

Exploring structural capital from the business administration perspective: a general framework on the existing literature¹

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Abstract

Purpose of the paper: *The aim of this paper is to identify the best way to manage and assess structural capital in the context of the current world situation and to define its profile in terms of management and evaluation aspects. In order for these intangible assets to be defined, structural capital is first analyzed and classified according to its relevance to a company's core business.*

Methodology: *The research approach follows a qualitative methodology, applying a single method approach. Secondary data were investigated through a research protocol.*

Findings: *The findings of this research are based, first, on organizing international literature concerned with structural capital in order to identify its strong and weak points in terms of its management and economic evaluation. We have introduced a general approach to managing structural capital under specific circumstances with the objective of creating long-term value for companies.*

Research limitations: *The limitations of the paper depend upon its theoretical format. The general framework used to describe the management and evaluation of structural capital originates from an updated understanding of the concept, derived from the literature on the topic.*

Research and management implications: *The objective of categorizing structural capital is to associate a suitable management strategy to each structural capital category with the purpose of gaining strategic advantage and creating value.*

Originality of the paper: *Structural capital encourages the circulation of knowledge within a company and stimulates the creation of long-term value. Strategic value and the unique nature of structural capital makes such a classification of structural capital possible, while defining the most appropriate management strategies that can be put into practice by managers.*

Key words: structural capital; intellectual capital; management; economic assessment

¹ This paper is the joint work of the four authors: the "Introduction" and "Findings and discussion" are by Giuseppe Russo, the "Intellectual Capital in the Knowledge Economy" and "Conclusion, limits and perspectives" sections are by Rosa Lombardi, the paragraph entitled "Structural Capital and the Management Perspective" is by S. M. Riad Shams and the "Structural Capital and the Economic Evaluation" and "Research Approach" paragraphs are by Federica Evangelista.

1. Introduction

Over recent decades, international literature (Lev, 1999; Guthrie and Petty, 2000; Stewart, 1997) has actively examined the concept of intellectual capital.

Although the taxonomy concerning this topic is varied, this paper is concerned with analyzing structural capital and the aspects describing its management and assessment. The objective is to offer an updated concept and understanding of this topic to the academic community and experts in this field.

Our research aim is to define the role of structural capital in contemporary companies (Zanda, 2011) and look at how it can be managed in the right way. Social interaction leads to the exchange of thoughts, ideas and opinions. Knowledge-sharing can increase company knowledge, promoting the development of new structural capital and resulting an increase in competitive advantage.

International literature on this topic was examined using a qualitative research approach based on the presumption that the creation of long-term value is generated through the very best management of structural capital.

The organization of the article is the following. After the introduction, section two analyzes literature relating to intellectual capital and structural capital, its management profile and economic appraisal. Section three describes the adopted research approach. Section four illustrates the research results. Section five presents the final considerations, the limitations and future orientation of the study.

2. Literature review

2.1 *Intellectual Capital in the Knowledge Economy*

Ever since the 1990s, focus on knowledge has resulted in confirming the strategic role played by intellectual capital (Petty and Guthrie, 2000; Kaufmann and Schneider, 2004).

Intangible assets are considered as a range of intangible resources that, if correctly appraised within company management (Darroch, 2005; Du Plessis, 2007), lead to an increase in long-term company value (Chen *et al.*, 2005).

The OECD (1999) considers intellectual capital to be the economic value of two categories of intangible company resources: structural (or organizational) capital and human capital. The structural capital of a company refers to factors linked to computer systems and distribution networks; human capital includes internal company resources (personnel) and external company resources (customers and suppliers). This definition makes a specific distinction between the terms “intellectual capital” and “intangible resources”, as they are often mistakenly used as synonyms.

According to Sullivan (2000), human capital is one of the elements that make up intellectual capital, but he also included it among intellectual

activities. These activities originate from human capital and represent the sources of innovation that the company can commercialize (programmes, database, documents, design and methods).

Arvidsson (2002) defines a model, The Intangibles' Network (TIN model) used to identify five classes of intangible intellectual capital. These are human intangibles, relational intangibles, organizational intangibles, R&D intangibles and legal intangibles; moreover, she draws up a formal definition of the main aspects of intangible assets.

