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Framework proposal for Management Control Systems and its application in the contexts of Innovation, Networks and Innovation Networks

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Abstract

The number of collaboration agreements between organizations to develop new products and services is increasing rapidly in the last years. Nevertheless, there is a gap between the existing literature related to Management Control Systems (MCS) and the specific control requirements of innovation networks. This paper aims to close that gap by identifying the constitutive elements of MCS for adapting them to the specific context of innovation, networks and their intersection: innovation networks. The methodology is based on an extensive literature review to synthesize the constitutive elements of MCS into four groups: context, means, ends, and reporting. Additionally, we have found that the design and implementation of the MCS in the context of innovation networks will be determined by the existing accountability relationships between parts which can be of two kinds: normative (social) or utilitarian (technical). These results are potentially generalizable to any MCS context.

Keywords: Performance Management, Management Control Systems, Open innovation, business networks, innovation networks

Abstract (in Italian)

Il numero di accordi di collaborazione tra organizzazioni per sviluppare nuovi prodotti e servizi è in rapido aumento negli ultimi anni. Tuttavia, esiste una breccia tra la letteratura esistente relativa a *Management Control Systems (MCS)* e i requisiti specifici di controllo delle reti di innovazione. Questo documento ha lo scopo di ridurre quella breccia, identificando gli elementi costitutivi dei MCS per adattarli allo specifico contesto di innovazione, le reti e la loro intersezione: le reti di innovazione. La metodologia si basa su una vasta revisione della letteratura per sintetizzare gli elementi costitutivi dei MCS in quattro gruppi: contesto, mezzi, fini, e referti. Inoltre, abbiamo trovato che la progettazione e l'attuazione dei MCS nel contesto di reti di innovazione sarà determinata dalle relazioni esistenti tra le parti che possono essere di due tipi: normativa (sociale) o utilitarista (tecnica). Questi risultati sono potenzialmente generalizzabili a qualsiasi contesto di MCS.

Keywords: Performance Management, Management Control Systems, Open innovation, business networks, innovation networks

INTRODUCTION

For many years Innovation Networks have been created. In the 80s, Industrial Economy theories influenced innovation research, which theorized the structural factors determinative of the innovative activities in a company. Those studies found that the ability to establish relationships in a network of organizations was a key issue, in order to develop a company's organizational innovative capacity.

Attention to innovation networks increased after the successful performance of Japanese companies. In the 80s, Nissan, Toyota and Mitsubishi built many strategic alliances with other organizations. Those alliances improved significantly the learning abilities of these Japanese companies from the interactions with their network members and they continue to do it.

For example, Mitsubishi and DoCoMo recently developed a new mobile multimedia market for a mobile videoconferencing platform. For this development, innovation networks allowed these companies to obtain both fast access to relevant knowledge and the synthesis of knowledge domains, which were created in long time periods by the departments of each company involved. For this purpose, it was necessary first to integrate each corporate capability internally and then, to reciprocally integrate the capabilities of both network partners externally.

In Taiwan, the high technology industry resulted from the development of an innovation network integrating a research institute, the government, universities, industrial companies and international organizations (Calia, et al., 2007).

These few examples show not only the importance that innovation networks have achieved in the last years but also the potential that they have in a *knowledge based economy* where the more knowledge is exploited, the more it increases its value. Nonetheless, successful innovation networks are not common. In fact, small and medium size European companies are cautious when choosing partners, because half of the partnerships fail and those companies do not have abundant resources to overcome unsuccessful projects.

At this point we may ask: why do innovation networks fail? The answer is related to the nature of innovation itself. Innovation is the result of the creativity of individuals and therefore it is chaotic, free from rules, unexpected and many times passes unnoticed. Companies have tried to manage innovation with the aim of obtaining benefits and just a few have been successful. Research and Development units have been created in both small and big organizations. In many cases, the high expenses that the innovation process demands have induced organizations to form and join to networks to share R&D costs and to develop innovation capability. Yet, not always organizations benefit from collaboration and one important reason is the poor management and control they have put into practice.

Researchers and practitioners in the field of Management Control Systems have found that there is a gap between the existing models and the control requirements of modern organizations and networks. Therefore, *the purpose of this thesis is to build a general framework of Management Control Systems that can be applied to the particular context of innovation networks to better manage and control the innovation process*. We will use a deductive method, starting from the existing literature and identifying the constitutive elements for building a general framework of Management Control Systems. Then we will analyze the framework in the context of R&D, business networks and their intersection: innovation networks. We will dive into the peculiarities of the innovation process, the potential of business networks including innovation networks, the different types of management and control, to finally combine all these concepts into an innovative model for Management Control Systems.

Among the main limitations of this research is the lack of validation with empirical information. Nevertheless, we assume that the model has a high potential in practice because of several reasons:

- The tutor of this thesis has both academic and practical experience in the field of MCS,
- The bibliography on which this document is based is comprehensive and up to date, and
- This research integrates other areas of management besides MCS such as human resource management, organizational behavior, management of innovation, knowledge management, and networking.

1 CHAPTER: INNOVATION NETWORKS

In this first chapter, we analyze the theoretical framework regarding Innovation networks, as a way of introducing the reader to important concepts which are necessary to understand the context of the whole thesis. First we start by defining some relevant notions such as Innovation, Networks and Open innovation to finally arrive to the main section about Innovation networks.

1.1 INNOVATION

No matter *what* a company does, there are always three success factors which lead it to be sustainable over time: first, the efficient management of recurring activities; second, the continuous improvement of recurring activities; and third, the ability to develop new products and processes (Van de Ven, 1986).

Innovation is a key ingredient of success, as it is stated in the third factor. A company may innovate in different parts of their business offering at different moments in time throughout the life of the company. It can innovate: Technologies, Products, Services and Communication Elements, Processes, Organizational Structure, Competencies, etc.

Researchers and practitioners have defined innovation in several different ways. Innovation is defined as a new idea, which might be a recombination of old ideas, a scheme that challenges the present order, a formula, or a unique approach which is perceived as new by the implicated individuals. As long as this idea is perceived as new to the people involved, it is an “innovation”, even though it might appear to others to be an “imitation” or something that exist elsewhere (Van de Ven, 1986).

While Van de Ven (1986) talks about innovation as an event, Druker (1985), introduces the concept of innovation as a process. He defines innovation as the outcome of an innovative process or as the innovative process itself. Innovation can also be the activity of people and organizations to change themselves and the environment. It means breaking routines and dominant ways of thinking, introducing new things and behaviors, launching new standards (Institute, 2003).

Those who see innovation as a process focus on the various stages that the potential adopter goes through over the course of an innovation effort. These stages include identifying problems, evaluating alternatives, arriving at a decision, and putting innovation into use (Cooper, 1998). A new product development process can be divided also into three phases: generating ideas, technical development, and commercializing (Ojasalo, 2008). In addition, the innovation process involves: searching, selecting, implementing, and learning (Tidd, et al., 2005).

Freeman, Dickson and Hajimanolis follow the school of Druker of innovation as a process but adding and interesting element: Commercialization. They suggest that an innovation is characterized as a process of commercialization of a newly developed product or practice (Ojasalo, 2008).

This last opinion leads us to believe that in general terms, Innovation can be defined as the sum of two parts:

1. The generation of an idea
2. The translation of this idea into a business opportunity

Innovation = Inventions (Exploration) + Exploitation

Regarding Management of innovation the definition of Innovation takes a different turn. Here innovation is conceived as the key factor that moves the trade-off curve between two performance indicators towards the better satisfaction of existing needs, or the creation of new performance dimensions/indicators for new, unsolicited/latent needs (Marchesi, 2008):

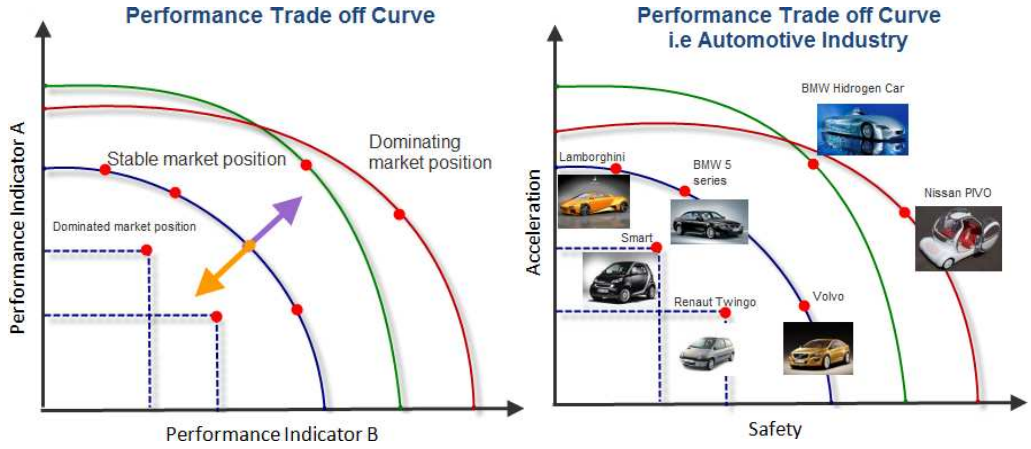

Figure 1a and 1b Performance Trade off curve of Innovation

Additionally, innovation might also be a relative term, since it depends on the actor who perceives it. An innovation can be something that is either new for a company, new for a market or both. This relationship of the different levels of newness is shown in the following figure:

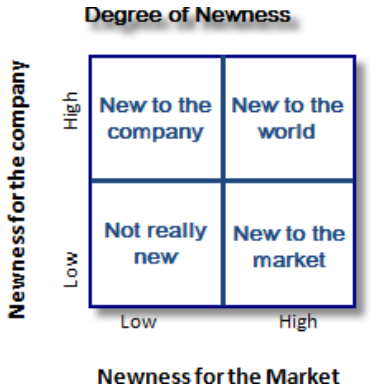

Figure 2 Innovation as a relative term

Since many definitions can be found, for the purpose of this thesis we propose the following one: *Innovation is an activity where people and organizations change themselves and the environment, which implies the commercialization of a newly developed product or practice. Innovation is a process that goes through three steps: generating ideas, technical development, and commercializing.*

1.1.1 Dimensions of Innovation

A comprehensive study carried out by Crossan et al. (2009) concludes that the ten dimensions of innovation found in the literature can be classified into two categories:

1. Innovation as an outcome: those dimensions which answer to the question ‘what’, and
2. Innovation as a process: those dimensions which answer to the question ‘how’.

These two categories are cause and effect as the approach of innovation as a process will lead to innovation as an outcome (see figure 3). However, the main focus of the scholars is on innovation as an outcome and the view of innovation as a process is under-developed in the literature (Crossan, et al., 2009).

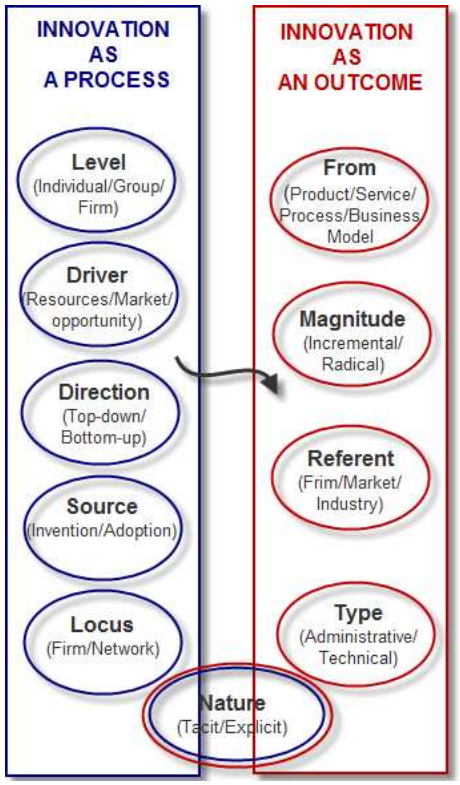

Figure 3 Dimensions of innovation. Crossan et al. (2009)

1.1.1.1 Innovation as an outcome

In table 1 the general characteristics of the dimensions of innovation as an outcome are enlisted:

DIMENSION	CATEGORY	DESCRIPTION
Form	Product/Service	• It is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics. It provides the most obvious means for generating revenues (OECD, 2005).
	Process	• A process innovation is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software (OECD, 2005). • In other words, a process innovation represents changes in the way firms produce end products or services (Cooper, 1998).
Magnitude	Incremental	• Incremental innovations involve small improvements that add value to the product or service and, as a result, generate benefits to the customer (publishing, 2005). The degree of strategic and structural change that the firm must undergo to accommodate the innovation in question is low (Cooper, 1998). • They usually emerge from practice, but there are many exceptions to each of these trends (Wikipedia, 2010).

	Radical	• It is a new product or system with original state-of-art proprietary technology that will significantly expand the capabilities of existing ones. • It usually requires significant R&D. • They represent advances so significant that revolutionary alteration of the organization and its support networks must occur to accommodate and implement change (Cooper, 1998). • As innovations become more radical or competence destroying, they entail clear, risky departures from existing practices (Cooper, 1998).
Referent	Firm	• This dimension establishes the benchmark which defines the newness of innovation as an outcome. • Incremental innovations such as continuous improvement initiatives may be new to the firm while radical innovation tends to be new to the market and to the industry.
	Market	
	Industry	
Type	Administrative	• It includes changes that affect the policies, allocation of resources, and other factors associated with the social structure of the organization (Cooper, 1998).
	Technical	• It involves the adoption of an idea that directly influences the basic output processes (Cooper, 1998).
Nature	Tacit	• Innovation can have a tacit nature that makes it difficult to formalize and communicate as opposed to the explicit nature.
	Explicit	

Table 1 Characteristics of the main dimensions of innovation as an outcome

1.1.1.2 Innovation as a process

As mentioned before, dimensions pertaining to innovation as a process should answer the question 'how'. *Driver* and *source* dimensions deal specifically with this question and both can be either internal or external. An internal *driver* of the innovation process can be available knowledge and resources, whereas an external *driver* would be a market opportunity or imposed regulations. An internal *source* of innovation is ideation, whereas an external *source* of innovation is the adoption of innovation invented elsewhere. The *locus* dimension defines the extent of an innovation process: firm only (closed process) or network (open process). The *direction* dimension considers how the innovation process starts and develops; whether it is top-down or bottom-up. The *level* dimension delineates the split between individual, group, and firm processes (see figure 3).

1.2 NETWORKS

Networks, in the context of the present work, should be understood as Business Networks. It refers to the way organizations create strategic associations to work conjointly to obtain common goals and solve common needs. These links can be either vertical or horizontal, but always imply independent firms that jointly define a strategy to achieve certain goals (Alfaro Saiz, et al., 2007)

Companies within a network collaborate with one another in order to pool their resources and capitalize on shared assets. Working together, the group members can take on projects that, individually, they might not have been able to manage (WiseGeek, 2003). This strategy of working together can also leverage the achievement of competitive advantages of a company, through the cooperation or creation of alliances with other firms, for the realization of activities within the supply chain that help the company to have a better presence in one or more markets. This type of cooperation can also be a tool for the development of the competitiveness of SME's, since it can help the reduction of their production and transaction costs and contributes to increase the value of the products or services offered to customers (IberPyme, 2002).

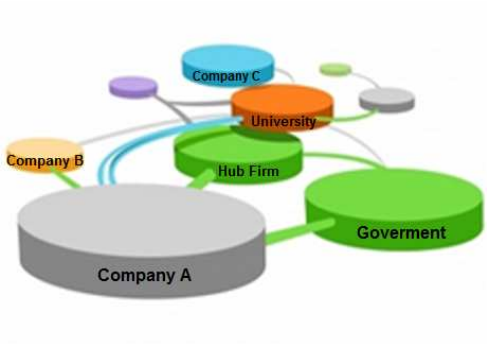

Figure 4 Links formed among network members

Strictly speaking, a network consists of "nodes" or positions (occupied by firms, households, strategic business units inside a diversified concern, trade associations, and other types of organizations) and "links" manifested by interaction between positions. These links are usually called relationships (see figure 4). A network can also be approached in terms of its activities, resources, and actors. The activities and resources in two different relationships can complement each other, or they may be in competition. Similarly, actors can use the existence of complementarity or competitiveness in their relationships in different ways when interacting with each other. Networks are an evolving organism and their dynamism is caused by the fact that actors, relationships, needs, problems, capabilities, and resources change over time (Ojasalo, 2008).

One important aspect about networks is that value is co-produced: the total value created in the network depends directly on how well partners' objectives are aligned to each other and on the commitment of the partners to invest in complementary assets.

To summarize, one definition of network is proposed: *A network is a strategic alliance between independent firms, related by vertical or horizontal agreements that jointly define a strategy to achieve certain common goals in the medium and long term, focused on the development of the competitiveness of each member.*

Nonetheless, sometimes the term Network might be confused with the term Cluster, but they are different because of the following reasons (Dini, 1996):

- Networks are mainly constituted by a much more limited number of firms than the clusters.
- Companies forming a network are clearly identified and the composition of the network is less variable.
- Members of a network might not belong to the same geographical area.

1.2.1 Characteristics of Networks

Based on our definition of networks, in the following paragraphs we will describe some of their characteristics, their types and the problems and opportunities originating from them.

1.2.1.1 Size of a Network

There are no limits regarding the dimension of a network. Usually it is possible to have a network starting from three companies. Nevertheless, in such a small network, it can happen that a very little negotiation power exists among the business that forms the network. This problem is stressed when firms have a small size (López Cerdán Ripoll, 1999). In contrast, in networks with relatively high number of members, there is a great power of negotiation. However, it is very difficult to have accordance among all the players**.**

By the experience of Maeso (Maeso, 1998) in Uruguay and López-Cerdán (López Cerdán Ripoll, 1999) in Mexico, it is possible to say that networks having more or less 10 enterprises, have a good negotiation power and are relatively diligent in their decision making process.

1.2.1.2 Economic Agents supporting Networks

Many networks have appeared spontaneously. They are formed by means of self-organization due to the capacity of the networks for combining and recombining learned capabilities without centralized, detailed managerial guidance (InnoSupport, 1999). However, other networks have followed a schema which is also very useful as development mechanism. As an example, López Cerdán (1999) has proposed a model which includes the presence of Local Economic Agents (LEA) as Networks Promoters. LEAs are formed by a series of entities that play a role in the region as regulators, financers, human resources trainers, technological developers, etc. These institutions might also have interest on participating in the promotion and development of networks. Some examples of LEA are the followings (López Cerdán Ripoll, 1999):

- Business organizations (Chambers of commerce, business associations)
- Government institutions (national, regional or local)
- Financial organisms and banks
- Educational institutions (universities)
- Business services' centers
- Nonprofit organizations
- International organisms

Each of these economic agents might have a particular interest for supporting the development of networks based on their mission, objectives, among other ends. They can also participate in specific phases inside the process of establishment of a network. Especially in:

- Network promotion
- Financing
- Human resources training
- Creation of the business environment
- Offer of specialized services: consulting, technological

The active participation of the LEA allows the creation of the environment and the physical infrastructure to support the process of developing networks. When this process is maintained over time, it can happen that the network evolves into a cluster.

However, it is extremely difficult that all the economic agents participate from the beginning in the network; as a consequence, it is very hard to have a consensus among all of them in the initial phase.

What history revels is that, in general, an economic agent or a group of them with a long term vision has existed and has acted as trigger to boost the network process. And once the process has started, other economic agents have been incorporated, little by little. There is no ideal detonator; it can be the government, the private sector, etc. The important is that the trigger exists.

As it was stated before, the function of the LEA is to participate in the development of networks throughout different instruments. These can be tools, actions and support used with the purpose of strengthening the companies within the network. For instance:

- Investment's promotion
- Systems of mutual surety or guarantee to underpin the financing of networks
- Financing programs
- Fiscal exemptions
- Training programs, business consulting and technical assistance
- Instruments for technology and innovation transference
- Programs of business services
- Instruments of territorial settlement support for companies through industrial states, industrial parks, high-quality parks and technology parks
- Programs for the creation of new enterprises through business centers, enterprise incubators
- Programs for the acquisition of suppliers through subcontracting exchanges, consumable fairs

1.2.2 Types of Networks

There are as many types of network groups as there are businesses. Groups can consist of companies in the same industry, such as a home builders' organization or association of regional manufacturers. There are networks that are made up of people in a specific ethnic group. A network can even be a group of small shops or stores in a specific neighborhood.

Networks can be differentiated in 3 different dimensions, which are according to their *structure, intensity in the use of capital* and the *level of aggregation* (López Cerdán Ripoll, 1999).

1.2.2.1 *According to their structure*

TYPE OF NETWORK	DESCRIPTION	EXAMPLES
Horizontal Networks	It is the alliance between group companies offering the same product or service which cooperate among themselves in some activities but compete with each other in the same market. This type of network is characterized by strong geographical dependence and the existence of an enabling environment.	The clustering of small firms in the clothing sector. They retain their individuality and meet their individual markets but cooperate with each other for the purchase of raw materials and / or to fill an order that exceeds individual capabilities of each of the companies.
Vertical Networks	It is the alliance between big companies and small businesses to develop suppliers. Thus, the former may engage in those activities that are more profitable and have greater organizational flexibility, while the latter can secure a market that will enable them to sustain in the short term and long-term growth.	The development of a production-oriented grouping of auto parts such as making pasta for brakes, harness assembly, or the casting of small parts to supply the automotive industry. The cluster development oriented leather tannery to supply shoe industry.

Table 2 Networks classification according to their structure

1.2.2.2 *By capital intensity:*

TYPE OF NETWORK	DESCRIPTION	EXAMPLES
With high concentration of capital goods	Centralize a production process through which a company will provide service to other network members or will add value to the product they produce. In general, economies of scale are reached	Cut and design centers (clothing industry and furniture industry). Pre-release centers or UV (graphic arts industry). Cotton manufactures (producers of natural fibers). Design and casting centers (jewelry industry) Centers for casting (automotive industry) Centers for tanning (footwear)
Without high concentration of capital goods	Only centralized purchases and sales and / or promotion (basic office).	Centers for purchasing on-line

Table 3 Networks classification according to their capital intensity

1.2.2.3 By the level of aggregation:

TYPE OF NETWORK	DESCRIPTION
Simple networks	It is a partnership between groups of businessmen.
Networks of networks	It is an alliance between the networks first second or third level (pyramid networks)

Table 4 Networks classification according to their level of aggregation

There is also a fourth dimension of categorization focused on what the participants share in a Network (Parung, et al., 2008).

1.2.2.4 According to what partners share:

TYPE OF NETWORK	DESCRIPTION
Supply chains	"Supply chain is the network of organizations interlinking suppliers, manufacturers and distributors in the different processes and activities that produce value in the form of products and services delivered to end consumer. This definition has been updated by the Supply Chain Council (1997) as every effort involved in producing and delivering a final product or service, from the supplier's supplier to the customer's customer (www.supply-chain.org). In this end-to-end process, all channels in the supply chain can bring or share data, information, and resources with partners in order to achieve their objectives. However, it is not common to share risks and benefits among participants in a supply chain" (Parung, et al., 2008).
Extended enterprises	"An extended enterprise is a conceptual business unit or system that consists of a purchasing company and suppliers who collaborate closely in such a way as to maximize the returns to each partner. Furthermore, the extended enterprise is a philosophy where member organizations strategically combine their core competencies and capabilities to create a unique competency (…). In extended enterprises, people across a number of organizations participate in the decision-making process (…). Sharing data, information, resources, and risks are commonplace in an extended enterprise in order to achieve mutual benefits amongst participants" (Parung, et al., 2008).
Virtual enterprises	"A virtual enterprise is considered as a temporal case of an extended enterprise. The virtual enterprise is a dynamic partnership among companies that can bring together complementary competencies needed to achieve a particular business task, within a certain period of time (…). A Virtual Enterprise is a temporal knowledge-based

	organization, which uses the distributed capabilities, competencies and intellectual strengths of its members to gain competitive advantage to maximize the performance of the overall virtual enterprise. In a virtual enterprise, participants usually shared data, information, resources, risks and benefits" (Parung, et al., 2008).
Clusters	"A cluster could be defined as a network of companies, their customers and suppliers, including materials and components, equipment, training, finance and so on (…). Clusters are also defined as geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. They include, for example, suppliers of specialized inputs such as components, machinery, and services, and providers of specialized infrastructure (…). In clusters, participants usually share data, information, resources and sometimes risks" (Parung, et al., 2008).

Table 5 Networks classification according to what partners share

1.2.3 Advantages and obstacles of Networks

Among the many advantages for joining a network we can mention (WiseGeek, 2003):

- Members can share a customer base and develop new business opportunities.
- Suppliers can be shared, leveraging strength in numbers for better pricing and stronger vendor commitment.
- A network also offers members shared resources and pools of information.
- It can also serve as an alliance of like-minded individuals with a common problem.

For the particular case of horizontal networks the advantages are:

- Economies of scale
    - Purchase of raw material
    - Access to high volume markets
    - Access and efficient use of high productivity technologies
- Dynamic Advantages
    - The network of contacts can be widen
    - Access to selected and tested information
    - It reduces uncertainty in decision making

It is important to highlight that these benefits are spread out among all the members of the network according to the rules previously established by them (Dini, 1996).

