is the percentage of sales invested in marketing and distribution strategies. High investments in marketing and distribution could be interpreted as a measure to express relationships existing between the organisation and its customers.
Firm's Performance	*EBITDA / Sales*	It is a profitability index that represents the percentage of EBITDA generated by the Sales.
	Cash ROCE = EBITDA / Capital Employed[22]	It is the percentage of EBITDA generated by the investments made by an organisation. This indicator is useful to identify companies having high growth capacities. It is one of the most important financial performance measure as stated by Haslam et al. (2013)
	ROE	ROE measures the income available to common stockholders as a percentage of the book value of their investment in the organisation.
	ROA	ROA measures the organisation's ability to use its assets to create profits
Firm Value	*Market to Book ratio = MV / BV*	It is used to investigate the gap existing between MV, calculated as share price * number of shares, and the BV (net book value of assets – net book value of liabilities). The concept underlying this ratio is that the gap between MV and BV is due to the "real" value of intangible resources.
	MV / EBITDA	It is a market multiple referring to the incomes. It represents the Market Value generated by the companies operating margins/incomes.
	MV / Sales	It is a market multiple that represents the Market Value generated by the Sales.

Table 52: Intellectual Capital and Financial variables

8.3 The new Positioning tool

To investigate how Intellectual Capital helps companies to enhance their performances (by looking at both learning and growth and financial perspectives, citing the Balanced Scorecard approach), the authors developed the following methodological steps:

[22] Capital Employed = Total Assets – Current Liabilities.

1. *Intellectual Capital commitment computing*[23]*:* firms were divided into quartiles according to their commitment on Intellectual Capital, thus, a rating ranging from *1* (the lowest commitment) to *4* (the highest commitment) was assigned to them (*4* = 1st quartile; *3* = 2nd quartile; *2* = 3rd quartile; *1* = 4th quartile);

2. *Financial scores computing:* a similar step was carried out to what concern the evaluation of financial performances; hence, companies were rated *1* if they belonged to the 4th quartile, which means they had, in a certain financial year, the worst financial performances; by contrast companies were rated *4* if they belonged to the 1st quartile, which means they had, in a certain financial year, the best financial performances.

3. *Evaluation:* an Intellectual Capital and a financial global score[24] has been calculated (for the all 10-year data) as average of the ratings obtained on each indicator (intellectual capital and financial ones respectively);

$$Global\ IC\ score\ (year\ X)_i = avg\left(score_{i1}; score_{i2}; \dots; score_{ij}; \dots; score_{im}\right), i = 1, \dots, 45\ firms\ and\ j = 1, \dots, 8\ IC\ proxies$$

$$Global\ financial\ score\ (year\ X)_i = avg(score_{i1}; score_{i2}; \dots; score_{ik}; \dots; score_{in}), i = 1, \dots, 45\ firms\ and\ k = 1, \dots, 7\ financial\ ratios$$

4. *Positioning:* On the basis of the global Intellectual Capital and financial scores, firms were positioned in a new tool, which is represented by the following matrix (Figure 33), named as "*Positioning Matrix*":

[23] In presence of missing data, for certain companies, it was assigned "0" as value of the specific IC proxy and "1" as score related to that proxy, since the authors interpreted the lack of IC information as a low Intellectual Capital commitment by those firms.

[24] Intellectual Capital and financial global scores were obtained by looking at the single rating assigned in the previous two methodological steps (1 and 2).

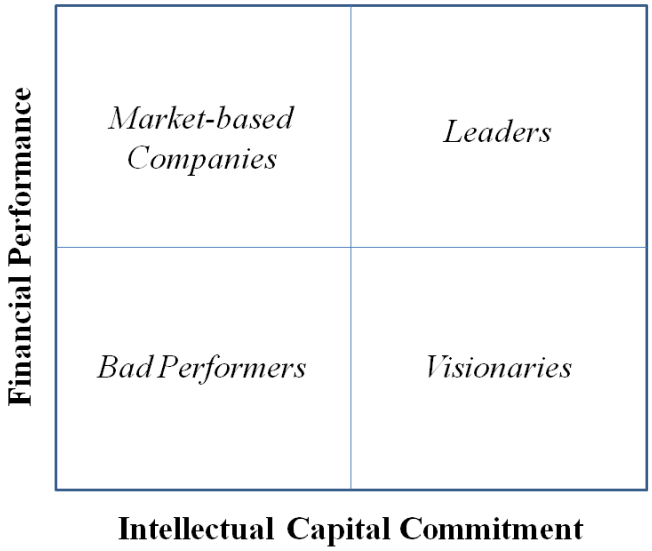

Figure 33: Positioning Matrix

The Positioning Matrix is a tool aiming at providing a graphical competitive positioning of four kinds of firms on the basis of two main dimensions:

(i) ***Intellectual Capital Commitment***: based on Intellectual Capital proxies (displayed in Table 52), it indicates the overall score (ranging from 1 to 4) describing the investments in Intellectual Capital (ICIs - Intellectual Capital Investments) made by a certain company in a certain financial year.

(ii) ***Financial Performance***: based on financial ratios proxies (displayed in Table 52), it indicates the overall score (ranging from 1 to 4) describing the financial/market performance obtained by a certain company in a certain financial year.

Thus, as stated previously, firms could be empirically positioned/classified as:

1. *Leaders*: these companies are characterised by a strong position in the business space. They have even long-term roadmaps due to their investments in Intellectual Capital resources. Since they have both good financial/market and Intellectual Capital performances, it is likely that they will lead the market in which they operate; in fact, leaders have both a strong focus on the future (demonstrated by the Intellectual Capital investments) and a good financial/market performance at present (in the reference year).

2. *Market-based companies*: these companies are generally characterised by a good financial/market performance; as a consequence, financially, they are better positioned, in the business space, better than visionaries. However, they show

difficulties in communicating or delivering their vision for the future; this could be noticed by looking at their low Intellectual Capital investments that highlight how companies classified as "market-based" are generally more focused on a short-term roadmap chiefly based on financial results. Being focused on short-term strategies could be misleading for these firms and may lead them towards a myopic way since they could not be able to adapt their market behaviours in response to innovations (i.e. new technologies, products, services, processes, etc.), which could threaten their actual business model, introduced by competitors, customers, suppliers, etc. Generally, these companies need to improve their Intellectual Capital investments, thus passing from a short-term to a long-term view, to become as strong as Leaders.

3. *Visionaries*: these companies make investments to enhance their Intellectual Capital resources; however, they do not reach a leadership position since they do not perform well in terms of financial/market ratios. Visionaries show a long-term roadmap emphasised by their high investments in Intellectual Capital; thus, they assume some risks even because financial returns are not guaranteed immediately. It is expected that they will get a more stable leadership position for the future if they make the right choices about Intellectual Capital investments; however, companies pursuing a visionary way will not be fully credited if their investment actions do not generate a valuable contribution in terms of new technologies, products, services, processes, etc. for the market (in fact, by measuring the financial ratios it is possible to figure out if their long-term investments are returning or not). Visionaries are different from Bad Performers since the firsts take risks, such as investing in complex R&D projects, to get a better financial performance "returned" from those risks.

4. *Bad Performers*: these kinds of firms are characterised by the lowest Intellectual Capital investments and the worst returns in terms of financial/market performances; consequently, it can be noted that they do not have neither a long-term view nor good financial performance in the reference year (at present). It is expected that they cannot get a leadership position immediately (from a reference year to the next one), thus, they should make towards either short-term (actions aimed at maximising current income by preserving the firm's capital and providing daily liquidity) or long-term choices (actions aimed at investing the firm's capital to get future and stable returns).

8.4 Findings

As claimed previously, this study started evaluating firms on the basis of (i) their commitment in Intellectual Capital and (ii) their financial/market performances; thus, Table 53 shows how Intellectual Capital commitment scores have been computed for a defined reference year (i.e. 2012)[25].

Firm	LC/ SALES	Score	R&D/ NE	Score	R&D/ SALES	Score	IA/ TA	Score	IA/NE	Score	M&DE/ Sales	Score
Ab_Inbev	0,121	1	1,199	3	0,005	3	0,625	4	490,613	4	0,271	4
Aegon	0,068	1	0,000	1	0,000	1	0,003	1	44,577	2	0,190	3
Ahold Kon.	0,136	2	0,000	1	0,000	1	0,107	2	12,552	1	0,020	2
Air Liquide	0,174	3	3,794	3	0,012	3	0,238	2	118,368	3	0,000	1
AkzoNobel	0,199	3	7,133	4	0,023	3	0,260	2	88,006	2	0,241	4
ArcelorMittal	0,148	2	0,902	3	0,003	3	0,090	2	29,656	1	0,109	3
ASML Holding	0,177	3	67,481	4	0,121	4	0,022	1	18,726	1	0,036	2
AXA	0,072	1	0,000	1	0,000	1	0,026	1	202,439	4	0,184	3
BNP Paribas	0,000	1	0,000	1	0,000	1	0,007	1	69,880	2	0,069	3
Bureau Veritas	0,504	4	0,000	2	0,000	2	0,507	4	31,765	1	0,000	1
Carrefour	0,096	1	0,000	1	0,000	1	0,209	2	25,780	1	0,235	4
Crédit Agricole S.A.	0,138	2	0,000	1	0,000	1	0,009	1	197,813	3	0,000	1
Danone	0,137	2	2,510	3	0,012	3	0,564	4	158,836	3	0,229	4
Dassault Systèmes	0,456	4	36,370	4	0,181	4	0,412	3	144,194	3	0,053	2
EADS	0,216	3	22,378	4	0,056	4	0,153	2	95,595	2	0,189	3
EDF	0,160	3	3,406	3	0,007	3	0,073	1	116,571	3	0,000	1
Essilor	0,311	4	3,195	3	0,032	4	0,399	3	53,457	2	0,285	4
France Télécom S.A.	0,238	4	0,000	2	0,000	2	0,435	3	229,851	4	0,000	1
Galp Energia	0,018	1	0,000	1	0,000	1	0,124	2	233,412	4	0,000	1
Heineken	0,163	3	0,000	2	0,000	2	0,500	4	232,639	4	0,046	2
Iliad	0,057	1	0,206	2	0,000	2	0,356	3	257,025	4	0,000	1
ING Group	0,160	3	0,000	2	0,000	2	0,002	1	31,150	1	0,016	2
Jéronimo Martins	0,074	1	0,000	1	0,000	1	0,184	2	12,791	1	0,200	4
KBC	0,168	3	0,000	2	0,000	2	0,005	1	25,975	1	0,048	2
Kering	0,153	2	0,000	2	0,000	2	0,582	4	488,832	4	0,000	1
Lafarge	0,153	2	0,000	1	0,000	1	0,334	3	199,015	4	0,033	2
Legrande	0,008	1	5,955	3	0,044	4	0,645	4	129,348	3	0,024	2
L'Oréal	0,197	3	10,883	4	0,035	4	0,316	3	125,330	3	0,188	3
LVMH	0,171	3	0,649	2	0,002	3	0,394	3	181,630	3	0,151	3
Michelin	0,250	4	5,797	3	0,029	4	0,041	1	7,614	1	0,038	2
Pernod Ricard	0,144	2	0,000	1	0,000	1	0,657	4	948,219	4	0,133	3
Philips	0,280	4	13,719	4	0,065	4	0,393	3	90,433	2	0,228	4
Publicis Groupe	0,617	4	0,000	2	0,000	2	0,403	3	115,635	3	0,000	1
Renault	0,141	2	8,852	4	0,027	4	0,046	1	27,399	1	0,300	4
Saint-Gobain S.A.	0,196	3	2,360	3	0,010	3	0,305	2	73,946	2	0,168	3
Sanofi	0,248	4	43,841	4	0,140	4	0,607	4	520,344	4	0,256	4
Schneider Electric	0,000	1	6,943	4	0,044	4	0,506	4	114,336	2	0,327	4
Shell	0,033	1	11,841	4	0,000	2	0,013	1	39,456	2	0,036	2
Société Générale	0,133	2	0,000	1	0,000	1	0,006	1	45,264	2	0,000	1
Sodexo Alliance	0,458	4	0,000	2	0,000	2	0,443	3	13,275	1	0,193	3
Technip	0,271	4	1,882	3	0,008	3	0,299	2	92,243	2	0,059	3
Total	0,039	1	8,288	4	0,004	3	0,076	2	132,385	3	0,000	1
Unilever	0,123	2	5,831	3	0,020	3	0,478	3	126,267	3	0,266	4
VINCI	0,264	4	0,000	2	0,000	2	0,498	4	0,000	1	0,000	1
Vivendi	0,122	2	0,000	1	0,000	1	0,554	4	554,522	4	0,000	2

Table 53: Intellectual Capital commitment scores (2012)

[25] In Table 53, it was provided an example of the global evaluation to show the readers how the scores were obtained.

A similar evaluation, dubbed as "*Step 2 - Financial performance score computing*" in the methodology, was carried out to assigning a score aiming at synthesising firms' financial/market performances; therefore, the following Table 54 shows how financial/market ratings were computed in a reference financial year (i.e. 2012).

