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Outsourcing and Network for developing innovation

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Ai miei genitori,

la mia forza, la mia vita!

Ai miei amici,

sempre vicini nei momenti più importanti.

SUMMARY

CHAPTER THREE

ABSTRACT

In recent years globalization, network strategies and outsourcing significantly modified the production organization of many industries. In particular, the automotive industry saw a process of vertical dis-integration, allowing automakers to take advantage from the global value chain path, especially through (i) a global relocation of their "non-core activities", (ii) the access to external competencies and resources, (iii) the exchange of knowledge and competencies.

However, the organizational re-configuration in the supply-chain mainly had a strong impact over suppliers in terms of requested knowledge, competencies and ability to forecast, by anticipating carmakers' specifications mainly by devising increasingly innovative technological solutions. This paper examines four research questions: *1) how governance mechanisms help to overcome innovation development obstacles, 2) the correlation between organizational management of collaboration and consequent goals 3) the relation between R&D activities and supply chain position, and 4) how R&D activities support innovation purposes.*

The first two points of the schedule above discuss about the critical role of collaboration, its governance aspects and how it supports innovation development; while the other two investigate about R&D activities, their efficacy for generating innovative products/services and the critical role covered by suppliers in developing these activities. The empirical analysis is based on data accessed from the research project "SMEs' competitiveness and innovation through inter-organizational networks in the automotive industry" led by Zirpoli, Moretti, and supported by CAMI and Anfia - through the

administration of an online questionnaire to a sample of 313 Italian automotive suppliers from June to September 2014. The results indicate that in terms of collaboration the level of organizational management between partners tends to increase when the interests in developing new R&D projects, in sharing production processes and in acquiring new resource tend to be higher; on the other hand, when the costs for being innovative, also affected by lack of information and volatile demand for innovative products or services, tend to increase, even the level of trust in partnership tends to improve.

Speaking of innovation, the filing of patents is positively related to an higher percentage of employees working in R&D and to improved logistics systems, supply systems and distribution systems, but it suffers as the supply chain position tends to be lower. In fact, statistical evidence also proves who holds another position in the supply chain tends to file more patents, by introducing new and/or upgraded products and by introducing new or improving its production processes.

CHAPTER ONE

1) THE PROCESS OF GLOBALIZATION

Globalization can be defined as a process of growth and integration between different societies and cultures; it is a complex phenomenon that results from the interaction between different areas: economic, political, cultural, social, environmental and so on. There is no single definition of globalization: according to Dicken (1998), globalization implies functional integration between international dispersed activities. Globalization has led to the internationalization of markets (Valdani and Bertoli, 2006), thanks to that the relationship between business and environment has deeply changed and modified every aspect of strategic orientation, in order to face a new enlarged competition. The meaning of the words 'globalization' and 'internationalization' are often confused.

Nowadays everybody lives in a globalized world, where boundaries, limits and the consequences of this phenomena are not always so obvious and homogeneous (Grandinetti and Rullani, 1996). The terms 'global' and 'international' are erroneously assimilated, although postpone a profoundly different concepts: the latter refers to geographic spread of economic activities across national boundaries.

Thus, in this view, internationalization is not simply linked to the export activity, but it is a process that includes the geographic deployment of the entire productive chain. In the new competitive landscape, companies operating solely within the individual national markets have limited prospects of growth and they are likely to suffer foreign competitors invasion. However, this problem also affects businesses that are opened to international

markets merely with export purposes, while international companies can gain a mature, global presence thanks to capital possessed, increased experiences (Waldman, 1978) and financial ability able to absorb losses arising from international operations (Williams, 1991). During the ‘90s, international operations undertaken by a minority of enterprises became more and more common activities among larger companies (Dawson, 1994). At the same time, most of the operations have been spread among developed economies, in order to sustain competitiveness.

Thus, functional integration between internationally dispersed activities became not only an option, but a necessity (Akehurst and Alexander, 1995).

For both, larger and smaller companies, the international business literature (McDougall and Oviatt, 2000) has contributed in providing a better understanding about what really influence this crucial process and the key role played by entrepreneur or/and management during the critical phases of international development. Moreover, important to remember is that small businesses are not the shortened version of big companies, but, they have to deal with unique and critical challenges linked to their specific dimensions: they behave differently from big enterprises in relation to their surrounding environment and its interaction (Shuman and Seeger, 1986).