On the other hand, for the creation of a network, there are three obstacles that need to be overcome and which become key factors to succeed:

- *Information management*: This not only includes managing the knowledge flows among the members, but also setting a proper ICT platform that supports all the knowledge exchange within the network
- *Trust:* For a successful knowledge exchange, the existence of a trustful relationship among the network members is mandatory. It is obvious that trust cannot be imposed or forced, but members can stimulate collective actions that promote the generation of trust.
- *Cost of learning:* Here all the costs related with the delays, mistakes and errors made in the process of aligning and organizing the network, are included. Nevertheless, this cost of learning can be seen just as a temporary lowering of the performance which can be improved with time.

1.3 OPEN INNOVATION

Before talking about Innovation Networks, the term *Open innovation* should be introduced, since the former is a particular example of the latter. Innovation networks are part of the wide definition of Open innovation related to the inter-organizational level.

In general, Open innovation is almost by definition related to the establishment of ties of innovation firms with other organizations. Companies are increasingly forced to team up with other companies to develop or absorb new technologies, commercialize new products or simple to stay in touch with the latest technological developments (Vanhaverbeke, 2006)

The so-called father of the Open innovation, Chesbrough, defines Open innovation as "a paradigm that assumes that firms can and should use external and internal ideas and internal and external paths to market. (…) Open innovation combines internal and external ideas into architectures and systems whose requirements are defined by a business model. The business model utilizes both external and internal ideas to create value, while defining internal mechanisms to claim some portion of that value" (Joel West, 2005)

In addition, Open innovation is both a set of practices for profiting from innovation, and also a cognitive model for creating, interpreting and researching those practices. It is carried out within the context of a given set of political and economic institutions, including regulation, intellectual property law, capital markets and industry structure.

A crucial goal of Open innovation is to capture external knowledge that flows between organizations, allowing firms to be more successful at innovation than firms that close off such flows. It is also recognizable that Open innovation is more readily applicable in some firm or industry settings than in others.

Companies have to team up with other actors in the business system and build inter-organizational networks to support Open innovation. But firms are not only embedded in their environment by inter-organizational networks: they can be part of regionally bounded clusters of competitive firms which, in turn, can be considered as a subsystem of a regional (or national) innovation system.

This last statement implies that there is a multilevel perspective which allows deepening the understanding of Open innovation (Cloodt, 2005) (Vanhaverbeke, 2006). In table 6 we describe the characteristics of the different levels of Open innovation:

LEVEL	CHARACTERISTICS
Individuals or Intra-organizational networks	Individuals who set-up informal intra-organizational network to exchange knowledge and information. These individuals by means of company mobility can also form inter-organizational networks, which is a further level for Open innovation. Internal networks play a crucial role in the way companies get organized to increase the effectiveness of acquiring external knowledge (Joel West, 2005).
Firm level	Innovation is conceived as the outcome of deliberate actions of a single firm, not by the performance of individual participants. In the Open innovation approach, firms can scan the external environment prior to initiating internal R&D work. If a technology is available from outside, the firm uses it. The firm constrains internal R&D work to focus on technologies that are not widely available, and/or those in which the firm possesses a core advantage, and seeks advantage from constructing better systems and solutions from its technologies. A complementary view is that Open innovation provides a much broader market for firms' core competences, enabling them to support other companies' business technologies. This could make core competences more valuable rather than less so. Thus Open innovation could separate out core competences into two broad categories: those related to creating technological innovations, and those related to outsourcing or integrating such innovations. The value of a technical invention is usually realized only through a business model of a firm (…). However, neither the practice nor the research on Open innovation is limited to the level of the firm, so other levels should be considered (Joel West, 2005).
Dyad Level	The dyad perspective takes into consideration the view of the two organizations that are involved in an Open innovation relationship, i.e. considering the interest of two (or more) companies that are tied to each other through equity or non-equity alliances, corporate venturing investments, etc. Open innovation is basically about non arm's-length relation between companies, therefore it can take advantage from a dyad level perspective analysis of strategic alliances (…) and external corporate venturing. At the dyadic level, the logical believe is that the search, negotiation, contractual, implementation and support phases of Open innovation would be better understood if researchers simultaneously captured the perspective of both the technology supplier and the technology user (Joel West, 2005).
Inter-organizational Networks level	Firms are embedded in networks, industries and sectors. Thus, to understand a firm's business model (particularly the value created and captured from innovation) it is essential to consider this level of analysis.

	A network perspective is necessary as a complementary approach of Open innovation. Key innovating companies do not profit from Open innovation only by deliberately in and out-sourcing intellectual property with different external partners. Key innovators have also to set up and manage inter-organizational networks both to develop new technologies and to exploit technology-based business opportunities. Moreover, networks can become "value constellations", where firms with different assets and competencies work together to create value and capture value based on new business models. When Open innovation is realized through extensive collaborative networks competition is not longer between individual firms but between groups of firms (Vanhaverbeke, 2006).
National or regional systems level	Open innovation is seen from the perspective of the role of nation-state in enabling (or constraining) innovation activities. The establishment and management of inter-organizational networks can be stimulated or hampered by the innovation system in which it is embedded. Open innovation is practiced within the context of a given set of political and economic institutions, including regulation, intellectual property law, capital markets and industry structure. These external relationship among key actors in the system (including enterprises, universities and government research institutes) are shaped by a set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provide the framework within which governments form and implement policies to influence the innovation process (…) This statement suggests that both formal institutions and factors such an industry structure will affect the flows of innovation between firms. (Joel West, 2005) For instance, a key institution affecting Open innovation is nation's IP policy, since the formal appropriation provided by patent and other laws will affect the incentives provided for creating and using Open innovations. Other important innovation policies include government funding of innovation development, particularly the funding of public research.

Table 6 A multilevel perspective of Open innovation

1.4 INNOVATION NETWORKS

Innovation Networks, or strictly speaking Innovation Business networks, is the last concept which will be introduced in this chapter. As it was seen in table 6, Innovation Networks are just a part of the Open innovation concept at an inter-organizational level. In this section a concrete definition of Innovation networks will be pointed out, as well as the different dimensions which have been used to classify them. Finally, at the end of this section, we will describe which are the advantages and disadvantages that Innovation Networks have and enlist some important aspects that could lead any Innovation Network to its success.

First of all, for the well understanding of the concept of Innovation Network, we can refer to the definition given by Innosupport[1]. They define Innovation networks as all forms of organizations that serve the exchange of information, knowledge and resources and by suitable learning among at least three partners help to bring about innovation. They are based on confidence and stable cooperation relations (InnoSupport, 1999).

In innovation networks innovation activities are coordinated, legally independent enterprises pool their business relations as far as their innovation potentials are concerned, stable relations are formed between enterprises and other players (training and research institutions, political players, etc) in order to gain competition advantages jointly and in a cooperative way. Finally, the joint efforts yield innovative products, processes and services.

The following schema, designed also by Innosupport, shows a hypothetical overview (from the point of view of an individual enterprise) of the partners that should be considered when thinking of establishing an innovation network (InnoSupport, 1999).

[1] Innosuport is a group that gathers European consortium of universities, research organizations, technology and incubation centers and other technology transfer organizations.

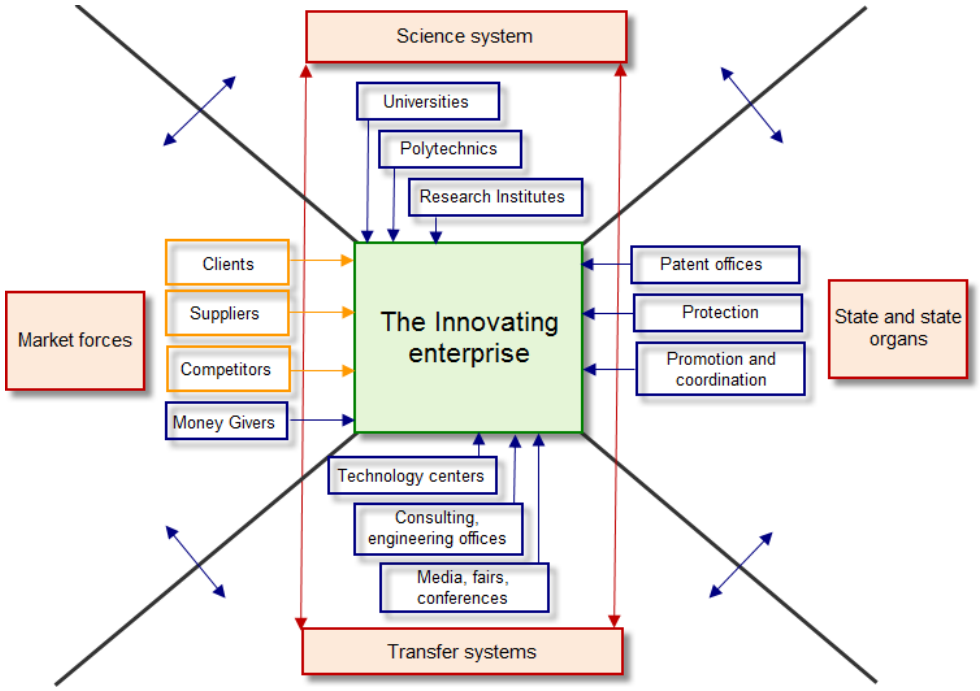

Figure 5 Hypothetical overview of an Innovation Network

In figure 5 we can distinguish how wide the network could be. It should have partners from very different systems, which will offer to the firm a large number of opportunities for mutual knowledge and know-how exchange. In this way an innovation's environment can, pretty much, be created.

1.4.1 Types of Innovation Networks

As it has been shown in previous sections (1.1 Innovation and 1.2 Networks), Innovation Networks can also be classified according to different dimensions. That is why in the present section a review of some of the dimension will be enlisted.

Scholars assure that the way a network is built has a profound impact on how companies within it innovate. A network is mostly designed according to the requirements of its members and this mainly depends upon type of industry. For instance, high-tech industries have shown networks of firms along the entire value chain, and pharmaceutical industries have witnessed a marked shift toward external alliances for new product development (Dhanara, 2006).

1.4.1.1 *Responsiveness and Distinctiveness Dimension*

Orton and Weick (1990) proposed a clear distinction among types of network by using responsiveness and distinctiveness as drivers. If there is responsiveness but no distinctiveness, the system is tightly coupled. If there is distinctiveness but no responsiveness, the system is decoupled. And if there is both, distinctiveness and responsiveness, the system is loosely coupled (Orton, et al., 1990).

TYPE OF SYSTEM	RESPONSIVENESS	DISTINCTIVENESS
Non coupled	X	X
Tightly coupled	√	X
Decoupled	X	√
Loosely couple	√	√

Innovation Networks

Table 7 Innovation Networks classification according to their responsiveness and distinctiveness

In particular, Orton and Weick (1990) concluded that Innovation networks can often be viewed as loosely coupled systems of autonomous firms.

- *Loosely:* It means that with no hierarchical controls, the network members preserve some degree of independence and indeterminacy.
- *Coupled:* It shows that voluntarily formed, low-density innovation networks contain elements that are linked and preserve some degree of determinacy.

1.4.1.2 *Integrated vs. Loosely-coupled Dimension*

Julian Birkinshaw (2002) has also differentiated two types of innovation networks: Integrated Network and Loosely-coupled network.

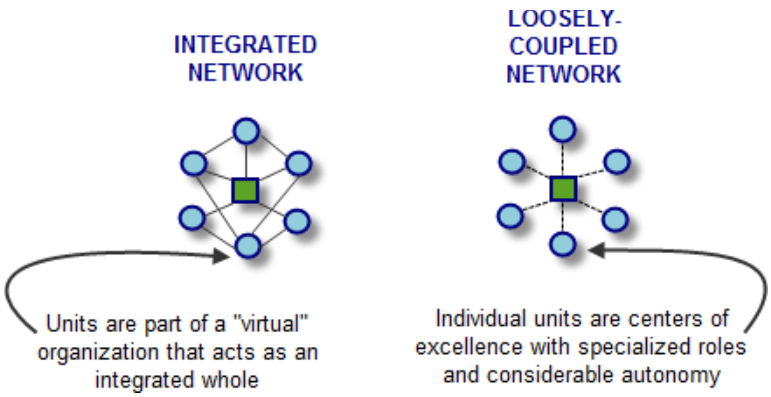

Figure 6 Integrated vs. Loosely-coupled Dimension of Innovation Networks

These models are chosen according to many factors, including industry, firm strategy, heritage, etc. and they focus on the "knowledge" or technology being developed. Their characteristics are listed in the following table (Birkinshaw, 2002):

FACTORS	LOOSELY-COUPLED NETWORK	INTEGRATED NETWORK
Nature of Knowledge assets in R&D	Generally low mobility	Generally low observability
Dominant types of R&D centers	Self contained centers Some Home based centers	Modular centers Some Home based centers
Nature of technology and products made by firm	Relatively stand-alone products	Relatively interdependent, greater reliance on technical standards, etc
Typical industries	Electrical, mechanical, engineering, automotive, industrial processes	IT, Telecommunications, pharmaceuticals
Approach to R&D strategy	Strategy broadly defined; R&D centre roles shaped through bottom-up process	Strategy defined in top-down manner
Centralization of decision making	Low	Moderate-High
Formalization of processes and standards	Low	High
Informal pattern of interactions	Low-moderate	High

Table 8 Innovation Networks classification: Integrated vs. Loosely-coupled Dimension

1.4.1.3 Continuity Dimension

Another widely used classification of innovation networks is the one related with its continuity. This theory suggests that innovation networks may be project specific or continuous. New products are always developed in projects, but when many products are involved, a company may choose to establish a new network for each product development project or carry them out with the same network composition. In the following table, some characteristics are contrasted to give a general view of this classification (Ojasalo, 2008):

TYPE OF NETWORK	PROJECT SPECIFIC	CONTINUOUS
Actors, activities and resources' permanence	The actors, activities, and resources are inherently reviewed and renewed in the establishment of a new innovation network.	Most of the elements remain the same, although a periodical review should exist.
Enablers (leadership, people, policy and strategy, partnership and resources, and processes)	Enablers change inherently from one project to another.	Enablers might not change from one project to another, unless explicit effort is invested in their renewal
Results (key performance results, people results, customer results, and society results)	Results change inherently from one project to another.	
Some Managerial implications		It is mandatory to improve and refresh all the aspects of management in order to respond to the dynamics of environment and to maintain its competitive strength. It is important to enhance the network actors' commitment to long-term relationships.[2]

Table 9 Innovation Networks classification: Continuity Dimension

1.4.1.4 Cross-sectoral vs. multidisciplinary dimension

In addition, innovation networks can also be categorized as cross-sectoral or multidisciplinary:

TYPE	DESCRIPTION
Cross-sectoral	It brings together people and organizations from the public, private, and non-profit sectors.
Multi-disciplinary	It uses expertise from various specialized knowledge bases. It can connect to a variety of communities.

Tabla 10 Innovation Networks classification: cross-sectoral or multidisciplinary Dimension

1.4.1.5 Objective's dimension

Enkel & Gassmann (2005) differentiate three forms of innovation networks as well: structure-based, application-based and technology-based networks.

[2] Commitment to long-term relationships is enhanced by trust, satisfaction and relationship benefits, investments and adaptations, sharing of information, good personal relationships between individuals, consistency of interaction, contractual terms, conflict handling, uncompensated short-term sacrifices, and shared values and culture. (Ojasalo, 2008)

TYPE OF NETWORK	CHARACTERISTICS
Structure-based networks	• Cooperation among established institutions, focusing on companies' research, development and common information activities • These networks share the results of their studies with interested groups; their knowledge therefore becomes public good. • The representatives of the companies and/or institutions involved choose the focus of the networks' research and development activities, while the network participants directly or indirectly fund the research (Enkel, et al., 2005).
Application-based networks	• Networks formed in order to develop a technology with which to solve a crucial and concrete problem. • This network form could therefore combine a small number of companies to initiate one or more research projects that are exclusively focused on personal value, in order to jointly commercialize the results later. • The research projects in these networks are jointly funded and decision-making is done collectively. • Application-based networks are only temporary in nature and are dissolved after the successful development of targeted technologies (Enkel, et al., 2005).
Technology-based networks	• The focus of the network is on creating special forms of knowledge and transferring them to as many interested parties as possible. • These networks should create knowledge that is related to a specific, crucial technology that is still under development. Technology-based networks therefore emerge in order to develop applications based on this crucial technology. • The size of the network is not limited; the more parties that want to profit from participation, the better. • Most of these networks are publicly funded, based on idealism and are driven by enthusiasts within research institutions (Enkel, et al., 2005).

Table 11 Innovation Networks classification: Objective's Dimension

1.4.1.6 Governance Structure's dimension

Furthermore, the way of managing innovation networks might also imply a different categorization of them. According to this, one last classification of innovation networks can be mentioned according to their governance structure:

GOVERNANCE STRUCTURE OF THE NETWORK	CHARACTERISTICS
Transaction costs theory as governance structure	In general, in the transaction costs approach the main explanatory variables for governance structures are specificity and appropriability. Here, the objectives of governance structures are to minimize transaction costs and opportunistic behavior, turning them into structural mechanisms (i.e. planning criteria, solving problems and organizing activities between partners) and safeguard mechanisms (i.e. the selection of a partner, the definition of responsibilities or the monitoring and control in the R&D network) (Arranz, 2006).
Social Capital Theory as governance structure	This theory supports the fact that social structures resulting from prior interaction between partners are very important. It also suggests that firms select contractual forms for alliances not only on the basis of the activities they include and the related appropriation concerns they anticipate at the outset, but also on the basis of the existence of the social network of prior alliances in which partners may be embedded. Here governance modes range from highly cohesive and closed networks to open and sparsely populated networks (Arranz, 2006).
Hub firm as controlling actor	A third way of managing innovation networks is related with the presence of a member leader, which coordinates the activities in the whole network. These coordination activities, known as orchestration process, are generally taken on by the network promoter, whose capacity for decision-taking and supervision is limited, and is subject to the consensus of partners. There is no marked hierarchical structure, and lateral links serve as the main mechanism for coordination between partners (Dhanara, 2006).
Management according to the nature of the innovation network	Different fundamental views on how controlled and structured the innovation and network management should be have been debated for many years. There are authors who support the idea about managing the networks in a more controlled and structured manner (Rigid Management), while others defend the theory about freedom as a way of enhancing the innovation process inside the network (Free Management) (Ojasalo, 2008).
Managing Innovation Networks seen as virtual organizations	Virtual organizations have the following characteristics: • They end up with more capabilities and power than they inherently possess. • Information technology plays a central role in their development, functioning, and success. • They have no physical office or hierarchy. • They are often temporary and loose coalitions which come together for a specific purpose. • They enable companies to work concurrently rather than sequentially (Ojasalo, 2008).

Table 12 Innovation Networks classification: Governance structure's Dimension

When talking about Management according to the nature of the innovation network, it was stated that governance modes range from highly cohesive and closed networks to open and sparsely populated networks. These lead us to a subtype of innovation networks itself: Closed networks and Open networks. Their main characteristics are listed in the following table (Arranz, 2006):

	CLOSED NETWORKS	OPEN NETWORKS
Objective	• To carry out *exploitation* activities which lead to a competitive improvement of products or services	• To perform *exploration* activities. • Its primary goal is capturing information.
Governance	• It is based on a higher cohesion characterized by high density and intensity of contacts among the partners of the network and a structural framework designed to execute its activity. • It uses planning and organization mechanisms in its governance form.	• It is characterized by the low importance of administrative factors.
Decision Making	It is carried out by consensus between the coordinator and the partners.	
Safeguard mechanisms[3]	It is mainly based on the selection of partners, the definition of responsibilities and the putting into practice of monitoring and control mechanisms.	It is characterized by low safeguard mechanisms.
Other characteristics	Degree of openness and external contacts is minimal.	External contacts and a higher degree of openness are of great importance while the cohesion factor, in terms of density and intensity of contacts, is less significant.

Table 13 Innovation Networks Sub-classification: Closed vs. Open Networks

Also within the framework of "Management according to the nature of the innovation network (Rigid and Free management)", it is worthy to mention the two different subtypes of networks that comprehend this classification and its particular characteristics (Ojasalo, 2008).

[3] Their objective is to mitigate situations of potential conflicts

FACTORS	RIGID MANAGEMENT NETWORKS	FREE MANAGEMENT NETWORKS
Duration of the network	Project-Specific network • The promoter decides on whether the product development project is realized in-house or in an inter-organizational network. • The promoter decides on who manages the networked product development project.	Continuous network • Cooperation is efficient because actors know one another well. • Receiving external influence and ideas requires more effort.
Reward from the network	Profits • Emphasis on commercial success of the innovation in the marketplace (people's creative self-fulfillment in second place). • Realistically executable product development projects (timetables, costs, degree of technological challenge).	Personal self-fulfillment • Creative and artistic self-fulfillment, life-style entrepreneurship, and friendship between individuals are the most important motivators. • Commercial potential of the innovation may remain unexploited.
Fundamental meaning of the network	Network as a means • The network exists for business purposes only • The company uses the network to mobilize various important resources for innovations processes unavailable in-house	Network as an end • The network is based on actors' friendship and a common professional desire to develop new innovative products • Commercial failure is less likely to break the network • The operation may shift from business to hobby (Problem attracting investors because its operation is overly life-style entrepreneurship)
The nature of networked organization	Traditional organization The innovation process is more restricted by location and time (It has a physical office, regular working hours, etc)	Virtual Organization • The innovation process is not restricted by location and time • Allows extensive freedom to individuals to organize their work • Requires sophisticated project management tools • May cause a lack of personal contacts

Planning, control, and trust	Planning and control most important, trust desirable • Written agreements integrally belong to the planning and control of operation • Agreements define actors' roles and responsibilities, timetables, and their completion criteria in product development projects	Trust most important, planning and control desirable • Operation is mostly based on trust between individuals • Certain amount of control is required • The network may not be convincing in the eyes of customers without legally valid agreements (written agreements are primarily for the sake of their customers, not for their own sake)
Hierarchies, authority, and coordination	Hierarchies should be avoided or minimized; however, there must be someone who has the highest authority and coordinates the cooperation • Hierarchies in an innovation network tend to block access to external resources and slow down the development process • Still, companies want someone to have the highest authority in the network to coordinate activities and make decisions on behalf of the network	

Table 14 Innovation Networks Sub-classification: Rigid Management vs. Free Management Networks

1.4.2 Advantages and obstacles of Innovation Networks

The main motivation for cooperation in innovation networks – above all for SMEs – is the expectation that entrepreneurs will reach their goals easier and better. Nevertheless, to cooperate might also have negative impacts inside the company. Below there is a list of some advantages and obstacles of innovation networks.

INNOVATION NETWORKS	
Advantages	**Obstacles**
Risk of failure is spread out among all members (mainly economically speaking)	The financial benefits coming from the innovation are shared (within in the frame of cooperation)
Better use of commercialization advantages. Networks offer more opportunities for achieving results arising from innovation processes than a single enterprise can utilize	Companies lose the exclusivity use of the technology created, since innovations are disseminated among the participating enterprises
Innovation targets can be reached faster and with better quality	Sometimes enterprises are no longer able to independently carry out innovation projects without using the resources of the networks

Expenditure for innovation purposes is lower, since its cost is shared among participants	By concentrating on the core competences currently required by the network, there is a risk of losing own (core) competences in future
Resources can be shared. It means that company can reach a particular innovation although it lacks of resources (material, information, personnel and financial)	
Strategic flexibility can be increased by adding new members to the network, e.g. by changes in technology	
Cooperation between companies increases knowledge gain and reduces the inherent waste of duplicated effort	
Networks have been found to yield beneficial returns on innovation such as increased patenting rates, improvements on existing products and new product creation, faster time to market, and access of new markets	

Table 15 Advantages and obstacles of Innovation Networks

It is relevant to say that many of these disadvantages or obstacles can be "intercepted or cushioned" in the initial phase of the network by establishing relevant cooperation contracts ("rules" of cooperation).

1.4.2.1 Central success factors

To guarantee the success of an innovation network, many factors should be considered. For instance, the selection of the partners and the relations they form towards each other (promoting factors) is crucial. Others can be (InnoSupport, 1999):

- *Clear need:* Companies should have a clear need to belong to the network. For instance, to be sure that the network can achieve something that they cannot achieve on their own.
- *Objectives:* The network should have clear needs and have the objectives that really reflect the needs of the members.
- *Leadership and vision:* Networks should have a leader who is able to articulate clear and concise goals and to be able to translate those goals into a realistic plan of action.
- *Trust:* The successful development of networks depends on the level of trust between member organizations. Above all, in cases where the network has companies that compete against each other. This has been called “coopetition”.
- *Time:* The formation of a durable network can take time. A considerable period can elapse before the members have developed trust and confidence in the network to undertake joint activities. Member

organizations need to interact socially before they can commit themselves to work with other members.

- *Key player:* In cases of critical mass, it is good to have a major player, with the vision and resources, capable of driving the network forward.
- *Communication / branding:* The development of a clear identity for a network can be critical for its longevity.
- *Social factors:* Social interaction among managers is crucial for breaking down barriers between them.
- *Process:* A network is both complex and challenging to operate. The key success factor is the process or the "how" factor, i.e. how companies are attracted to participate in a network, how their commitment is gained, how the process of developing the network is managed, how it is structured, how decisions are made, how communications is handled, how action programs are delivered, etc.