Firm	MTBV	Score	MV/ EBITDA	Score	MV/ Sales	Score	ROE	Score	ROA	Score	Cash ROCE	Score	EBITDA/ Sales	Score
Ab_Inbev	3,3871	**4**	8,4284	**3**	3,4292	**4**	0,1799	**4**	0,1127	**3**	0,2064	**3**	0,4069	**4**
Aegon	0,4832	**1**	2,4866	**1**	0,3058	**1**	0,0671	**2**	0,0067	**1**	0,1052	**1**	0,1230	**2**
Ahold Kon.	1,7972	**3**	5,4061	**2**	0,3281	**1**	0,1384	**3**	0,0812	**3**	0,2316	**3**	0,0607	**1**
Air Liquide	2,9060	**4**	7,9614	**3**	1,9362	**4**	0,1576	**3**	0,1013	**3**	0,2330	**3**	0,2432	**4**
AkzoNobel	1,7195	**2**	-23,5604	**1**	0,7700	**2**	-0,3147	**1**	-0,0697	**1**	-0,0489	**1**	-0,0327	**1**
ArcelorMittal	0,5150	**1**	27,5475	**4**	0,3095	**1**	-0,0736	**1**	-0,0359	**1**	0,0131	**1**	0,0112	**1**
ASML Holding	4,9554	**4**	14,8326	**4**	4,2593	**4**	0,2819	**4**	0,1592	**4**	0,2817	**4**	0,2872	**4**
AXA	0,7453	**1**	5,1650	**2**	0,3107	**1**	0,0971	**2**	0,0080	**1**	0,1155	**1**	0,0601	**1**
BNP Paribas	0,6157	**1**	3,3376	**1**	0,6104	**2**	0,0730	**2**	0,0075	**1**	0,0856	**1**	0,1829	**3**
Bureau Veritas	8,1915	**4**	13,9242	**4**	2,4025	**4**	0,2600	**4**	0,1368	**4**	0,2774	**4**	0,1725	**3**
Carrefour	1,8325	**3**	5,2586	**2**	0,1749	**1**	0,1647	**4**	0,0241	**1**	0,1584	**2**	0,0333	**1**
Crédit Agricole S.A.	0,3826	**1**	4,3685	**2**	0,3045	**1**	-0,1629	**1**	0,0017	**1**	0,0153	**1**	0,0697	**1**
Danone	2,6328	**3**	9,5698	**4**	1,5380	**3**	0,1372	**3**	0,0933	**3**	0,2016	**3**	0,1607	**2**
Dassault Systèmes	4,4363	**4**	15,9206	**4**	5,1720	**4**	0,1416	**3**	0,1489	**4**	0,2742	**4**	0,3249	**4**
EADS	2,3443	**3**	5,7375	**2**	0,4320	**1**	0,1180	**2**	0,0251	**1**	0,3056	**4**	0,0753	**1**
EDF	0,9996	**2**	1,8669	**1**	0,3554	**1**	0,1282	**2**	0,0284	**1**	0,1930	**2**	0,1904	**3**
Essilor	4,4286	**4**	14,5850	**4**	3,2527	**4**	0,1594	**4**	0,1269	**4**	0,2655	**4**	0,2230	**3**
France Télécom S.A.	0,9088	**1**	2,0762	**1**	0,5076	**2**	0,0337	**1**	0,0499	**2**	0,1893	**2**	0,2445	**4**
Galp Energia	1,6791	**2**	8,4743	**3**	0,4864	**2**	0,0625	**1**	0,0471	**2**	0,1358	**1**	0,0574	**1**
Heineken	2,4866	**3**	5,5521	**2**	1,5814	**3**	0,2522	**4**	0,1122	**3**	0,2277	**3**	0,2848	**4**
Iliad	4,2963	**4**	7,8074	**3**	2,3526	**4**	0,1097	**2**	0,0794	**3**	0,3294	**4**	0,3013	**4**
ING Group	0,5501	**1**	5,4527	**2**	0,6360	**2**	0,0508	**1**	0,0036	**1**	0,0308	**1**	0,1166	**2**
Jéronimo Martins	7,5835	**4**	12,3312	**4**	0,8448	**3**	0,2975	**4**	0,1075	**3**	0,4180	**4**	0,0685	**1**
KBC	0,6601	**1**	0,0000	**1**	0,6821	**2**	-0,0260	**1**	0,0000	**1**	0,0000	**1**	0,0000	**1**
Kering	1,5545	**2**	8,4583	**3**	1,8224	**3**	0,0918	**2**	0,0736	**3**	0,1456	**2**	0,2155	**3**
Lafarge	0,8842	**1**	4,7268	**2**	0,8760	**3**	0,0276	**1**	0,0501	**2**	0,1088	**1**	0,1853	**1**
Legrande	2,6359	**3**	8,2068	**3**	1,8796	**3**	0,1587	**3**	0,1291	**4**	0,2180	**3**	0,2290	**4**
L'Oréal	3,0462	**4**	13,4204	**4**	2,8386	**4**	0,1370	**3**	0,1357	**4**	0,2265	**3**	0,2115	**3**
LVMH	2,8689	**3**	10,2015	**4**	2,5076	**4**	0,1394	**3**	0,1201	**4**	0,2432	**3**	0,2458	**4**
Michelin	1,5330	**2**	3,7163	**2**	0,6068	**2**	0,1836	**4**	0,1247	**4**	0,3339	**4**	0,1633	**3**
Pernod Ricard	2,0647	**3**	10,9879	**4**	2,7152	**4**	0,1061	**2**	0,0700	**2**	0,1010	**1**	0,2471	**4**
Philips	1,7093	**2**	8,0211	**3**	0,7682	**2**	0,0198	**1**	0,0391	**2**	0,1597	**2**	0,0958	**2**
Publicis Groupe	2,0600	**3**	7,5241	**3**	1,4377	**3**	0,1598	**4**	0,0661	**2**	0,2364	**3**	0,1911	**3**
Renault	0,4953	**1**	2,0877	**1**	0,2915	**1**	0,0729	**2**	0,0365	**2**	0,1868	**2**	0,1396	**2**
Saint-Gobain S.A.	0,9812	**2**	4,4794	**2**	0,3961	**1**	0,0439	**1**	0,0410	**2**	0,1415	**2**	0,0884	**1**
Sanofi	1,6489	**2**	8,6182	**3**	2,7053	**4**	0,0866	**2**	0,0664	**2**	0,1612	**2**	0,3139	**4**
Schneider Electric	1,8247	**3**	8,2790	**3**	1,2682	**3**	0,1106	**2**	0,0827	**3**	0,1591	**2**	0,1532	**2**
Shell	0,7222	**1**	2,4009	**1**	0,2855	**1**	0,1440	**3**	0,1204	**4**	0,2596	**4**	0,1189	**2**

Firm	MTBV	Score	MV/ EBITDA	Score	MV/ Sales	Score	ROE	Score	ROA	Score	Cash ROCE	Score	EBITDA/ Sales	Score
Société Générale	0,4440	**1**	2,9758	**1**	0,3092	**1**	0,0097	**1**	0,0037	**3**	0,0439	**1**	0,1039	**2**
Sodexo Alliance	3,2561	**4**	7,3449	**3**	0,5417	**2**	0,1730	**4**	0,0799	**1**	0,2409	**3**	0,0738	**1**
Technip	2,4511	**3**	9,4572	**4**	1,1954	**3**	0,1349	**3**	0,0747	**3**	0,1817	**2**	0,1264	**2**
Total	1,2658	**2**	2,7062	**1**	0,5063	**2**	0,1467	**3**	0,1431	**4**	0,3583	**4**	0,1871	**3**
Unilever	2,9470	**4**	5,3817	**2**	0,8704	**3**	0,2955	**4**	0,1563	**4**	0,3669	**4**	0,1617	**2**
VINCI	1,5550	**2**	3,7158	**1**	0,5292	**2**	0,1437	**3**	0,0601	**2**	0,1889	**2**	0,1424	**2**
Vivendi	1,2149	**2**	3,3806	**1**	0,7737	**3**	0,0089	**1**	0,0466	**2**	0,2134	**3**	0,2289	**3**

Table 54: Financial/market performance scores (2012)

Computations regarding the Intellectual Capital commitment and the financial performances that firms obtained within the period 2003-2012 were followed by what the authors labelled "*Evaluation*" in the methodological steps. It aimed at assessing the overall scores obtained by each company in the two perspectives considered in this study: Intellectual Capital and financial/market respectively. As done for the previous steps, the following Table 55 summarises the outcomes obtained in a sample year, 2012[26], by the analysis:

[26] Findings obtained for all the 10-year data can be found by looking at the Annexes.

Firm	RD/NE	LC/SALES	RD/ SALES	IATA	IA/ Sales	IA/NE	M&DE/ Sales	Sales/ NE	IC score	MTBV	MV/ EBITDA	MV/ Sales	ROE	ROA	Cash ROCE	EBITDA/ Sales	Financial score
Ab_Inbev	3	1	3	4	4	4	4	2	**3,13**	4	3	4	4	3	3	4	**3,57**
Aegon	1	4	2	1	1	2	3	4	**2,25**	1	1	1	2	1	1	2	**1,29**
Ahold Kon.	1	1	1	2	1	1	2	2	**1,38**	3	2	1	3	3	3	1	**2,29**
Air Liquide	3	1	3	2	2	3	2	3	**2,38**	4	3	4	3	3	3	4	**3,43**
AkzoNobel	4	3	3	2	2	2	4	3	**2,88**	2	1	2	1	1	1	1	**1,29**
ArcelorMittal	1	3	3	2	2	1	3	2	**2,13**	1	4	1	1	1	1	1	**1,43**
ASML Holding	4	1	4	1	1	1	2	4	**2,25**	4	4	4	4	4	4	4	**4,00**
AXA	2	2	1	1	2	4	3	4	**2,38**	1	2	1	2	1	1	1	**1,29**
BNP Paribas	2	1	1	1	2	2	3	3	**1,88**	1	1	2	2	1	1	3	**1,57**
Bureau Veritas	1	2	1	4	3	1	1	1	**1,75**	4	4	4	4	4	4	3	**3,86**
Carrefour	1	3	1	2	2	1	4	2	**2,00**	3	2	1	4	1	2	1	**2,00**
Crédit Agricole S.A.	1	3	1	1	2	3	1	4	**2,00**	1	2	1	1	1	1	1	**1,14**
Danone	3	1	3	4	3	3	4	1	**2,75**	3	4	3	3	3	3	2	**3,00**
Dassault Systèmes	4	3	4	3	3	3	2	1	**2,88**	4	4	4	3	4	4	4	**3,86**
EADS	4	3	4	2	2	2	3	3	**2,88**	3	2	1	2	1	4	1	**2,00**
EDF	3	3	3	1	2	3	1	4	**2,50**	2	1	1	2	1	2	3	**1,71**
Essilor	3	3	4	3	3	2	4	1	**2,88**	4	4	4	4	4	4	3	**3,86**
France Télécom S.A.	2	2	2	3	4	4	1	2	**2,50**	1	1	2	1	2	2	4	**1,86**
Galp Energia	1	4	2	2	1	4	1	4	**2,38**	2	3	2	1	2	1	1	**1,71**
Heineken	2	2	2	4	4	4	2	2	**2,75**	3	2	3	4	3	3	4	**3,14**
Iliad	2	4	2	3	3	4	1	4	**2,88**	4	3	4	2	3	4	4	**3,43**
ING Group	2	4	1	1	1	1	2	4	**2,00**	1	2	2	1	1	1	2	**1,43**
Jéronimo Martins	1	2	2	2	1	1	4	1	**1,75**	4	4	3	4	3	4	1	**3,29**
KBC	1	2	1	1	1	1	2	2	**1,38**	1	1	2	1	1	1	1	**1,14**
Kering	2	4	2	4	4	4	1	3	**3,00**	2	3	3	2	3	2	3	**2,57**
Lafarge	1	3	2	3	4	4	2	2	**2,63**	1	2	3	1	2	1	1	**1,57**
Legrande	3	2	4	4	4	3	2	1	**2,88**	3	3	3	3	4	3	4	**3,29**
L'Oréal	4	2	4	3	3	3	3	3	**3,13**	4	4	4	3	4	3	3	**3,57**
LVMH	2	1	2	3	3	3	3	2	**2,38**	3	4	4	3	4	3	4	**3,57**
Michelin	3	2	4	1	1	1	2	1	**1,88**	2	2	2	4	4	4	3	**3,00**
Pernod Ricard	2	2	2	4	4	4	3	3	**3,00**	3	4	4	2	2	1	4	**2,86**
Philips	4	2	4	3	3	2	4	1	**2,88**	2	3	2	1	2	2	2	**2,00**
Publicis Groupe	1	4	1	3	4	3	1	1	**2,25**	3	3	3	4	2	3	3	**3,00**
Renault	4	3	4	1	1	1	4	3	**2,63**	1	1	1	2	2	2	2	**1,57**
Saint-Gobain S.A.	3	4	3	2	2	2	3	2	**2,63**	2	2	1	1	2	2	1	**1,57**
Sanofi	4	4	4	4	4	4	4	3	**3,88**	2	3	4	2	2	2	4	**2,71**
Schneider Electric	4	3	4	4	3	2	4	1	**3,13**	3	3	3	2	3	2	2	**2,57**
Shell	4	1	3	1	1	2	2	4	**2,25**	1	1	1	3	4	4	2	**2,29**
Société Générale	2	4	1	1	1	2	1	3	**1,88**	1	1	1	1	3	1	2	**1,43**
Sodexo Alliance	1	1	1	3	2	1	3	1	**1,63**	4	3	2	4	1	3	1	**2,57**

Firm	RD/NE	LC/SALES	RD/ SALES	IATA	IA/ Sales	IA/NE	M&DE/ Sales	Sales/ NE	IC score	MTBV	MV/ EBITDA	MV/ Sales	ROE	ROA	Cash ROCE	EBITDA/ Sales	Financial score
Technip	3	4	3	2	3	2	3	2	**2,75**	3	4	3	3	3	2	2	**2,86**
Total	4	1	3	2	1	3	1	4	**2,38**	2	1	2	3	4	4	3	**2,71**
Unilever	3	1	3	3	3	3	4	3	**2,88**	4	2	3	4	4	4	2	**3,29**
VINCI	1	1	1	4	4	1	1	1	**1,75**	2	1	2	3	2	2	2	**2,00**
Vivendi	2	4	2	4	4	4	1	4	**3,13**	2	1	3	1	2	3	3	**2,14**

Table 55: Global scores (2012)

The last step, "*Positioning*", concerned the placement of each company in the business space made up by (i) Intellectual Capital commitment (x-axis) and (ii) financial/market performance (y-axis). Figure 34 displays the *Positioning Matrix* for the sample year 2012[27]:

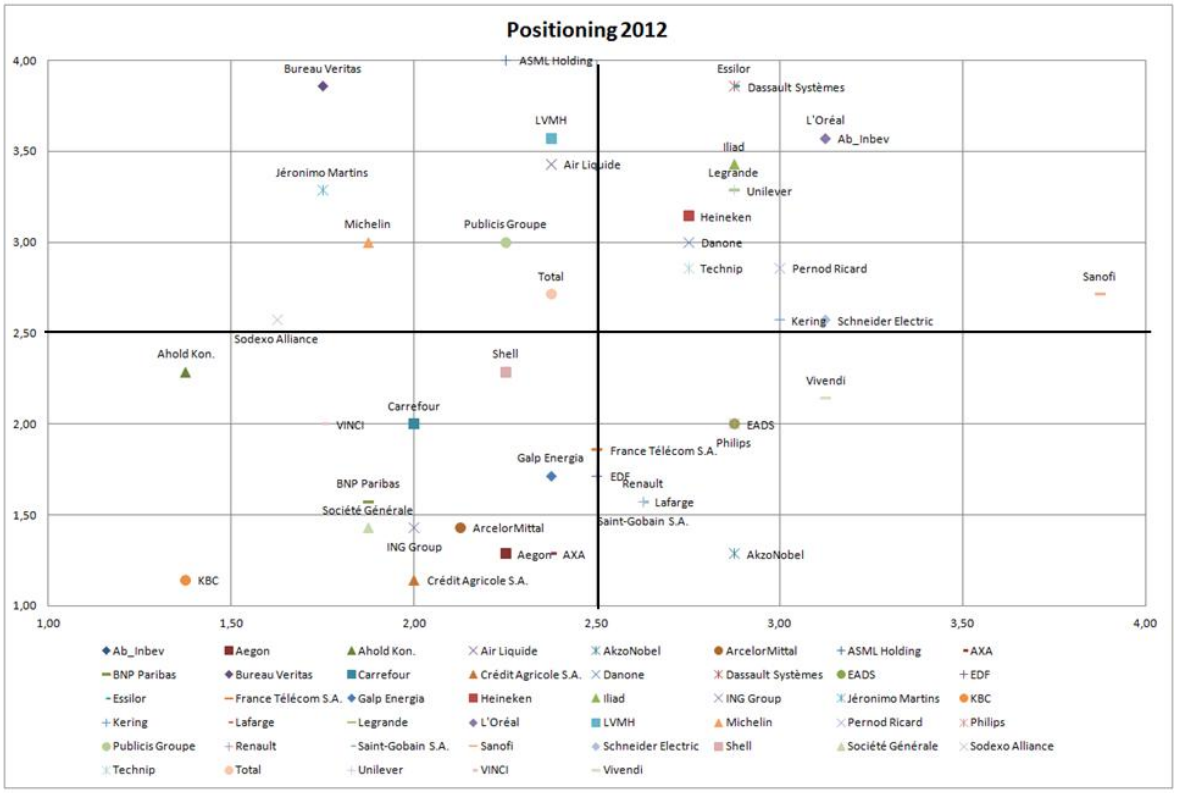

Figure 34: Positioning Matrix (2012)

At the end of the analysis, the authors produced a table (Table 56) aiming at summarising the results obtained for each financial year (from 2003 to 2012) taken into account, in order to help analysts to identify how companies move within the four quadrants of the business space described previously. Hence, by using this table, it is possible to have an idea on what strategies each company was focused over ten years.