Peterseons and AF-Bjurstrom (1991) highlight another definition of intangible resources. These authors classify company intangibilities into three macro categories: human capital, market capital and confidence capital. Human capital includes the set of qualities describing the resources used within the company, such as leadership (Bennis and Nanus, 1985; Bradford and Cohen, 1984; Friedman, 1985; Mintzberg, 1973), motivation, know-how and the ability to achieve objectives. Market capital involves translating the perception that customers have of the company and its products. Confidence capital indicates the opinions and behaviour of company stakeholders with regard to the company, as well as how capable the company is of proving its reliability.

Edvinsson, Saint-Onge and Petrash (Edvinsson and Malone, 1997) have devised a model called the Value Platform, used to identify the inter-relationships that are important for creating value. The authors recognize human capital, organizational capital and customer capital as elements of intellectual capital.

Stewart (1997b) identifies intellectual capital as "*all intellectual material - knowledge, intellectual features, experience - that may be made available to create wealth*". According to the author, intellectual capital consists of three conceptual dimensions: human capital, relational capital and structural capital.

Structural capital represents coded and non-coded company knowledge, technology, inventions, formal and informal organizational procedures, best practice, patents, databases and intranet networks.

We can certainly declare that these immaterial assets were not often assessed by companies in the past. When companies and managers began to understand their importance in achieving competitive advantage and creating value, they attracted the attention of scholars who then started to analyse, study and attempt to define them.

2.2 Structural Capital and the Management Perspective

Structural capital is an expression of the organizational and management aspects of a company; it can be defined through a range of coded and uncoded knowledge about a contemporary company.

Several authors (Sullivan, 2000) examine the intellectual activity that derives from intellectual capital-produced innovation. Intellectual assets include programmes, inventions, processes, databases, methodologies, industrial projects and intellectual property rights (patents, copyrights, brands, trade secrets) and all similar aspects over which the company can claim property rights.

Edvinsson and Malone (1997) further classified structural capital into organizational, process and innovation capital. Organizational capital includes the organization's philosophy and its systems for exploiting its capabilities. Process capital includes the techniques, procedures and programmes that can be implemented to enhance the delivery of goods and services. Innovation capital includes intellectual property and intangible capital. Intellectual property involves protected commercial rights such as patents, copyrights and trademarks. Intangible capital includes all other expertise and the ideas used to run an organization.

For Sveiby (1997), structural capital (or internal structure) includes the range of patents, models, administrative systems and software that are created by employees and owned by the organization. Company culture is also contained within this definition.

Company culture plays a very important role in the development of organizational aspects that can generate, manage and maintain intellectual capital within an organization. It includes a range of rules, values and principles that affect the decisions made by company employees.

This generates the dynamic interdependence between human capital and structural capital. The knowledge and skills of each individual play a very important role in the creation of structural capital. Individual knowledge is appraised, circulated among company employees and transformed into action.

Because of the role played by structural capital in the creation of value, there is the need to develop methods by which it can be managed, making knowledge more widely available throughout the organization (Sánchez *et al.*, 2000).

Boisot (2002) states that structural capital is where the value added to the company by non-linearities within the knowledge creation process apparently resides.

Snell *et al.* (1999) analyze the strategic value of a company's structural capital in terms of two dimensions: idiosyncratic dimension and strategic values. The relevance of these assets grows as they contribute towards the creation of a competitive differentiation (Collis and Montgomery, 1995).

With an increase in the uniqueness of structural capital, companies are encouraged to invest more resources in its capital management to reduce risk and capitalize on its productive potential.

Table 1 (Structural Capital Matrix) shows the different types of structural capital, which are classified according to their idiosyncratic dimension and strategic value.

Tab. 1: Structural Capital Matrix

		Strategic value	
		Low	High
Idiosyncratic dimension	High	Idiosyncratic structural capital	Core structural capital
	Low	Ancillary structural capital	Compulsory structural capital

Idiosyncratic structural capital (low value and high unique nature) consists of the specific knowledge about the company that indirectly contributes to achieving long-term value. This should be the objective of company investment in order to differentiate the company from its competitors.