In addition, there are five critical success factors for innovations management in networks (Biemans, 1990) (Biemans, 1992). These are:

- Cooperation between parties
- Coordination of activities
- Communication between people
- Creativity
- Level of chaos

The advantage of cooperation is that each party can do what it does best. The benefits of cooperation will be materialized when the parties involved establish effective and efficient coordination of activities to be undertaken. An important prerequisite for successful coordination includes creating and maintaining good and timely intra and inter-organizational communications. Cooperation, coordination, and communication reduce the level of chaos in an innovations process, and, thus, increase the probability of developing successful innovations (Biemans, 1990). Successful innovation is not achieved through routine adherence to prescribed detailed procedures, schedules, and measures (Ojasalo, 2008).

On the other hand, there are also some characteristics that, if present, an innovation network might fail:

- Different aims and strategies
- Lack of identification (on a personal level) with the aims of cooperation

- Varying interest and power potential in a network that may lead to an unequal distribution of resources
- Opportunist behavior of individual network players
- Too large number of network participants making the network difficult to survey
- Exaggerated need for harmony and a trend towards avoidance of conflicts, exclusion of competition among network participants counteract the original intention; they inhibit innovation rather than promote it.

1.5 SOME IMPORTANT ASPECTS REGARDING INNOVATION NETWORKS

In order to conclude this first chapter some relevant information regarding Innovation Networks will be presented. Two important ideas will be introduced: the first one refers to the knowledge flows among partners and the second to the links between members. Along with these last ideas, some key institutions which can help to speed up the innovation process inside the network will be mentioned as well as the areas of application of Innovation Networks.

1.5.1 Knowledge flows

Unlike information, knowledge requires a knower: "information is a flow of messages, while knowledge is created and organized by an intensive flow of information, anchored on the commitment and beliefs of its holders (…). Therefore, knowledge flows through and resides in individuals" (Caroline Simard, 2005).

Knowledge is often divided into tacit and explicit, and both can be used to create innovations. Tacit knowledge is not articulated or codified, it is generally harder for competitors to imitate, and thus it has a greater competitive value.

Some companies are particularly worried about keeping know-how inside the company, so they tend to develop new technologies in-house from scratch, surround their R&D activities with secrecy, close their boundaries through non-compete and non-disclosure agreements, and acquire external knowledge through costly vertical integration strategies (Caroline Simard, 2005). These strategies sometime work, but most of the time knowledge goes out anyways.

Some unintended knowledge spillovers occur between firms, when labor mobility exists and through interpersonal interaction between individuals. This is particularly true in the case of tacit knowledge held by individuals which is an essential antecedent to creative breakthroughs (Caroline Simard, 2005).

According to this, one can say that a good strategy for these companies could be to participate in a network, which will make knowledge to flow outside their boundaries, in a way under some control,

but also it will certainly allow knowledge to flow inside the company as well. In other words, companies can start managing the knowledge inside the network.

As we will see later on, knowledge management is "a systematic approach to manage the use of information in order to provide a continuous flow of knowledge to the right people at the right time enabling efficient and effective decision making in a firm's everyday business" (Sena, 2009).

Moreover, if these companies are interested on innovation, they should understand that in many cases knowledge flows between firms are crucial. This knowledge can flow trough networks of formal and informal ties, enabling firms to build upon the broad pool of knowledge outside the firm.

1.5.2 Ties in innovation Networks

To generate innovations within a network implies an extensive use of inter-organizational ties to in source external ideas and to market internal ideas through external market channels outside a firm's current business. Network ties may reflect formal collaboration, such as joint ventures, alliances or R&D partnerships. They may correspond to customers-supplier relationships (i.e. licensing, contracting, or providing key components) or more lateral alliances to co-market or develop complementary products (Caroline Simard, 2005).

In particular, some types of inter-organizational ties are:

- Spin-ins
- Spin-offs
- Corporate Venture investments
- Joint Ventures
- Non-equity alliances

In literature, we can also find other types of classification of ties. For instance, Simard and West argue that companies have to build ties that are both *Wide* and *Deep* as well as *Formal* and *Informal* (Caroline Simard, 2005). These types of ties may reflect informal links between individuals, built through past collaborations.

Firms need to build wide and deep ties, and at the same time, they must also make sure that the value of the knowledge flowing into the company is greater than the value that the knowledge outflows provides to potential competitors.

DEEP vs. WIDE TIES	
Deep ties	**Wide ties**
They enable a company to capitalize on its existing knowledge and resources (exploitation of existing technologies).	They enable a company to find yet untapped technologies and markets by accessing to different networks i.e. different sources of information (Opportunity to explore new technologies).
They are the result of a company's strong network position that allows it to tap into key resources for innovation	
They are enhanced by the geographical proximity of the partners and by building trust in networks.	Geographical proximity is very valuable, since explorative search is enhanced by ties that span structural holes and link the innovating firms with diverse technological environments.
They are appropriate to strengthen companies in their existing business.	
They are characterized by redundant information overlapping with existing knowledge base of the companies involved. This suggests that deep networks tend to lead to incremental innovations.	Wide networks give a company access to non-redundant information and have as such greater potential for innovation.

Table 16 Wide vs. Deep ties in Innovation Networks

Organizations and individuals are embedded in networks, and thus both inter-organizational and interpersonal knowledge flows are guided by formal institutionalized and less visible informal relationships of those involved in innovative activities (Caroline Simard, 2005).

FORMAL vs. INFORMAL TIES	
Formal	**Informal**
Agreements based on a formal contract	They provide an important pathway for flows of valuable knowledge- particularly for exploiting unforeseen knowledge opportunities.

They are planned channels for knowledge exchange between organizations (e.g. strategic alliances)	Some informal networks lead to more formal arrangements to cooperate
They can be more easily incorporated into Open innovation strategy. For instance, a firm can identify gaps of internal knowledge and then seek potential partners for collaboration.	Informal networks are harder to manage and make it more difficult to control the knowledge flows in and out of the firm.
They can have unexpected knowledge spillover benefits. For example, a joint technology development agreement will not only foster the planned technological knowledge exchange, but also can enable labor movement between companies, creating access to unforeseen knowledge through informal ties between those individuals (social networks).	

Table 17 Formal vs. Informal ties in Innovation Networks

The combination of both dimensions (*deep-wide* and *formal-informal*) leads to different types of networks. All of them have advantages and disadvantages and an innovation firm has to balance the mix to optimize the return on Open innovation.

Studies have shown that firms involved in multiple types of ties are more innovative than organizations that engage in a single type of tie, since different types of ties can transfer different types of knowledge (Caroline Simard, 2005).

1.5.3 Key institutions

An optimal innovation strategy would exploit multiple types of ties to multiple types of institutions, as each type of tie and institution favors the flow of different pieces of knowledge (Caroline Simard, 2005).

- Universities: they have been shown to be a central creator of basic knowledge in regional economies. High-quality research universities produce knowledge spillovers through commercialization initiatives (patenting and licensing), industrial parks, and information flows of students entering the labor market. However, increasing attempts by universities to profit from their research are potentially reducing those spillovers.

- Venture capitalist (VCs): Since they are actively involved in the creation of start-up companies, they become an important source of knowledge. With their ties to multiple start-up companies, VCs can help identify needed knowledge and potential synergies that are beneficial to both established companies and start-ups. VCs are a powerful partner in an innovation network, since they are always focused on commercialization of technologies, converting ideas into products. Formal ties with them can be created by joint investments in start-ups or spinoffs.
- Focal Firms: Highly successful start-ups act as a breeding ground for knowledge creation and further ventures. This local "starts" can attract other big companies to the region, thus ensure a steady flow of knowledgeable workers and entrepreneurs.

In particular, each industry has its own institutions that lead innovation benefits. For instance, in biotechnology, public research institutes may be an important source of knowledge. Other examples include government entities like the military for telecommunications industry or other organizational forms such as law firms and consultants for several industries.

1.5.4 Areas of application

It is proved that innovation networks work especially well in:

- Extension of application oriented R&D
- Strengthening of the innovation potential of network members
- Strengthening of the innovation potential of a whole region
- Forming a regional profile
- Technology transfer (effective and speedy dissemination and application of new technologies)
- Support in internationalization (this is especially important for SMEs)

2 CHAPTER: MANAGEMENT CONTROL SYSTEMS

In this chapter we will first define the concept of Management Control Systems and then we will depict its four constitutive elements. Later, we will contrast them in the contexts of MCS for Innovation and MCS for Networks. These constitutive elements will also serve as the base of a new framework of MCS for Innovation Networks in Chapter 3.

2.1 MANAGEMENT CONTROL SYSTEMS "AS IS"

Several definitions of Management Control Systems (MCS) can be found in the literature including those under the terms 'Performance Management Systems' or 'Performance Management Control Systems'. Most of them are reduced to a Performance Measurement System (PMS) and Performance Evaluation System (PES) perspectives, in which organizational control objects are measured and evaluated with the purpose of achieving corporate objectives in the most effective and efficient way. This *performance measurement and evaluation* point of view can be synthesized into four steps:

1. Setting performance standards (which are expected to lead towards corporate objectives and goals).
2. Measurement of actual performance.
3. Comparing actual performance with standards in order to analyze deviations.
4. Correcting deviations (feedback and learning; adjustment of strategy).

Nevertheless, the special issue on MCS is motivated by the recurring concerns expressed by academics, managers, stakeholders and corporate regulators that the existing framework may be obsolete (Nixon, 2005). The control needs of the current environment are significantly different from those developed in an earlier period and improvements are urgently required among which Nixon (2005) propose:

1. To integrate the growing literature in MCS with the emerging management practice into a new framework, especially the new strategies and implementation processes that are evolving in organizations and networks, and;
2. To integrate the concepts of MCS with those of the control-related literatures such as strategic management; organization structure; corporate governance; risk management; alliances (including networks) and clusters; globalization; information and communication technology; human resource management; society; and performance measurement in accounting and finance,

marketing, manufacturing, intangible assets, knowledge management, and organizational behavior.

That is why in the last years some authors (Ferreira, et al., 2009) (Broadbent, et al., 2009) have been trying to distance from this particular focus on the achievement of *ends* and have proposed an extended framework which considers also the *means* used to achieve corporate objectives. In addition, they consider that these *ends* and *means* are determined by the specific *context* of the organization. In other words, factors such as the organizational structure, the accountability relationships among its members and the type of control relationship will determine the way that an MCS is designed and implemented in a specific organization or business process.

For the scope of this paper we define MCS as a *concise representation of the accountability relationships among the different stakeholders of an organization, with their particular interests, which attempts to ensure that common ends are achieved and predefined means are used to attain these ends.*

2.1.1 MCS Constitutive elements

For the definition of the constitutive elements of a MCS we departed from the Management Control System frameworks proposed by Ferreira and Otley (2009) and Broadbent and Laughlin (2009) who have identified three main elements: *context*, *ends* and *means*. Besides, we have added the *reporting* element which we consider fundamental to have a complete view of a MCS. The four constitutive elements of a MCS are represented in figure 7 (refer also to Appendix A).

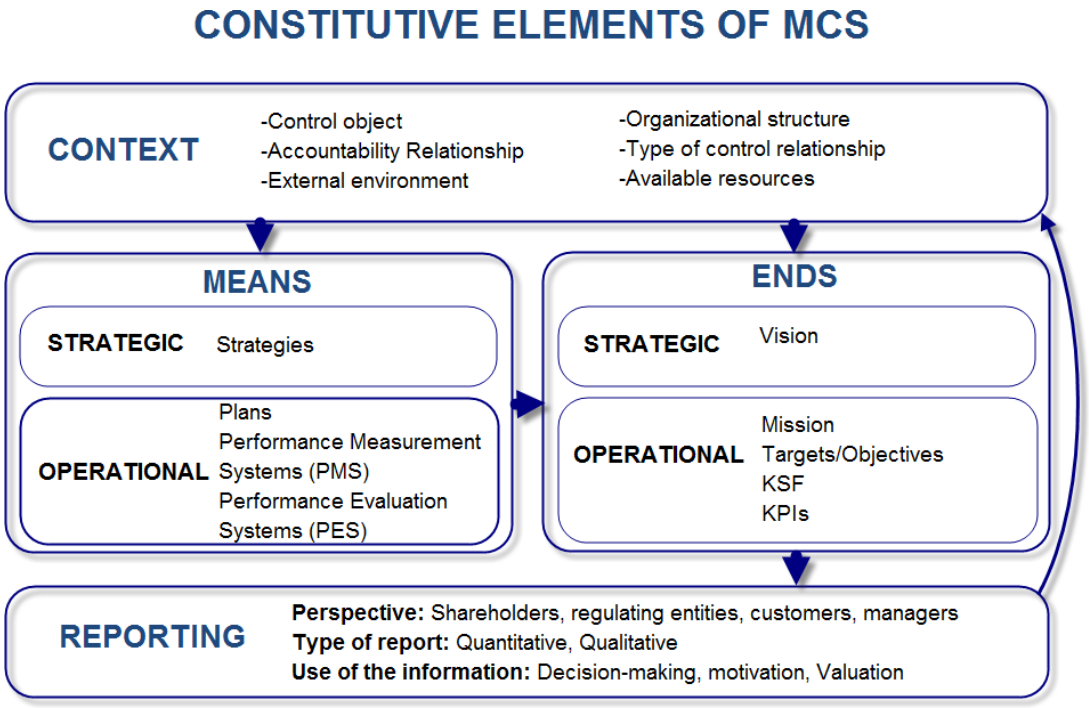

Figure 7 Constitutive elements of MCS

The first constitutive element, the *Context*, refers to the identification of the control object and the factors that influence the definition of the other constitutive elements of the MCS. The second element refers to the *Means* or the strategies, plans, Performance Measurement Systems (PMS) and Performance Evaluations Systems (PES), which are used to reach the ends. The third one is based on the accomplishment of outcomes or *Ends* which include corporate vision, mission, targets/objectives, key success factors (KSF) and quantitative and qualitative key performance indicators (KPIs). Finally, *Reporting* refers to the identification of recipients of information generated by the MCS and the use that they will give to this information.

2.1.1.1 Context

"Context, in broad terms, refers to the nature of the organization or the part of the organization which the MCS is attempting to control […]. This context varies considerably depending on history, purpose, technology, people, environment […]. It also refers to the channels through which the MCS attempts to achieve the aspirations it has through the organizations or parts of organization that it is trying to control […] (based on a logic of financial transfers and accountability relationships) a MCS has a focus upon and uses the unique role of money to ensure that the desired ends are achieved and the chosen means to achieve these ends are pursued" (Broadbent, et al., 2009).

To better understand this definition, Broadbent and Laughlin (2009) proposed four groups of questions based on the work of Ferreira and Otley (2009):

- What specific feed-back and feed-forward information flows has the organization devised for itself? What sort of information flows have been created for monitoring current performance and bringing about adaptation of current behavior? What types of feed-forward information flows (if any) have been formulated to enable the organization to learn from its experience, to generate new ideas and to recreate strategies and plans?
- What type of use is given to feed-back and feed-forward information flows and to the various control mechanisms in place? Is this use predominantly diagnostic, interactive, or a combination of both?
- How has the performance management and control system changed in the light of the change dynamics of the organization and of its environment? What changes have occurred at the level of those systems in anticipation or response to such stimuli?
- How strong and coherent are the links between the components of the performance management and control system?

These questions provide insight in contextual factors but they fall short to capture the complexity of the organizational context and its environment. This is because the context has a broader scope: it tries to identify the circumstances which gave birth to the accountability relationships and financial transfers. Thus, it is first necessary to identify core individuals/groups who are either directly or indirectly involved in the fact-building process and to ask why and how they became interested in the construction of accounting numbers (Chua, 1995). In other words, the context refers to the identification of control objects which have the potential to deliver value to stakeholders and the factors which affect the control on those objects. For this purpose we have instead defined the following three questions:

1. What does the organization want to control?
2. Does the control object deliver value to stakeholders?
3. What factors affect control?

The first question refers to the identification of the control object. To help answering this question we refer to the second question which tries to understand how important a control object is. Finally, the third question refers to factors that affect the control context. We next describe all these aspects mentioned before (See Figure 8).

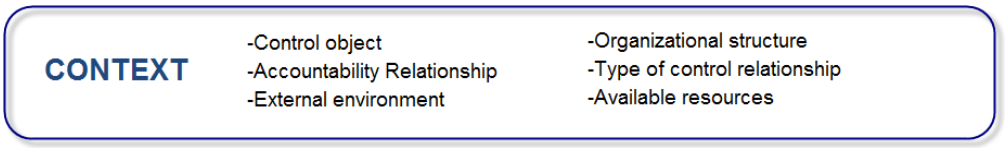

Figure 8 First MCS Constitutive Element: CONTEXT

Control object

The control object can be an organization, a business unit, a business process, a team or an individual. Usually a MCS is the result of the institutionalization of existing accountability relationships and financial transfers and not the result of the implementation of a model found in the literature. These accountability relationships are driven by both money and power to achieve value, although money has power itself to become a potential channel and instrument for control (Broadbent, et al., 2009). In practice, the link between the control object and the entity that wants to control it becomes strengthened by their accountability relationships. This means that the control object has to return the invested resources through financial transfers. Nevertheless, financial transfers are mostly in the interest of shareholders but there are other stakeholders who also demand intangible (non-financial) transfers. The type of accountability relationship between the control object and the entity that wants to control it, either financial, non-financial, or both, will also determine the context of the MCS.

Organizational structure

The design of the organizational structure has the following three components (Daft, 2003):

- To designate formal reporting relationships including number of levels in the hierarchy and the span of control of managers and supervisors.
- To identify the grouping together of individuals into departments and of departments into the total organization.
- To include the design of systems to ensure effective communication, coordination and integration of efforts across departments.

The first two components refer to the structural framework (vertical hierarchies) that supports the accountability relationships which are the foundation of the MCS. The third component pertains to the pattern of interactions among organizational employees (horizontal information and coordination) that promotes the institutionalization of the MCS.

A MCS is constitutive when it has reached a high degree of institutionalization. "One accounting map of an organization may be as good as any other since neither works because it better represents reality, each may differ fundamentally in terms of its institutionalized supporting structures and power effects. If a MCS had no support from important actors inside and outside the organization it would become a black box were no one would understand why they are doing what they are doing" (Chua, 1995). At the same time, detractors who continually question the role of the MCS and its effectiveness are crucial for maintaining interest in the MCS and unfolding major issues (Arnaboldi, et al., 2010).

Type of control

There are three types of control relationships that affect the performance of organizations (Sisaye, 2005):

- *Normative:* allocation of "symbolic rewards", "esteem and prestige symbols", and the use of rituals and norms to facilitate positive response. Leaders who exercise normative power have charisma, are persuasive and manipulative in the use of expressive activities to build their social power.
- *Coercive:* use of physical sanctions including force to secure compliance. It can be effective when an organization is confronted with highly alienated participants.
- *Remunerative-instrumental (utilitarian):* control over material resources and rewards through allocation of salaries and wages, commissions and contributions, working conditions, "fringe benefits", services and commodities. Utilitarian organizations have tendencies to exhibit dual power structures where remuneration incentives are the predominant form of control, but accompanied by coercive sanctions to secure employee compliance.

The predominance of any of these control relations depends on cultural processes and existing relationships inside the organization. They are useful to explain why organizations which apply normative control mechanisms reach higher degrees of social interaction among its members and facilitate information sharing.

Nevertheless, the model known as "Levers of Control", developed by Simons (1995) is the most used in the MCS literature. It considers that strategy control is achieved by integrating four levers of control: belief systems, boundary systems, diagnostic control systems and interactive control systems. Thus, one control mechanism can produce different types of control which are (Martínez Ramos, et al., 2003):

1. The Beliefs Systems of the organization provide the inspiration for both the emergent and intended strategies. The vision held by top management motivates the members of the enterprise to search for and create opportunities to accomplish the general mission of the firm. These systems appeal to the wishes that members of the organization have to belong and contribute to purposive organizations.
2. The Boundary Systems keep the realized strategies within the acceptable domain of activity and ensure that business activities occur in defined product markets and at acceptable levels of risk. These systems serve to limit experimentation and the search for opportunities so that they are within the possibilities of the firm.
3. Diagnostic Control Systems are essential tools for transforming intended strategies into realized strategies. They focus on accomplishing goals for both the enterprise and the individual. These systems allow outcomes to be measured and compared with pre-set standards of performance, which in turn allows deviations to be corrected. Diagnostic controls measure critical performance variables. Without them, directors would not be able to assess whether the intended strategies are being accomplished. As a diagnostic system, management accounting performs a follow-up of the proposed strategies like "the gauges in the cockpit of an airplane". In addition to the standard levels, it is also possible to set levels of tolerance for possible fluctuations, if direct intervention is not necessary (management by exception).
4. Interactive Control Systems provide the highest level of management with tools with which to exert an influence in the search for opportunities that can yield emergent strategies as their outcome. These controls are the ones that directors choose to perform their follow-up by holding talks with the organization about the threats and opportunities that can put the current strategy at risk. In other words, they allow them to monitor the strategic uncertainties of the firm. The choice of these controls provides a signal to subordinates about what aspects need attending to and which is the best moment to put forward and try new ideas. Therefore, organizational learning is activated, allowing new strategies to emerge through dialogue. Interactive management control requires regular attention from the operating managers at all levels of the organization. The data generated by the system are interpreted in meetings attended by the different hierarchical levels and are dealt with in the light of future strategic initiatives.

CONTROL SYSTEM	PURPOSE	COMMUNICATES	CONTROL OF THE STRATEGY AS
Beliefs Systems	Empower and expand search activity	Vision	Perspective
Boundary Systems	Provide limits of freedom	Strategic domain	Competitive position

Diagnostic Control Systems	Co-ordinate and monitor the implementation of intended strategies	Plans and goals	Plan
Interactive Control Systems	Stimulate and guide emergent strategies	Strategic uncertainties	Pattern of actions

Table 18 Four levers of control to strategy (Martínez Ramos, et al., 2003).

The four levers of control can be classified in two categories: social/informal controls (belief and boundary systems) which can be associated to normative control mechanisms, and technical controls (diagnostic and interactive control systems) which can be associated to remunerative-instrumental (utilitarian) control mechanisms.

Social/informal controls are becoming more important in the 21st century, as a consequence of the growing knowledge intensity in the global economy which implies a greater reliance on confidence and trust (Nixon, 2005). There should be a balance between the technical (hard) and social (soft) dimensions of control to increase the effectiveness of the Levers of Control model and thus translate it into organizational performance (see fig 9).

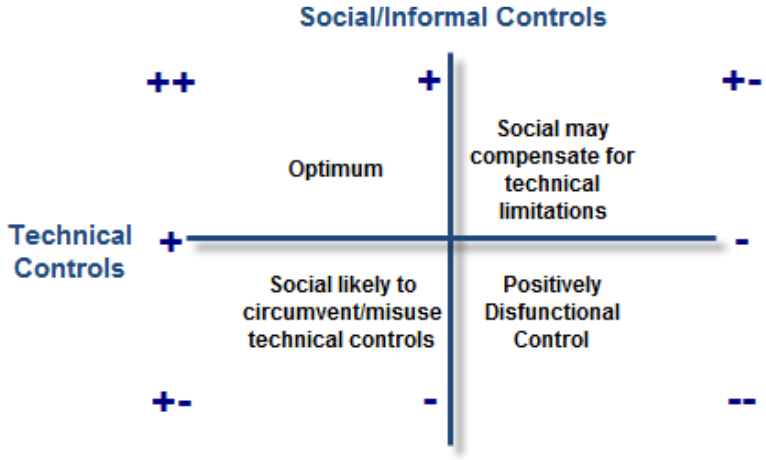

Figure 9 Matching social and technical controls. Nixon et al. (2005).

External environment

The external environment has a strong impact in the way that accountability relationships are shaped. For example: the flow of reports must be faster in a high-tech industry where the product lifecycle is shorter than one year; having many competitors in one sector will require a company to

modify its targets and operative goals according to those of the competitors; in regulated sectors companies will put more stress in the reporting system to comply with specific norms; or companies which work in networks have to develop accountability relationships even with competitors. All this factors have to be considered for the design and implementation of a MCS.

Available resources

The available tangible and intangible resources represent the pool of inputs or factors of production that the organization is able to use for obtaining a benefit. The efficient allocation of these resources is one of the most important decisions that a MCS can support. Moreover, the level of technology of an organization influences the way in which these resources are allocated. Parung and Bititci (2008) have classified the available resources which they call *value generators* in five categories:

- *Financial assets*: cash.
- *Physical assets*: property, plant and equipment.
- *Human capital*: includes personnel knowledge, skills, education level, and experience.
- *Relational capital*: for example distribution channels, customer relations, and brand image.
- *Organizational capital*: includes patents, designs, systems, and procedures.

2.1.1.2 Means

Before talking about *means* and *ends*, it is important to highlight that in theory, two different rationalities can be adopted for their definition: the *instrumental rationality* and the *communicative rationality* (Broadbent, 2009). In practice, the resulting MCS lies in the middle of these two rationalities (see Table 19).

MODEL OF RATIONALITY	COMMUNICATIVE RATIONALITY	INSTRUMENTAL RATIONALITY
Ownership of the MCS	Stakeholders	Sub-group of stakeholders
Resulting type of MCS	Relational	Transactional
Authority structure	Reflexive	Legal-rational
Preferred type of measurement	Qualitative	Quantitative
Definition of ends and means	Consensus among stakeholders	Decisions made by the sub-group of stakeholders

Table 19 Models of rationality in the design of a MCS. Adapted from Broadbent (2009).