[27] Even in this case, all the Positioning Matrixes can be found by looking at the Annexes

Firm	Quadrant 2003	Quadrant 2004	Quadrant 2005	Quadrant 2006	Quadrant 2007	Quadrant 2008	Quadrant 2009	Quadrant 2010	Quadrant 2011	Quadrant 2012
Ab_Inbev	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader
Aegon	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer
Ahold Kon.	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Market-based	Bad Performer	Bad Performer	Bad Performer	Bad Performer
Air Liquide	Market-based	Leader	Leader	Leader	Leader	Leader	Leader	Market-based	Market-based	Market-based
AkzoNobel	Leader	Leader	Leader	Leader	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary
ArcelorMittal	Bad Performer	Market-based	Market-based	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer
ASML Holding	Bad Performer	Market-based	Market-based	Market-based	Market-based	Market-based	Bad Performer	Market-based	Market-based	Market-based
AXA	Visionary	Visionary	Bad Performer	Visionary	Visionary	Visionary	Bad Performer	Visionary	Bad Performer	Bad Performer
BNP Paribas	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer
Bureau Veritas	Market-based	Bad Performer	Bad Performer	Bad Performer	Market-based	Market-based	Market-based	Market-based	Market-based	Market-based
Carrefour	Market-based	Market-based	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer
Crédit Agricole S.A.	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer
Danone	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader
Dassault Systèmes	Market-based	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader
EADS	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary
EDF	Bad Performer	Bad Performer	Bad Performer	Market-based	Market-based	Market-based	Leader	Visionary	Bad Performer	Visionary
Essilor	Leader	Leader	Market-based	Market-based	Market-based	Leader	Leader	Leader	Leader	Leader
France Télécom S.A.	Leader	Leader	Visionary	Visionary	Leader	Leader	Leader	Leader	Leader	Visionary
Galp Energia	Bad Performer	Bad Performer	Bad Performer	Market-based	Market-based	Bad Performer	Market-based	Market-based	Market-based	Bad Performer
Heineken	Market-based	Market-based	Market-based	Market-based	Market-based	Visionary	Leader	Leader	Leader	Leader
Iliad	Leader	Leader	Market-based	Market-based	Market-based	Market-based	Market-based	Leader	Leader	Leader
ING Group	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer
Jéronimo Martins	Market-based	Market-based	Market-based	Market-based	Market-based	Market-based	Market-based	Market-based	Market-based	Market-based
KBC	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer
Kering	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Leader
Lafarge	Leader	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary
Legrande	Visionary	Visionary	Visionary	Leader	Leader	Leader	Leader	Leader	Leader	Leader
L'Oréal	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader
LVMH	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Market-based	Market-based
Michelin	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Market-based	Market-based
Pernod Ricard	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader
Philips	Visionary	Visionary	Visionary	Visionary	Leader	Visionary	Visionary	Visionary	Visionary	Visionary
Publicis Groupe	Leader	Market-based	Market-based	Market-based	Bad Performer	Market-based	Market-based	Market-based	Market-based	Market-based
Renault	Bad Performer	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary
Saint-Gobain S.A.	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary	Visionary
Sanofi	Visionary	Visionary	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader
Schneider Electric	Visionary	Visionary	Visionary	Visionary	Visionary	Leader	Leader	Leader	Visionary	Leader
Shell	Market-based	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer
Société Générale	Bad Performer	Market-based	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer
Sodexo Alliance	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Market-based	Bad Performer	Bad Performer	Market-based	Market-based

Firm	Quadrant 2003	Quadrant 2004	Quadrant 2005	Quadrant 2006	Quadrant 2007	Quadrant 2008	Quadrant 2009	Quadrant 2010	Quadrant 2011	Quadrant 2012
Technip	Visionary	Visionary	Visionary	Visionary	Visionary	Leader	Visionary	Leader	Leader	Leader
Total	Market-based	Market-based	Market-based	Market-based	Market-based	Market-based	Market-based	Market-based	Market-based	Market-based
Unilever	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader	Leader
VINCI	Bad Performer	Market-based	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer	Bad Performer
Vivendi	Visionary	Leader	Leader	Leader	Visionary	Leader	Visionary	Leader	Leader	Visionary

Table 56: Summarised Positioning results

8.5 Discussions

This work showed how firms' intellectual capital and financial/market performances can be viewed as two integrated perspectives (Iazzolino et al., 2014); particularly, it highlighted how firms can be positioned in a new business space made up by the perspectives beforehand mentioned.

Hence, starting from the Table 56 and the Positioning Matrixes (Figure 34 and Annexes), it could be noticed (i) how the 45 firms of the sample performed over ten years and (ii) what position, amidst the four possible ones, they got within the business space (Figure 33) from 2003 to 2012.

As claimed previously by looking at the Table 56, it could be noted that firms did not have the same positioning throughout the considered period; therefore, the following Figure 35 shows what changes occurred over all the ten years:

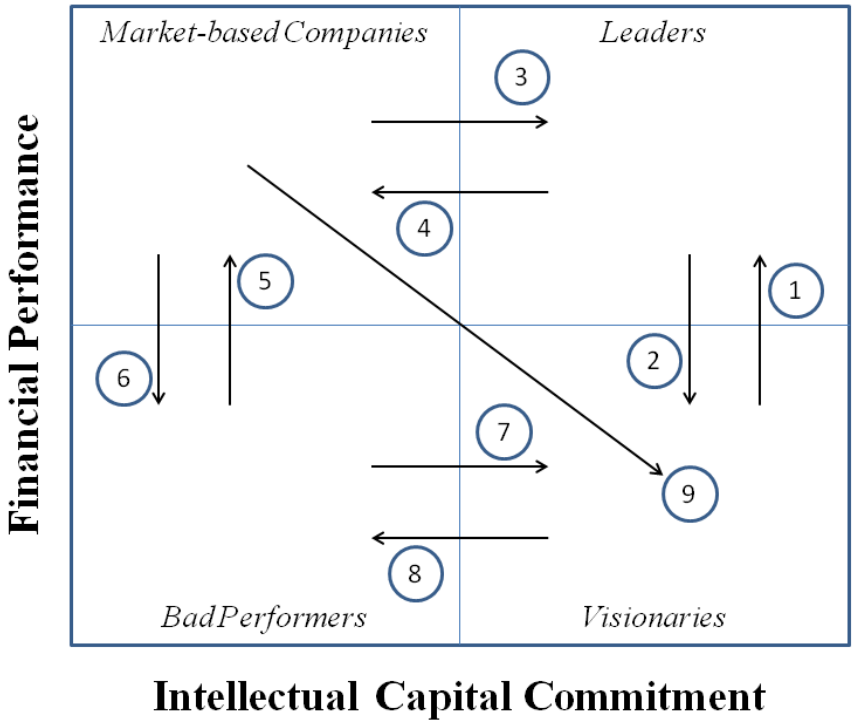

Figure 35: Positioning changes

The nine positioning changes occurred within the considered period could provide some useful explanations aiming at verifying whether the hypotheses can be either accepted or rejected:

1. *Visionaries → Leaders*: firms that passed from being *Visionaries* to *Leaders* denoted that they had high intellectual capital commitment that allowed them to get the market leadership. By looking at their initial state (*Visionaries*), it could be noticed that they did not perform as good as *Leaders*; however, at that specific financial year, they were investing in intellectual capital resources (human, structural or relational ones) demonstrating that they were focused on long-term strategies. After making such investments, they got a leadership position since the market recognised (in their products, services, etc.), as demonstrated by the scores obtained on their financial performances, their effort in enhancing their intellectual capital, which means they made, for instance, investments in R&D activities, new and more efficient workforce, new relations with their customers, etc.
2. *Leaders → Visionaries*: this kind of change involved firms that were positioned as *Leaders* in a certain financial year; therefore, they were characterised by high intellectual capital commitment (i.e. high investments in R&D and intangibles, human resources, relations with customers, etc.) and good financial/market performances (i.e. high ROE, Cash ROCE, MTBV, EBITDA/Sales, etc.). In spite of maintaining adequate investment in intellectual capital, these firms saw their financial performance shrink in the year immediately next to that one where they were acknowledged as *Leaders*. This could be mean that these firms keep on having a long-term roadmap; however, they experienced some market contingencies (i.e. market crises, interest rates growth, stock prices deflation, etc.), which did not allow them preserving the leadership.
3. *Market-based → Leaders*: considering a certain company, passing from being positioned as *Market-based* firm to being recognised amongst the *Leaders* means that it started making investments in intellectual capital resources, trying to move its organisational vision towards long-term roadmaps. This case is similar to the change 9 but, here, intellectual capital investments are able to produce returns, in terms of financial/market indicators, in the year immediately following the year in which these investments are made. Positive returns, and as a consequence the market leadership in the business space/positioning matrix (Figure 33), mean that investments in intellectual capital positively impressed (by looking, for instance, at new products, services, technologies, etc.) the market; therefore, companies that experienced this kind of change, did not suffer of any performance bending caused by the cash outflows of the intellectual capital investments.

4. *Leaders → Market-based*: it represents the change made by a certain firm that, in a defined year were recognised amidst *Leaders*, and in the year immediately following they became a *Market-based* company. Here, it could be noticed that these companies maintained good financial/market performances; however, they were positioned among *Market-based* firms since they stopped investing in intellectual capital resources. This means that these companies started passing from long-term to short-term strategies, trying to diminishing cash outflows due to intellectual capital investments and to maximising revenues deriving from their "status-quo" (i.e. a company could decide to not invest more in innovating its products and/or services, trying to maximise revenues deriving from selling them).
5. *Bad performers → Market-based*: firms that pass from being *Bad performers* to being acknowledged as *Market-based* companies, exploit short-term strategies to get good financial/market performances. Generally, by looking at the Table 56, it is possible to notice that firms that experienced this change were not able to maintain good financial/market performances for more than two years consecutively; this is due to their short-term strategy, which aimed at obtaining positive results immediately without looking at getting a stable market leadership position.
6. *Market-based → Bad performers*: this change is similar to the previous one. Even in this case, firms were focused on short-term strategies; however, since they did not invest in intellectual capital resources (i.e. R&D), they saw their financial performance going down, even because they were not able to demonstrate, to the market, of being able to innovate their products, services, processes, etc., and, as a consequence to satisfy their stakeholders.
7. *Bad performers → Visionaries*: firms that passed from being *Bad performers* to being *Visionaries* demonstrated (by investing in intellectual capital) how they had the willingness to pass from a short-term to a long-term roadmap. By looking at the Table 56, it could be noted that there are no *Bad performers* that were able to get a *Leader* position; as a matter of fact, although they started investing in intellectual capital, hence demonstrating that they were interested to have a long-term strategy for their stakeholder, it was quite improbable that the market would have recognised such willingness.
8. *Visionaries → Bad performers*: although the majority of *Visionaries* became *Leaders*, there is one case where a firm (AXA in Table 56) passed from being a *Visionary* to being a *Bad performer*. It could be noted that *Visionaries* are generally

characterised by relatively low financial/market performances, in spite of making high investments in intellectual capital resources; therefore, it is reasonable to think that, if a firm makes wrong investments in intellectual capital or, if these investments are affected by some market contingencies (i.e. interest rates growth), some costs linked to them would contribute negatively on the firm's financial performance. Further, the firm that experienced such kind of change stopped its investments in intellectual capital, becoming, as a consequence a *Bad performer*, and being forced to pass from a long-term to a short-term strategy aiming at maximising the investments made in the past years.

9. *Market-based → Visionaries*: this change is similar to the change 3; in Table 56, it could be noticed that Heineken, passed from being a *Market-based* company to being acknowledged amongst *Visionaries*. This change demonstrated how the firm had the willingness to implement long-term roadmaps; however, differently to the change 3, it passed from an intermediate state of *Visionary* before entering amidst *Leaders*. Hence, it is possible to observe that this strategic change produced good results for Heineken even though the positive returns were obtained after two years.

This empirical study showed how firms can be positioned, and consequently how they could get the market leadership, over their life (this work analysed 10-year data for 45 companies) according to the integration of two main perspectives characterising their overall performance: (i) intellectual capital commitment and (ii) financial/market results.

In their main hypothesis, the authors stated that intellectual capital investments help firms to get a leadership position; then, this main hypothesis was split into two where the authors claimed that the market leadership could be obtained even by firms having low financial performances but that they are willing to invest steadily in intellectual capital (*Hp. 1*) and that the market leadership could be reached by firms having good financial performances, only if they demonstrate to invest in intellectual capital (*Hp. 2*).

Starting from the *Hp. 1*, it seems to be verified by the following changes (Figure 35):

- *Change 1 (Visionaries → Leaders)*: as stated previously, *Visionaries* are companies characterised by low financial/market results and high intellectual capital commitment. It is noteworthy that the majority of these firms (except one - AXA)

became *Leaders*; thus, this could be intended as an empirical proof[28] of what the authors stated in the *Hp. 1*.

- *Change 5 (Bad Performers → Market-based)*: this case is another confirmation of the *Hp. 1*; in fact, by looking at the Table 56, it could be noticed that there are no *Bad performers* that got the market leadership directly. However, in this case, firms that experienced this change were able to get good financial performance, generally for short timeframes.

- *Change 7 (Bad Performers → Visionaries)*: it is similar to the previous case; in fact, *Bad performers* might decide to implement short-term or long-term strategies; here, they start employing the second ones, however, a stable market leadership was not spotted, since, as beforehand claimed, it is quite improbable that stakeholders are able to recognise immediately the effort made by *Bad performers* for investing in intellectual capital resources.

Even the *Hp. 2* seems to be verified by the findings (Table 56) and the changes displayed in Figure 35:

- *Change 3 (Market-based → Leaders)*: although *Market-based* companies have good financial performances, they are more focused on short-term strategies; hence, they do not invest in intellectual capital, however, when passing to long-term roadmaps, *Market-based* companies demonstrated that they can get the market leadership in many cases (as demonstrated by the Table 56). This kind of change could be considered as an empirical proof of what the authors stated in the *Hp. 2* since firms having good financial performances can become *Leaders* only by investing in intellectual capital, which means they are implementing long-term strategic choices; in fact, in many cases, firms that experienced this change were able to maintain the leadership for more than two years.
- *Change 9 (Market-based → Visionaries)*: this change is not a direct proof of the *Hp. 2*; however, it could be considered as an indirect empirical verification of it. By taking a look at the Table 56, it might be noticed that Heineken passed from being a *Market-based* (2007) to being a *Visionary* (2008), after experiencing this change, it was acknowledged amidst *Leaders* since 2009. This could means that Heineken changed its strategy, from a short to a long-term one; although its effort was not recognised by the market immediately, its investments were awarded in the

[28] Empirical proof is intended to be limited to this specific sample

following years (from 2009 to 2012) and the company got a stable market leadership position. In conclusion, this change appeared in the analysis could be "mutated" into: *Market-based → Visionaries → Leaders*.