Ancillary structural capital is defined by both its low strategic value and low idiosyncratic dimension. This type of knowledge is produced through the company's own operations, but does not create specific value for consumers or the company.

High strategic value and a high idiosyncratic value characterize core structural capital. The employees' core knowledge and their relationship with other agents (suppliers, consumers, stakeholders, shareholders) are institutionalized and codified into organizational practices, databases and intellectual property that are protected by commercial rights.

Compulsory structural capital (high strategic value and low idiosyncratic value) is the general knowledge widely known on the market, which can ensure long-term competitive advantage (Porter, 1985).

An increase in these immaterial assets encourages the circulation of knowledge within the company and stimulates the creation of long-term value (Teece, 2000; Varian, 2005)

Accessibility to company knowledge, in this way, plays a very important role if analyzed from an internal as well as an external perspective.

Starting from the internal perspective, intangible goods must be managed appropriately, as they have a high level of dispersion. This results in the need for collection and coding practices.

A creative approach to coded knowledge presumes that it has been conceived with the new situation in mind.

Creation of knowledge can lead to resistance on the part of stakeholders, who are afraid of losing their prestige and contractual power within the organization. Additionally, when a competitor's knowledge can be imitated there may be ensuing new costs relating to internal personnel and the need for external consultancy.

In order for knowledge to be diffused within the organization, contributing to the creation of new internal capital, the company must develop:

- leadership focused on initiatives concerning knowledge management (Alavi and Leidner, 1999; Bollinger and Smith, 2001), which stimulates personnel to exchange knowledge;
- a culture that encourages the development and use of cognitive capital, including through modern techniques;
- operative systems encouraging employees to share knowledge;
- a reticular, network type of organizational structure where individuals are given shared values and objectives. This kind of structure allows various responsibilities to be outlined and this, in turn, stimulates individuals towards greater creativeness and dynamism in answering external requests.

Structural capital belongs to the organization in its entirety. It may be reproduced and made available to each individual (Stewart, 2002; Daum, 2003).

An analysis of the accessibility of structural capital involves problems relating to knowledge management.

The development and creation of new knowledge also requires substantial investment. Consequently, there is the demand to protect such knowledge from imitation and embezzlement, so that the company may profit from the economic benefits deriving from the creation of an innovative idea.

The protection methods used by contemporary organizations include technical protection and legal protection.

Technical protection limits access to internally developed knowledge by restricting and controlling access. Legal protection allows modern companies to legally protect knowledge that is developed internally against improper use by others, who may use this knowledge without having the right to do so.

The legal or technical protection of structural company capital produces two conflicting results. It stimulates company investment in terms of research and development but, at the same time, it restricts the circulation of knowledge and, as a consequence, the creation of new knowledge resulting from an accumulation effect.

However, communication does not have always a negative effect.

In the current economic environment, there is a key role for highly innovative companies with knowledge assets concerning, in particular, structural capital. In order to increase transparency and promote the understanding and evaluation of the company by its main stakeholders, organizations will increase the number of tools used to communicate, report on market data and provide information about the intangible heritage of the company (Cravera *et al.*, 2001).

In this way, the company can enjoy significant benefits, including an increase in company relational capital, which translates into an improvement of image and reputation.

Therefore, a correct and effective communication strategy will only have positive effects, especially when the strategy is qualitatively and quantitatively differentiated, compared to that of the company's competitors, and addresses innovation (Grojer and Johanson, 1999).

This information is not reported in the financial statements, which are mostly expenditure figures for R&D purposes or investment advice concerning such immaterial assets, but it is of great value, especially on the financial market and for business partners. Such an increase in transparency also has a positive effect on the staff's motivation and sense of belonging, highlighting the company's ability to innovate, create new knowledge and implement the best practice possible, while communication can be used as a marketing tool directed at stakeholders and corporate investors.

By analyzing structural capital, our study has raised the issue of its management. Structural capital has two features (strategic value and idiosyncratic dimension) and, according to their level of significance, this entails managing them in various ways. This perspective must be examined carefully, especially to comply with another point of view, that

of the staff's ability and willingness to share this knowledge and capability among themselves .