It is important to understand from the previous table that according to the type of rationality an MCS style comes out, “relational” or “transactional”. In addition, these different types of MCS cause an interesting impact on two of the constitutive elements of the MCS, the *means* and the *ends*. For instance, whenever a particular MCS is conceptually defined as “relational”, it relies on the consensus about the *means* to achieve objectives and targets. And when the MCS is classified as “transactional”, it is likely to have a high level of specificity about the *ends* to be achieved (e.g. through performance measures, targets, etc.) (Broadbent, et al., 2009).

To begin talking about *means* we can refer to some questions that Broadbent, et al. (2009) have made based on Ferreira, et al. (2009):

- What are the key factors that are believed to be central to the organization’s overall future success?
- What strategies and plans has the organization adopted and what are the processes and activities that it has decided will be required for it to ensure its success?
- What is the organization structure and what impact does it have on the design and use of the performance management and control system? How does it influence and is influenced by the process of strategy implementation?
- What processes does the organization use for evaluating individual, group, and organizational performance?
- How important is formal and informal information on these processes? What are the consequences of the performance evaluation processes used?
- What rewards (both financial and non-financial) will managers and other employees gain by achieving performance targets (or, conversely, what penalties will they suffer by failing to achieve them)?’

As we can see, all the previous questions refer to variables such as external environment, strategy, culture, organizational structure, size, technology and ownership structure, which have a great impact on how a company achieves its ends/goals and also have influence on the control system of the organization. In other words, we are talking about the *means* strategically designed by the company which are used to achieve its *ends*.

The previous, lead us to elaborate another question: how can a company achieve its ends? It certainly has to design a strategy, organize its processes and organize its most important asset, its employees. All these activities can be done both, at a strategic level and at an operational level.

For the purpose of our project we will consider for *Strategic level means* the strategies and for the *Operational level means* the Plans, the Performance Measurement System (PMS) and the Performance Evaluation Process (see figure 10).

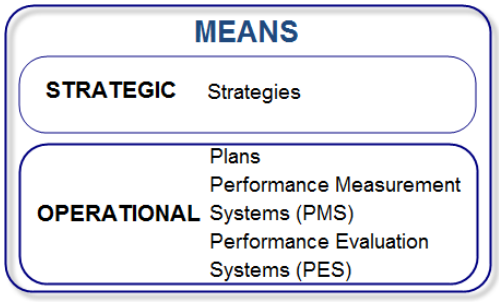

Figure 10 Second MCS constitutive element: MEANS

Strategic level

Strategy

It is a plan for integrating with the competitive environment to achieve organizational goals. Some managers think of goals and strategies as interchangeable, but for our purposes *goals* define where the organization wants to go and *strategies* define how to get there. Strategies can include any number of techniques to achieve the goal. The essence of formulating strategies is choosing whether the organization will perform different activities than its competitors or will execute similar activities more efficiently that its competitors do. (Daft, 2003)

Operational level

Plans

A plan is usually any procedure used to achieve an objective. It can also be a set of intended actions, through which one expects to achieve a goal. There are plans which are structured or formal, used in projects or in business processes and Informal or ad-hoc plans which are created by individuals in all of their pursuits.

Performance Measurement Systems (PMS)

In general terms, Performance Measurement Systems are any of many different measurement systems used to evaluate how well a company is using its resources to make a profit. It usually uses indicators to assess progress towards certain predefined goals and then gives information for a further analysis of the company's performance.

Performance measures can be applied to the whole organization or to particular departments, branches, or individuals (Encyclopedia.com, 2006). They are often divided into:

- Strategic indicators: related to successful and effective performance over the lifetime of an organization;
- Operational indicators: related to the success and profitability of products and services; product mixes and portfolios; and productivity and output;
- Specific indicators: including organization income or profit per member of staff, per customer, per offering, per outlet, per square foot; returns on investment; speed of response; product durability and longevity of usage; volume and quality targets;
- Behavioral indicators: related to staff management aspects; prevailing attitudes and values; the extent of strikes, disputes, absenteeism, labor turnover, and accidents; harmony/discord, cooperation/conflict; the general aura of well-being;
- Confidence indicators: reflecting the relationship between the organization and its environment, its backers, its stakeholders, its customers, and its communities;
- Ethical indicators: reflecting the standards of behavior and performance that an organization sets for itself and its acceptance in both markets and communities.

A distinction is also made between financial measures, such as return on capital employed, residual income, and Economic Value Added, and non-financial measures, such as delivery time or customer retention (Encyclopedia.com, 2006).

It is important to highlight that there are several Performance Measurement Systems approaches in MCS literature among which the most cited and implemented is the Balanced Scorecard. The Balanced Scorecard (BSC) is a strategic Performance Measurement tool that can be used by managers to keep track of the execution of activities and monitor the consequences arising from these actions. It was originally created to manage the implementation of a strategy. BSC highlights the key perspectives that are needed to understand success. The First Generation design method was based on the use of three non-financial topic areas in addition to one financial. The four "perspectives" proposed were (Kaplan, et al., 1992):

- Financial
- Customer
- Internal processes
- Innovation and learning

BSC designs that include a 'strategy map' or 'strategic linkage model' (e.g. the Performance Prism, later Kaplan & Norton designs, the Performance Driver model of Olve & Wetter) constitute the Second Generation of Balanced Scorecard design. To develop a strategy map, managers select a few strategic objectives within each of the perspectives, and then define the cause-effect chain among these objectives by drawing links between them (Kaplan, et al., 2000).

Designs that augment the strategy map/strategic linkage model with a separate document describing the long-term outcomes sought from the strategy (the "Destination Statement" idea) comprise the Third Generation Balanced Scorecard design. The Vision or Destination Statement is a statement of what "strategic success," or the "strategic end-state" looks like (Cobbold, et al., 2002).

Performance Evaluation System

The Performance Evaluation System is also called formal performance appraisal process. It should be viewed as a beneficial process within the context of an effective system of personnel management. In addition, it needs to be accepted as a normal management responsibility to review the performance of all employees and for all managers to discuss performance with their subordinates on a regular basis. The key elements of an effective performance appraisal system are: clearly defined performance standards, an effective monitoring system, regular discussions of performance, development of appropriate action plans as a consequence of the appraisal. These elements will help to ensure that performance appraisals conducted in any organization will yield the desired benefits and be more readily accepted by all concerned (Simpson, 2001).

There are three major steps in the performance appraisal process:

- Identification,
- Measurement
- Management

With identification, the behaviors necessary for successful performance are determined. Measurement involves choosing the appropriate instrument for appraisal and assessing performance. Management, which is the ultimate goal, is the reinforcing of good performance and the correction of poor performance (Kleiman, 2010).

The literature about performance appraisal of workforce related to Management Control is still scarce. Caruth and Humphreys (2008) affirm that without a consistent alignment between strategic control and human resources, performance appraisal becomes an exercise in futility instead of a vital control measurement, often resulting in not only personnel dissatisfaction, but also, more importantly, an impediment to systematic strategy implementation.

According to Shani et al. (2009), the objective of a Performance Appraisal is to gather information about workforce performance for decision-making in management and compensation, staffing, training, research evaluation and program evaluation. The performance appraisal system should be designed by immediate supervisors, human resource professionals, internal customers and external customers. Five dimensions should be considered for design:

1. *Measurement content*: workforce can be evaluated considering;
    - quality of the outcome;
    - quantity of the outcome;
    - timeliness (punctuality);
    - cost-effectiveness (relationship between outcomes and cost of resources);
    - need for supervision; and/or
    - interpersonal impact (degree of influence on others).
2. *Measurement process*: workforce performance can be measured in three ways;
    - comparing among ratees,
    - comparing among performance-level anchors, or
    - comparing to performance-level anchors.
3. *Evaluation administrator*: the raters could be single individuals or a 360° system.
4. *Level of performance to rate*: appropriate and achievable performance targets must be set.
5. *Administrative characteristics*: including frequency of measurement, control of rating errors, consideration of situational constrains on performance, and providing feedback to ratees.

In addition, Albar (2008) states that, the main aim of a performance appraisal system is to identify the performance gap. This gap is the shortfall that occurs when performance does not meet the standards set by the organization as acceptable. Secondly, a feedback system is supposed to inform the employee about the quality of his/her performance. The appraiser also receives feedback from the employee about his/her job problems (Albar, 2008). Thus, the objectives of a Performance Appraisal are to:

- Provide employees with a sense of their work accomplishments relative to expectations and pre-defined performance indicators,
- Support employee development through discussion of assigned opportunities and training,
- Emphasize an organization's commitment to continuous improvement and learning,
- Encourage appropriate relationship between work performance and reward,
- Motivate creativity and support good ideas, avoid surprises and keep lines of communication open.

Finally, within the topic of Evaluation Systems, we would like to add two more ideas to the last aspect of the Evaluation process: the reinforcement of good performance and the correction of poor performance. They will be next described as the Reward system and the Penalty system.

The Reward system

Rewards process, are procedures, rules, and standards associated with allocation of benefits and compensation to employees. Employee motivation and performance management depend on good systems that offer both financial and non-financial rewards (non-monetary rewards). Non-monetary rewards can be as important as monetary rewards. Several authors have highlighted the importance of linking Business Performance Measurement systems to rewards. For instance, Kaplan and Norton (1992; 1996; 2001) argue that a linkage between the Balanced Scorecard and rewards is critical as it provides a powerful mean for implementing the strategy of a firm, by enhancing internal communication and motivating employees' performance to achieve the goals and targets.

In addition, there is an interesting philosophy that links rewards with motivation and motivation with performance, called the Expectancy Theory. It has its basis on the fact that people are influenced by the expected results of their actions. It also states that motivation is a function of the relationship between:

- The effort expended and perceived level of performance
- The expectation that rewards (desired outcomes) will be related to performance.
- The expectation that rewards (desired outcomes) are available.

These relationships determine the strength of the 'motivational link' (see Figure 11). Performance therefore depends upon the perceived expectation regarding effort expended and achieving the desired outcome.

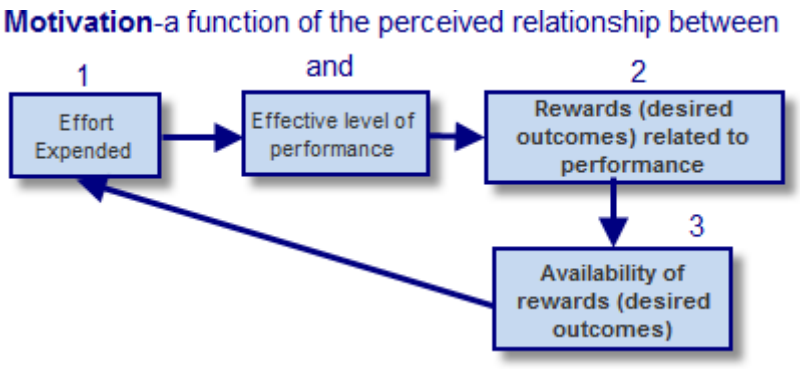

Figure 11 Expectancy theory: the motivational link

Authors like Porter and Lawler (1968) have gone further in this Expectancy Theory; by developing a model which points out that effort expended (motivational force) does not lead directly to performance. It is mediated by individual abilities and traits, and by the person's role perceptions. They also introduce rewards as an intervening variable. Their model recognizes that job satisfaction is more dependent upon performance, than performance is upon satisfaction […] In other words; satisfaction is an effect rather than a cause of performance. It is performance that leads to job satisfaction (Mullins, 2005). See figure 12 below:

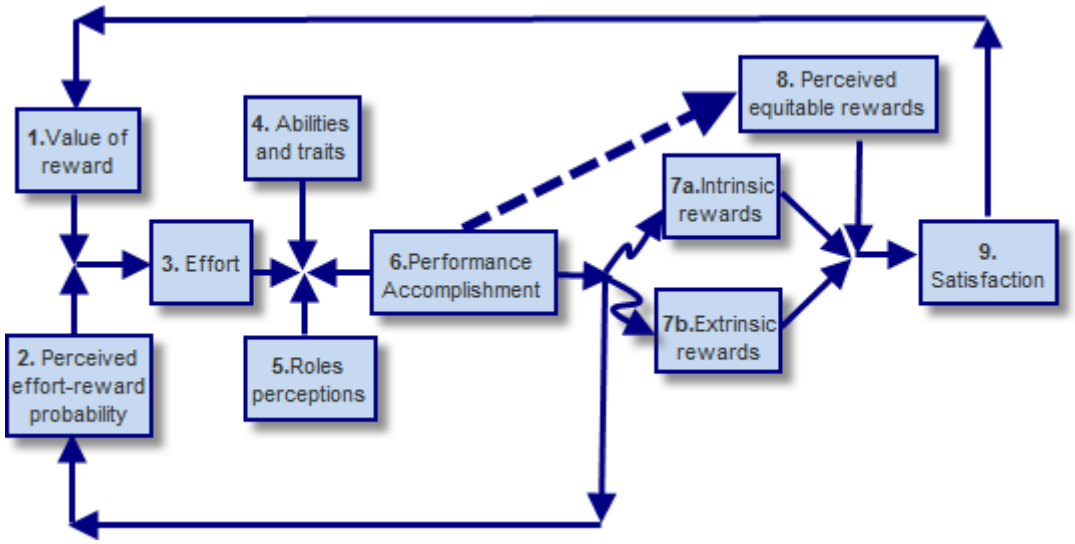

Figure 12 The Porter and Lawer Motivation model

In the next table a complete explanation of each box can be found:

BOX	DESCRIPTION
1. Value of reward	People desire various outcomes (rewards) which they hope to achieve from work. The value placed on a reward depends on the strength of its desirability.
2. Perceived effort–reward probability	It refers to a person's expectation that certain outcomes (rewards) are dependent upon a given amount of effort.
3. Effort	It is how hard the person tries, the amount of energy a person exerts on a given activity. It does not relate to how successful a person is in carrying out an activity. The amount of energy exerted is dependent upon the interaction of the input variables of value of reward, and perception of the effort–reward relationship.
4. Abilities and traits	Porter and Lawler suggest that effort does not lead directly to performance, but is influenced by individual characteristics. Factors such as intelligence, skills, knowledge, training and personality affect the ability to perform a given activity
5. Role perceptions	It refers to the way in which individuals view their work and the role they should adopt. This influences the type of effort exerted. Role perceptions will influence the direction and level of action which is believed to be necessary for effective performance.
6. Performance	It depends not only on the amount of effort exerted but also on the intervening influences of the person's abilities and traits, and their role perceptions. If the person lacks the right ability or personality, or has an inaccurate role perception of what is required, then the exertion of a large amount of energy may still result in a low level of performance, or task accomplishment.
7. Rewards (Boxes 7A and 7B)	7A and 7B are desirable outcomes. Intrinsic rewards derive from the individuals themselves and include a sense of achievement, a feeling of responsibility and recognition. Extrinsic rewards derive from the organisation and the actions of others, and include salary, working conditions and supervision (the wavy line between performance and extrinsic rewards indicates that such rewards do not often provide a direct link to performance).
8. Perceived equitable rewards	This is the level of rewards people feel they should fairly receive for a given standard of performance. Most people have an implicit perception about the level of rewards they should receive commensurate with the requirements and demands of the job, and the contribution expected of them. Self-rating of performance links directly with the perceived equitable reward variable. Higher levels of self-rated performance are associated with higher levels of expected equitable rewards. The heavily arrowed line indicates a relationship from the self-rated part of performance to perceived equitable rewards.
9. Satisfaction	This is not the same as motivation. It is an attitude, an individual's internal state. Satisfaction is determined by both actual rewards received, and perceived level of rewards from the organisation for a given standard of performance. If perceived equitable rewards are greater than actual rewards received, the person experiences dissatisfaction. The experience of satisfaction derives from actual rewards which meet or exceed the perceived equitable rewards.

Table 20 The Porter and Lawer Motivation model description

The Penalty system

On the other hand, penalty systems are based on punishments. They are used after an undesirable behavior, and it is intended to decrease or eliminate the occurrence of that it. It may be triggered either due to the performance of an undesirable act (negligence) or the non-performance of a desirable act (disobedience). Punishments take the form of presentation of an unpleasant stimulus (criticism or warning) or withdrawal of a pleasant one (employment or promotion) (Businessdictionary.com, 2010).

2.1.1.3 Ends

In the same way used before, we would like to consider other four questions, taken from the reflection made by Broadbent et al. (2009) recalling the ones made by Ferreira, et al. (2009):

- What is the vision and mission of the organization and how is this brought to the attention of managers and employees?
- What are the key factors that are believed to be central to the organization's overall future success?
- What are the organization's key performance measures deriving from its key objectives, key success factors, and strategies and plans? How does the organization go about assessing and measuring its success in achieving them?
- What level of performance does the organization need to achieve in each of the areas defined in the above questions, and how does it go about setting appropriate performance targets for them?

All the previous questions lead us to think that Ends are many, and for every company they might be particular. That is why we came up with another question that gathers all the previous ones: what ends does the organization want to achieve?

For the present thesis we will then consider for an End, the vision and the mission of the company, targets/objectives, KSF in relation to ends and KPI's. As it was made in the case of Means, we will separate these *ends* in strategic and operational. The first refers to the vision and the latter to the rest of the Ends (see figure 13).

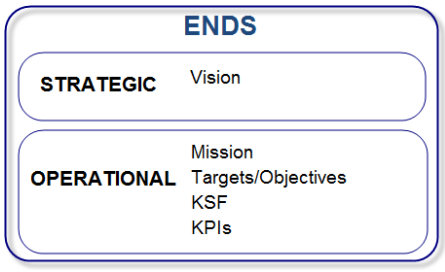

Figure 13 Third MCS constitutive element: ENDS

Strategic level

Vision

Corporate vision summarizes what the organization intends to become and to achieve at some point in the future. Vision refers to the category of intentions that are broad, all-inclusive and forward-thinking. It is the image that a business must have of its goals before it sets out to reach them. It describes aspirations for the future, without specifying the means that will be used to achieve those desired ends (Kotelnikov, 2001).

Operational level

Mission

It is the overall goal for an organization or the enterprise's reason for existence. The mission describes the organization's vision, its shared values and beliefs, and its reason for being. It can have a powerful impact on an organization. The mission is sometimes called the official goals, which refers to the formally stated definition of business scope and outcomes the organization is trying to achieve. Official goal statements typically define business operations and may focus on values, markets, and customers that distinguish the organization (Daft, 2003). The mission statement articulates the company's purpose both for those in the organization and for the public (Ward, 2010).

Operative goals (Targets/Objectives)

They designate the ends sought through the actual operative procedures of the organization and explain what the organization is actually trying to do. They might be also called company's targets or objectives.

Operative goals describe specific measurable outcomes and are often concerned with the short run. Operative versus official goals represent actual versus stated goals. Operative goals typically pertain to the primary task an organization must perform. These goals concern overall performance, boundary spanning, maintenance, adaptation and production activities. Specific goals for each primary task provide direction for the day-to-day decisions and activities within departments.

Overall performance can be then measured according to the type of organization, and it might include the aspects such as: Profitability, Customer Service, Resource goals, Market goals, Employee development, Innovation and Change, Productivity, among others (Daft, 2003).

Successful organizations use a carefully balanced set of operative goals. Although profitability is important, some of today's best companies recognize that a single-minded focus on bottom-line profits may not be the best way to achieve high performance. Innovation and change goals are increasingly important, even though they might initially cause a decrease in profits. Employee development goals are critical for helping to maintain a motivated, committed work force (Daft, 2003).

Key Success Factors (KSF)

Key Success Factors (KSF), also called Critical Success Factors (CSF), are those important aspects or activities required for ensuring the success of a project or an organization. They are mainly chosen according to the characteristics of the company and the industrial sector where it operates. In the specific case of KSF in relation to the ends, we gather all the factors that will guarantee the achievement of the ends established by the company. For instance, the KSF for a store might be "attract new customers", which is directly related to the end of increasing sales.

Key Performance Indicators (KPI's)

In general terms, Key Performance Indicators (KPI) are quantifiable measurements, agreed to beforehand, that reflect the critical success factors of a company, department, or project. In other words, the KPIs selected by an organization must reflect the organization's goals, they must be key to its success, and they must be measurable. Among many of the KPI's characteristics we can highlight the following ones:

- They can be financial and non-financial metrics or measures.
- They usually are long-term oriented.
- They help companies achieve organizational goals through the definition and measurement of progress.
- Usually the KPI metrics are identified and validated by stakeholders.

2.1.1.4 Reporting

The reporting system consists of people, equipment, and procedures to gather, sort, evaluate, and distribute timely and accurate information to the stakeholders, according to their particular interests. For example Shareholders want knowledge about the rate of return of their invested capital; the Accountability function wants knowledge about costs; or the Human Resources function wants knowledge about employee motivation.

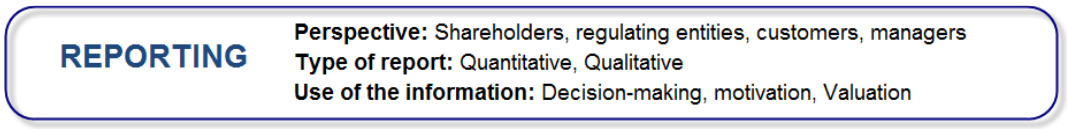

Figure 14 Forth MCS constitutive element: REPORTING

We have identified the reporting as the constitutive element which tries to answer the following two questions:

1. Who must be held accountable for control?
2. What use will be given to the information generated by the MCS?

For answering the first question the most used framework is the Balanced Scorecard (Kaplan, et al., 2000) where the information generated by the MCS is classified in four groups which satisfy different stakeholders which include shareholders, customers and managers:

- Financial perspective: it tries to answer the question "How do we look to shareholders?" In private-sector organizations, this perspective contains the financial results such as profit, return on capital, cash flow, and margins. In non-profit organizations, it describes income from sponsors or taxpayers, cash flow and cost control results.
- Customer perspective: it tries to answer the question "How do customers see us?" It contains measurements such as time, quality, performance and service, price or rate.
- Internal processes perspective: it tries to answer the question "What must we excel at?" Involves operations management processes, customer management processes, innovation processes, social and regulatory processes.

- Learning and growth perspective: "Can we continue to improve and create value?" Includes indicators about human, relational and organizational capital.

Having identified the core individuals/groups who are the recipients of the reporting system, the information can be adapted to their requirements. This is the purpose of the second question. For instance, reporting to shareholders is different of reporting to regulating entities because the former requires mostly quantitative information, while the later requires a combination of quantitative and qualitative information to verify compliance to norms.

The requirements of each stakeholder differ in the use that they give to the information generated by the MCS. We have found in the literature that these uses can be classified in three groups:

1. *Information for decision-making*: important decisions based on performance include resource allocation, budget management and organizational improvement.
2. *Information for motivation*: organizations give rewards such as money, promotion and recognition to employees according to their contribution to the achievement of ends. Also organizations give dividends to shareholders and discounts to customers based on performance.
3. *Information for company valuation*: the market value of an enterprise depends on its expected financial performance in the future. At the same time, the market value depends on financial operations such as the variation of the level of debt or the number of outstanding shares.

Finally, for the presentation of reports it is important to consider that "visualization is especially persuasive; it appeals to the sense of sight, the most valued sense in Western, literate cultures" and that to foster information credibility, the MCS “needs spokespersons, people who genuinely believe in its utility and final, comparative advantage over competitors" (Chua, 1995). The reporting system must be able to provide one page representations of the reality of the organization to the right people at the right time.

2.2 MCS IN INNOVATION

In the innovation context, the role of Management Control is ambiguous. First of all, R&D has recently become an accountable process too, even if it was once considered as a unique and unstructured one that it was almost impossible to monitor and control (Chiesa, et al., 2007). Second, there are differences between authors' position regarding the level of control of the innovation process. Some authors agree that innovation is fostered by "freedom from rules", "freedom to experiment", "no punishment for mistakes", "flexibility in jobs, budgets, functional areas", and "minimized bureaucracy" (Ojasalo, 2008). Other authors argue that in business, innovation rarely spring from a flash of inspiration, therefore a certain degree of control is required to translate ideas into actions (Drucker, 2002).

The literature about MCS in innovation is limited to just a few contributions. The most significant problems in defining a model for MCS in R&D activities include (Frattini, 2008):

- R&D outcomes are hard to quantitatively measure.
- Tangible results become manifest in a very long time.
- Performance measurement might hinder the creativity of scientists and researchers.

Nevertheless, Chiesa et al. (2007) have proposed a model for MCS in R&D that consider the following four elements (see fig 15):

1. The objectives of the measurement.
2. The monitored dimensions of performance and the relative indicators.
3. The structure (control objects).
4. The process.