Summarising, *Hp. 1* and *Hp. 2* (and as a consequence the main *Hp.*) have been verified by the analyses carried out in this empirical study; however, apart from those just mentioned, what did the other changes proved?

Changes 2, 4, 6 and 8 made clear (in this study) that:

Intellectual capital commitment was just a necessary condition but it should not be considered as sufficient to get the market leadership.

In fact, although it has been widely recognised that intellectual capital influence financial/market performances (Guo et al., 2012; Murthy and Mouritsen, 2011; F-Jardón and Martos, 2009; Li and Wu, 2004; Mention and Bontis, 2013; Gosh and Wu, 2007; Vergauwen et al., 2007; Alwert et al., 2009), these latter could be even affected by other factors such as, for instance, outsourcing strategies, amounts of liquidity and debts, stock price fluctuations, inflation, variations of the interest rates, etc. (Haslam et al., 2013; Damodaran, 2010; Venanzi, 2012); therefore this confirms that intellectual capital can play an important role for every company that struggle to achieve the market leadership (as explained by changes 1, 3, 5, 7, and 9), however, other factors, such those ones beforehand cited, could restrain the impact of intellectual capital investments (as borne out by changes 2, 4, 6 and 8).

8.6 Conclusions

This study drew up an empirical analysis to investigate how intellectual capital helps firms to get the market leadership.

The idea on which this work was based on, started from the consideration that intellectual capital is a fundamental asset to get competitive advantage and therefore to compete globally in every market (Guo et al., 2012; Murthy and Mouritsen, 2011; F-Jardón and Martos, 2009; Li and Wu, 2004; Mention and Bontis, 2013; Gosh and Wu, 2007; Vergauwen et al., 2007; Alwert et al., 2009; Iazzolino and Migliano, 2014; Iazzolino et al., 2013b).

In this research it has been developed a new tool, named as "Positioning Matrix", which aimed at positioning companies on the basis of (i) their intellectual capital commitment

and (ii) financial/market performances; this could be useful, on the one hand, for scholars, to advance knowledge about the linkage between Intellectual Capital and Financial theories; on the other hand, for practitioners, to figure out how investments in Intellectual Capital should be addressed to get better financial performances and a stable leadership position in the markets in which they operates.

Despite these benefits, some research limitations are listed below:

- It should be considered a larger sample; in fact, such results are referred to only 45 firms (since there is not any standard way to disclose IC data, some companies needed to be excluded by the analysis);
- The hypotheses were investigated only empirically; therefore, it could be interesting to carry out and apply statistical and mathematical frameworks to verify them.

Therefore, further studies could be carried out taking account of these limitations and then, they should consider a larger sample and also indicators not included in this analysis such as, investments plans in human capital (i.e. investment plans for employees), customer service expenses, customer satisfaction indexes, etc., which can be obtained by examining reporting documents drawn up by firms.

It should be investigated what external factors could be included within the Positioning Matrix, in order to provide guidelines to the firms and help them to increase their value. Furthermore, other quantitative methodologies and tools to evaluate Intellectual Capital, based, as previously stated i.e. on statistical and mathematical approaches, need to be developed to get over limitations linked to empirical studies.

In conclusion, it could be argued that this research sheds light on implications that Intellectual Capital components could have on the achievement of the market leadership; firms should pay more attention to the development of their Intellectual Assets as well as to their reporting system to have a clearer vision of its intangible assets on which they should be focused to get competitive advantage in this knowledge era.

DISCUSSIONS AND CONCLUSIONS

The main idea of this thesis is to unveil how Intellectual Capital (IC), viewed by different perspectives, could be integrated in many fields of theoretical and practical applications such as:

1. Measurement of the impact of IC in Credit Risk evaluation (chapter 3);
2. Measure the effect of IC (according to the Pulic's viewpoint) on the market value of both Capital and Knowledge-intensive firms (chapter 4);
3. Theoretical investigations about the differences existing between Intellectual Capital (viewed according to the VAIC theory) and the Economic Value Added (as a tool deriving from the financial theory) in measuring the "value creation" of firms (chapter 5);
4. Integration of IC within the Relative Valuation of companies by developing a new Intellectual Capital Multiple (chapter 6);
5. Development of a framework aiming at displaying what are the linkages amidst the Intellectual Capital components (human, structural and relational capital) and, how these contribute to firms' performances and market value (chapter 7);
6. Understanding of how Intellectual Capital could help firms to get good financial performances and a stable market leadership position, even by developing a new "positioning tool" that is able to show, over a defined period, how a certain firm is recognised by the market (chapter 8).

Therefore, these works demonstrated how two different perspectives: (i) financial and (ii) leaning and growth, to cite the BSC (Kaplan and Norton, 1996), could be integrated in a framework aiming at giving a clearer idea on how firms' performances can be measured.

Since economy has been following a new paradigm, where knowledge resources are becoming increasingly important in the enhancement of firms' performances, over the last few years, companies tend to invest ceaselessly on their intellectual capital (Iazzolino and Migliano, 2014; Guthrie et al. 2007).

Hence, considering firms' performances just made up by financial indicators (such ROE, ROA, ROI, leverage ratios, etc.) could be misleading. As demonstrated by the framework developed in chapter 3, intellectual capital helped to have a more accurate credit risk assessment by reducing, and sometimes eliminating, errors caused by other models that

took into account only financial ratios. This result is in accordance with Alwert et al. (2009) who stated that intellectual capital could give analysts a clearer idea on firms' performances.

Then, in the next works, intellectual capital was used to explain the increasing gap existing between market and book value of companies. However, in chapter 4 and chapter 5, it was used a different viewpoint of intellectual capital; in fact, these two works were based on the VAIC theory, which define intellectual capital starting from the Value Added Income Statement. As stated in the paragraph 1.2, the VAIC theory defines (i) human capital as the amount of investments made in wages, salaries, training, etc. and (ii) the structural capital as the value added after deducting investments in human capital (as a consequence, EBITDA) (Iazzolino and Laise, 2013).

However, this non-conventional definition of intellectual capital, helped us to give a better explanation of the "value creation" concept according to the perspectives aforementioned (financial and learning and growth). Therefore, in chapter 5, it was proved, by applying a correlation analysis, that the concept of value creation can be interpreted as a "theoretical inequality" where VAIC is considered as a measure of work productivity and the EBIT-based measures (such as EVA) as a measure of the economic profit according to a shareholders' standpoint.

Furthermore, in chapter 4, the concept of value creation according to the VAIC theory was used firstly to distinguish Knowledge-based industries from Capital-intensive ones, and then to measure the impact of Intellectual Capital Efficiency (ICE) on firms' market value. Main results emerging from this study demonstrated that, generally, the value of human capital is the highest in every sector considered by the analyses. However, knowledge-intensive industries were characterised by a higher usage of human capital with respect to the capital-intensive ones. Further, knowledge-intensive sectors showed higher values of intangible depreciations and amortizations than the capital-intensive ones. In fact, knowledge-intensive companies make more investments in intangible assets with respect to the tangible ones.

The impact of intellectual capital on firms' performances and market value was deepened in chapter 6, chapter 7 and chapter 8; however, in these studies, intellectual capital was intended as made up of its three theoretical components: human, structural and relational capital.

In chapter 6, it was proposed a new multiple based on the three intellectual capital components, therefore, the study aimed at creating a new tool that could be used in the field of the relative valuation. Results showed that the Intellectual Capital Multiple (ICM) can be considered as reliable in those industries particularly featured by a high usage of intellectual resources, such as Software and Telecommunications even in accordance with the findings of chapter 4 (despite the different definition of intellectual capital); in fact, the new ICM seems to be valid and reliable as much as the traditional economic-financial multiples such EV/EBITDA and EV/Sales, therefore, it can be added to these latter to get a clearer relative valuation of a firm market value.

Chapter 7 and chapter 8 provided new insights on how intellectual capital is related to firms' performances and market value and how companies might exploit it to get a market leadership position.

The first study, carried out by using 45 firms listed on Euronext, displayed how intellectual capital components are linked to each other and, it was found that human capital was significantly linked to structural and relational capital; however, it did not affect directly either firms' performances or firm market value. Differently, the other two IC components (structural and relational capital) impacted directly on firms' performances and in certain cases, only structural capital had a direct relationship with firm market value.

In the other work (chapter 8), it was showed, empirically, how intellectual capital and firms' performances could be viewed as two parts of the same evaluation framework; in fact, it was developed a new tool aiming at displaying a business space where companies can be placed (or positioned). Therefore, the "Positioning Matrix" helped us to figure out how intellectual capital commitment could give firms the opportunity to get a market leadership position. In particular it was found that only by investing in intellectual capital, a company can get the leadership; however, this condition is not sufficient by itself. In fact, firms' performances and market value could be affected by other factors, which are external to intellectual capital investments (Haslam et al., 2013; Damodaran, 2010; Venanzi, 2012), i.e. stock price volatility, outsourcing strategies, financial crisis, market contingencies etc.; accordingly, intellectual capital commitment can be only as necessary condition to get a market leadership position.

All the studies carried out in this thesis could be useful for academics and practitioners to figure out how intellectual capital should be considered when evaluating firms' performances and market value. As demonstrated in these chapters, intellectual capital

gives analysts a clearer understanding of firms' performances by looking them from a different viewpoint; however, it is strongly suggested to integrate the evaluation of intellectual capital and financial/market performances into a new overall idea mouldable to the new market dynamics.

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LIST OF FIGURES

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ANNEXES

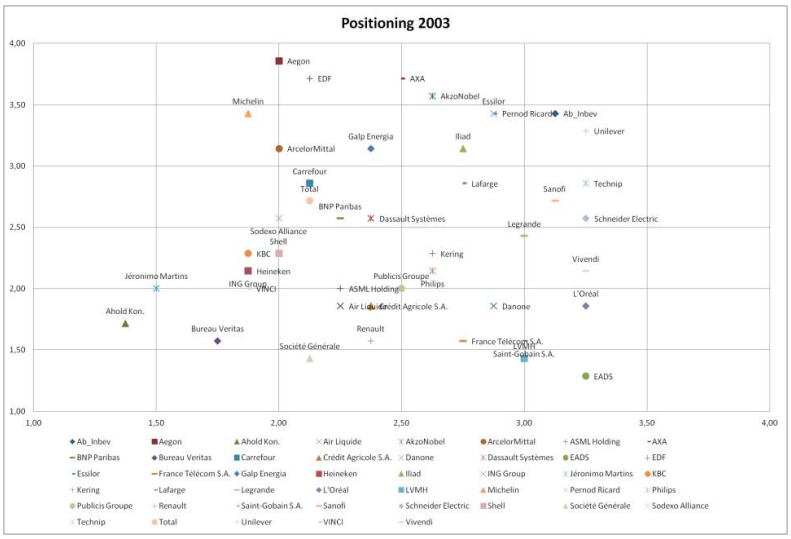

Figure A 1: Positioning Matrix (2003)

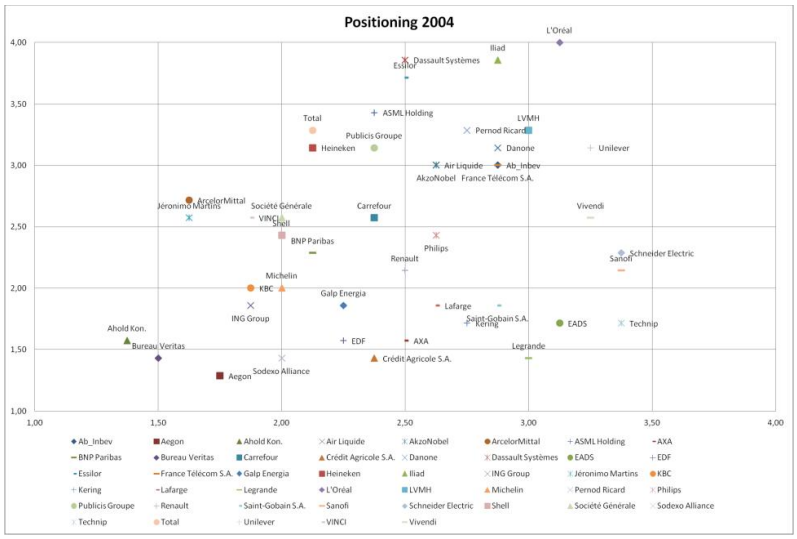

Figure A 2: Positioning Matrix (2004)

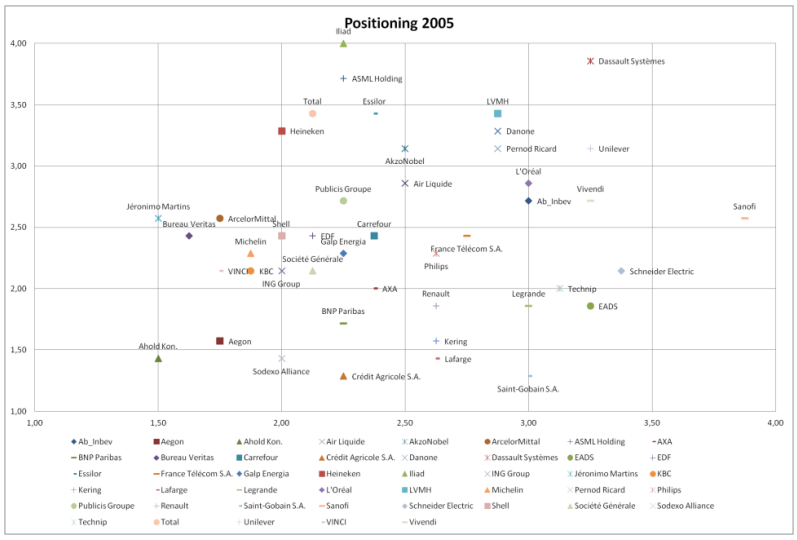

Figure A 3: Positioning Matrix (2005)

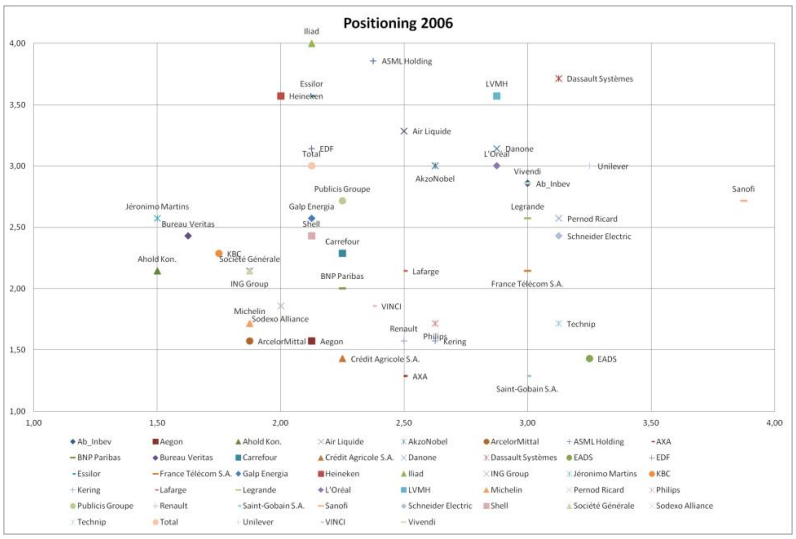

Figure A 4: Positioning Matrix (2006)