Communication of data and information about immaterial assets can be of significant importance to its management.

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2.3 Structural Capital and economic evaluation

The economic value of structural capital (Zanda *et al.*, 2005) can be estimated by using one of three main methods: the cost-based approach, value-based approach or real options-based approach.

The cost-based approach (Ford and Ryan, 1981) uses historical cost and reproduction cost to give an estimate of the economic value of structural capital.

The historical cost includes all costs borne by the company that relate to the invention and application process of a technology. This method is not easy to apply: there may be many inter-connected common costs within the variously involved research centres and the total cost may not represent the value of technology adequately. The cost of reproduction represents all the costs that will be incurred in creating something as useful as the technology included in the estimate. This method has some limitations: it is difficult to identify replacement knowledge in terms of usefulness and what is available on the market, and there is also the uncertainty that the costs of creating this technology will lead to the same results.

The value-based approach assesses the future economic benefits that a technology can create for the benefit of a company. Three problems arise, however, when elaborating this estimation: the identification of the flow of expected economic benefits, the choice of how often these benefits must be updated and the definition of the lifecycle of technology.

The flow of expected economic benefits may be in function of the differential in future profit between the economic benefits achieved before the new technology and those that will be achieved after the technology is introduced.

This means that the assessment of technology, carried out by updating the flows of future benefits - at an adequate rate of remuneration for pure capital and risk investment - represents an equal and neutral theoretical value of general exchange that satisfies the seller as well as the buyer. The exchange value of the technology is represented in the following formula (Zanda *et al.*, 2005):

$$Wx = \sum_{s=1}^k C_s (1 + i)^{-s}$$

where:

W_x is the economic value of technology;

C_s is the flow of competitive benefits or differentials provided by the technology to the company in k number of years;

i is the discount rate of benefit flows that takes into consideration risk and remuneration for pure capital investment.

The value-based approach has been applied by Ferrata (2007) to estimate the economic value of basic research through insurance related logic. Some aspects, such as the need for new knowledge arising from demand, the possibility of using basic research to solve laboratory problems that may crop up during the project, the benefits deriving from the sale of each unit of product following the development of the technology, must all be included in the analysis. The assessment of basic research can be represented in the following formula:

$$Y = \sum_{s=1}^k P_i (\Delta R_{i\% - m})_{r\% - t - m}$$

where:

- Y stands for the value of the basic research project with k as the alternative of use;
- k stands for the markets involved in the research field;
- P_i stands for the probability of exceeding the limits whereby knowledge cannot be used on the market i;
- i is for the minimum net of incomes, estimated with reference to the market i;
- r% is for the discount rate;
- m stands for the estimate of the time necessary for the project to become operative on the market i;
- t stands for the the period of time in which the cash flows generated by the market i are expected to extend to i.

Another suitable approach for estimating the economic value of structural capital is the real options-based approach. This approach stems from the theory (Amram and Kulatilaka, 1999; Black and Scholes, 1972) stating that it is suitable for assessing applied research, since this method, defined by rationality, objectivity and neutrality, can enhance investments where there is a high level of uncertainty. The real options approach is set up as an option relating to an investment project.

The problems innate in this method refer to the definition of contractual conditions, which must be clarified on each occasion, and compliance of the investment with some specific features. The value of the investment is affected by contingent values, the uncertainty of the investment with the consequent need for further information; the possibility of making changes to the strategy once the process is underway; the flexibility of the investment, with the entrepreneur possibly choosing several alternative businesses. Since the investment follows several strategies, it has high-growth possibilities.

The assessment process includes several types of real options (Black and Scholes, 1972; Rooney, 2003): development of real options, connected with “platform investments” for the implementation of other projects; deferment real options, related to the opportunity of postponing any decision concerning further investments for a certain period of time; real flexibility options, typical of research projects where the final objectives can easily be changed. Real abandonment options give the operator the possibility of interrupting the project within a certain period of time at

advantageous conditions, in the hypothesis where it is no longer convenient in the context of future investment developments.

The existence of real options can be proved empirically, starting with a preference for investments in research with greater liquidity on the market if choosing between two investments with the same characteristics.