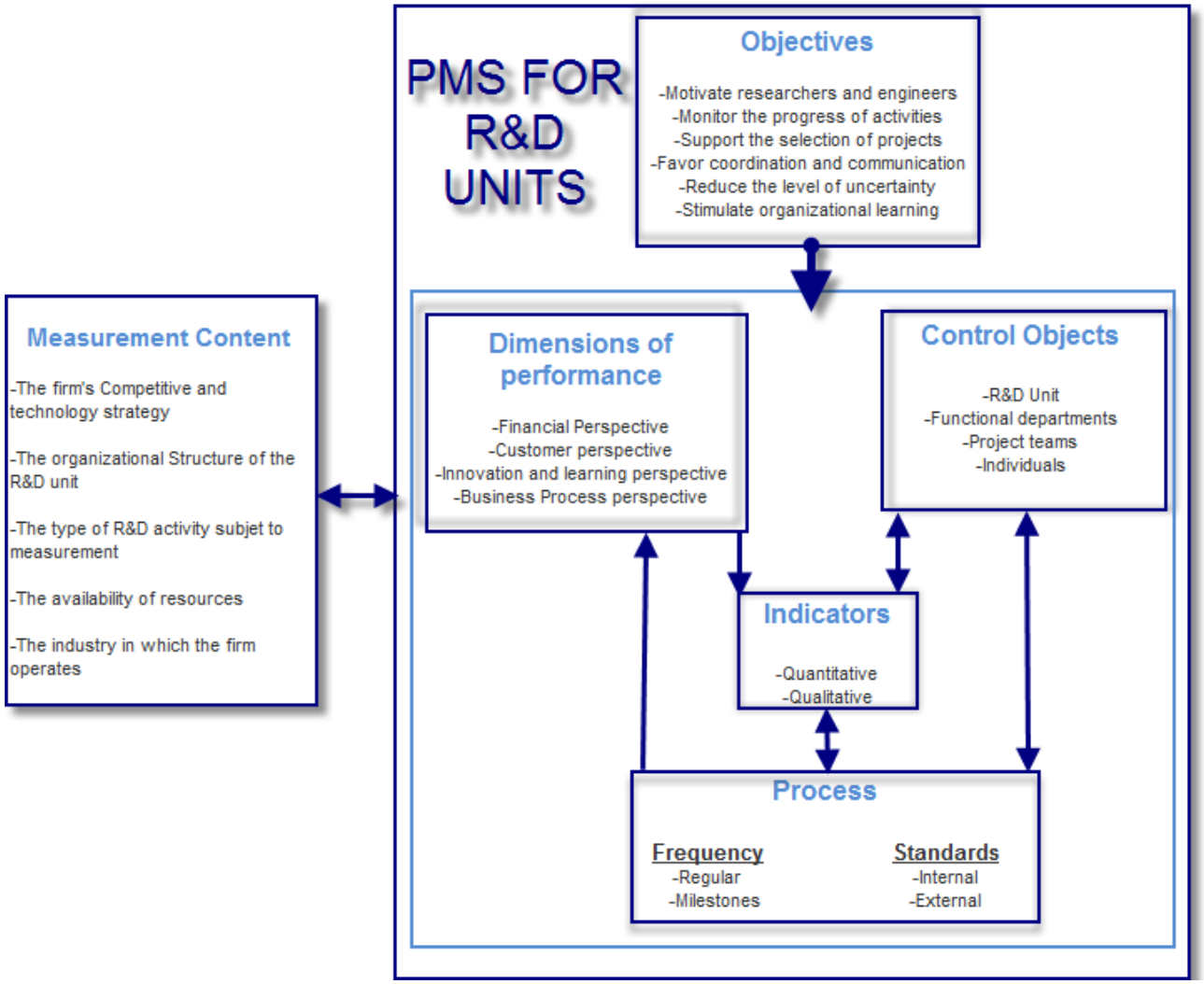

Figure 15 The constitutive elements of a MCS for R&D. Chiesa et al. (2007)

It is interesting how this model can be reorganized in order to adapt it to the framework proposed in this project:

- Context: the measurement context and the control objects.
- Ends: the ends are not explicit in this model.
- Means: the measurement process.
- Reporting: the monitored dimensions of performance, the objectives of the measurement, and the relative indicators.

We next explain in detail what can be added or highlighted to the MCS "as is" when applied to innovation by applying the four constitutive elements previously introduced (refer also to Appendix B).

2.2.1 MCS in Innovation Constitutive elements

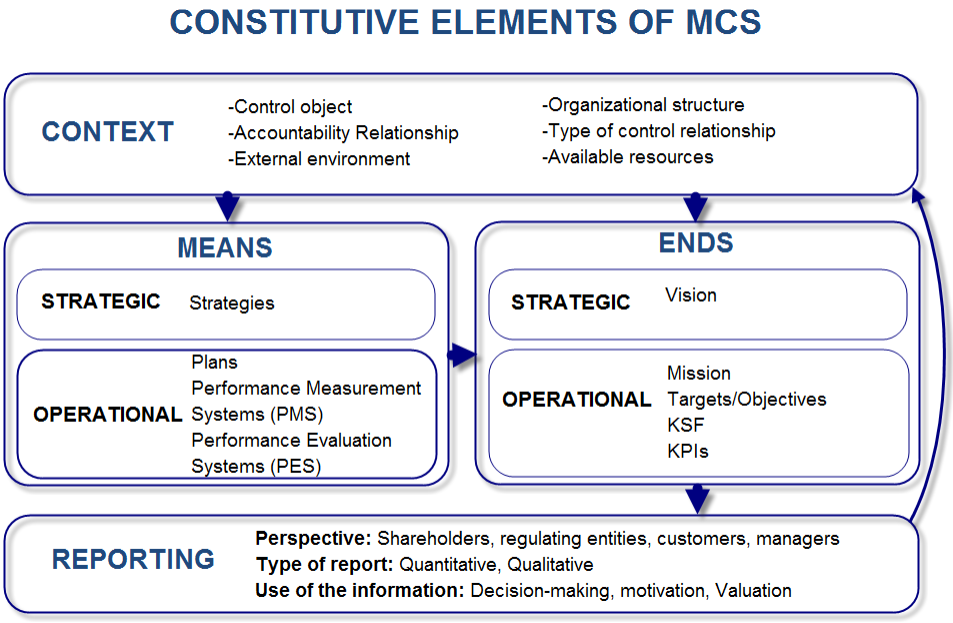

Figure 16 Constitutive elements of MCS

2.2.1.1 MCS Context

Regarding the first question, (what does the organization want to control?) proposed in the constitutive elements of MCS "as is", there are several potential R&D control objects identified in the literature which can be measured in an organization (Chiesa, et al., 2009):

- The R&D function as a whole.
- The different units the R&D function is generally composed of.
- The technical and scientific departments within each unit.
- The project team.
- The individual scientist, engineer or researcher.

Chiesa et al. (2009), propose a specialization of the performance management practices in R&D, e.g. designing and using two different MCS, one for *basic and applied research* and other for *new product development*, since they both follow different objectives. Consequently, the control objects can be classified as follows:

	RESEARCH	DEVELOPMENT
Prevalent Control Object	Research Unit	Development unit
	Individuals	Project teams

Table 21 Differences between MCS frameworks used in research and development (Chiesa et al., 2009)

Concerning the second question (does the control object deliver value to stakeholders?) we will see that the value delivered by any of these control objects is mostly intangible (knowledge for instance). In fact, one of the characteristics of the MCS for innovation is that tangible results become manifest in a very long time.

Finally, about the third question (what factors affect control?) Chiesa et al. (2009) consider that the contextual factors which have more impact in the design and implementation of MCS for innovation are:

- The company's R&D strategy.
- The organizational structure of the R&D function.
- The type of activity being measured, being it Basic and Applied Research or New Product Development.
- The resources available for the design, implementation and use of the MCS, in terms of time, money, human resources and know-how.
- The sector of activity, or type of industry, in which the firm operates

These contextual factors correspond to those that we proposed in the constitutive elements of the MCS "as is" except for the company's R&D strategy which we have classified as one of the *means*.

In addition to these factors, the type of control relationships has received a lot of attention by scholars.

Type of control

Lately, a dynamic perspective of control has been proposed by Chiesa et al. (2009), based on the concept of the "Levers of Control" (Simons, 1995). They conclude that the Management Control System adopted in the innovation projects, even independently from their radicalness, evolves along the project, as the information needs vary: in the early stages social controls are more diffused in response to the higher uncertainty characterizing radical projects, while as the concept gets more and more frozen, and the project moves towards commercialization, technical controls are easier to introduce and gets more adopted.

Going deeper into the type of control relationship, the differences between *basic and applied research* and *new product development* activities imply that the first one should be controlled with a 'softer' approach (social controls) while the latter involves a 'harder' control (technical controls). The differences between managerial principles used in both control objects are summarized in Table 22.

Managerial principles of R organizations	Managerial principles of D organizations
Culture • Creation of a positive environment (freedom to express scientific opinions and flexibility in reviewing projects) • "Open door" Policy • Accept mistakes • Direct Communication • Right for initiative for everyone	**Culture** • Clear cut priority setting • Identify and solve areas of weakness • Play for speed • Formal communication
Organization • Creation of highly specialized core teams • Sharing information among different scientific disciplines and fields of research • Minimum hierarchical levels • Sound patent strategy (the company cares for the results of the research dept.) • Placing pressure not as deadline but with a sense of urgency ("other groups are in better position than us") • Long-term commitment • Identification of external technical centers of excellence with whom to co-operate	**Organization** • Teamwork among technical specialist • Involvement of a number of highly specialized scientific areas • Creation of a structure that integrates business and science perspectives • Definition of hierarchy, and fixing of project milestones • Formal Planning • Pressures on deadlines • Strong integration with marketing • Coordination of many outside engineers and technical service providers in several nations
People • Research is the right place for a "prima donna" • Reward on qualitative and quantitative output • Company scientist must be integrated and connected to the outside world of science • Opportunities to present their work to peer review committees • The most creative people should not become managers • Look for public recognition, tangible benefits, support	**People** • Teamwork • Avoidance of people spending much of their time moving process along • Avoidance of people with pure science credentials • Recruitment of people who can manage across corporate functions (marketing, technical development) • People with broad perspectives (business implications of scientific results)

scientific efforts (staff increase)	• People with long-term strategic view plus day-to-day activities • People with an entrepreneurial spirit (winning attitude)

Table 22 Differences between managerial principles used in research and development (Chiesa et al., 2009)

Nevertheless, Chiesa et al. (2009) suggest that having both, research and development as control objects, can be a valuable alternative only under specific circumstances among which they mention:

1. Organizational separation between the research and development functions
2. Strategic relevance of R&D activities
3. Internal rivalries among companies in the same industry
4. Availability of resources dedicated to the MCS design and implementation
5. High level of uncertainty in R&D
6. Organizational restructuring
7. Financial crisis
8. Regulatory and institutional control

2.2.1.2 Means

As it was stated in the case of MCS "as is", by M*eans* we refer to how can a company achieve its ends and how can an organization do it at different levels. In the context of MCS in innovation the answer is not very different from the case "MCS as is". Therefore, *Strategic level means* will be the strategies and *Operational level means*, will be the Plans, the Performance Measurement System (PMS) and the Performance Evaluation Process.

Strategic level

Strategy

In the context of Innovation, we can say that Innovation is a strategy itself. It is related to the way a company can challenge the existing methods within an industry to create customer value in order to meet newly emerging customer needs, add additional value, and create new markets and new customer groups.

Operational level

Plans

Plans in for Innovation can be all the procedures used to achieve a desired level of innovation within a company. They can be focused on promoting the innovation process among the company's employees, investing more resources on R&D, etc.

Performance Measurement Systems (PMS)

When talking about PMS in the innovation context, two important aspects are worthwhile to be mentioned. First, the measurement of R&D as a main driver of the innovation process, and second, something that is a consequence of the innovation itself: the presence of intangible assets and the relevance of its valuation.

R&D Measurement

For measuring R&D activities, a company should take two important operational choices that will drive the organization to the achievement of R&D objectives (Chiesa, et al., 2007):

1. *The choice of the reference standards to measure performance:* because of the higher degree of uncertainty, isolation and secrecy that characterizes innovative processes, internal standards are prevalent and can be defined on an ad hoc basis. For instance, as future objectives for R&D performance set on the basis of the firm's competitive strategy, and on the basis of the information about the firm's past R&D performance. In only few cases firms can employ external standards, defined through a benchmarking analysis of industry or major competitors' R&D performance.
2. *The definition of the measurement frequency:* the measurement frequency should be adapted to the PMS objectives, which in turn can be different for each dimension of performance (and/or indicator) and for different control objects. Measurement can take place together with the project's milestones or with a regular frequency (e.g. weekly, monthly or yearly).

These operational choices can also be contextualized according to the type of R&D activities (*basic and applied research* and *new product development)*:

	RESEARCH (soft)	DEVELOPMENT (hard)
Operational Choices	• Low frequency of performance measurement (annual) • Collective definition of standards	• High frequency of performance measurement (monthly) • Standard imposed by superiors • Standards defined on basis of past performance or industry benchmarks

Table 23 Operational choices according to the type of R&D activities

Measurement of intangible assets

One emerging trend in the R&D literature is towards the measurement of intangibles. Turki and Mention (2010) affirm that employees and their individual competencies, the networks and communities they are involved in as well as the structural resources of the organization itself, are expected to play an important role on the innovation capabilities of Research and Technology Organizations, but tend to be neglected in the traditional performance reporting and management systems.

Consequently, Lev (2004) proposed the improvement of the management and corporate reporting model of an organization through the assessment of the total factor productivity[4] departing from two hypotheses:

1. Intangible assets themselves neither create value nor generate growth: they need to be combined with other production factors. The organizational infrastructure, defined as a bundle of systems, processes and business practices, represents the major intangible of an enterprise.
2. The value of intangible assets is related to the future. They represent capabilities and "potential" for future growth and income. Our current management and corporate reporting practice are primarily focused on backward looking information. This needs to change towards forward looking information and we must adopt a more dynamic approach than traditional performance management concepts that are based on annual budgeting. A key support process for this is forecasting.

The result of this improvement is a holistic enterprise performance management system in the form of a scorecard which enables the systematic monitoring of performance as well as of emerging opportunities and risks in the company's overall value creation system (see fig 17).

[4] The added value to invested inputs such as labor and capital investments which is derived from their use in a productive manner.

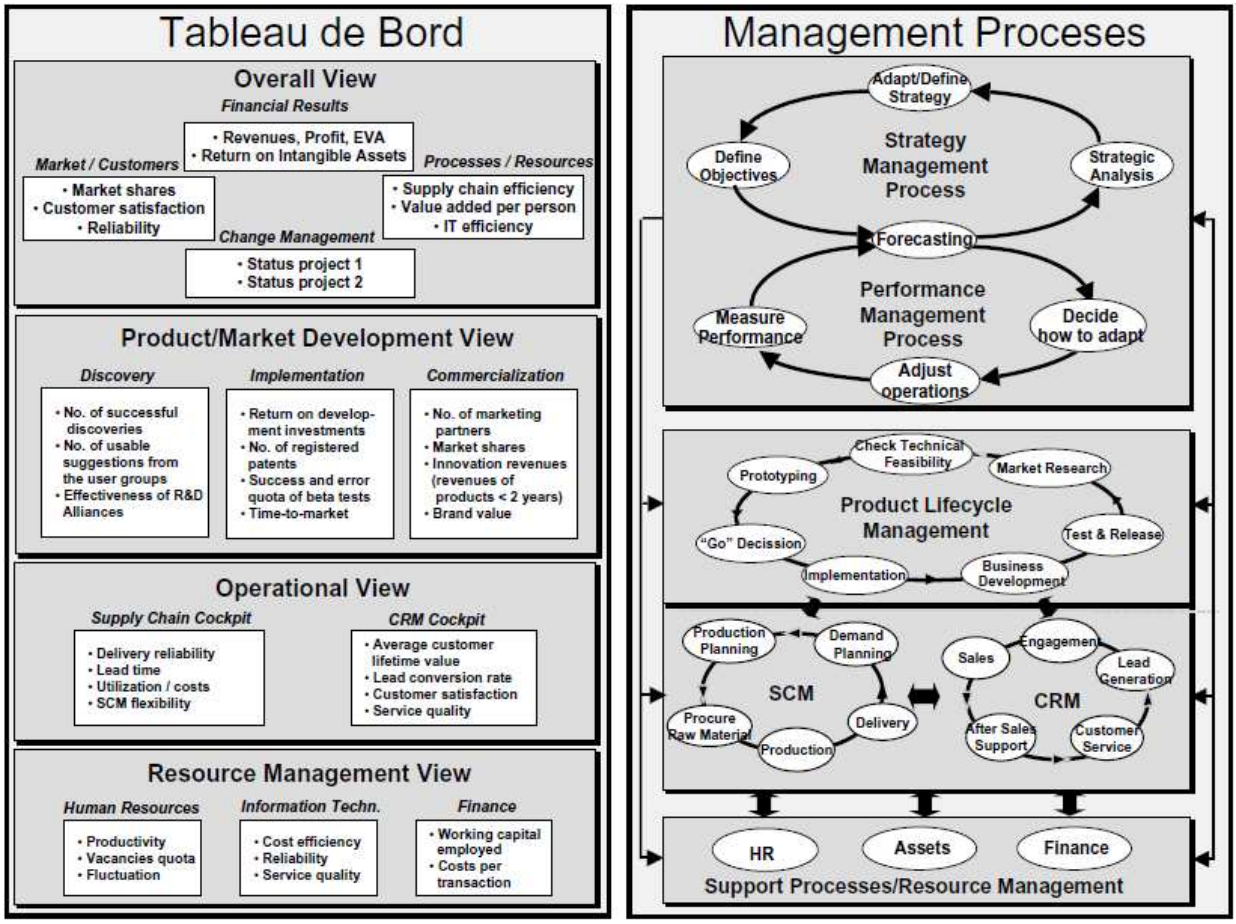

Figure 17 The enterprise performance management system (Lev, et al., 2004)

Performance Evaluation System

When we talk about Performance Evaluation System in the context of innovation, one idea comes to our minds: How does a company evaluate its innovation? This is certainly related with the way this company measures and evaluates the creative performance of its business, due to its innovative processes, its new product developments, its employees, etc.

Evaluation system should include multi-objective focus based on economic indicators, technical level, and social benefits, and treats of the system as the core content for performance evaluation. Multi-objective evaluation and effective incentive make the technological innovation results be recognized by all sides and form the innovation culture of "encouraging innovation, advocating innovation, and initiative innovation". In such kind of innovation system, seniors attach importance to innovation, technical managers are proud of innovation, and professional technicians are respected for making innovation (support, 1999).

Regarding to innovation we found that the main participant in this process are individuals with creative capacities to not only make a good decision, but also to create a new product or process, to early detect a serious problem or a solution to a problem, or finally to enhance an existing product or process. Individuals are drivers of innovation, and that is why to evaluate their performance is one of the most important things for innovative processes inside a company.

Establishing and communicating employee objectives and measuring results, is critical and can be achieved with the help of a good performance appraisal system. Such a system will provide managers with the tools to effectively align the goals of their team and each direct report with the strategic initiatives of the company. It will help to measure performance of each employee, and deliver feedback during the appraisal process that is helpful and constructive. It will make the employee performance review a powerful tool for greater business gain, and develop greater leadership potential in top talent (Authoria, 2009).

The previous idea about evaluating the performance of individuals leads to elaborate an appraisal system that evaluates the employees' work involvement. This evaluation system must be fair and accurate, and should be developed taking into consideration two aspects.

- *Managerial ingredients:* Companies and managers need to be aware of the factors that would affect their evaluation and improve them. That is why Good operational knowledge of the system's measurement instruments, accuracy training, and well developed interpersonal and communication skills, as well as the ability to clearly define job objectives, roles and responsibilities should be taken into consideration.
- *Organizational Culture*: The second major precondition for an effective appraisal system is an organizational culture that enhances the creativity and enables the appropriate implementation of the evaluation system as intended.

Albar (2008) affirms that influence of organizational context and the perceptions of all participants have great impacts on the accuracy and effectiveness of appraisals. The prominence of accuracy as an attribute of performance rating is a consequence of the multitude of considerations that depend on it. For example (Albar, 2008):

- Employees' motivation and satisfaction are directly related to their perception of fair and equitable treatment. In addition, most organizational rewards (such as raises, bonuses, promotions, and even

special training opportunities) are tied to performance assessments. These conditions require ratings to be both accurate and valid in order to reflect the true level of performance.

- It is widely acknowledged that accurate employee appraisals significantly contribute to the attraction and retention of desirable employees. This is a major goal of performance management systems.
- Inaccurate appraisals could make the company vulnerable to legal action, particularly in cases of firing, corrective action, or reward denial. Legal action can have devastating effects on the company's reputation, demoralizing effects on employees, and can be very costly.
- Accurate ratings improve creativity and loyalty to the organization.
- Accurate ratings improve communication between managers and employees, help them translate company objectives into individual employee goals, and encourage employee participation in achieving performance system objectives.
- There is heavy reliance on performance ratings for the selection of employees for ordinary or even fast track promotions into higher management positions. The more accurate the ratings, the more sound and reliable these important, long-term decisions are.
- Company reputation is paramount in attracting a talented and competent workforce. Rating accuracy and workplace fairness are crucial parts of the expected standard of desirable corporations.

Finally, it is important to know that creative performance is affected by four elements: power, information, knowledge, and reward. Missing one or more of these four elements affects the employees' performance. That is why we would like to expose here also some recommendations for managers who are in charge of the appraisal process in innovation (Albar, 2008):

- Rating and rewarding have a direct effect on innovation. Before evaluating the employees, their manager or team leader has to give them some power or opportunity to participate in decision-making, do their work or think in different way within the organization boundary, and give them the information and resources they need within the capacity of the organization.
- If we want employees to achieve creativity and high performance, then before evaluating them, we need to make sure that there are clear objectives that link the goals of the company with that of the employees. The work environment provided by the company should support innovation and creativity, and be enhanced by a style of management that promotes that kind of culture.
- HR has to stop forcing managers from ranking and rating employees within certain percentages and graphs. The employee's evaluation has to be positively utilized to identify the gap, and enhance and encourage high performance.
- Rewards motivate competition and stimulate creativity. However, when evaluation has bias towards some employees or is not accurate, it would kill motivation and loyalty to the organization.
- Expected reward for high effort could strengthen and, in turn, be influenced by employees' perception that the organization valued their contributions. In many cases, it is not the reward itself,

rather the perception of being valued and cared about by the organization that would ultimately encourage the incorporation of organizational membership and role status into the employee's self-identity and as a result, increase pro-social acts carried out on behalf of the organization.

- Leadership, not management, is what enhances creative performance. Managers usually manage the events and solve the problems, but it takes leaders to manage the change, make it happen, take care of problems before they happen, look for opportunities and benefit from them, and know how to stimulate and use the human resources at hand toward innovation and towards achieving the goals of the organization.

2.2.1.3 Ends

As it was previously mentioned the question to be answered here is: what ends does the organization want to achieve? We can also divide these ends in *strategic ends* (the vision) and *operational ends* (the mission of the company, targets/objectives, KSF in relation to ends and KPI's). As we can see, for the case of innovation these factors are similar to those describe in the "As is" case but have a closer relationship with the innovative activities of the company.

Strategic level

Vision

The vision for innovation encapsulates the future of what innovation will do for a company. It provides clear direction on how an organization will innovate, forms the basis for the innovation efforts, and becomes a rallying cry to inspire employees (Futurethink, 2005-10).

Operational level

Mission

Being the mission the overall goal of the organization, in the innovation context, the mission would be the definition of the innovation scope of the organization, as well as the outcomes it is trying to achieve in this aspect.

Objectives

Innovation goals pertain to internal flexibility and readiness of the company to adapt to unexpected changes in the environment. Innovation goals are often defined with respect to the development of specific new services, products, or production processes (Daft, 2003).

Bringing back the distinction of Research and Development activities, we can say that according to each activity, a goal is pursued. For instance, the primary objective of *basic and applied research* is the advancement of knowledge to improve organization's innovation capability, while the primary objective of *new product development* is the application of research to efficiently produce new or improved materials, products, processes or services (Chiesa, et al., 2009).

Key Success Factors (KSF)

Innovation is important in today's markets and can dramatically improve a company's competitive position. In management literature it is observed that innovation drives corporate success and is a strategic endeavor contributing to a firm's differentiating capacity, growth, and sustainable competitive advantage. Recent studies have investigated the key success factors and source of attaining competitive advantage through innovation […]. New concepts and approaches on innovation management have often arisen out of management practices. The management field has initiated the interest to find critical success factors without a need for theoretical foundations […] (Trienekens, et al., 2008).

KSFs are the relatively small number of truly important matters that managers should focus attention on. They represent the few "factors" that are "critical" to the "success" of the organization […] (Trienekens, et al., 2008).

The key to success for managers is to focus their limited resources on things that really make the competitive advantage or the difference between success and failure. CSFs can be ordered in typical areas […] (Trienekens, et al., 2008):

- *The industry*: each sector has a set of CSFs that are determined by the characteristics of the sector itself.
- *Competitive strategy and industry position:* each company's situation within the industry is determined by its history and current competitive advantage.
- *Environmental factors* (little control by the companies).
- *Temporal factors:* a number of areas of activity become critical for a particular period of time for a company or a sector. Either because something out of the ordinary has taken place or a unique resource is temporary available.
- *Functional management focus:* each management area has a set of CSFs associated with functional disciplines.

Additionally, KSF are also related with the type of innovation developed by the company. In the following table, some examples are given (Trienekens, et al., 2008):

INNOVATION'S TYPE	KSF EXAMPLE	CONTEXT
Product innovation	• Product Attributes • Product Assortment	Product innovation has to answer consumer demand and wishes. Product strategy is important to reach the consumer and make him recognize the right product attributes and product assortment.
Process Innovation	• Process Superiority • Top-management support and skill	Processes have to be efficient and of high quality to better answer consumer demand. To fulfill this requirement, top management must support process innovation and should have the adequate skills. If some skills are not available or inadequate, the chances for success decrease.
Marketing innovation	• Market • Company Environment	Marketing innovations are important to understand consumer demand. A new product is developed for a certain market where size, potential value and growth of the market determine if the product has possibilities to be sold. In a well perceived environment, the likelihood of success increases a lot.
Organizational Innovation	• Strategic fit • Communication/organization	No innovations can succeed if at the organizational level, there is no good communication or if the innovation does not fit the company strategy.