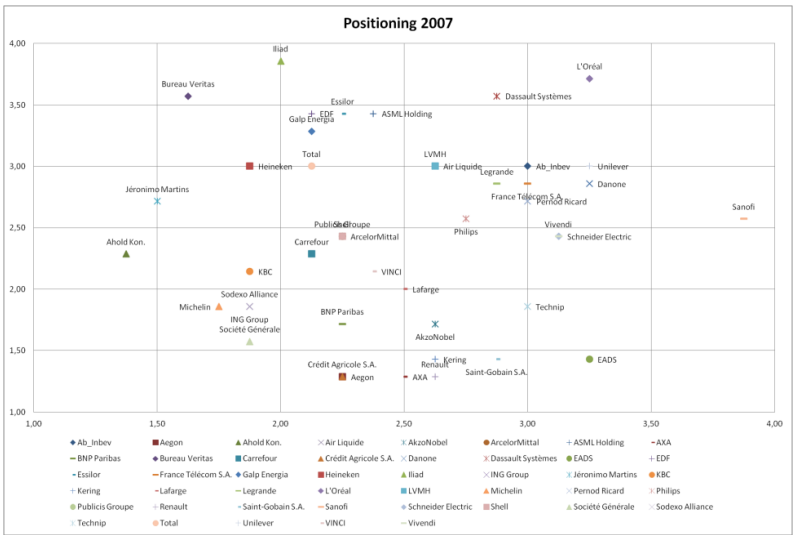

Figure A 5: Positioning Matrix (2007)

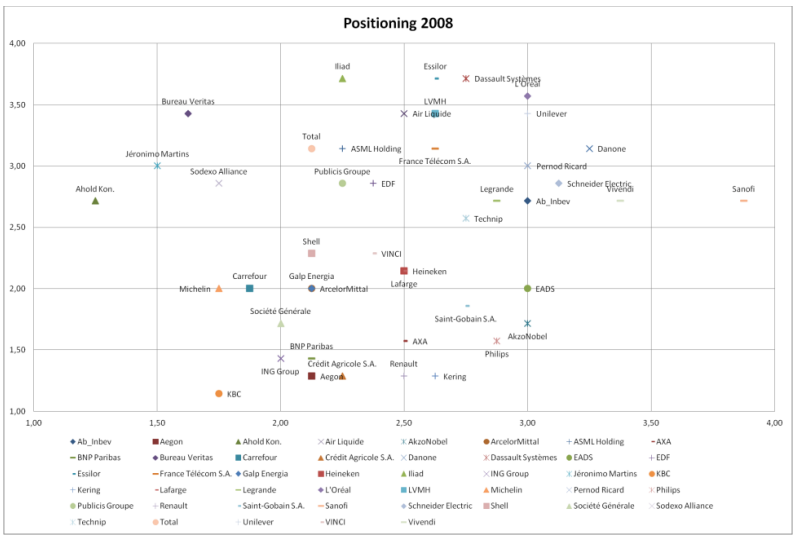

Figure A 6: Positioning Matrix (2008)

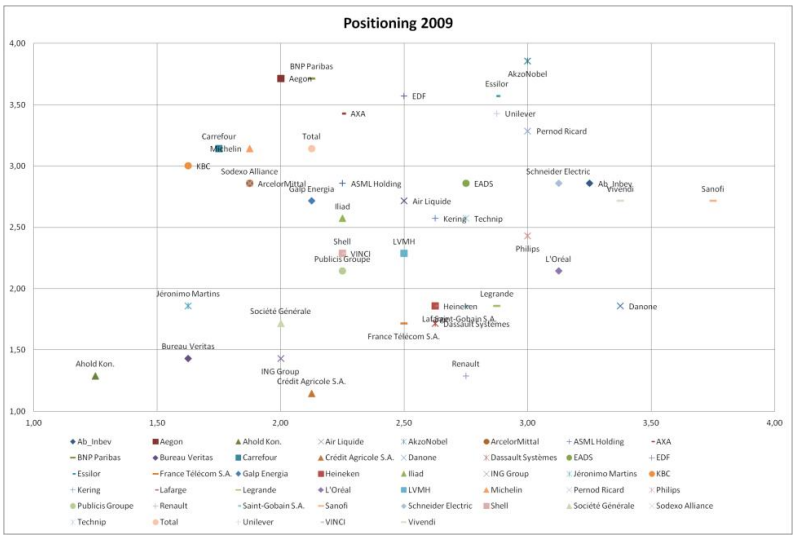

Figure A 7: Positioning Matrix (2009)

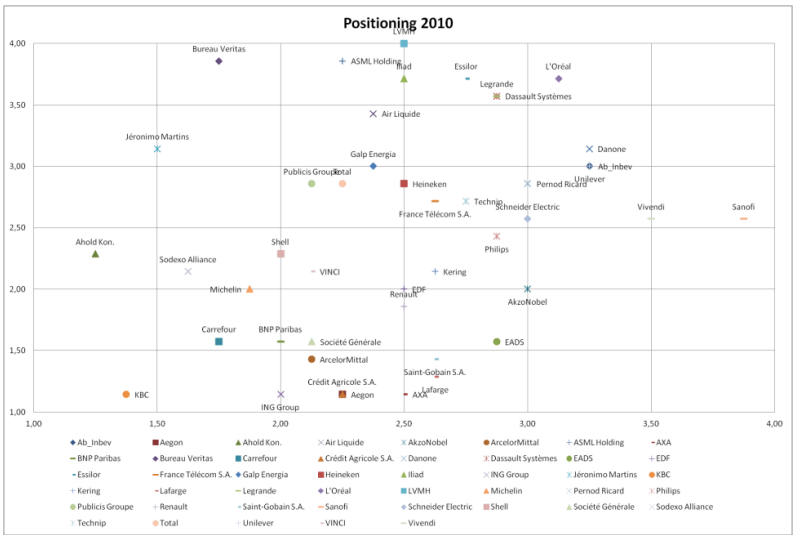

Figure A 8: Positioning Matrix (2010)

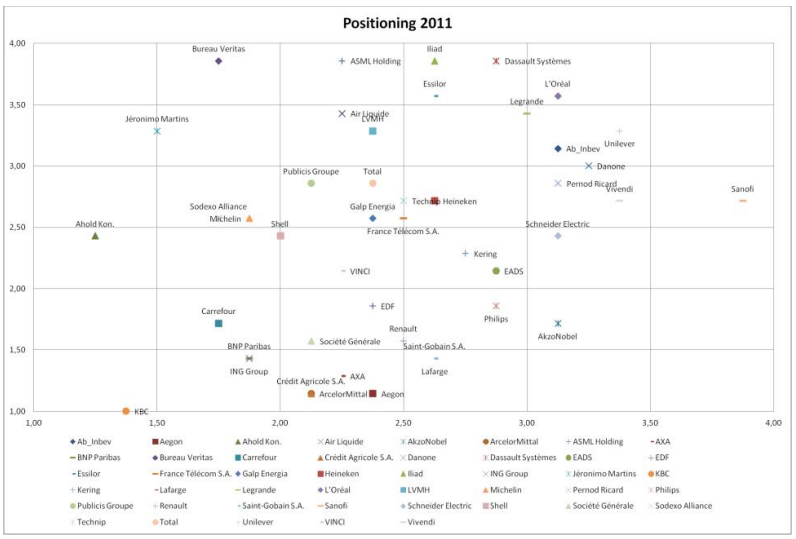

Figure A 9: Positioning Matrix (2011)

Firm	Year #	RD/ NE	HC/ SALES	RD/ SALES	IA/ TA	IA/ SALES	IA/ NE	M&DE/ SALES	SALES/ NE	IC score	MTBV	MV/ EBITDA	MV/ SALES	ROE	ROA	Cash ROCE	EBITDA/ SALES	Financial score
Ab_Inbev	2003	2	3	2	4	4	4	4	2	**3,13**	3	3	3	2	3	3	4	**3**
	2004	2	3	2	4	4	3	4	1	**2,88**	3	4	4	1	3	2	4	**3**
	2005	2	3	2	4	4	4	4	1	**3**	2	3	4	1	3	2	4	**2,71**
	2006	2	3	2	4	4	4	4	1	**3**	2	3	4	1	3	3	4	**2,86**
	2007	2	3	2	4	4	4	4	1	**3**	2	2	4	2	4	3	4	**3**
	2008	2	2	3	4	4	4	4	1	**3**	3	3	4	2	2	1	4	**2,71**
	2009	3	2	3	4	4	4	4	2	**3,25**	3	2	4	4	4	3	4	**3,43**
	2010	3	2	3	4	4	4	4	2	**3,25**	3	3	4	2	3	2	4	**3**
	2011	3	1	3	4	4	4	4	2	**3,13**	3	3	4	3	3	2	4	**3,14**
	2012	3	1	3	4	4	4	4	2	**3,13**	4	3	4	4	3	3	4	**3,57**
Aegon	2003	1	3	1	1	1	1	4	4	**2**	2	1	2	2	1	1	1	**1,43**
	2004	1	1	1	1	1	1	4	4	**1,75**	1	1	2	2	1	1	1	**1,29**
	2005	1	1	2	1	1	1	3	4	**1,75**	1	2	2	2	1	1	2	**1,57**
	2006	1	4	2	1	1	1	3	4	**2,13**	1	2	2	3	1	1	1	**1,57**
	2007	1	4	2	1	1	1	4	4	**2,25**	1	2	1	2	1	1	1	**1,29**
	2008	1	4	1	1	1	1	4	4	**2,13**	1	3	1	1	1	1	1	**1,29**
	2009	1	3	1	1	1	1	4	4	**2**	1	1	1	1	1	1	1	**1**
	2010	1	4	2	1	1	1	4	4	**2,25**	1	1	1	1	1	1	2	**1,14**
	2011	1	4	2	1	1	2	4	4	**2,38**	1	1	1	1	1	1	2	**1,14**
	2012	1	4	2	1	1	2	3	4	**2,25**	1	1	1	2	1	1	2	**1,29**
Ahold Kon.	2003	1	1	1	2	1	1	2	2	**1,38**	2	2	1	1	2	2	1	**1,57**
	2004	1	1	1	2	1	1	2	2	**1,38**	3	3	1	1	1	1	1	**1,57**
	2005	1	1	1	2	1	1	2	3	**1,5**	2	3	1	1	1	1	1	**1,43**
	2006	1	1	1	2	1	1	2	3	**1,5**	3	2	1	2	3	3	1	**2,14**
	2007	1	1	1	2	1	1	2	2	**1,38**	3	2	1	3	3	3	1	**2,29**
	2008	1	1	1	1	1	1	2	2	**1,25**	3	3	2	4	3	3	1	**2,71**
	2009	1	1	1	1	1	1	2	2	**1,25**	3	1	1	4	1	4	2	**2,29**
	2010	1	1	1	1	1	1	2	2	**1,25**	3	2	1	3	3	3	1	**2,29**
	2011	1	1	1	1	1	1	2	2	**1,25**	3	2	1	4	3	3	1	**2,43**
	2012	1	1	1	2	1	1	2	2	**1,38**	3	2	1	3	3	3	1	**2,29**
Air Liquide	2003	3	1	3	2	2	2	2	3	**2,25**	3	4	4	2	4	3	4	**3,43**
	2004	3	1	3	3	3	3	2	3	**2,63**	3	3	4	2	3	2	4	**3**
	2005	3	1	3	2	3	3	2	3	**2,5**	3	3	4	2	2	3	3	**2,86**
	2006	3	1	3	2	3	3	2	3	**2,5**	4	3	4	2	3	3	4	**3,29**
	2007	3	1	3	3	3	3	2	3	**2,63**	4	3	3	3	3	2	3	**3**
	2008	3	1	3	2	3	3	2	3	**2,5**	3	3	4	4	3	3	4	**3,43**
	2009	3	1	3	2	3	3	2	3	**2,5**	4	3	4	4	3	4	4	**3,71**
	2010	3	1	3	2	2	3	2	3	**2,38**	4	3	3	4	3	3	4	**3,43**
	2011	3	1	3	2	2	2	2	3	**2,25**	4	3	4	3	3	3	4	**3,43**
	2012	3	1	3	2	2	3	2	3	**2,38**	4	3	4	3	3	3	4	**3,43**
AkzoNobel	2003	4	3	4	2	1	1	4	2	**2,63**	3	3	2	4	3	4	2	**3**
	2004	4	3	4	2	1	1	4	2	**2,63**	3	2	2	4	4	4	2	**3**
	2005	4	3	4	1	1	1	4	2	**2,5**	4	2	2	4	4	4	2	**3,14**
	2006	4	3	4	2	1	1	4	2	**2,63**	3	2	2	4	4	4	2	**3**
	2007	4	3	3	2	2	2	3	2	**2,63**	1	4	3	1	1	1	1	**1,71**
	2008	3	3	3	3	3	3	4	2	**3**	2	4	2	1	1	1	1	**1,71**