The approach proposed by Amran and Kulatilaka (1999) organizes the real options model into four phases: definition of the mathematical model in function of properties and sources of uncertainty; application of the assessment model of the option (Cox *et al.*, 1979; Black and Scholes, 1972); examination of the results achieved according to the data included in the model; possible redefinition of the investment following the re-elaboration of strategies or results that were not in line with management expectations.

From the definition of the various structural capital evaluation methods, it can be inferred that the limitations of the cost based approach and the value based approach mean that these methods are difficult to apply. It follows that the method based on real options seems the only way forward.

3. Methodological approach

The research approach of the present study is based on the qualitative method (Maylor and Blackmon, 2005; Myers, 2013). The research examines the topic of structural capital, emphasizing its role in the knowledge economy. Special attention is, therefore, paid to the following aspects:

- the concept of structural capital;
- management and enhancement features of structural capital;
- definition of the correct trade-off between accessibility and protection of company structural capital.

Data were acquired using the single-method approach, with a research protocol (Yin, 1994) that was needed/necessary for data processing.

For clarification, the research protocol involved the following steps:

1. the objective of the study was identified through a report summarizing the project;
2. the data collection procedures were defined and tasks assigned to each member of the three-person work group, which also researched secondary data.
3. guidelines were defined for the study report, highlighting the essential points of the project.

The research used secondary sources that were selected using the following search process:

- 25 scientific articles were selected on the basis of: “intellectual assets”, “knowledge management”, “structural capital” and “real options”;
- two databases were used and 20 scientific articles were found and consulted using the EBSCO database and word searches for “intellectual capital”; ten scientific articles consulted on Google Scholar by using the keyword “structural capital”;
- several websites, news articles and open access journals were also consulted.

4. Findings and discussion

The research findings originated from an analysis of international literature on structural capital. Structural knowledge stimulates the accumulation of knowledge within and without the company that generated such knowledge; this, in turn, may inspire the creation of new technologies (Choen and Levinthal, 1989) and the formulation of new ideas.

Among the investigated aspects, it can be observed that the traditional methods of assessing social capital are not capable of evaluating investments in applied research, and therefore enhance opportunities. The high level of uncertainty in the results of an investment makes it difficult to estimate the value of technology (starting with necessary costs to create an equivalent technology of use) or to attribute a certain profitability or financial flow to it.

The real options approach meets this requirement, despite the difficulty of identifying its main elements (current price, applicable price, method of execution of the option) in the Option Pricing Model.

Another issue to consider is choosing a better way of managing structural capital (Lombardi *et al.*, 2014).

An increase in the importance of structural capital within the existing economic framework has encouraged the dynamic management of knowledge, which is no longer a static management model (Chesbrough, 2006) entrusted to the legal area or external specialists.

Therefore, the strategy needed to manage structural capital must be developed continuously according to the business phases of the company.

The dynamic management of knowledge should involve the clear identification of rights associated to its existing or potential capacity, achieved by defining which assets have a greater return on R&D investment.

Organizations can, therefore, develop innovation (Vrontis *et al.*, 2015) in different ways. They can create new knowledge on their own or, alternatively, agree to work in partnership with other organizations, under joint venture or development agreements (Palfrey, 2012). A third solution can be to acquire structural capital from a third party, such as another company, a university or a research institution.

When a company develops a technology, it expects its investments to be repaid through the profit that is generated by the innovation. A good level of protection provides the entrepreneur with an appropriate level of return.

A limited degree of protection, on the other hand, may lead to an increased fear of imitation. In this case, it makes sense to adopt management models based on the sharing of innovation: this is the case of licensing.

Due to the complexity of and increase in technologies, the shortening of the technology cycle, the globalization of technology and the increase in R&D costs and technology, partnerships have become significantly more frequent.

The sale of patents or companies buying and selling each others' licenses and technologies has become an acceptable way of doing business. This mutual interest in licensing agreements among companies can lead to excellent results for their business (Tidd *et al.*, 1997).

Sometimes, a company owns ideas and patents that are not used because they would not work in their own business, so they can transfer them (also through licensing agreements) to companies that are capable of exploiting their potential (Chesbrough, 2006).