Table 24 KSF related with the type of innovation

Key Performance Indicators (KPI's)

As stated in Chapter 1, R&D is the creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of human, culture and society, and the use of this stock of knowledge to devise new applications.

For the case of R&D, it can be said that Key Performance Indicators should be chosen according to the company and the type of innovations that comes out from the R&D process. This means that they should be adapted to each particular case. Nevertheless, a common factor among industries and types of innovation is the fact that R&D is used for obtaining:

- Operational Excellence
- Cost Leadership
- Product/Service Differentiation
- Customer Intimacy

According to this last statement, many KPI's are designed with the intention of evaluating and controlling these factors. In table 25 some examples of KPI for R&D are enlisted, as well as its definition (KPI Library, 2004-2010):

KPI NAME	KPI DESCRIPTION	UNIT TYPE	DIRECTION
Time-to-market of changes to existing products/services	Time-to-market of changes/improvements to existing products/services. The time it takes from the time a product is envisioned or defined until it is on store shelves	Time (i.e. Days)	Minimize
Time-to-market of new products/services	The time it takes from the time a product is envisioned or defined until it is on store shelves.	Time (i.e. Days)	Minimize
R&D spend as % of revenue	Research and development activities spend as percentage of revenue.	%	
Percent R&D cost for new products	Percentage of R&D cost for new products.	%	
Product Innovation Index	Number of new, innovative, or upgraded product features distinguishable from the previous product.	Score	
% of sales from products launched previous year	Percentage of sales from products launched previous year.	%	
% dedicated resources for radical innovation	Percentage of dedicated resources (in FTE) for radical innovation.	%	
% of rejected patents	Patents rejected as percentage of total patents.	%	
Average time from idea to first patent filing	Average time (e.g. in days) from idea to first patent filing.	Time (i.e. Days)	Minimize
Research idea conversion rate	% of ideas submitted by Research that made it to a qualified portfolio Business Case with revenue commitment	%	Maximize
% of new product/service development launched on budget	Percentage of new product/service developments launched on budget	%	Maximize
Percentage of new product/service developments launched on time	Percentage of new product/service developments launched on time	%	Maximize

Average age of knowledge assets.	Average age (e.g. in days) of knowledge assets.	Time (i.e. Days)	
% of sales due to launched product/services	Percentage of sales due to product/services launched in previous period (e.g. the past year).	%	
Ratio of number of concepts to actual products	Ratio of number of concepts to actual products introduced into the market.	Ratio	
Number of ideas developed	Number of ideas developed within measurement period.	Number	
Average time-to-profitability for new product/service.	Average time-to-profitability (e.g. in months) for new product/service.	Time	Minimize

Table 25 KPI's examples for Innovation

2.2.1.4 Reporting

R&D activities in organizations concern to all the stakeholders (shareholders, customers, employees among others) as they are drivers of change and competitive advantage which will translate in future profits, better products and services, and new knowledge.

To answer the first question, who must be held accountable for control? we have found that in practice, the Balanced Scorecard framework has been also adopted in R&D activities. This demonstrates the need of having a balance between financial (tangible) and non-financial (intangible) indicators which can be classified into one of the four perspectives of the BSC.

Nonetheless, instead of the Balanced Scorecard we propose four different perspectives considering the balance between different objectives in the context of innovation:

- ***Financial perspective***: it tries to answer the question: *how much the organization contributes to shareholder added value?* This perspective contains the financial results such as profit, return on capital, cash flow, margins, income from sponsors, and cost control results.
- ***Customer perspective***: it tries to answer the question: *how much the organization contributes to the customer added value?* This perspective includes indicators related to new product development and commercialization which main goal in the short term is the application of research to efficiently produce new or improved materials, products, processes or services that satisfy customer needs. One example could be: number of forecasted customer needs implemented into new products or services.
- ***Knowledge perspective***: it tries to answer the question: *how much the organization contributes to the knowledge added value?* This perspective includes indicators related to basic and applied research

which main goal in the long term is the advancement of knowledge to improve organization's innovation capability. For example: number of inputs in the Knowledge Management System per innovation project.

- ***Innovative environment perspective***: it tries to answer the question: *how much individuals contribute to an innovative environment inside the organization?* This perspective includes indicators related to the means to reach the goals. For example: power distribution, member connectedness, coordination, trust, and communication efficiency.

Chiesa et al., (2007) summarize the characteristics of R&D indicators as follows:

	RESEARCH	DEVELOPMENT
Indicators	• Use of several indicators to measure each performance dimension • Predominance of quantitative subjective and qualitative indicators	• Use of few indicators to measure each performance dimensions • Predominance of quantitative objective indicators

Table 26 R&D PMS objectives and characteristics. Chiesa et al., 2007.

Concerning the use of the information, the literature about MCS in R&D identifies the following as the most relevant ones (Chiesa, et al., 2007):

	RESEARCH	DEVELOPMENT
Use of the information	• Motivating people • Facilitate people interaction and knowledge sharing • Stimulate learning	• Decision-making support • Reducing R&D risks • Improving R&D performance

Table 27 R&D PMS objectives and characteristics. Chiesa et al., 2007.

This arrangement suggests that the information generated by a MCS for *basic and applied research* is commonly used for social controls (soft) while the information of a MCS for *new product development* is commonly used for technical controls (hard).

2.3 MCS IN NETWORKS

One of the most important trends that will continue to shape the competitive environment is the rise of networking as a business model. The literature about Management Control Systems for Networks is very scarce given the novelty of this matter and the abstract nature of networks, yet it is becoming one of the relevant areas of performance measurement. In this section we synthesize the state of the knowledge regarding Management Control Systems for Networks and we contextualize it on the basis of our four constitutive elements (refer also to Appendix C).

2.3.1 MCS in Networks Constitutive elements

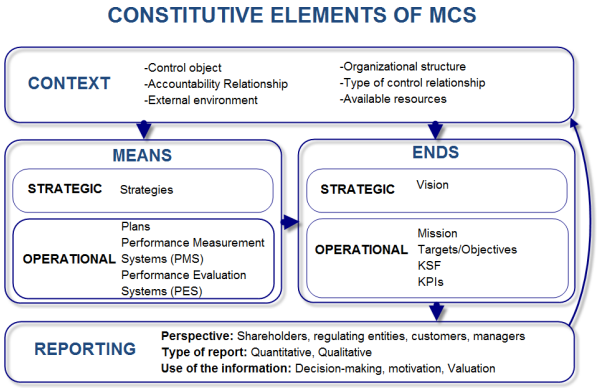

Figure 18 Constitutive elements of MCS

2.3.1.1 MCS Context

In this section we reorganize what we have found in the literature through the three questions presented before. After adapting the first question to the context of networks: what does the network want to control? there are two different perspectives from which networks can be understood:

- *Extended business processes or supply chains*: from this point of view networks are sequences of processes which transcend individual organizations (Bititci, et al., 2005) (Alfaro Saiz, et al., 2007).
- *Collaborative networks*: from this point of view networks are pools of resources which are shared by each member organization for value creation (Parung, et al., 2008) (Allee, 2008).

Considering the scope of this document, we will focus on the collaborative networks perspective. For this point of view, Allee (2008) has defined three simple elements which are necessary to map out the value exchanges across the network (see fig 19):

1. *Roles* are played by real people or participants in the network (called *actors* by Ojasalo, 2008) who provide contributions and carry out functions. *Actors* have the power to initiate action, engage in interactions, add value, and make decisions. They can be individuals; small groups or teams; business units, whole organizations; collectives, such as business webs or industry groups; communities; or even nation states.
2. *Transactions*, or *activities*[5], originate with one participant and end with another. The arrow is a directional link that represents movement and denotes the direction of what passes between two roles. Solid lines are formal contract exchanges around product and revenue, while the dashed lines depict the intangible flows of market information and benefits.
3. *Deliverables* are the actual "things" that move from one role to another (equivalent to *resources* by Ojasalo, 2008, or *value generators* by Parung and Bititci, 2008). A deliverable can be physical (e.g. a document or a table) or it can be non-physical (e.g. a message or request that is only delivered verbally). It can also be a specific type of knowledge, expertise, advice, or information about something, or a favor or benefit that is bestowed upon the recipient.

Roles, *activities*, and *resources* can be identified as sub-elements of the control object which is the collaborative network.

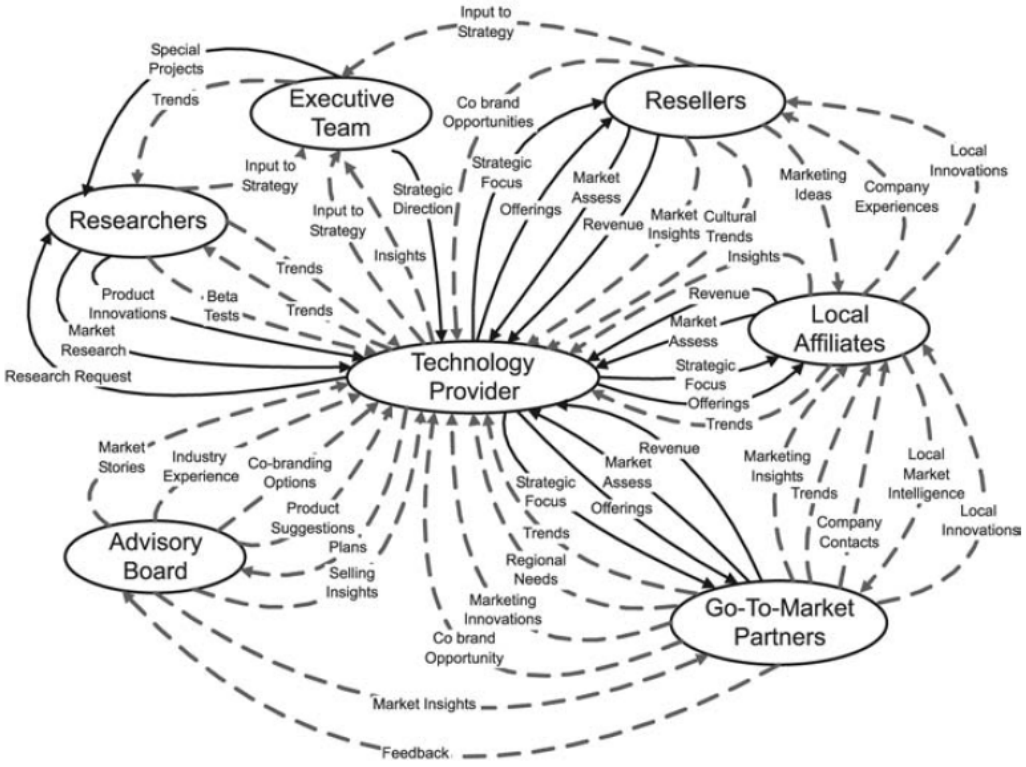

Figure 19 Example of a value network mapping. Allee (2008)

[5] Instead of using the term 'transaction' which might generate misunderstanding with regard to the 'transactional' approach to Performance Management Systems, we prefer to use the term 'activity'.

Concerning the second question (does the control object deliver value to stakeholders?) Allee (2008) has proposed to do a *value network analysis* through three basic questions:

1. Exchange analysis: What is the overall pattern of exchanges and value creation in the system as a whole? How healthy is the network and how well is it converting value?
2. Impact analysis: What impact does each value input have on the roles involved in terms of value realization? What are the activities generated by the value inputs? What are the costs, benefits and risks of these activities?
3. Value creation analysis: What is the best way to create, extend, and leverage value, either through adding value, extending value to other roles, or converting one type of value to another? What is the perceived value from the perspective of the direct recipients of each value output? What is the value (or negative value in terms of costs) that these outputs hold for industry, for society, and for the environment?

The strength of the *value network analysis* is that it identifies both tangible and intangible value added. Nevertheless, the main disadvantage is that the analysis tends to be subjective and qualitative calling for discussion and consensus among participants.

Regarding the third question (what factors affect control?) there are several factors such as the alignment of partners' objectives, the type of network or the size of the network which we have mentioned in section 1.2. Networks.

Nevertheless, we make emphasis in three factors which have more relevance for MCS: the organizational structure, the type of control relationship, and the available resources.

Organizational structure

Several authors agree in the reduction of vertical hierarchies to promote interactions among organizational employees. This is particularly important in collaborative networks where treating all network members as equals has a positive effect on trust and information sharing and facilitates the institutionalization of the MCS (Crossan, et al., 2009). Cross functional management teams with members coming from all the companies forming the network promote participation from each company and the safeguard of their particular interests.

Type of control relationship

Social/informal controls (normative control mechanisms) in collaborative networks are as relevant as technical controls (remunerative-instrumental) as a consequence of the greater reliance on trust. This means that leadership plays an important role in network management but also remuneration incentives are a secondary form of control accompanied by coercive sanctions to avoid opportunistic behaviors from network members.

Available resources

Individual organizations in a network have access to resources shared by other network partners which otherwise they may not have. For that reason, the use of resources can be optimized and the efficiency of the network can be increased. In addition, the standardization of processes and information technologies among network organizations will have an improved effect on efficiency when possible.

2.3.1.2 Means

In the context of MCS in Networks, means as constitutive element answers the question: how can a company achieve its ends? In the case of networks the question must be in plural: how can companies within a network achieve their ends? They certainly can do it through all the elements mentioned in the cases of "MCS as is" and "MCS in Innovation" such as Strategy, Plans, the Performance Measurement System (PMS) and the Performance Evaluation Systems. The only critical point here is that they must align these *Means* in relation with the common goals of the network which they belong to. They should come up with a common strategy and the plans to follow it. In addition, they should try not only to standardize their PMS's, but also their PES's.

Operational level

Performance Measurement Systems (PMS)

Since a critical point to achieve the goals, are Performance Measurement Systems common for all the members of the organization, we would like to present two different approaches:

- The Performance Measurement System for Enterprise Networks (PMS-EN) (Alfaro Saiz, et al., 2007)
- Value metrics in Collaborative Networks (Parung, et al., 2008)

The first one is mainly focused on performance measurement related to the supply chain, which is a kind of Network; hence its ideas and procedures can be similarly applied to the other types of extended enterprise networks. The second is focused on the importance of measuring the value generated by each member and in the collaborative network as a whole, which is a missing part of the first approach.

Performance Measurement System for Enterprise Networks (PMS-EN)

This approach tries to close the gaps in the existing frameworks for performance measurement in enterprise networks. The methodology is divided in three phases following a top-down approach, which tries to recreate a win/win business environment, in order to properly define both a strategic and a process framework to finally follow it up and monitor it (Alfaro Saiz, et al., 2007):

1. *Definition of strategic framework*: this phase includes philosophical planning (mission and vision), stakeholders' requirements (clients, shareholders/owners, community, employees, etc), and basic performance measurement elements (objectives, strategies, critical success factors and key performance indicators). The strategic framework is defined first to the enterprise network level and then to both the supply chain and individual level, verifying the coherence of interests among network's participants and network's levels. The model uses the Balanced Scorecard for the definition of the performance measurement perspectives (see fig 20).

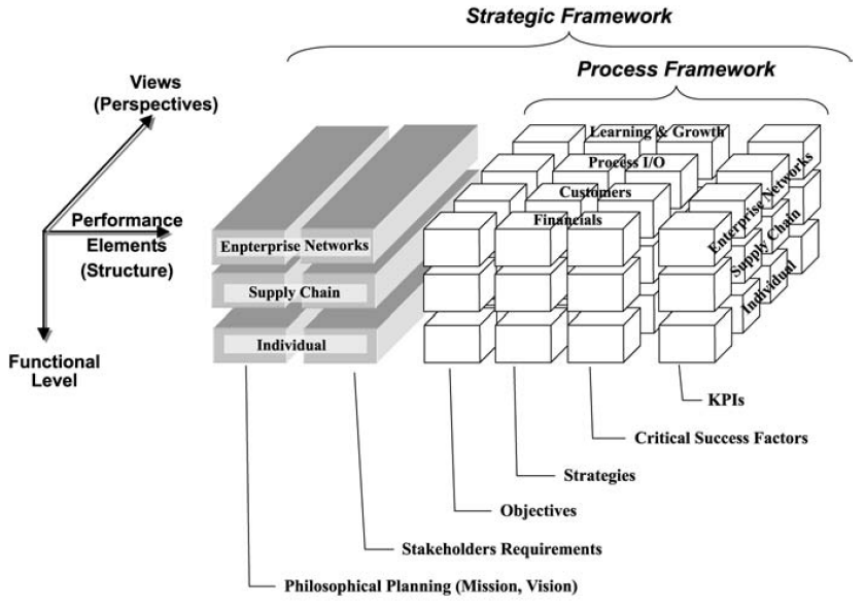

Figure 20 Phase 1. Definition of strategic framework. Alfaro, J. et al. (2007).

2. *Definition of the process framework*: this phase operates in a similar way to the last one but with all the efforts targeted at defining the basic performance measurement elements for only those business processes considered as vital from the network ambit. Following the BSC methodology, cause-effect relationship within each level's elements must be found. For a better understanding of this step, the concept of "meta-performance" is introduced: "meta-performance is the pursued performance degree to be achieved at the whole network level". It has clearly been stated the evident high importance acquired by the two essential factors commented upon by different authors within these types of network: equity and trust.

3. *Follow-up and monitoring*: this phase illustrates how such performance elements are deployed throughout the functional levels in graphical representations (see section 2.3.1.4 Reporting).

The main weakness found by the authors lays in the application of the PMS-EN framework, as it is difficult for enterprises to reach a quick and satisfactory to all parts consensus. Moreover, they depart from the assumption that trust and equity previously exist in partners' relationships and basic performance measurement elements are standard among partners, which in theory should be easy to implement but not so much in practice.

Since the previous approach does not take into account the added value generated through the collaboration among network members, the collaborative network approach is presented:

Value metrics in Collaborative Networks

We have mentioned in section 1.2 that companies within a network collaborate with each other to create and deliver more value than network partners alone through the development of close and healthy relationships. Recent literature tries to explain how individual contribution to network's success could be measured and how to ensure that each partner gain from collaboration.

For instance Parung and Bititci (2008) have proposed a model based on the idea that value creation in collaborative organizations should be a win-win-win situation for all parties concerned. The model considers the application of a process analysis tool (input–process–output) into a collaborative network and the use of three kinds of measurements with their different perspectives which might influence the success and failure of collaborative networks (see figure 21). The estimation methods heavily rely on discussion and consensus among partners.

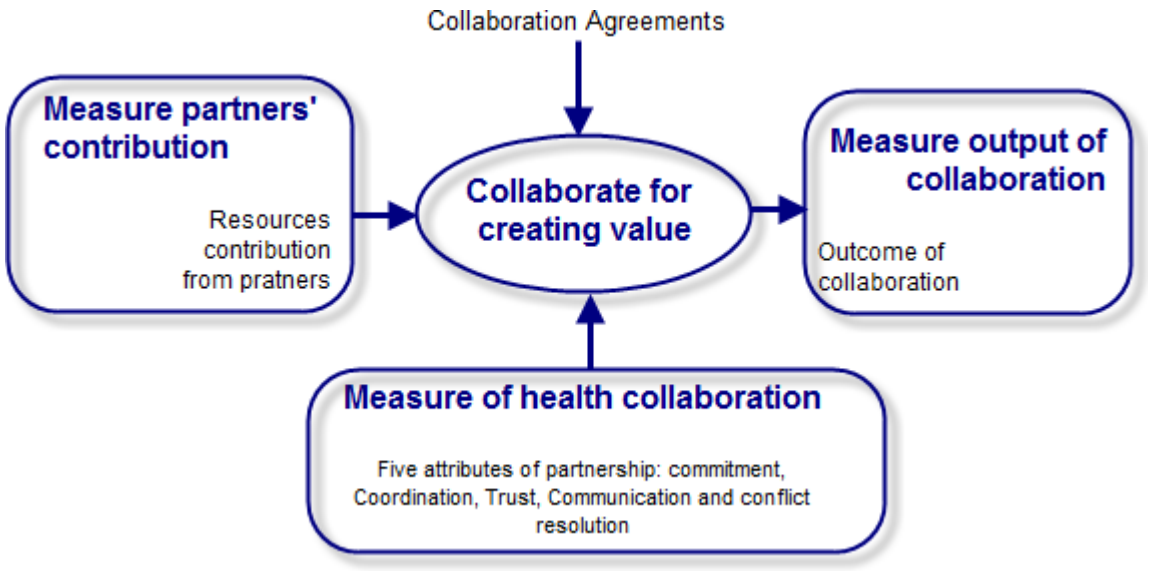

Figure 21 Model for measuring value in collaborative networks. Parung and Bititci (2008)

In the following table the three ways of measurement are explained, contrasting its different perspectives as well as their estimation methodologies (see table 28).

MEASUREMENT DIMENSIONS	PERSPECTIVES	ESTIMATION METHOD
Resources contribution from partners (also called value generators)	Financial asset Physical asset Human capital Relational capital Organizational capital	Qualitative: consensus among network partners about contribution of each factor for the collaboration project; then converted to weighted value.
Health of collaboration	Commitment Coordination Trust Communication Conflict resolution	Qualitative: consensus among network partners about the level of health of each perspective.
Outcome of collaboration	Shareholders' value Customers' value Employees' value	Quantitative: sum of the products of the value of each shared attribute in the network by its weighted value.

Table 28 Dimensions of value's measurements Parung and Bititci (2008)

As drawbacks of this model, the authors affirm that is has been proven only in one network as a case study and the positive results tend to be explained by the strong relationship among network partners.

2.3.1.3 Ends

In the particular case of networks, the *ends* should include all members of the network. Therefore, the question must be formulated as follows: what ends does the network want to achieve? Usually, the *ends* of the network are different to the *ends* of individual organizations. Each member of the network has a different vision (*strategic end)*, mission, targets/objectives, KSF in relation to ends and KPI's (*operational ends*); hence at some point they should make an effort to align them. They should look for a common goal that allows an MCS to work.

In section 1.4.1 we mentioned some types of Innovation Networks, and particularly in the sub-section of Governance Structure's dimensions we talked about two different subtypes of Networks, classified according to their managerial approaches: Rigid and Free management (Ojasalo, 2008). We also pointed out that according to this managerial style the *ends* of the network are different. That is why, for *ends* as constitutive element of MCS in Networks, this distinction is very important. Specifically for the case of Rigid Management the network exists for business purposes only, hence its *ends* are only focused on Profits. In the second case, where management is consider as Free, the network is based on actors' friendship and a common professional desire to develop new innovative products-management, therefore, *ends* can be considered as mainly personal self-fulfillment.

Additionally, we have identified one common *end* which is fundamental to motivate companies to organize themselves in Networks: to generate value not only for the network, but most important, for each member's shareholders and customers. Value is defined by Bititci et al. (2004) as the trade-off between multiple benefits (monetary and non-monetary) and sacrifices gained for stakeholders of a collaborative network organization. They have identified four different types of value transactions:

- Shareholder value – the value proposition of each member to its shareholders – this is essentially equivalent to internal value as defined in the value creation literature.
- Individual value proposition – the value proposition of each member to its end-customers. This is generally a function of each member's own competencies and capabilities, except in the case of a

cluster where members can leverage the capabilities and competencies available in the cluster to enhance their own value propositions to their customers and markets.

- Intra-network value proposition – the value proposition of each member to the overall network. Essentially this represents the value a single member adds (or contribution it makes) to the overall network. This is a function of its core competencies and capabilities.
- Network value proposition – the value proposition of the network to external markets. This is a function of the combined competencies and capabilities of the network but it may be a combination of traditional value propositions in the case of virtual and extended enterprises and a structural and infrastructural value proposition in the case of a supply chain.

Key Success Factors (KSF)

Regarding KSF in relation to ends, we can bring back what was stated on section 1.2.3 Advantages and obstacles of Networks. We mentioned that there are three obstacles that need to be overcome and which become key factors to succeed:

- Information management
- Trust
- Cost of learning

In addition, Lopez Cerdán Ripoll (1999) affirms that networks can succeed if the players have (López Cerdán Ripoll, 1999):

- Common activities or complementary ones inside a supply chain
- A clear and precise work plan supported by a business plan, which lead them to articulate:
    - The conditions for the business opportunity
    - The reasons of existence for the business opportunity
    - The launching and growing strategy
    - The most significant risks
    - The potential benefits in the short and long run
    - The financial future of the company
- An strict selection and evaluation process for the new comers
- An experienced manager capable of:
    - Closing deals with suppliers in the operative level (before 3 months)
    - Managing the new company considering the projected strengths and weaknesses foreseen by the company members (during the first 6 months)
    - Reaching the final consumer through the establishment of a commercial network (between 6^{th} and 12^{th} month)

- An established process of accompaniment and evaluation of the members to:
    - Monitor and measure the network progress (it is important to highlight that for very dynamic companies this should occur every 2 months)

Key Performance Indicators (KPI's)

Finally, to talk about KPI's for networks is not an easy task, since there are KPI's at different levels, organizational level or network level. For the KPI's at an organizational level, we can refer to the previous sections of this chapter, but if we talk about KPI's at a network level, then we must agree that they depend upon the purpose of the network. In other words, the KPI's are set according to the ends. For instance, if the end of the network is forming to develop a new medicine, then a good KPI would be Time to Market, but if the end is just reaching economies of scale, then a good KPI can be Sales growth.