Firm	Year #	RD/ NE	HC/ SALES	RD/ SALES	IA/ TA	IA/ SALES	IA/ NE	M&DE/ SALES	SALES/ NE	IC score	MTBV	MV/ EBITDA	MV/ SALES	ROE	ROA	Cash ROCE	EBITDA/ SALES	Financial score
	2009	3	3	3	3	3	3	4	2	**3**	2	3	2	2	2	2	2	**2,14**
	2010	3	3	3	3	3	3	4	2	**3**	2	3	2	2	2	1	2	**2**
	2011	3	3	3	3	3	3	4	3	**3,13**	2	2	2	1	2	2	1	**1,71**
	2012	4	3	3	2	2	2	4	3	**2,88**	2	1	2	1	1	1	1	**1,29**
ArcelorMittal	2003	2	2	2	1	1	1	4	3	**2**	3	1	1	4	2	3	1	**2,14**
	2004	1	3	1	1	1	1	4	1	**1,63**	1	1	1	4	4	4	4	**2,71**
	2005	1	3	1	2	1	1	4	1	**1,75**	1	1	1	4	4	4	3	**2,57**
	2006	1	3	2	2	2	1	3	1	**1,88**	1	1	2	2	2	1	2	**1,57**
	2007	1	3	2	2	2	2	4	2	**2,25**	2	1	2	3	3	3	3	**2,43**
	2008	1	3	2	2	1	1	4	3	**2,13**	1	1	1	3	3	3	2	**2**
	2009	1	3	2	2	2	1	3	1	**1,88**	2	4	3	1	1	1	1	**1,86**
	2010	1	3	3	2	2	1	3	2	**2,13**	1	3	2	1	1	1	1	**1,43**
	2011	1	3	3	2	2	1	3	2	**2,13**	1	2	1	1	1	1	1	**1,14**
	2012	1	3	3	2	2	1	3	2	**2,13**	1	4	1	1	1	1	1	**1,43**
ASML Holding	2003	4	2	4	1	1	1	2	3	**2,25**	4	4	4	1	1	1	1	**2,29**
	2004	4	2	4	1	1	1	2	4	**2,38**	4	4	4	3	4	2	3	**3,43**
	2005	4	2	4	1	1	1	2	3	**2,25**	4	4	4	3	4	3	4	**3,71**
	2006	4	2	4	1	1	1	2	4	**2,38**	4	3	4	4	4	4	4	**3,86**
	2007	4	2	4	1	1	1	2	4	**2,38**	4	3	4	4	4	1	4	**3,43**
	2008	4	1	4	1	1	1	2	4	**2,25**	4	4	4	3	3	2	2	**3,14**
	2009	4	2	4	1	1	1	2	3	**2,25**	4	4	4	1	1	1	1	**2,29**
	2010	4	1	4	1	1	1	2	4	**2,25**	4	3	4	4	4	4	4	**3,86**
	2011	4	1	4	1	1	1	2	4	**2,25**	4	3	4	4	4	4	4	**3,86**
	2012	4	1	4	1	1	1	2	4	**2,25**	4	4	4	4	4	4	4	**4**
AXA	2003	2	2	1	2	2	4	3	4	**2,5**	2	4	1	1	1	1	1	**1,57**
	2004	2	2	2	1	2	4	3	4	**2,5**	1	3	2	2	1	1	1	**1,57**
	2005	2	2	1	1	2	4	3	4	**2,38**	3	3	2	2	1	2	1	**2**
	2006	2	2	1	1	2	4	4	4	**2,5**	1	3	1	1	1	1	1	**1,29**
	2007	2	2	1	1	2	4	4	4	**2,5**	1	3	1	1	1	1	1	**1,29**
	2008	2	2	1	1	2	4	4	4	**2,5**	2	4	1	1	1	1	1	**1,57**
	2009	2	1	1	1	2	4	3	4	**2,25**	1	2	1	2	1	2	1	**1,43**
	2010	2	2	1	1	2	4	4	4	**2,5**	1	2	1	1	1	1	1	**1,14**
	2011	2	1	1	1	2	4	3	4	**2,25**	1	2	1	2	1	1	1	**1,29**
	2012	2	2	1	1	2	4	3	4	**2,38**	1	2	1	2	1	1	1	**1,29**
BNP Paribas	2003	2	1	2	1	3	3	2	4	**2,25**	2	2	3	2	1	3	4	**2,43**
	2004	2	1	2	1	2	3	2	4	**2,13**	2	1	3	2	1	3	4	**2,29**
	2005	2	1	2	1	2	3	3	4	**2,25**	1	1	3	2	1	1	3	**1,71**
	2006	2	1	2	1	2	3	3	4	**2,25**	1	1	2	2	1	3	4	**2**
	2007	2	1	2	1	2	3	3	4	**2,25**	1	1	2	2	1	2	3	**1,71**
	2008	2	1	2	1	2	2	3	4	**2,13**	1	1	1	1	1	2	3	**1,43**
	2009	2	1	2	1	2	2	3	4	**2,13**	1	1	2	2	1	1	3	**1,57**
	2010	2	1	1	1	2	2	3	4	**2**	1	1	2	2	1	1	3	**1,57**
	2011	2	1	1	1	2	2	3	3	**1,88**	1	1	2	1	1	1	3	**1,43**
	2012	2	1	1	1	2	2	3	3	**1,88**	1	1	2	2	1	1	3	**1,57**
Bureau Veritas	2003	1	2	1	4	3	1	1	1	**1,75**	1	1	1	4	4	4	3	**2,57**

Firm	Year #	RD/ NE	HC/ SALES	RD/ SALES	IA/ TA	IA/ SALES	IA/ NE	M&DE/ SALES	SALES/ NE	IC score	MTBV	MV/ EBITDA	MV/ SALES	ROE	ROA	Cash ROCE	EBITDA/ SALES	Financial score
	2004	1	2	1	3	2	1	1	1	**1,5**	1	1	1	4	1	1	1	**1,43**
	2005	1	2	1	3	3	1	1	1	**1,63**	1	1	1	4	4	4	2	**2,43**
	2006	1	2	1	3	3	1	1	1	**1,63**	1	1	1	4	4	4	2	**2,43**
	2007	1	2	1	3	3	1	1	1	**1,63**	4	4	3	4	4	4	2	**3,57**
	2008	1	2	1	3	3	1	1	1	**1,63**	4	3	3	4	4	4	2	**3,43**
	2009	1	2	1	3	3	1	1	1	**1,63**	4	3	3	4	4	4	3	**3,57**
	2010	1	2	1	4	3	1	1	1	**1,75**	4	4	4	4	4	4	3	**3,86**
	2011	1	2	1	4	3	1	1	1	**1,75**	4	4	4	4	4	4	3	**3,86**
	2012	1	2	1	4	3	1	1	1	**1,75**	4	4	4	4	4	4	3	**3,86**
Carrefour	2003	1	3	1	3	2	2	4	1	**2,13**	4	3	2	4	3	4	1	**3**
	2004	1	4	1	3	2	2	4	2	**2,38**	4	2	1	4	2	4	1	**2,57**
	2005	1	4	1	3	2	2	4	2	**2,38**	4	3	1	3	2	3	1	**2,43**
	2006	1	3	1	3	2	2	4	2	**2,25**	4	2	1	3	2	3	1	**2,29**
	2007	1	4	1	3	2	1	4	1	**2,13**	3	3	1	3	2	3	1	**2,29**
	2008	1	3	1	2	2	1	4	1	**1,88**	3	2	1	2	2	3	1	**2**
	2009	1	3	1	2	1	1	4	1	**1,75**	3	2	1	2	2	3	1	**2**
	2010	1	3	1	2	1	1	4	1	**1,75**	3	2	1	1	1	2	1	**1,57**
	2011	1	3	1	2	1	1	4	1	**1,75**	3	4	1	1	1	1	1	**1,71**
	2012	1	3	1	2	2	1	4	2	**2**	3	2	1	4	1	2	1	**2**
Crédit Agricole S.A.	2003	1	3	2	1	3	4	1	4	**2,38**	1	2	2	1	1	1	2	**1,43**
	2004	1	3	2	1	3	4	1	4	**2,38**	1	3	2	1	1	1	1	**1,43**
	2005	1	3	2	1	2	4	1	4	**2,25**	1	1	2	1	1	1	2	**1,29**
	2006	1	3	2	1	2	4	1	4	**2,25**	1	1	1	2	1	1	3	**1,43**
	2007	1	3	2	1	2	4	1	4	**2,25**	1	1	1	1	1	1	3	**1,29**
	2008	1	3	2	1	2	4	1	4	**2,25**	1	1	1	1	1	1	3	**1,29**
	2009	1	2	2	1	2	4	1	4	**2,13**	1	1	1	1	1	1	2	**1,14**
	2010	1	3	2	1	2	4	1	4	**2,25**	1	1	1	1	1	1	2	**1,14**
	2011	1	3	1	1	2	4	1	4	**2,13**	1	1	1	1	1	1	2	**1,14**
	2012	1	3	1	1	2	3	1	4	**2**	1	2	1	1	1	1	1	**1,14**
Danone	2003	2	4	3	3	3	3	4	1	**2,88**	3	4	4	3	4	3	3	**3,43**
	2004	3	4	3	3	3	2	4	1	**2,88**	4	4	4	1	4	3	2	**3,14**
	2005	3	4	3	3	3	2	4	1	**2,88**	4	4	4	4	3	2	2	**3,29**
	2006	3	4	3	3	3	2	4	1	**2,88**	4	4	4	3	3	2	2	**3,14**
	2007	3	4	3	4	4	4	3	1	**3,25**	3	4	4	4	2	1	2	**2,86**
	2008	3	4	3	4	4	4	3	1	**3,25**	4	4	4	3	3	1	3	**3,14**
	2009	3	4	3	4	4	4	4	1	**3,38**	3	3	4	2	3	2	3	**2,86**
	2010	3	4	3	4	4	3	4	1	**3,25**	3	4	3	4	3	2	3	**3,14**
	2011	3	4	3	4	4	3	4	1	**3,25**	3	4	3	2	3	3	3	**3**
	2012	3	1	3	4	3	3	4	1	**2,75**	3	4	3	3	3	3	2	**3**
Dassault Systèmes	2003	4	3	4	2	1	1	2	2	**2,38**	4	4	4	3	4	4	4	**3,86**
	2004	4	3	4	2	2	1	2	2	**2,5**	4	4	4	3	4	4	4	**3,86**
	2005	4	3	4	4	4	3	2	2	**3,25**	4	4	4	3	4	4	4	**3,86**
	2006	4	3	4	4	4	3	2	1	**3,13**	4	4	4	3	4	3	4	**3,71**
	2007	4	3	4	3	3	3	2	1	**2,88**	4	4	4	2	4	3	4	**3,57**
	2008	4	3	4	3	3	2	2	1	**2,75**	4	4	4	3	4	3	4	**3,71**
	2009	4	3	4	2	3	2	2	1	**2,63**	4	4	4	3	4	3	4	**3,71**

Firm	Year #	RD/ NE	HC/ SALES	RD/ SALES	IA/ TA	IA/ SALES	IA/ NE	M&DE/ SALES	SALES/ NE	IC score	MTBV	MV/ EBITDA	MV/ SALES	ROE	ROA	Cash ROCE	EBITDA/ SALES	Financial score
	2010	4	3	4	3	3	3	2	1	**2,88**	4	4	4	2	4	3	4	**3,57**
	2011	4	3	4	3	3	3	2	1	**2,88**	4	4	4	3	4	4	4	**3,86**
	2012	4	3	4	3	3	3	2	1	**2,88**	4	4	4	3	4	4	4	**3,86**
EADS	2003	4	3	4	3	3	3	3	3	**3,25**	1	2	2	1	2	2	2	**1,71**
	2004	4	3	4	2	3	3	3	3	**3,13**	1	2	2	1	2	2	2	**1,71**
	2005	4	3	4	2	3	3	4	3	**3,25**	2	3	2	1	1	3	1	**1,86**
	2006	4	3	4	2	3	3	4	3	**3,25**	1	4	1	1	1	1	1	**1,43**
	2007	4	3	4	2	3	3	4	3	**3,25**	1	4	1	1	1	1	1	**1,43**
	2008	4	3	4	2	2	3	3	3	**3**	2	1	1	2	2	4	2	**2**
	2009	4	2	4	2	2	2	3	3	**2,75**	1	3	1	1	1	1	1	**1,29**
	2010	4	3	4	2	2	2	3	3	**2,88**	2	2	1	1	1	3	1	**1,57**
	2011	4	3	4	2	2	2	3	3	**2,88**	3	2	2	2	1	4	1	**2,14**
	2012	4	3	4	2	2	2	3	3	**2,88**	3	2	1	2	1	4	1	**2**
EDF	2003	3	1	3	2	2	2	1	3	**2,13**	1	1	1	1	2	3	4	**1,86**
	2004	3	2	3	2	2	2	1	3	**2,25**	1	1	1	1	1	3	3	**1,57**
	2005	3	1	3	2	2	2	1	3	**2,13**	3	2	3	2	1	3	3	**2,43**
	2006	3	1	3	2	2	2	1	3	**2,13**	4	3	3	4	1	4	3	**3,14**
	2007	3	1	3	2	2	2	1	3	**2,13**	4	4	4	3	1	4	4	**3,43**
	2008	3	2	3	2	2	2	1	4	**2,38**	4	3	3	3	1	3	3	**2,86**
	2009	3	2	3	2	2	3	1	4	**2,5**	3	1	3	3	2	3	4	**2,71**
	2010	3	2	3	2	2	2	3	3	**2,5**	2	2	3	1	1	2	3	**2**
	2011	3	2	3	2	2	2	1	4	**2,38**	2	1	2	2	1	2	3	**1,86**
	2012	3	3	3	1	2	3	1	4	**2,5**	2	1	1	2	1	2	3	**1,71**
Essilor	2003	3	3	4	3	3	2	4	1	**2,88**	3	4	4	3	4	3	4	**3,57**
	2004	3	2	4	2	2	2	4	1	**2,5**	4	4	4	3	4	3	4	**3,71**
	2005	3	2	4	2	2	1	4	1	**2,38**	4	4	4	2	4	3	3	**3,43**
	2006	3	1	4	2	2	1	3	1	**2,13**	4	4	4	3	4	3	3	**3,57**
	2007	3	2	4	2	2	1	3	1	**2,25**	4	4	4	2	4	3	3	**3,43**
	2008	3	3	4	2	3	1	4	1	**2,63**	4	4	4	3	4	3	4	**3,71**
	2009	3	4	4	3	3	1	4	1	**2,88**	4	4	4	3	4	4	4	**3,86**
	2010	3	2	4	3	3	2	4	1	**2,75**	4	4	4	3	4	4	3	**3,71**
	2011	3	2	4	3	3	2	3	1	**2,63**	4	4	4	3	4	3	3	**3,57**
	2012	3	3	4	3	3	2	4	1	**2,88**	4	4	4	4	4	4	3	**3,86**
France Télécom S.A.	2003	3	1	3	4	4	4	1	2	**2,75**	4	2	3	4	2	3	4	**3,14**
	2004	3	1	3	4	4	4	1	3	**2,88**	4	1	3	3	3	3	4	**3**
	2005	3	1	3	4	4	4	1	2	**2,75**	2	1	3	3	1	3	4	**2,43**
	2006	3	2	3	4	4	4	1	3	**3**	2	1	3	1	2	2	4	**2,14**
	2007	3	2	3	4	4	4	1	3	**3**	2	1	3	3	3	4	4	**2,86**
	2008	1	2	2	4	4	4	1	3	**2,63**	3	2	3	2	4	4	4	**3,14**
	2009	2	1	2	3	4	4	1	3	**2,5**	2	1	3	3	3	4	4	**2,86**
	2010	2	1	2	4	4	4	1	3	**2,63**	2	1	3	3	3	3	4	**2,71**
	2011	2	2	2	3	4	4	1	2	**2,5**	2	1	2	3	3	3	4	**2,57**
	2012	2	2	2	3	4	4	1	2	**2,5**	1	1	2	1	2	2	4	**1,86**
Galp Energia	2003	1	4	2	2	2	3	1	4	**2,38**	1	1	1	3	3	3	2	**2**
	2004	1	4	2	2	1	3	1	4	**2,25**	1	1	1	3	3	3	1	**1,86**