Another proposed solution for managing internal capital, when the fear of imitation is high, is to provide knowledge in an open source format. These assets are shared, through special user licences among several operators, who can use them and easily make changes to them. The companies can compensate for any economic loss with the sale of complementary products.

Using the matrix adapted by Snell *et al.* (1999), it was possible to define a framework to manage the different forms of structural capital and maximize their contribution to the organization.

The following table (Table 2) lists the management models for structural capital, linked to the features of each form of structural capital, that were analyzed.

Tab. 2: Strategies associated to structural capital

Forms of structural capital	Management Strategy
Idiosyncratic structural capital	Collaboration between organizations (partnerships, joint ventures, alliances)
Ancillary structural capital	License agreements to transfer by marketing the structural capital
Core structural capital	License agreements to transfer by marketing the structural capital
Compulsory structural capital	- License agreement for the acquisition by marketing structural capital; - Providing the structural capital through an open source

Source: our elaboration

Idiosyncratic structural capital is not central to strategic value creation, since it can be developed by companies that work in collaboration with other organizations. The unique nature of this knowledge supports the establishment of long-term partnerships, engendering reciprocity and collaboration between the company and its partners. Investments should concentrate on connecting this knowledge with other forms of structural capital.

Ancillary structural capital has limited strategic value and uniqueness, so sometimes there is no strong incentive to maintain this kind of asset. Companies often prefer to contract license agreements and transfer the structural capital elsewhere.

Core structural capital is more likely to contribute to a company's core business. Consequently, companies have (financial and strategic) incentives to invest both in the internal development of these assets and in their

protection (as in commercial rights). In this way, companies can retain exclusive knowledge, which leads to a strategic advantage.

Compulsory structural capital is also important for creating value and driving strategic advantage. Since this kind of structural capital is not unique, two different strategies come into play, and they both depend on the possibilities of imitation and asset ownership. If the assets have a high probability of imitation and the company owns the assets, the company can release them in an open source format, while, if there is a lower probability of imitation and no structural capital ownership, the company must purchase its assets on the market.

The arrangements for managing structural capital are a consequence of its evaluation. The structural capital value chain (structural capital generation, evaluation and exploitation) suggests which management model (Laursen and Salter, 2006) is best adopted by the company.

The best way of handling these intangible assets requires managers to classify them according to their relevance (uniqueness and strategic value) to the company's core business (Tan *et al.*, 2007; Maditinos *et al.*, 2011; Kannan and Aulbur, 2004). A universal approach, however, may not be sufficient (Chesbrough, 2006).

5. Conclusions, limitations and perspectives

There is a significant amount of literature covering the topic of intellectual capital. Companies that exploit internal knowledge to create innovation and implement efficient and effective production processes secure their position of competitive advantage.

As a result, today's companies are rich, vital and competitive when they own a high level of intellectual capital.

Following this concept, company performance was investigated in its entirety by looking at the range of achieved results and considering various tangible and intangible elements.

This study has introduced an updated conception of structural capital in terms of its intangible components, with special reference to management and assessment.

With regards to the external management of company knowledge, structural capital management models were also investigated.

Starting from Snell *et al.*'s Matrix (Snell *et al.*, 1999), company structural capital was categorized on the basis of the strength of its strategic value and the uniqueness of its assets, and classified into idiosyncratic structural capital, core structural capital, ancillary structural capital and compulsory structural capital.

For each of these, companies can implement a structural capital management strategy to ensure that strategic advantage is achieved to create long-term value.

Our findings have some implications. Specifically, the taxonomy identified for structural capital means that managers, after defining the kind of asset they are referring to, can specify the best way for it to be managed in order to achieve a strategic advantage.

Moreover, structural capital assessment and management is becoming a basic feature in fully appreciating the organization's creation of value.

This paper highlights some limitations. These include its theoretical form and the fact that the analysis that was carried out is an updated interpretation of concepts found in literature through the previously illustrated research method.

Therefore, the aim of future research is to summarize the literature on the topic of structural capital with the objective of providing further qualitative analysis.

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