In general, for Network's performance KPIs we can refer to those given by KPI Library (2004-2010) as good examples (see table 29):

KPI	KPI DESCRIPTION	UNIT TYPE	DIRECTION
Effectiveness of networking skills	This is a latest KPI in staffing and recruitment……as now a days there are less dependencies in portals and more on social networking…..this is mandatory as the recruiter or staffing professional needs to have some huge networks to source profiles and successful hiring process…..		
% of investment proposals worth setting up a meeting with	As a Network Member a company wants to receive quality deal flow. This KPI in combination with the Deal flow KPI tracks if a company receives proposals that are actually intriguing enough to pursue. If it tracks this per region, age group of entrepreneurs and business, a company gets insight where it referral networks work and where they don't work.	%	Maximize

Table 29 KPI's for Networks

2.3.1.4 Reporting

Regarding the first question proposed in the MCS "as is" (who must be held accountable for control?) several authors (Bititci, et al., 2005) (Parung, et al., 2008) suggest creating a management team at the network level with members coming from all the partner organizations in the network. This management team coordinates the MCS through consensus about the ends and means and following a win/win philosophy which tries to ensure that each partner gain from collaboration.

On the other hand, there are economic agents supporting the creation of business networks such as those proposed by López Cerdán (1999) among which we have:

- Business organizations (Chambers of commerce, business associations)
- Government institutions (national, regional or local)
- Financial organisms and banks
- Educational institutions (universities)
- Business services' centers
- Nonprofit organizations
- International organisms

These economic actors establish financial and non-financial accountability relationships becoming member organizations of the network and for this reason they must be held accountable for control. Therefore we identify three levels for reporting:

- *Business unit*: the business units (or functional areas) of the member organizations of the network.
- *Organization*: the corporate level of each member organization of the network.
- *Network*: the management team which includes members of the corporate level of each member organization.

At the network level, individuals working in cross-organizational teams (for example project teams) have a double-reporting position. They must report to their own organizations but also to the network. This situation can be problematic when the ends of the organizations and the network are not aligned. Therefore, excellent communication and documentation is the key to overcome this problem.

As in the MCS "as is", the Balanced Scorecard (Kaplan, et al., 2000) with its four perspectives is the most commonly used in the literature about networks since it brings together financial and non-

financial perspectives. Alfaro et al. (2007) in their Performance Measurement System for Enterprise Networks (PMS-EN) propose to visualize the Balanced Scorecard in an analytical and graphical way at both global and individual levels of the enterprise networks through the deployment in two types of graphical representations;

1. *Graphics of global deployment*: there will be one graph for the objectives, another for the strategies, another for the critical success factors and, finally, another for the key performance indicators (see fig 22).

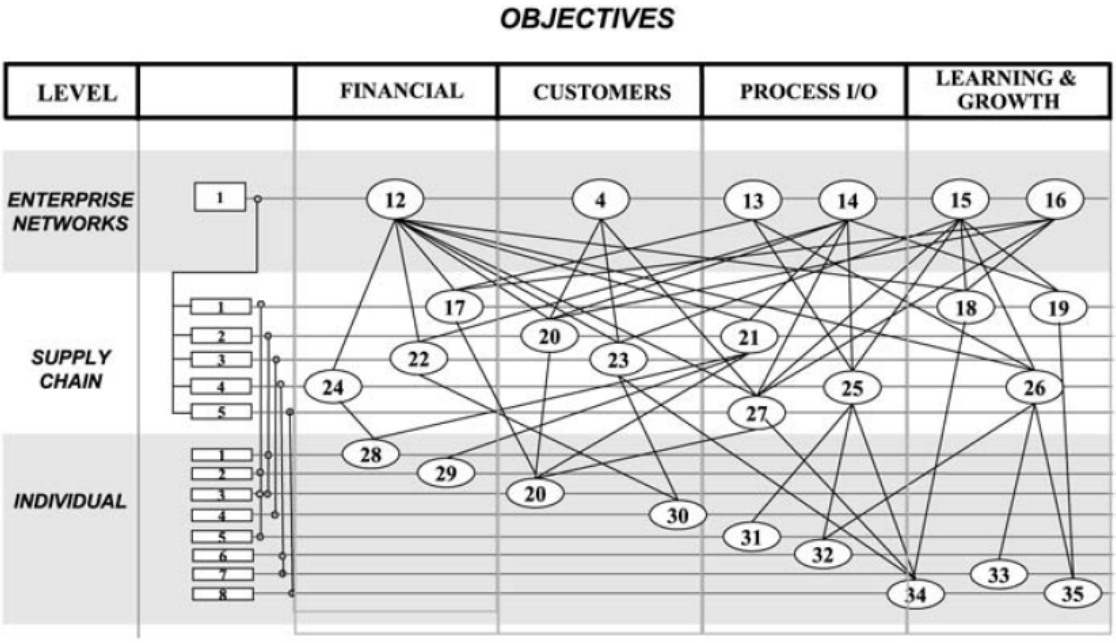

Figure 22 Example of graphics of global deployment for the different network levels

2. *Graphics of partial development*: it shows how the performance measurement elements (objectives, strategies, critical success factors and key performance indicators) are deployed, which elements participate in the generation of parameters, which parameters are the most important ones, etc.

This way of presentation of the information has more impact as the addressees of the reports can see the cause-effect relationship between the different levels. For example they can visualize the effect at the network level of the achievement of one end which was proposed for the individual level.

Concerning the second question (what use will be given to the information?), the most important use given to the information generated by the MCS in collaborative networks is motivation. Several

authors agree that trust is the most important element to foster motivation, understood here as the desirable behavior of partner's collaboration inside networks. In fact, Parung and Bititci (2008) include the "health of the collaboration" as one of the measurement dimensions of their metric for collaborative networks. This dimension includes five attributes which must be controlled to improve network's atmosphere:

- Commitment
- Coordination
- Trust
- Communication
- Conflict resolution

In addition, precise information coming from the measurement of the individual contribution of each partner organization (for example resources, core competencies, or value added) to the network's success has also impact on motivation and can be used to ensure that each partner gains from collaboration. All these attributes imply that there is a predominance of quantitative subjective and qualitative indicators.

Considering information for decision-making, the literature suggests the following uses:

- Improvement of network's effectiveness and efficiency as a whole.
- Optimization of network structure by strengthening of vital links and reconfiguration of weak ones.
- Training and development for important actors in order to develop new competences.

Regarding valuation, funding is the most important use of information. Positive results in a network can attract other organizations and investors which will have a positive impact on the value of the network and its member organizations.

3 CHAPTER: MCS IN INNOVATION NETWORKS

The literature about MCS in innovation networks is still scarce but there is a clear trend towards the formation of innovation networks to share the costs and risks of R&D activities. The amount of R&D partnerships has increased particularly in high-tech sectors and other sectors where learning and flexibility are important features of the competitive landscape (Ojasalo, 2008).

In this final chapter, we would like to bring all the concepts previously seen and propose a new framework for the MCS in Innovation networks. We will show how the constitutive elements of MCS proposed along this project, can also be applied to innovation Networks by combining the ideas and strategies done for "MCS as is", "MCS in Innovation" and "MCS in Networks". Also some new factors and models will be introduced thanks to the contribution that some authors have given to this field (refer also to Appendix D).

At the end of the chapter the reader will be able to see a complete new model about MCS in Innovation Networks; he will understand who the responsible to make it work are and how it is possible to design it, manage it, control it and evaluate its performance.

3.1 MCS Constitutive elements

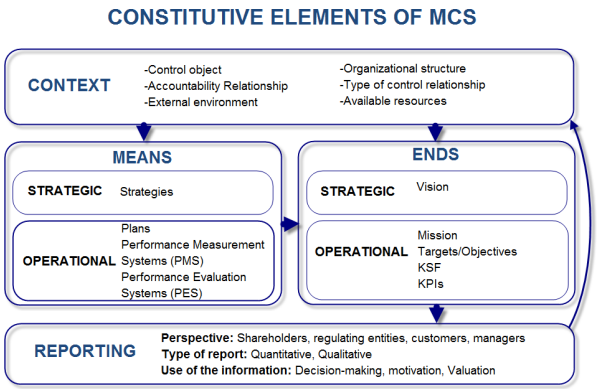

Figure 23 Constitutive elements of MCS

3.1.1 MCS Context

After adapting the first question of context for innovation questions (what does the network want to control?) two control objects arise from the two perspectives explained in section 2.3 MCS in networks:

- The innovation network understood as the value chain of three main activities: idea generation (basic and applied research), technical development (new product development) and commercialization of the innovation.
- The innovation network understood as the arrangement of three elements: roles (actors), transactions (activities), and deliverables (resources).

These perspectives can be merged into one, considering that the roles (actors) are the ones who add, extend or convert value (Daal, et al., 2009). Therefore the elements that compose the innovation network are summarized in table 30:

ELEMENTS	SUB-ELEMENTS	EXAMPLES
Actors	Idea generator	Research institutes, incubators, universities, customers, suppliers
	Technical developer	Entrepreneurs, start-ups, OEM, innovators
	Marketer	Brokers, sales agents, distributors
	Facilitators	Transport companies, venture capitalists, banks, patent offices, and consultants
Activities	Add value	To provide training to the personnel
	Extend value	To make information in a report available to other network partners
	Convert value	To publish an industry analysis to sell as a product to generate revenue
Resources	Financial assets	Cash
	Physical assets	Property, plant, equipment
	Human	Personnel knowledge, skills, education level, experience
	Relational	Distribution channels, customer relations, brand image
	Organizational	Patents, designs, systems, procedures, processes

Table 30 Elements of an innovation network

The control object in this context is the innovation network, while actors, activities and resources are elements of the control object.

Regarding the second question (does the control object deliver value to stakeholders?) value is added, extended and converted through the *activities*, understood as formal exchanges and intangible flows of *resources* among *roles* (Allee, 2008). The development and selling of a patent from a research institute to a product developer and then the finished product to a marketer is a typical example of value creation along the innovation network. Consequently, the type of value created during the early stages of *basic and applied research* is of an intangible nature while in the subsequent stages of *new product development* and *commercialization* of the innovation value becomes tangible.

For the third question (what factors affect control?) we next explain the importance of different factors:

External environment

One of the reasons for improvement of innovation in the last years is the increase in the number of R&D partnerships (Ojasalo, 2008). This kind of business cooperation creates a great opportunity for both small and big organizations to share resources, costs, and risks, but also to move forward on new types of control which transcend organizational boundaries. Moreover, the development of Information and Communication Technologies has an impact in two aspects of control:

- The increase in the speed and complexity of information-processing causes that managers are not only required to make faster decisions, but also to anticipate the market.
- New developments in ICT have led to an increasingly mobile workforce. This trend has driven the creation of virtual teams which are more difficult to control because of their physical absence.

Therefore, it is mandatory to constantly improve and update all the aspects of management in order to respond to the dynamics of environment and to maintain the competitive strength of the network.

Network structure

In section 1.4.1 we have described different types of innovation network configurations. Nevertheless, for the purpose of defining the limits of this study we will focus our attention in innovation networks with the following characteristics:

- *Free management networks*: Trust has been identified as the cohesive element which leads to a high density and intensity of contacts among partners. Nevertheless, time is needed to develop trust as in any kind of relationship. Therefore, we limit our model to free management networks in which member organizations have expressed their desire to belong and contribute to the innovation network. Those members which are not contributing will not be considered part of the network to avoid opportunistic behavior.
- *Closed networks*: Administrative factors such as network governance and the definition of cooperation policies (i.e. intellectual property rights) are important to carry out exploitation activities. Therefore we limit our model to closed networks, although with a controlled degree of exploration and openness.
- *Hub firm as a controlling actor*: Hierarchies should be avoided or minimized; however, there must be someone who has the highest authority and coordinates the activities in the whole network in a moderate way. This orchestration process is generally taken on by the network promoter, whose capacity for decision-making and supervision is limited and is subject to the consensus of partners. Moreover, networks should have a leader who is able to articulate clear and concise goals and to be able to translate those goals into a realistic plan of action.

With regard to the last point and with the aim of promoting the reduction of hierarchical levels in the innovation network while keeping a formal authority, we propose the alternative of creating a *network committee* instead of the *hub firm* as a controlling actor. The *network committee* is composed by three representatives from each member organization of the Innovation Network (i.e. if there are three member organizations, the network committee will have up to nine members). The three representatives, chosen by each organization, will play the following roles (Shani, et al., 2009):

a. *Top manager*: the person who provides vision, leadership and facilitates resources.
b. *Product champion*: supported by the top management, is the person that promotes innovation along the organization overcoming resistance to change.
c. *Technological gatekeeper*: the person with technical know-how and formal influence in different parts of the organization.

The creation of each network committee is motivated by several reasons including (Mullins, 2005):

- The variety of experience and expertise among members provides a synergetic effect which can be applied to the increasingly complex problems of modern organizations.
- It provides a feeling of identity, and the chance to acquire role recognition and status within each organization which can be used as means for the implementation of social controls.

- Group members collaborate to protect their interests from outside pressures or threats.

To avoid having a network committee with many representatives, particularly in big networks, we suggest that one person can play more than one role. This means that each member organization can have up to three representatives in the network committee. The optimization of the number of representatives will have a positive impact in the decision-making process of the network.

In addition, we also suggest that the selection of the network committee members must consider the following creative traits typical of "knowledge workers" based on Shani (2009):

a. Self-confident to promote own ideas.
b. Keep knowledge updated.
c. Risk-taker: "stay out of the comfort zone".
d. Curious.
e. Strategic thinker: "see the big picture".
f. Never satisfied: "everything can be improved".
g. Aware of changes in the environment.
h. Innovative networks promoter: people who share their ideas for feedback and support.
i. Perseverant: "innovation is 99% hard work, 1% inspiration".
j. Emotional intelligent: people with the ability to sense, understand and effectively apply the power of emotions

Type of control relationship

"How should the terms "management" and "control" be used in the context of networks and innovation? Management should be understood as a conscious attempt to define and reach the goals with certain actions as well as possible, rather than an ability to reach all the goals with 100 percent […] "Managing" and "controlling" in the context of networks do not mean total management and control, and they are not synonym for "command" and opportunistic use of coercive power". (Ojasalo, 2008). However, for innovation networks there should be a certain level of control as in the context of innovation in single organizations.

We start from the hypothesis that there should be a balance between social (normative) and technical (utilitarian) controls because of the different orientation of network members. For instance, venture capitalists tend to be profit-oriented while universities tend to be relationship-

oriented. The existence of contradictory ends and means must be seen not as a disadvantage of innovation networks but as a challenge for MCS and an opportunity to satisfy a largest group of stakeholders. In fact, innovation networks have to preserve a positive atmosphere to overcome cultural differences among partners and foster a sense of belonging and self-realization, and at the same time they have to improve efficiency and effectiveness to obtain economic benefits.

We also consider the dynamic perspective of control proposed by Chiesa et al. (2009), based on the concept of Simons' Levers of Control for which the Management Control System adopted in the innovation projects evolves along the project. It starts with more emphasis on social controls and finalizes with more emphasis on technical controls as the level of uncertainty decreases.

Available resources

One of the elements of the innovation network is the "pool" of resources shared by its member organizations. Therefore, each single organization has more resources at hand in the network than working separately. However, at the network level it is important to identify which resources (tangible and intangible) are required to lead the network towards its ends. These required resources are compared with the "pool" of resources which have been contributed by each network member to evaluate the feasibility and organization of new projects. This evaluation helps to define the scope of the research areas.

3.1.2 Means

In the context of MCS in Networks, we changed the question asked for *means* as constitutive element for: how can companies within a network achieve their ends? In the context of Innovation Network, this question is the same and also should be answered in the same terms as the cases of "MCS as is" and "MCS in Innovation". This means that we also can separate means in *strategic means*, which includes the Strategy of the Innovation Network, and *operational means*, which refers to, Plans, the Performance Measurement System (PMS) and the Performance Evaluation Systems.

Once again it should be understood in this context that all these *Means* should be aligned among network's members in relation with the common goals. A single strategy should be designed as well

as the plans to make it work. Additionally, as in the case of any Network, its members should try to standardize their PMS's, and their PES's.

Strategic level

Strategy

In Innovation Networks, the Strategy is a plan for integrating with the competitive environment to achieve particular goals, which are mainly focused on the success of Innovation Activities within the Network. The essence of formulating strategies is also done, by choosing whether the Innovation Network will perform different activities than its competitors or will execute similar activities more efficiently that its competitors do.

Operational level

Plans

A plan is any course of action used to accomplish an objective. Within the Innovation Networks plans can be:

- Structured or formal, used in conjoint projects or in business processes
- Informal or ad-hoc plans which are created by individuals, coming from the company members, in all of their common quests.

Either these plans are formal or informal, we consider that they should be designed by the coordinator of the Innovation Network, which is network Committee mentioned in the first MCS constitutive element, context (refer to section 3.1.1), and executed by the company's representatives (Top manager, Product champion and Technological gatekeeper). Some examples of good plans (formal or informal) for Innovation Networks can be taken from the study carried out by Silvia (2010) about 'integrative' leadership behaviors in public networks:

- Treating all network members as equals.
- Freely sharing information amongst network members.
- Encouraging support from different stakeholders outside the network to develop commitment and support for network processes.
- Identifying the tangible and intangible assets that each organization can share with the network.
- Communicating the decisions made at the network level to their own organizations.

- Defending the particular interests of each organization in a collaborative way with the aim of obtaining a win-win outcome.

Performance Measurement Systems (PMS)

In this section, we would like to highlight that nowadays, hardly any literature investigates performance measure and management mechanisms within networks or, more specifically, in innovation networks (Enkel, et al., 2005). Nevertheless, in our literature review we have found two approaches of models that give us an idea on how PMS for innovations Networks can be implemented.

The first Model, called *Model of Hage and Hollingsworth* (Hage, et al., 2000), suggests two concepts which aim at describing and analyzing a particular Innovation Network (The idea network[6]) The first concept is the *shape of the innovation network* and the second is the *connectedness of the members* within the Innovation Network (See table 31)

CONCEPT	DESCRIPTION
Shape of the innovation network (Hard Aspects)	It reflects the amount of research activity within the network: • Number of researchers (technologists, scientists, and higher professionals) working on a problem • Level of research expenditures from various sources (both public and private) • Distinctive kinds and quantities of outputs, whether ideas, papers, patents, machines, or quality control instruments, etc • The selection of members, their roles, the network's management, the level of research expenditure and the kind and quality of the output
Member connectedness (Soft Aspects)	Amount of communication among actors within and across members: *Note: The form of communication can vary among actors as well as the communicated outputs (e.g. scientific papers, patents, products).* • It includes elements that define the quality of the relationships within the network such as: density and integration, and transparency that influence the relationships, relationship's stability, the kind of transfer, the relationship's flexibility as well as the hierarchy, or symmetry of relationships within the network and the redundancy in relationships. • Also the network members or the management's intention and motivation; cultural aspects like trust, openness, socialization, network culture, reciprocity, and cultural diversity.

[6] Network that exist at the level of an industrial sector and market sector, and is defined as the research activities in six different functional arenas (Basic research, applied research, research on quality control and research about the commercialization and marketing of products) in which various types of innovative processes occur, and the connectedness within and among these arenas in a particular sector.

	• The transfer of people from one research group to another, both within and among organizations; • Joint research projects involving face-to-face collaboration among researchers, as distinct from long-distance collaboration • Joint publications • The strength of managerial, financial, and research ties among organizations in joint ventures • The strength of ties among actors in research consortia

Table 31 PMS elements for innovations Networks proposed in of Hage and Hollingsworth's model

Additionally to these indicators, they emphasized that the output of research on product development can be measured by the number of radical products, or by the development of radical processes such as that of new manufacturing technologies.

Second, there is another Model developed by of Ellen Enkel & Oliver Gassmann (Enkel, et al., 2005) which applied to a particular Innovation Network called EURADOS[7] and is focused on understanding the connection between results and the expected value creation of the members of an innovation network. This model also consider the two factors of the Model of Model of Hage and Hollingsworth *shape of the innovation network* and the *connectedness of the members* but it adds two more: *Funding* and *Member's home institution* (see table 32):

CONCEPT	DESCRIPTION
Funding	Funding is an important factor for measuring an innovation network's impact, because with the funding comes responsibility for goals connected to this funding.
Member's home institution	This variable describes the influence of the members' home institution on the network-related innovation outcome. Besides the direct value created by the network, like publications or methods and processes, innovation can also occur in the members' institutions when the members return and integrate the knowledge gained in the network.

Table 32 Additional PMS elements for innovations Networks proposed in of Ellen Enkel & Oliver Gassmann's model

[7] EURADOS is a European innovation network for research on radiation dosimetry. This network aims to advance the scientific understanding of ionizing radiation dosimetry to promote dosimetric methods and instruments' technical development as well as their implementation in routine dosimetry, and to ensure the consistency of the dosimetric procedures used within the EU as well as compliance with international guidelines. This network consists of 47 European organizations in 31 different countries. The member organizations range from small to big laboratories (e.g., CERN in Switzerland), or research institutions (Institute of Nuclear Physics, Poland) to governmental institutions for radiation protection (National Agency for New Technology, Energy and the Environment, Italy) to companies that produce and sell dosimetric tools (ARC Seibersdorf Research, Austria).

In our opinion these two models previously mentioned do not reflect the entire world of PMS in Innovation Networks. They pointed point out very interesting ideas about measurements performance in particular networks, but they do not solve the problem about monitoring the current value creation of the Network and its members. According to this, we next propose a model of what a PMS in Innovation Networks should include.

It is very important to point out again what was stated in section 2.1.1.2 which has even more strength regarding "knowledge workers": *inappropriate performance measures do more harm than good*. That is why, in order to design a PMS that covers all the aspects of a Network, it should include a kind of 360 degree approach to what it is needed to be measured. Being more specific we believe that to design a complete PMS, a Network should look forward to answer the following questions:

- How much network members contribute to the **knowledge added value** of the network and vice versa (long term goal).
- How much network members contribute to the **customer added value** of the network and vice versa (short term goal).
- How much network members contribute to an **innovative environment** inside the network and vice versa (means to reach the goals).
- How much network members contribute to **shareholder added value** (short/long term goal)

By answering these questions it is possible to cover not only, main critical variables to evaluate the performance of each member, but also the performance of the Innovation network as a whole.

Due to the fact that every Innovation Network is different, we cannot propose general measurements for each of the four aspects previously mentioned. In fact, every network should design targets, measurements methodologies and KPI ad hoc.

Performance Evaluation System

There are some key elements that guarantee the effectiveness of a performance appraisal system (see section 2.1.1.2) such as: clearly defined performance standards, an effective monitoring system, regular discussions of performance, and development of appropriate action plans as a consequence of the appraisal. In this section we would like to contextualize these key elements for the case of Innovation Networks:

- *Clearly defined performance standards*: in order to set standards within an innovation Networks, it is important to first, consider the differences among the company's MCS systems already implemented, and second to make a effort to make them equal or comparable for the possible evaluation, analysis and correction.
- *An effective monitoring system:* By having just one single MCS the process of monitoring the performance of all members of the innovation network, can be assessed easier.
- *Regular discussions of performance:* The members of the network should frequently evaluate and discuss all the aspects regarding their performance, so they can improve what it is not going well and keep on doing those things that are well done.
- *Development of appropriate action plans as a consequence of the appraisal:* After knowing how each member is performing, the entire network could be reconfigured in order to make it more efficient and effective. For example, if the network's management could monitor its performance, this could help to optimize its structure and activities, which would facilitate adapting to a changing environment or new challenges, thus enabling optimal impact. (Enkel, et al., 2005)

3.1.3 Ends

For the case of Innovation Networks, the question to be answered should be: what *ends* does the network want to achieve? Here, we have to consider that *ends* can be either company specific or Network as a single entity. In the second case, it is mandatory that the company members align their ends and come up with a single idea, in order to make the Network work.

Keeping in mind this agreement of ends, we can talk about ends in Innovation networks in the two different levels mentioned earlier. They are, *strategic ends (*the vision) and *operational ends (*the mission and targets/objectives, KSF in relation to ends and KPI's)

Strategic level

Vision

Although an Innovation Network is formed by many companies who have different visions, it will be necessary that the Innovation Network creates a single one. This is important due to the fact that we are developing a model for a continuous Innovation Network, and that means that it will last on time. Hence it is fundamental that the Innovation Network as a single unit has with a clear idea about what it intends to become and to achieve at some point in the future.

Operational level

Mission

The mission, as in the case of the Vision, should be designed by all the members, and should condense the overall goal for the innovation network or its reason for existence. As any normal mission it describes the innovation network's vision, its shared values and beliefs, and its reason for being.

Operative goals (Targets/Objectives)

Operative goal or targets designate the ends looked for through the processes of the innovation network and explain what it is actually trying to do. They should be set by consent among all the Innovation Network's partners and need to be flexible enough to be adapted to unexpected changes in the environment.

One can think that management and controlling innovation networks may be driven only by economic objectives, since economic realities are always present and forgetting them may lead into waste of resources and unsuccessful products. However, overemphasize short-term profits may decrease the networks' creativity and risk taking willingness which is important for successful innovation. For instance, in some networks it might be more important the personal creative self-fulfillment and freedom than profit maximization. Also, there is likely to be a numbers of other objectives which may override the profit maximization.