Firm	Year #	RD/ NE	HC/ SALES	RD/ SALES	IA/ TA	IA/ SALES	IA/ NE	M&DE/ SALES	SALES/ NE	IC score	MTBV	MV/ EBITDA	MV/ SALES	ROE	ROA	Cash ROCE	EBITDA/ SALES	Financial score
	2005	1	4	2	2	1	3	1	4	**2,25**	1	1	1	4	4	4	1	**2,29**
	2006	1	4	2	2	1	2	1	4	**2,13**	3	1	1	4	4	4	1	**2,57**
	2007	1	4	2	2	1	2	1	4	**2,13**	4	4	2	4	4	4	1	**3,29**
	2008	1	4	2	2	1	2	1	4	**2,13**	3	4	2	2	1	1	1	**2**
	2009	1	4	2	2	1	2	1	4	**2,13**	4	4	2	3	3	3	1	**2,86**
	2010	1	4	2	2	1	4	1	4	**2,38**	4	4	2	4	3	3	1	**3**
	2011	1	4	2	2	1	4	1	4	**2,38**	4	3	2	3	2	3	1	**2,57**
	2012	1	4	2	2	1	4	1	4	**2,38**	2	3	2	1	2	1	1	**1,71**
Heineken	2003	2	2	2	2	2	2	2	1	**1,88**	4	3	3	4	4	4	4	**3,71**
	2004	2	3	2	2	2	2	2	2	**2,13**	3	3	3	2	4	4	3	**3,14**
	2005	2	2	1	3	2	2	2	2	**2**	4	3	3	3	3	4	3	**3,29**
	2006	2	2	1	3	2	2	2	2	**2**	4	3	3	4	4	4	3	**3,57**
	2007	2	2	1	2	2	2	2	2	**1,88**	4	3	3	2	3	4	2	**3**
	2008	2	2	2	3	3	3	2	3	**2,5**	3	2	3	1	2	2	2	**2,14**
	2009	2	3	2	3	3	3	2	3	**2,63**	4	2	3	4	4	4	3	**3,43**
	2010	2	3	2	3	3	3	2	2	**2,5**	3	3	3	3	3	2	3	**2,86**
	2011	2	3	2	3	3	3	3	2	**2,63**	3	2	3	3	3	2	3	**2,71**
	2012	2	2	2	4	4	4	2	2	**2,75**	3	2	3	4	3	3	4	**3,14**
Iliad	2003	3	4	2	3	2	3	1	4	**2,75**	1	1	1	4	4	4	3	**2,57**
	2004	3	3	2	3	3	4	1	4	**2,88**	4	4	4	3	4	4	4	**3,86**
	2005	2	3	2	2	2	2	1	4	**2,25**	4	4	4	4	4	4	4	**4**
	2006	2	3	2	2	1	2	1	4	**2,13**	4	4	4	4	4	4	4	**4**
	2007	2	3	2	2	1	2	1	3	**2**	4	3	4	4	4	4	4	**3,86**
	2008	2	4	2	2	2	2	1	3	**2,25**	4	3	4	4	3	4	4	**3,71**
	2009	2	4	2	2	1	2	1	4	**2,25**	4	2	4	4	4	4	4	**3,71**
	2010	2	4	2	2	2	3	1	4	**2,5**	4	2	4	4	4	4	4	**3,71**
	2011	2	4	2	2	3	4	1	3	**2,63**	4	3	4	4	4	4	4	**3,86**
	2012	2	4	2	3	3	4	1	4	**2,88**	4	3	4	2	3	4	4	**3,43**
ING Group	2003	2	3	1	1	1	1	2	4	**1,88**	2	1	2	3	1	1	1	**1,57**
	2004	2	3	1	1	1	1	2	4	**1,88**	3	1	2	4	1	1	1	**1,86**
	2005	2	3	2	1	1	1	2	4	**2**	3	1	2	4	1	2	2	**2,14**
	2006	2	3	1	1	1	1	2	4	**1,88**	2	2	3	4	1	1	2	**2,14**
	2007	2	3	1	1	1	1	2	4	**1,88**	2	1	2	4	1	1	2	**1,86**
	2008	2	3	1	1	1	2	2	4	**2**	1	4	1	1	1	1	1	**1,43**
	2009	2	3	1	1	1	2	2	4	**2**	1	4	1	1	1	1	1	**1,43**
	2010	2	3	1	1	1	2	2	4	**2**	1	2	1	1	1	1	1	**1,14**
	2011	2	3	1	1	1	1	2	4	**1,88**	1	2	2	1	1	1	2	**1,43**
	2012	2	4	1	1	1	1	2	4	**2**	1	2	2	1	1	1	2	**1,43**
Jéronimo Martins	2003	1	2	1	2	2	1	2	1	**1,5**	4	2	1	4	3	4	2	**2,86**
	2004	1	2	2	2	2	1	2	1	**1,63**	3	2	1	4	3	4	1	**2,57**
	2005	1	2	1	2	2	1	2	1	**1,5**	4	2	1	4	3	3	1	**2,57**
	2006	1	2	1	2	2	1	2	1	**1,5**	4	2	1	3	3	4	1	**2,57**
	2007	1	2	1	2	1	1	3	1	**1,5**	4	3	1	4	2	4	1	**2,71**
	2008	1	2	1	2	1	1	3	1	**1,5**	4	3	2	4	3	4	1	**3**
	2009	1	2	2	2	1	1	3	1	**1,63**	4	3	2	4	3	4	2	**3,14**
	2010	1	2	1	2	1	1	3	1	**1,5**	4	4	2	4	3	4	1	**3,14**

Firm	Year #	RD/ NE	HC/ SALES	RD/ SALES	IA/ TA	IA/ SALES	IA/ NE	M&DE/ SALES	SALES/ NE	IC score	MTBV	MV/ EBITDA	MV/ SALES	ROE	ROA	Cash ROCE	EBITDA/ SALES	Financial score
	2011	1	2	1	2	1	1	3	1	**1,5**	4	4	3	4	3	4	1	**3,29**
	2012	1	2	2	2	1	1	4	1	**1,75**	4	4	3	4	3	4	1	**3,29**
KBC	2003	1	2	2	1	1	2	3	3	**1,88**	1	2	3	2	1	1	3	**1,86**
	2004	1	2	2	1	1	2	3	3	**1,88**	2	2	3	2	1	1	3	**2**
	2005	1	2	2	1	1	2	3	3	**1,88**	2	2	3	2	1	1	4	**2,14**
	2006	1	1	2	1	1	2	3	3	**1,75**	2	2	3	3	1	1	4	**2,29**
	2007	1	1	2	1	2	2	3	3	**1,88**	2	1	3	3	1	1	4	**2,14**
	2008	1	1	1	1	2	2	3	3	**1,75**	1	1	2	1	1	1	1	**1,14**
	2009	1	1	1	1	2	2	2	3	**1,63**	1	1	2	1	1	1	1	**1,14**
	2010	1	1	1	1	1	1	2	3	**1,38**	1	1	2	1	1	1	1	**1,14**
	2011	1	1	1	1	1	1	2	3	**1,38**	1	1	1	1	1	1	1	**1**
	2012	1	2	1	1	1	1	2	2	**1,38**	1	1	2	1	1	1	1	**1,14**
Kering	2003	1	4	1	4	4	4	1	2	**2,63**	2	3	2	2	2	1	1	**1,86**
	2004	2	4	1	4	3	4	1	3	**2,75**	1	2	1	2	3	1	2	**1,71**
	2005	1	4	1	4	4	4	1	2	**2,63**	1	3	2	1	2	1	1	**1,57**
	2006	1	4	1	4	4	4	1	2	**2,63**	1	3	2	1	2	1	1	**1,57**
	2007	1	4	1	4	4	4	1	2	**2,63**	1	2	2	1	2	1	1	**1,43**
	2008	1	4	1	4	4	4	1	2	**2,63**	1	2	1	1	2	1	1	**1,29**
	2009	1	4	1	4	4	4	1	2	**2,63**	1	4	2	2	2	1	1	**1,86**
	2010	1	4	1	4	4	4	1	2	**2,63**	2	4	3	2	2	1	1	**2,14**
	2011	1	4	2	4	4	4	1	2	**2,75**	2	3	3	2	2	2	2	**2,29**
	2012	2	4	2	4	4	4	1	3	**3**	2	3	3	2	3	2	3	**2,57**
Lafarge	2003	2	3	2	3	4	3	3	2	**2,75**	2	2	3	2	3	2	4	**2,57**
	2004	2	3	2	3	4	3	2	2	**2,63**	2	2	3	2	2	1	1	**1,86**
	2005	2	3	3	3	3	3	2	2	**2,63**	1	1	2	1	2	2	1	**1,43**
	2006	2	3	2	3	3	3	2	2	**2,5**	2	2	3	2	3	2	1	**2,14**
	2007	2	3	2	3	3	3	2	2	**2,5**	2	1	3	2	3	2	1	**2**
	2008	2	3	2	3	3	3	2	2	**2,5**	1	1	2	2	3	2	4	**2,14**
	2009	1	3	2	3	4	4	2	2	**2,63**	1	1	3	2	2	2	1	**1,71**
	2010	1	3	2	3	4	4	2	2	**2,63**	1	1	2	1	2	1	1	**1,29**
	2011	1	3	2	3	4	4	2	2	**2,63**	1	2	2	1	2	1	1	**1,43**
	2012	1	3	2	3	4	4	2	2	**2,63**	1	2	3	1	2	1	1	**1,57**
Legrande	2003	4	1	4	4	4	4	2	1	**3**	1	1	1	1	1	1	3	**1,29**
	2004	4	1	4	4	4	4	2	1	**3**	1	1	1	1	2	1	3	**1,43**
	2005	4	1	4	4	4	4	2	1	**3**	1	1	1	3	2	2	3	**1,86**
	2006	4	1	4	4	4	4	2	1	**3**	3	3	3	1	3	2	3	**2,57**
	2007	4	1	4	4	4	3	2	1	**2,88**	3	2	3	3	3	3	3	**2,86**
	2008	4	1	4	4	4	3	2	1	**2,88**	2	2	3	3	4	2	3	**2,71**
	2009	4	1	4	4	4	3	2	1	**2,88**	3	2	3	3	3	3	3	**2,86**
	2010	4	1	4	4	4	3	2	1	**2,88**	4	3	4	3	4	3	4	**3,57**
	2011	4	2	4	4	4	3	2	1	**3**	3	3	3	4	4	3	4	**3,43**
	2012	3	2	4	4	4	3	2	1	**2,88**	3	3	3	3	4	3	4	**3,29**
L'Oréal	2003	4	2	4	4	3	3	3	3	**3,25**	4	4	4	3	4	4	3	**3,71**
	2004	4	2	4	3	3	3	3	3	**3,13**	4	4	4	4	4	4	4	**4**
	2005	4	2	3	3	3	3	3	3	**3**	3	4	4	1	3	2	3	**2,86**

Firm	Year #	RD/ NE	HC/ SALES	RD/ SALES	IA/ TA	IA/ SALES	IA/ NE	M&DE/ SALES	SALES/ NE	IC score	MTBV	MV/ EBITDA	MV/ SALES	ROE	ROA	Cash ROCE	EBITDA/ SALES	Financial score
	2006	4	2	3	3	3	3	3	2	**2,88**	3	4	4	2	3	2	3	**3**
	2007	4	3	4	3	3	3	3	3	**3,25**	4	4	4	3	4	3	4	**3,71**
	2008	4	2	4	3	3	3	3	2	**3**	4	4	4	3	4	3	3	**3,57**
	2009	4	2	4	3	3	3	3	3	**3,13**	4	4	4	3	4	3	3	**3,57**
	2010	4	2	4	3	3	3	3	3	**3,13**	4	4	4	3	4	4	3	**3,71**
	2011	4	2	4	3	3	3	3	3	**3,13**	4	4	4	3	4	3	3	**3,57**
	2012	4	2	4	3	3	3	3	3	**3,13**	4	4	4	3	4	3	3	**3,57**
LVMH	2003	2	2	3	4	4	4	3	2	**3**	4	4	4	2	3	3	4	**3,43**
	2004	2	2	3	4	4	4	3	2	**3**	4	4	4	2	3	3	3	**3,29**
	2005	2	2	2	4	4	4	3	2	**2,88**	4	4	4	2	3	3	4	**3,43**
	2006	2	1	3	4	4	4	3	2	**2,88**	4	4	4	3	3	3	4	**3,57**
	2007	2	1	2	3	4	4	3	2	**2,63**	3	3	4	2	3	3	3	**3**
	2008	2	1	2	3	4	4	3	2	**2,63**	3	3	4	3	4	3	4	**3,43**
	2009	2	1	2	3	3	4	3	2	**2,5**	3	4	4	3	4	3	4	**3,57**
	2010	2	1	2	3	3	4	3	2	**2,5**	4	4	4	4	4	4	4	**4**
	2011	2	1	2	3	3	3	3	2	**2,38**	3	4	4	2	3	3	4	**3,29**
	2012	2	1	2	3	3	3	3	2	**2,38**	3	4	4	3	4	3	4	**3,57**
Michelin	2003	3	1	4	1	1	1	3	1	**1,88**	1	1	1	1	2	3	2	**1,57**
	2004	4	1	4	1	1	1	3	1	**2**	2	1	2	2	2	3	2	**2**
	2005	3	1	4	1	1	1	3	1	**1,88**	2	1	1	3	3	4	2	**2,29**
	2006	3	2	4	1	1	1	2	1	**1,88**	2	1	1	1	2	3	2	**1,71**
	2007	3	1	4	1	1	1	2	1	**1,75**	2	1	1	2	2	3	2	**1,86**
	2008	3	1	4	1	1	1	2	1	**1,75**	2	2	2	2	2	2	2	**2**
	2009	3	2	4	1	1	1	2	1	**1,88**	2	2	1	1	2	2	2	**1,71**
	2010	3	2	4	1	1	1	2	1	**1,88**	2	1	1	2	3	3	2	**2**
	2011	3	2	4	1	1	1	2	1	**1,88**	2	1	1	4	4	4	2	**2,57**
	2012	3	2	4	1	1	1	2	1	**1,88**	2	2	2	4	4	4	3	**3**
Pernod Ricard	2003	2	2	2	3	4	4	3	3	**2,88**	3	3	4	3	3	2	4	**3,14**
	2004	2	2	1	3	4	4	3	3	**2,75**	3	4	4	3	3	2	4	**3,29**
	2005	2	3	1	3	4	4	3	3	**2,88**	3	4	4	2	3	2	4	**3,14**
	2006	2	3	2	4	4	4	3	3	**3,13**	3	4	4	1	2	1	3	**2,57**
	2007	2	2	2	4	4	4	3	3	**3**	3	4	4	1	2	1	4	**2,71**
	2008	2	2	2	4	4	4	3	3	**3**	3	4	4	2	3	1	4	**3**
	2009	2	2	2	4	4	4	3	3	**3**	2	2	4	3	3	1	4	**2,71**
	2010	2	2	2	4	4	4	3	3	**3**	3	4	4	2	2	1	4	**2,86**
	2011	2	2	2	4	4	4	3	4	**3,13**	3	4	4	2	2	1	4	**2,86**
	2012	2	2	2	4	4	4	3	3	**3**	3	4	4	2	2	1	4	**2,86**
Philips	2003	4	2	4	2	2	2	3	2	**2,63**	3	4	3	1	2	1	1	**2,14**
	2004	4	2	4	2	2	2	3	2	**2,63**	2	3	3	3	2	2	2	**2,43**
	2005	4	2	4	2	2	2	3	2	**2,63**	2	4	3	2	2	2	1	**2,29**
	2006	4	2	4	2	2	2	3	2	**2,63**	1	4	3	1	1	1	1	**1,71**
	2007	4	2	4	2	2	2	4	2	**2,75**	1	2	3	4	3	2	3	**2,57**
	2008	4	2	4	3	3	1	4	2	**2,88**	1	4	2	1	1	1	1	**1,57**
	2009	4	2	4	3	3	2	4	2	**3**	2	3	2	1	1	2	2	**1,86**
	2010	4	2	4	3	3	2	3	2	**2,88**	2	3	3	2	2	3	2	**2,43**
	2011	4	2	4	3	3	2	4	1	**2,88**	2	4	3	1	1	1	1	**1,86**

Firm	Year #	RD/ NE	HC/ SALES	RD/ SALES	IA/ TA	IA/ SALES	IA/ NE	M&DE/ SALES	SALES/ NE	IC score	MTBV	MV/ EBITDA	MV/ SALES	ROE	ROA	Cash ROCE	EBITDA/ SALES	Financial score
	2012	4	2	4	3	3	2	4	1	**2,88**	2	3	2	1	2	2	2	**2**
Publicis Groupe	2003	1	4	1	4	4	4	1	1	**2,5**	4	4	4	3	2	2	3	**3,14**
	2004	1	4	1	4	4	3	1	1	**2,38**	4	3	3	4	2	3	3	**3,14**
	2005	1	4	1	3	4	3	1	1	**2,25**	3	3	3	3	2	2	3	**2,71**
	2006	1	4	1	3	4	3	1	1	**2,25**	3	3	3	3	2	2	3	**2,71**
	2007	1	4	1	3	4	3	1	1	**2,25**	2	2	2	3	2	3	3	**2,43**
	2008	1	4	1	3	4	3	1	1	**2,25**	2	2	3	4	2	4	3	**2,86**
	2009	1	4	1	3	4	3	1	1	**2,25**	2	3	3	3	2	2	3	**2,57**
	2010	1	4	1	3	4	2	1	1	**2,13**	3	3	3	4	2	2	3	**2,86**
	2011	1	4	1	3	4	2	1	1	**2,13**	3	3	3	3	2	3	3	**2,86**
	2012	1	4	1	3	4	3	1	1	**2,25**	3	3	3	4	2	3	3	**3**
Renault	2003	4	2	3	1	1	1	4	3	**2,38**	1	1	2	3	3	2	3	**2,14**
	2004	4	2	3	2	1	1	4	3	**2,5**	1	1	2	3	3	2	3	**2,14**
	2005	4	2	4	2	1	1	4	3	**2,63**	1	1	1	3	2	3	2	**1,86**
	2006	4	2	4	1	1	1	4	3	**2,5**	1	1	1	2	1	3	2	**1,57**
	2007	4	2	4	2	2	1	3	3	**2,63**	1	1	1	1	1	2	2	**1,29**
	2008	4	2	4	2	1	1	3	3	**2,5**	1	1	1	1	1	2	2	**1,29**
	2009	4	3	4	2	1	1	4	3	**2,75**	1	4	1	1	1	1	1	**1,43**
	2010	4	2	4	1	1	1	4	3	**2,5**	1	1	1	3	2	3	2	**1,86**
	2011	4	2	4	1	1	1	4	3	**2,5**	1	1	1	2	2	2	2	**1,57**
	2012	4	3	4	1	1	1	4	3	**2,63**	1	1	1	2	2	2	2	**1,57**
Saint-Gobain S.A.	2003	3	4	3	3	3	3	3	2	**3**	1	2	2	2	3	2	2	**2**
	2004	3	4	3	3	3	2	3	2	**2,88**	1	2	2	2	2	2	2	**1,86**
	2005	3	4	3	3	3	3	3	2	**3**	1	2	1	1	2	1	1	**1,29**
	2006	3	4	3	3	3	3	3	2	**3**	1	1	1	1	2	2	1	**1,29**
	2007	3	4	3	3	3	2	3	2	**2,88**	1	2	1	1	2	2	1	**1,43**
	2008	3	4	3	3	2	2	3	2	**2,75**	2	2	1	2	2	2	2	**1,86**
	2009	3	4	3	3	2	2	3	2	**2,75**	2	3	1	1	2	2	2	**1,86**
	2010	3	4	3	2	2	2	3	2	**2,63**	2	2	1	1	1	2	1	**1,43**
	2011	3	4	3	2	2	2	3	2	**2,63**	1	2	1	1	2	2	1	**1,43**
	2012	3	4	3	2	2	2	3	2	**2,63**	2	2	1	1	2	2	1	**1,57**
Sanofi	2003	4	4	4	2	2	2	4	3	**3,13**	4	1	4	4	1	1	1	**2,29**
	2004	1	4	4	4	4	4	4	2	**3,38**	3	4	4	1	1	1	1	**2,14**
	2005	4	4	4	4	4	4	4	3	**3,88**	3	4	4	1	1	1	4	**2,57**
	2006	4	4	4	4	4	4	4	3	**3,88**	2	4	4	1	2	2	4	**2,71**
	2007	4	4	4	4	4	4	4	3	**3,88**	2	3	4	1	2	2	4	**2,57**
	2008	4	4	4	4	4	4	4	3	**3,88**	2	3	4	2	2	2	4	**2,71**
	2009	4	4	4	4	4	4	3	3	**3,75**	2	2	4	3	3	3	4	**3**
	2010	4	4	4	4	4	4	4	3	**3,88**	2	2	4	2	2	2	4	**2,57**
	2011	4	4	4	4	4	4	4	3	**3,88**	2	3	4	2	2	2	4	**2,71**
	2012	4	4	4	4	4	4	4	3	**3,88**	2	3	4	2	2	2	4	**2,71**
Schneider Electric	2003	4	4	4	3	4	3	3	1	**3,25**	2	4	4	1	2	1	2	**2,29**
	2004	4	4	4	4	4	3	3	1	**3,38**	2	3	3	1	3	2	2	**2,29**
	2005	4	4	4	4	4	3	3	1	**3,38**	2	3	3	1	3	1	2	**2,14**
	2006	3	4	4	3	3	3	4	1	**3,13**	2	3	3	2	3	2	2	**2,43**

Firm	Year #	RD/ NE	HC/ SALES	RD/ SALES	IA/ TA	IA/ SALES	IA/ NE	M&DE/ SALES	SALES/ NE	IC score	MTBV	MV/ EBITDA	MV/ SALES	ROE	ROA	Cash ROCE	EBITDA/ SALES	Financial score
	2007	3	3	4	4	3	3	4	1	**3,13**	2	3	3	2	3	2	2	**2,43**
	2008	3	3	4	4	3	3	4	1	**3,13**	2	2	3	3	4	3	3	**2,86**
	2009	3	3	4	4	3	3	4	1	**3,13**	2	4	3	2	3	2	2	**2,57**
	2010	3	3	3	4	3	3	4	1	**3**	3	3	3	2	3	2	2	**2,57**
	2011	3	3	4	4	3	3	4	1	**3,13**	2	3	3	2	3	2	2	**2,43**
	2012	4	3	4	4	3	2	4	1	**3,13**	3	3	3	2	3	2	2	**2,57**
Shell	2003	3	1	2	1	1	2	2	4	**2**	2	2	2	3	4	4	3	**2,86**
	2004	3	1	2	1	1	2	2	4	**2**	2	1	1	3	4	4	2	**2,43**
	2005	3	1	2	1	1	2	2	4	**2**	1	1	1	4	4	4	2	**2,43**
	2006	4	1	2	1	1	2	2	4	**2,13**	1	1	1	4	4	4	2	**2,43**
	2007	4	1	3	1	1	2	2	4	**2,25**	1	1	1	4	4	4	2	**2,43**
	2008	4	1	3	1	1	1	2	4	**2,13**	1	1	1	3	4	4	2	**2,29**
	2009	4	1	3	1	1	1	3	4	**2,25**	1	1	1	2	3	3	2	**1,86**
	2010	4	1	2	1	1	1	2	4	**2**	1	1	1	3	4	4	2	**2,29**
	2011	4	1	2	1	1	1	2	4	**2**	1	1	1	4	4	4	2	**2,43**
	2012	4	1	3	1	1	2	2	4	**2,25**	1	1	1	3	4	4	2	**2,29**
Société Générale	2003	2	4	1	1	2	2	1	4	**2,13**	2	3	3	2	3	2	2	**2,43**
	2004	2	4	1	1	2	2	1	3	**2**	2	3	3	3	2	2	3	**2,57**
	2005	1	4	2	1	2	2	1	4	**2,13**	2	2	2	3	2	1	3	**2,14**
	2006	1	4	1	1	2	2	1	3	**1,88**	2	1	2	3	2	2	3	**2,14**
	2007	1	4	1	1	1	2	1	4	**1,88**	1	2	2	1	2	1	2	**1,57**
	2008	2	4	2	1	1	2	1	3	**2**	1	1	2	1	2	2	3	**1,71**
	2009	2	4	1	1	2	2	1	3	**2**	1	3	2	1	3	1	2	**1,86**
	2010	2	4	2	1	2	2	1	3	**2,13**	1	1	2	1	2	1	3	**1,57**
	2011	2	4	2	1	2	2	1	3	**2,13**	1	1	1	1	3	1	3	**1,57**
	2012	2	4	1	1	1	2	1	3	**1,88**	1	1	1	1	3	1	2	**1,43**
Sodexo Alliance	2003	1	1	1	4	3	1	4	1	**2**	3	3	1	2	1	2	1	**1,86**
	2004	1	1	1	4	3	1	4	1	**2**	2	2	1	1	1	2	1	**1,43**
	2005	1	1	1	4	3	1	4	1	**2**	2	3	1	1	1	1	1	**1,43**
	2006	1	1	1	4	3	1	4	1	**2**	3	3	1	2	1	2	1	**1,86**
	2007	1	1	1	3	3	1	4	1	**1,88**	3	3	1	2	1	2	1	**1,86**
	2008	1	1	1	3	2	1	4	1	**1,75**	4	3	3	4	1	4	1	**2,86**
	2009	1	1	1	4	2	1	4	1	**1,88**	3	2	1	4	1	3	1	**2,14**
	2010	1	1	1	3	2	1	3	1	**1,63**	3	3	1	3	1	3	1	**2,14**
	2011	1	1	1	3	2	1	4	1	**1,75**	4	3	2	4	1	3	1	**2,57**
	2012	1	1	1	3	2	1	3	1	**1,63**	4	3	2	4	1	3	1	**2,57**
Technip	2003	3	4	3	3	4	4	2	3	**3,25**	1	3	2	1	1	1	1	**1,43**
	2004	3	4	3	3	4	4	3	3	**3,38**	2	4	2	1	1	1	1	**1,71**
	2005	3	4	3	3	3	4	2	3	**3,13**	3	4	3	1	1	1	1	**2**
	2006	3	4	3	3	3	3	3	3	**3,13**	2	4	2	1	1	1	1	**1,71**
	2007	3	4	3	3	3	3	2	3	**3**	3	4	2	1	1	1	1	**1,86**
	2008	3	4	3	2	2	3	2	3	**2,75**	2	1	2	4	3	4	2	**2,57**
	2009	3	4	3	2	2	3	2	3	**2,75**	3	3	2	2	2	2	2	**2,29**
	2010	3	4	3	2	3	2	3	2	**2,75**	3	4	3	3	2	2	2	**2,71**
	2011	3	4	3	2	2	2	2	2	**2,5**	3	4	3	3	2	2	2	**2,71**

Firm	Year #	RD/ NE	HC/ SALES	RD/ SALES	IA/ TA	IA/ SALES	IA/ NE	M&DE/ SALES	SALES/ NE	IC score	MTBV	MV/ EBITDA	MV/ SALES	ROE	ROA	CashROCE	EBITDA/ SALES	Financial score
	2012	3	4	3	2	3	2	3	2	**2,75**	3	4	3	3	3	2	2	**2,86**
Total	2003	4	1	3	1	1	2	1	4	**2,13**	3	3	3	4	4	4	3	**3,43**
	2004	4	1	3	1	1	2	1	4	**2,13**	3	2	3	4	4	4	3	**3,29**
	2005	4	1	3	1	1	2	1	4	**2,13**	3	2	3	4	4	4	4	**3,43**
	2006	4	1	3	1	1	2	1	4	**2,13**	3	1	2	4	4	4	3	**3**
	2007	4	1	3	1	1	2	1	4	**2,13**	3	1	2	4	4	4	3	**3**
	2008	4	1	3	1	1	2	1	4	**2,13**	3	1	3	4	4	4	3	**3,14**
	2009	4	1	3	1	1	2	1	4	**2,13**	3	1	3	4	4	4	3	**3,14**
	2010	4	1	3	2	1	2	1	4	**2,25**	2	1	2	4	4	4	3	**2,86**
	2011	4	1	3	2	1	3	1	4	**2,38**	2	1	2	4	4	4	3	**2,86**
	2012	4	1	3	2	1	3	1	4	**2,38**	2	1	2	3	4	4	3	**2,71**
Unilever	2003	3	4	3	4	3	3	4	2	**3,25**	4	2	3	4	4	4	3	**3,43**
	2004	3	4	3	4	3	3	4	2	**3,25**	4	3	2	4	3	4	2	**3,14**
	2005	3	4	3	4	3	3	4	2	**3,25**	4	2	2	4	4	4	2	**3,14**
	2006	3	4	3	4	3	3	4	2	**3,25**	3	2	2	4	4	4	2	**3**
	2007	3	4	3	4	3	3	4	2	**3,25**	3	2	2	4	4	4	2	**3**
	2008	3	4	3	4	3	2	3	2	**3**	4	2	3	4	4	4	3	**3,43**
	2009	3	4	3	1	3	3	4	2	**2,88**	4	2	2	4	4	4	3	**3,29**
	2010	3	4	3	3	3	3	4	3	**3,25**	3	2	2	4	4	4	2	**3**
	2011	3	4	3	4	3	3	4	3	**3,38**	4	2	3	4	4	4	2	**3,29**
	2012	3	1	3	3	3	3	4	3	**2,88**	4	2	3	4	4	4	2	**3,29**
VINCI	2003	2	1	1	3	3	3	1	1	**1,88**	3	2	1	3	2	2	2	**2,14**
	2004	2	1	1	3	3	3	1	1	**1,88**	3	2	2	4	2	3	2	**2,57**
	2005	2	1	1	3	3	2	1	1	**1,75**	3	2	2	3	2	2	1	**2,14**
	2006	2	1	1	4	4	4	1	2	**2,38**	3	1	2	2	2	1	2	**1,86**
	2007	2	1	1	4	4	4	1	2	**2,38**	3	1	2	3	2	2	2	**2,14**
	2008	2	1	1	4	4	4	1	2	**2,38**	3	1	2	4	2	2	2	**2,29**
	2009	2	1	1	4	4	3	1	2	**2,25**	3	1	2	4	2	2	3	**2,43**
	2010	2	1	1	4	4	3	1	1	**2,13**	2	2	2	3	2	2	2	**2,14**
	2011	2	1	1	4	4	3	1	2	**2,25**	2	2	2	3	2	2	2	**2,14**
	2012	1	1	1	4	4	1	1	1	**1,75**	2	1	2	3	2	2	2	**2**
Vivendi	2003	3	3	3	4	4	4	1	4	**3,25**	2	3	3	1	1	2	2	**2**
	2004	3	3	3	4	4	4	1	4	**3,25**	2	3	3	1	2	3	4	**2,57**
	2005	3	3	3	4	4	4	1	4	**3,25**	2	2	3	2	3	3	4	**2,71**
	2006	3	2	3	3	4	4	1	4	**3**	2	2	3	3	3	3	4	**2,86**
	2007	3	2	3	4	4	4	1	4	**3,13**	2	2	3	1	3	2	4	**2,43**
	2008	4	3	3	4	4	4	1	4	**3,38**	2	2	3	2	3	3	4	**2,71**
	2009	4	3	3	4	4	4	1	4	**3,38**	2	1	3	2	2	1	4	**2,14**
	2010	4	3	4	4	4	4	1	4	**3,5**	1	1	3	2	3	4	4	**2,57**
	2011	4	3	3	4	4	4	1	4	**3,38**	2	1	3	2	3	4	4	**2,71**
	2012	2	4	2	4	4	4	1	4	**3,13**	2	1	3	1	2	3	3	**2,14**

Table A 1: Intellectual Capital commitment and Financial scores (2003 - 2012)

THANKSGIVINGS

It's always difficult, for me, to write what I feel in moments like this; I'm approaching to get the Ph.D. after doing (I hope) my best.

As usual, at the end of a gruelling thesis, it is a good practice to thank some people we love, so, being not completely different from any other student in the World, I'd also like to thank someone who strongly supported me for reaching this wonderful goal; I simply call them "my Fans".

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