To better control and monitor and innovation networks, it is also important to have in mind what are the goals expected from the network, and then to focus on which are the aspects related to obtain that goal. Jaafari and Manivong (2000) proposed that the management process within a network may include emphasis on hard or soft aspects, or a combination of both, depending on the case under consideration. They suggested that, when the innovation network's primary goal is in profit maximization (profits oriented), particularly in the short-term, then the emphasis should be in the management of hard aspects. In contrast, if the short-term profit maximization does not have the highest priority (relationship oriented), the emphasis may be on the management of soft aspects. However, if the emphasis is on management of hard aspects, the importance of management of soft aspects should also be recognized, and vice versa (see table 33).

PRIMARY GOAL	EMPHASIS ON MANAGEMENT PROCESS NEEDED
Profit maximization **(In the short run)**	Hard Aspects • Budgeting • Risk management • Control plans
Others	Soft Aspects • Team management • Communication management • Human and industrial relations management

Table 33 Management emphasis according to primary goal of the Innovation Network

Besides profit maximization (either in the long or in the short run) there is an important and common goal mentioned before in the case of "MCS in networks", which is also applied in Innovation Networks: generate value not only for the network, but most important, for each member's shareholders and customers. Therefore, we revisit the different types of value defined by Bititci et al (2004): Shareholders value, Individual Value Proposition, Intra-Network Value Proposition and Network value proposition.

In addition, there is something that we would like to highlight regarding to how to set targets for an Innovation Network. It is known that the level of uncertainty increases in industries with high levels of innovation forcing top managers to focus more in the future in order to anticipate. Forecasting is becoming a key support process which can lead to a better decision-making, planning and control. That is why we consider that setting targets should be done not only by looking at past performance or benchmarking, but also, and more important, by forecasting future performance of the network.

Key Success Factors (KSF)

KSF are those important aspects or activities required for ensuring the success of the Innovation Network. They should be chosen according to the characteristics of the network and gather all the factors that will guarantee the achievement of the ends established by the members.

Some examples of KSF for innovation networks can be found in the study conducted by Rampersad et al. (2009) about the key factors that lead to effectiveness in an innovation network:

- Power distribution is important; players should facilitate a balanced atmosphere by refraining from abuses of power or uses of intimidation strategies which may undermine network relationships.
- In cases where an organization is the coordinating body, it should apply moderate, but not rigid, coordination to ensure understanding and harness the input of all collaborators to facilitate synchronization.
- To foster a harmonious environment, business participants should appreciate the necessity of being actively involved and of becoming engaged with their research partners in networks from the beginning. This would allow them not only to be able to initiate projects, and become proactive since early phases when research agenda are set, but also to easily assimilate ensuing network outcomes.
- Adequate negotiation training may also be useful or even fundamental for all network participants for ensuring that healthy give-and-take practices are used among them, that opinions are well articulated and that promised outcomes are achieved.
- Trust is a critical element in network success, and therefore, participants should engage in trustworthy practices, such as, keeping promises, exhibiting frankness and candor and demonstrating integrity.
- Communication efficiency could be encouraged by addressing transparency via the public availability of information without compromising patents; credibility via formalized channels in accessible language; and secrecy by taking adequate steps for managing intellectual property.

Rampersad et al. (2009) conclude that in order to promote efficiency, collaborators should be selected based on their value contribution rather than their political affiliation. Additionally, it is worth to mention the KSF proposed by Parung and Bititci (2008) in their model of Value metrics in Collaborative Networks (refer to section 2.3.1.2), who state that the KSF which lead to effectiveness are related to those used by them to measure the health of relationships in collaborative networks (Commitment, Coordination, Trust, Communication, Conflict resolution), while the KSF which promote efficiency are those used as input for their model (Financial assets, Physical assets, Human capital, Relational capital, Organizational capital).

One last KSF we want to highlight is the power of anticipating or forecasting what are the actors, activities and resources that the network will need to reach ends. The innovation network should anticipate technologies, competencies (i.e. knowledge, abilities and skills) and customer needs by focusing on emerging trends, with the aim of maintaining a balanced portfolio of technologies and/or competencies coming from all the participants.

Finally, although all these KSF are important, we believe that the other KSF mentioned in previous sections can also be applied to Innovation Networks. For instance the ones in section 1.4.2:

- The network should have clear needs and have the objectives that really reflect the needs of the members
- Networks should have a leader who is able to articulate clear and concise goals and to be able to translate those goals into a realistic plan of action
- the successful development of networks is dependent on the level of trust between member organizations
- …

Key Performance Indicators (KPI's)

KPIs should reflect the organization or the Network's goals, they must be key to its success, and they must be measurable. Additionally they directly depend upon the purpose of the organization or network (Profit Oriented or Relationship Oriented).

To give examples of good KPI's we believe that many of the KPI's mentioned in earlier sections are can be applied to Innovation Networks, as well. For example:

- Time-to-market of new products/services
- R&D spend as % of revenue
- Product Innovation Index
- % dedicated resources for radical innovation
- Average time from idea to first patent filing
- Research idea conversion rate
- Percentage of new product/service developments launched on time
- % of sales due to launched product/services
- Ratio of number of concepts to actual products
- Number of ideas developed
- Average time-to-profitability for new product/service.
- Effectiveness of networking skills
- Number of researchers (technologists, scientists, and higher professionals) working on a problem
- The transfer of people from one research group to another, both within and among organizations;
- Joint research projects involving face-to-face collaboration among researchers, as distinct from long-distance collaboration
- Joint publications
- The strength of managerial, financial, and research ties among organizations in joint ventures
- The strength of ties among actors in research consortia
- …

3.1.4 Reporting

To answer the first question of context, who must be held accountable for control? we consider the network structure as we did for networks. Individuals and teams have to report to their business units and business units to their organization. In the case of cross-organizational teams, individuals are required to report to both their own organization and the network committee. The levels for reporting are the same as for networks:

- *Business unit*: in the context of innovation networks we mainly refer to Research and Development units, and Sales and Marketing units.
- *Organization*: the corporate level of each member organization of the innovation network.
- *Network*: the network committee which includes members of the corporate level of each member organization, but also product champions and technological gatekeepers.

Nonetheless, instead of the Balanced Scorecard we propose four different perspectives (as we did for the context of innovation) considering the balance between different objectives in the context of innovation networks:

- ***Financial perspective***: it tries to answer the question: *how much network members contribute to shareholder added, extended, and converted value?* This perspective contains the financial results such as profit, return on capital, cash flow, margins, income from sponsors, and cost control results.
- ***Customer perspective***: it tries to answer the question: *how much member organizations contribute to the customer added, extended, and converted value of the network and vice versa?* This perspective includes indicators related to new product development and commercialization which main goal in the short term is the application of research to efficiently produce new or improved materials, products, processes or services that satisfy customer needs. One example could be: number of forecasted customer needs implemented into new products or services.
- ***Knowledge perspective***: it tries to answer the question: *how much member organizations contribute to the knowledge added, extended, and converted value of the network and vice versa?* This perspective includes indicators related to basic and applied research which main goal in the long term is the advancement of knowledge to improve organization's innovation capability. For example: number of inputs in the Knowledge Management System per innovation project.
- ***Innovative environment perspective***: it tries to answer the question: *how much network members contribute to an innovative environment inside the network and vice versa?* This perspective includes indicators related to the means to reach the goals. For example: power distribution, member connectedness, coordination, trust, and communication efficiency.

For the presentation of reports is very important to identify the recipient. The report must be adapted to the required type of information (qualitative/quantitative) and must be presented by a spokesperson which in this context must belong to the network committee.

Concerning the second question, what use will be given to the information? the answer is the same that we gave for networks:

- Information for motivation
- Information for decision-making
- Information for company valuation

With regard to the information for motivation, we draw attention to the importance of feedback as a vital ingredient of the communication process. Positive feedback on good performance is a strong motivator, but also constructive criticism. Moreover, “knowledge workers” have the need of clear and unambiguous feedback as they tend always to be moving on to something a little more challenging and they prefer personal responsibility for performance (Mullins, 2005). This can be extended at the innovation network level, as we are talking about knowledge, and conclude that each organization needs feedback to take responsibility on the corrective actions that must take place to improve performance.

Finally, we mention some advantages and disadvantages derived from the use of shared information in MCS for networks:

- The advantages include economies of scale and the network effect. Economies of scale can be reached inside networks by having a centralized and standardized MCS when possible. Hence, the costs of the system are divided among the network members. On the other hand, the network effect is created when more organizations join to the network. The value of the network is increased due to a reduction of the risk which is a consequence of the increase of interactions and collaboration. Knowledge is an intangible resource which increases its value and quality when more people use it.
- Disadvantages may arise in closed networks when the cost of opportunity of the absence of partners who can contribute more resources is higher than the value generated by the network. Also congestion of the communication among members and difficulty in consensus play against networks.

4 CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

This work has touched interesting topics which are worth to be mentioned. From the beginning to the end several definitions have been proposed and the most important: we have built a general framework of Management Control Systems that can be applied to the particular context of innovation networks to better manage and control the innovation process.

In chapter one, we defined the terms Innovation, Networks and Innovation Networks, to make the reader familiar with the concepts used later on. *Innovation* can be either an event or a process, and it gathers all types of activities where people and organizations are flexible enough to change themselves and the environment, in order to commercialize a newly developed product or introduce a new practice. We also defined *Networks* as strategic alliances between independent firms, related by vertical or horizontal agreements that jointly define a strategy to achieve certain common goals in the medium and long term, focused on the development of the competitiveness of each member. One important aspect is the fact that in networks value is co-produced. In fact, the total value created in the network depended directly on how well partners' objectives are aligned to each other and on the commitment of the partners to invest in complementary assets. Three obstacles were pointed out, which need to be overcome and which become key factors to succeed: Information management, Trust and Cost of learning. Finally, *Innovation Networks* were seen as part of the Open innovation concept at an inter-organizational level, which are all forms of organizations that serve the exchange of information, knowledge and resources and by suitable learning among at least three partners help to bring about innovation. They are based on confidence and stable cooperation relations.

In chapter two, Management Control Systems (MCS) was defined as a concise representation of the accountability relationships among the different stakeholders of an organization with their particular interests which attempts to ensure that common *ends* are achieved and predefined *means* are used to attain these ends. Additionally, a MCS should be flexible enough to be adapted for measuring and controlling performance in particular *contexts* and it must give clear and accurate data. It should allow reporting results to the entities involved, so corrective actions can be executed.

The last definition helped us to identify four constitutive elements, which are the hearth of a new MCS framework that covers the entire company, its external and internal environment, its plans and activities, and more important its goals. They are: Context, Means, Ends and Reporting (in table 34 a summary of these constitutive elements is given).

MCS constitutive elements	DEFINITION	QUESTION	SUB-ELEMENTS
Context	The first constitutive element, the *Context*, refers to the identification of the control object and the factors that influence the definition of the other constitutive elements of the MCS	• What does the organization want to control? • Does the control object deliver value to stakeholders? • What factors affect control?	• Control object • Accountability relationship • External environment • Organizational structure • Type of control relationship • Available resources
Means	The second constitutive element refers to the Means or the strategies, plans, Performance Measurement Systems (PMS) and Performance Evaluations Systems, which are used to reach the ends.	• How can the organization achieve the ends?	**Strategic:** • The strategies **Operational:** • Plans • The performance measurement system (PMS) • The performance evaluation systems (PES)
Ends	The third constitutive element of our model is based on the accomplishment of outcomes or Ends which include corporate vision, mission, targets/objectives, key success factors (KSF) and quantitative and qualitative key performance indicators (KPIs).	• What ends does the organization want to achieve?	**Strategic:** • The vision **Operational:** • The mission • Targets/objectives • KSF in relation to ends • KPI's
Reporting	Finally, the Reporting refers to the identification of the recipients of the information generated by the MCS and the use that they will give to this information.	• Who must be held accountable for control and how? • What use will be given to the information?	• Perspectives • Type of report • Decision-making • Motivation • Company valuation

Table 34 MCS constitutive elements in detail

With regard to the hypothesis of the thesis: Is it possible to design a general framework of Management Control Systems that can be applied to the particular context of innovation networks to better manage and control the innovation process? We conclude that the design and implementation of a framework of MCS in the context of innovation networks will be determined by the existing accountability relationships between parts which can be of two kinds: normative (social) or utilitarian (technical). These two approaches lead to two different types of MCS: Relational and Transactional (Broadbent, et al., 2009). In practice, the resulting MCS will lie in the middle having a combination of these two perspectives (in table 35, the two types of MCS are presented). We believe that these results are potentially generalizable to any MCS context independently from the control object.

MCS constitutive elements	Predominant sub-elements	Type of MCS	
		Relational (Soft)	Transactional (Hard)
Context	**Control object:** Innovation Network Innovation network	**Relationship-oriented:** Research unit Collaborative network Free management networks	**Profit-oriented:** Development/Commercial units Extended enterprise Rigid management networks
	Value delivered	Intangible	Tangible
	External environment	Coopetitive environment	Competitive environment
	Type of organizational/ network structure	Horizontal (reflexive)	Vertical (legal-rational)
	Type of control relationship	Normative (social)	Utilitarian (technical)
	Resources	Human, Relational and Organizational capital	Financial and Physical assets
Means	Strategic	Strategies (relationship-oriented)	Strategies (profit-oriented)
	Operational	Integrative leadership and motivation theories	Rewards/penalties
Ends	Strategic	Vision (relationship-oriented)	Vision (profit-oriented)
	Operational	Motivation, personal-fulfillment, and value generation	Efficiency, effectiveness, and value generation
Reporting	Type of recipient	Stakeholders	Sub-group of stakeholders (shareholders)
	Type of report	Qualitative	Quantitative
	Use of information	Decision-making (consensus among stakeholders) and Motivation	Decision-making (consensus among shareholders) and Company valuation

Table 35 Types of MCS for innovation networks

In chapter three, we have confirmed what several scholars affirm: there is a gap between the existing MCS literature and the new ways of organizing at the individual and organizational level. This is particularly evident for innovation networks where the speed of technological development facilitates the creation of virtual teams and organizations that are more difficult to manage and control.

When the MCS is applied to innovation, the most relevant aspects concern the existence of two types of control objects: the Research unit and the Development and Commercialization units. The difference in the ends influences the means of the MCS since in the first case the existence of collaborative relationships among individuals are crucial to create new knowledge. In other words the MCS should be relationship oriented and interactions among members must be managed and controlled. For the Development and Commercialization units the ends of the MCS are profit oriented, therefore management and control should be implemented on economic aspects and employee behavior must be adjusted by the use of rewards and penalties.

When the MCS is applied to Networks, three main challenges are presented: The first one refers to the alignment of the goals and standards of partners during the implementation of the MCS. The second one refers to the measurement of the value created by the network and its allocation to each partner organization. And the third one refers to the designation of a figure with authority (for instance the network committee) to make decisions and coordinate activities in the network without having a vertical network structure.

When the MCS is applied to Innovation Networks, ideas coming from the previous contexts were combined and applied to this particular type of network. We highlight the relevance of two hot topics: Forecasting and Trust. Forecasting as a key support process which can lead to a better decision-making, planning and control, and Trust is a fundamental pillar for the successful collaboration among members.

Finally, we can point out two directions for future research. First of all, the main limitation of this thesis is the lack of validation with empirical information. Therefore, future research could be centered in the verification of the proposed framework through case studies not only in innovation networks but also in business networks and innovation-focused organizations. Special attention should be paid to the selection of both, organizations and networks with a preference to normative

controls and organizations and networks with a preference to utilitarian controls. Moreover, the framework could be generalized to any kind of organization to test the reliability of the proposed constitutive elements.

Another important direction refers to the context and particularly to the factors that affect control in innovation networks. We believe that the external environment affects the type of MCS as we suggested in table 35. Our hypothesis is that organizations in a "coopetitive" environment, i.e. competitors that collaborate with each other to share resources and risks, are more likely to develop a relational type of MCS. On the other hand, organizations in a competitive environment with no collaboration will tend to develop a transactional type of MCS.

5 APPENDIXES

APENDIX A. Constitutive Elements of MCS "as is"

C.E	Questions	Sub-elements		MCS AS IS
CONTEXT	What does the organization/network want to control?	Control object		Organization, business unit, business process, team, individual
	Does the control object deliver value to stakeholders?	Accountability relationship		Financial (tangible) transfer and intangible transfer
	What factors affect control?	External environment		Industry, competitors, regulations, technologies
		Organizational/network structure		Vertical, horizontal or mixed
		Type of control relationship		Normative (social), utilitarian (technical) or mixed
		Available resources		Financial assets, physical assets, Human capital, Relational capital, Organizational capital (Tangibles and intangibles)
MEANS	How can the organization/network achieve the ends?	Strategic	Strategies	Integration with the competitive environment to achieve organizational goals
		Operational	Plans	Procedures used to achieve an objective They can be formal or informal
			Performance Measurement System (PMS)	Measurement systems used to evaluate how well a company is using its resources to achieve its goals It includes Strategic, Operational, Specific, Behavioral, Confidence and Ethical indicators
			Performance Evaluation Systems (PES)	Also called formal performance appraisal process The key elements: clearly defined performance standards, an effective monitoring system, regular discussions of performance, development of appropriate action plans as a consequence of the appraisal. It includes the reward system and the Penalty system
ENDS	What ends does the organization/network want to achieve?	strategic	Vision	It summarizes what the organization intends to become and to achieve at some point in the future
		operational	Mission	It is the overall goal for an organization or the enterprise's reason for existence It describes the organization's vision, its shared values and beliefs, and its reason for being
			Targets/objectives	They designate the ends sought through the actual operative procedures of the organization and explain what the organization is actually trying to do. Operative goals describe specific measurable outcomes and are often concerned with the short run
			KSF	They are those important aspects or activities required for ensuring the success of a project or an organization.
			KPI's	They are quantifiable measurements, agreed to beforehand, that reflect the critical success factors of a company, department, project. They can be financial and non-financial metrics and usually they are long-term oriented.
REPORTING	Who must be held accountable for control and how?	Perspectives		Financial, customer, processes and learning
		Type of report		Quantitative, qualitative or mixed
	What use will be given to the information?	Decision-making		Resource allocation, budget management, improvement, corrective actions, among others.
		Motivation		Rewards (money, promotion, recognition), dividends, discounts
		Valuation		Stock issue, market value, fund raising

APENDIX B. Constitutive Elements of MCS in Innovation

C.E	Questions	Sub-elements		MCS IN INNOVATION
CONTEXT	What does the organization/network want to control?	Control object		Research unit, development unit, Marketing&Sales unit, project team, individual
	Does the control object deliver value to stakeholders?	Accountability relationship		Intangible transfer on R&D and Financial (tangible) transfer on Comercialization
	What factors affect control?	External environment		Sector of activity in which the firm operates (Speed of technology development)
		Organizational/network structure		Horizontal for freedom in research Efficient structure for development
		Type of control relationship		Social (normative) for research Technical (utilitarian) for development and commercialization
		Available resources		Financial assets, physical assets, Human capital, Relational capital, Organizational capital (Tangibles and intangibles)
MEANS	How can the organization/network achieve the ends?	Strategic	Strategies	Innovation is a strategy itself It is related to the way a company can challenge the existing methods within an industry to create customer value in order to meet newly emerging customer needs, add additional value, and create new markets and new customer groups.
		Operational	Plans	Plans for Innovation can be all the procedures used to achieve a desired level of innovation within a company.
			Performance Measurement System (PMS)	Measurement of R&D as main driver of the innovation process (basic and applied research or new product development and commercialization) Presence of intangible assets and how to valuating them
			Performance Evaluation Systems (PES)	Measurement of the creative performance of a company's business, due to its innovative processes, its new product developments, its employees, etc. (Individuals as key drivers) It should include multi-objective focus based on economic indicators, technical level, and social benefits.
ENDS	What ends does the organization/network want to achieve?	strategic	Vision	It encapsulates the future of what innovation will do for a company
		operational	Mission	It is the definition of the innovation scope of the organization, as well as the outcomes it is trying to achieve in this aspect.
			Targets/objectives	They pertain to internal flexibility and readiness of the company to adapt to unexpected changes in the environment. They are often defined with respect to the development of specific new services, products, or production processes Different for Research and Development
			KSF	They are a relatively small number of truly important matters that managers should focus attention on to improve a company's competitive position thanks to innovation They are related with the type of innovation developed by the company
			KPI's	They should be chosen according to the company and the type of innovation
REPORTING	Who must be held accountable for control and how?	Perspectives		Financial, customer, knowledge and Innovative Environment
		Type of report		Several qualitative and quantitative for research, few quantitative for development and commercialization
	What use will be given to the information?	Decision-making		Resource allocation, investment, improvement of R&D performance. corrective actions, among others.
		Motivation		Rewards (money, promotion, recognition), increase knowledge sharing and communication, stimulate learning (mostly for research)
		Valuation		Stock issue, market value, fund raising

APENDIX C. Constitutive Elements of MCS in Networks

C.E	Questions	Sub-elements		MCS IN NETWORKS
CONTEXT	What does the organization/network want to control?	Control object		Collaborative network or Extended enterprise
	Does the control object deliver value to stakeholders?	Accountability relationship		Financial (tangible) transfer and Intangible transfer (Value Network Analysis)
	What factors affect control?	External environment		Industry, competitors (coopetition and competition), regulations, technologies
		Organizational/network structure		Horizontal to promote trust, information sharing, and institutionalization of MCS among partners (coordinating authority)
		Type of control relationship		Balance between social and technical controls
		Available resources		Shared resources (tangible and intangible)
MEANS	How can the organization/network achieve the ends?	Strategic	Strategies	Common strategies designed by consensus of all members
		Operational	Plans	They should be designed to achieve the common goals of the Network
			Performance Measurement System (PMS)	They should be standarized to all members of the network They should be focused not only on measuring the performance, but also on measuring the value generated by each member and the network as a whole
			Performance Evaluation Systems (PES)	They should be common and fair to all members
ENDS	What ends does the organization/network want to achieve?	strategic	Vision	It is what the network intends to become and to achieve in a pre-stablished future
		operational	Mission	Members should look for a common goal that allows an MCS to work, that means having just one mission or end: profit maximization or self-fulfillment and value generation.
			Targets/objectives	They should be set according to the type of end the Network wants to achieve: profits, self-fulfillment or value
			KSF	They are mainly aim to overcome Information management and Trust problems, as well as diminishing the cost of learning
			KPI's	According to the ends are the KPI's and they can be implemented at different levels: Individual, Team, Organizational or network level
REPORTING	Who must be held accountable for control and how?	Perspectives		Financial, customer, processes and learning
		Type of report		Quantitative, qualitative or mixed
	What use will be given to the information?	Decision-making		Improvement of efficiency and effectiveness, optimization of network structure, training and development
		Motivation		Positive atmosphere (Commitment, Coordination, Trust, Communication, Conflict resolution)
		Valuation		Fund raising

APENDIX D. Constitutive Elements of MCS in Innovation Networks

C.E	Questions	Sub-elements		MCS IN INNOVATION NETWORKS
CONTEXT	What does the organization/network want to control?	Control object		Innovation network (free or rigid management)
	Does the control object deliver value to stakeholders?	Accountability relationship		Financial (tangible) transfer and Intangible transfer (Value Network Analysis)
	What factors affect control?	External environment		Industry, competitors (coopetition and competition), regulations, technologies (development of ICT: speed, complexity, virtual teams/organizations)
		Organizational/network structure		Horizontal to promote trust, information sharing, and institutionalization of MCS among partners (coordinating authority) Variable (integrated vs loosely-coupled, project vs continuos, transaction cost vs social capital vs hub firm, rigid vs free, concurrent vs sequential)
		Type of control relationship		Balance between social and technical controls
		Available resources		Shared resources (tangible and intangible)
MEANS	How can the organization/network achieve the ends?	Strategic	Strategies	Plan for integrating with the competitive environment to achieve particular goals, which are mainly focused on the success of Innovation Activities within the Network
		Operational	Plans	They are the actions made to achieve the Innovation Network Goals They are designed by the coordinator of the Innovation Network, which is network Committee, to guarantee a consensus from all the members
			Performance Measurement System (PMS)	It is a measurement system that should measure aspects like the shape of the network, the conecteness of its member, and the value contribution of each member (shareholder, customer, knowledge, innovative environment perspectives)
			Performance Evaluation Systems (PES)	As in the case of Networks they should be fair a common to all members
ENDS	What ends does the organization/network want to achieve?	strategic	Vision	It is the single idea about what the innovation network wants to achieve in the future
		operational	Mission	Members should look for a common goal that allows an MCS to work, that means having just one mission or end: profit maximization or self-fulfillment and value generation.
			Targets/objectives	They designate the ends looked for through the processes of the innovation network and explain what it is actually trying to do. They should be set by consent among all the Innovation Network's partners and need to be flexible enough to be adapted to unexpected changes in the environment.
			KSF	They should be chosen according to the characteristics of the network and gather all the factors that will guarantee the achievement of the ends established by the members. They can be Motivation, Efficiency, or Effectiveness oriented
			KPI's	They can be applied at different leves as in the case of Networks, and directly depend upon the purpose of the organization or network (Profit Oriented or Relationship Oriented).
REPORTING	Who must be held accountable for control and how?	Perspectives		Financial, customer, knowledge and Innovative Environment
		Type of report		Several qualitative and quantitative for research, few quantitative for development and commercialization
	What use will be given to the information?	Decision-making		improvement of efficiency and effectiveness, optimization of network structure, training and development
		Motivation		Feedback (partner contribution), positive atmosphere (Commitment, Coordination, Trust, Communication, Conflict resolution)
		Valuation		Fund raising

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