1.1) Reasons for Market integration

Open markets can be considered the natural consequence of globalization and the most obvious manifestation of an economy in constant transformation and markets increasingly

integrated and interdependent (Cedrola, 2005). As previously highlighted, not only economic factors led to this situation.

The most important reasons can be traced to:

- *Technological development and exchange of 'know-how'*. These two factors considerably affected the process of national economies' opening up and the spread of scientific knowledge across the world. Knowledge plays an increasingly important role in the production process, becoming more and more an active factor and source of competitiveness. *'Know-how'* can be defined as transnational, in the sense that it can be generated in different contexts, and no actor can be considered self-sufficient and independent from it (Christopher, 1971). Of course, for gaining competitive advantages, higher investments in R&D are required and they represents a natural consequence and often a problem for those companies that are not big enough to guarantee sales and returns over their incurred investments. However, for some firms become even difficult to keep exclusive control over autonomous know-how and its potential. In fact, for managing this situation, companies often set up connected networks that govern through processes of mutual exchange, share of resources or technologies. It has a positive impact over their efficiency, by increasing the accumulation of competencies and their final performances.
- *Advancement in Information technology (IT) and communications.* The global network created by computers, televisions and telephones has considerably increased the capacity of transporting information more than one million times (De

Benedictis, Helg, 2002). In this context, the increasing usage of Internet and its applications plays a key role which lead to a rapid and widespread marketing of goods and services, also allowing the spread of different value chain stages in countries geographically distant from each other. Advanced IT facilitates collaboration and cooperation of teams, integration of tasks, reuse of products and design information among the agents involved in the joint project. IT also challenges uncertainty by enabling diverse project teams to communicate any change in real time (Carte and Chidambaram, 2004). Firms with higher levels of IT endowments are expected to show higher propensity toward networks of innovation (Van Beers and Zand, 2013).

- *The change of political scenarios*. It could symbolically be drawn with the collapse of the Berlin Wall (1989),which decreed the end of the division of the world into two blocks, even by representing a new opportunity for both western and eastern countries. Especially the latter has undergone transformation phenomena and openness to international trade, by proving economic openness and by accepting settlements of Western products.
- *National borders permeability*. The international agreements signed by various countries had the aim to reduce every barriers erected in the past. Their introduction were designed to significantly reduce protection customs and tariff barriers, so improving conditions for accessing markets through the promotion of fair competition and trades between countries involved. A further aspect to underline concerns the interventions for reducing artificial barriers. In fact, the

mobility of people, goods and capital has been obtained only during the last two decades thanks to the enlargement of the European Union and its gradual expansion that has tied individual member countries and their growing trade integration, economic development and monetary union.

- The *homogenization of lifestyles and consumption* is another interesting aspect that often tends to be overlooked. It concerns the process of making flatter cultural and behavioral distances among different populations located in different places. Despite everything, this process does not necessarily lead to the existence of a universal consumer. In fact, a double phenomenon tends to develop: on one hand, the differences between various national contexts, socio-cultural environment, consumption habits, patterns of industrial development, political systems and legislation, infrastructure, characteristics of the production and distribution system, etc.. tend to fade; on the other hand, these differences remain still highly relevant, allowing enterprises to implement market segmentation strategies focused on groups of consumers that have the opportunity to demand in varied and variable ways.
- *The dynamics of financial markets*. They have seen a marked acceleration of trade by involving, first, the most advanced countries and then the so-called 'emerging' countries. The total amount of financial transactions involving investors, banks and governments, surpasses the annual GDP of medium size countries. It has happened due to free movement of capital (a phenomenon that began in the first half of the '80s),the foreign liberalization and inward deregulation, the development of

information technology (IT) and the creation of funding subsidized to developing countries. Each of these factors contributed to an increasingly close connection between domestic markets and international markets.

For the typical small and medium enterprises (SMEs) the struggle for survival becomes very difficult without necessary requirements and adequate supporting competitive strategies. In this increasingly dynamic environment, SMEs have been forced to face and deal with an increasing and overwhelming speed (Meyers, 1997), especially regarding product life cycle and technological innovations (Coviello and Munro, 1995), also facing problems as scarcity of resources and higher costs related to R&D investment (Lindqvist, 1990). The failure of traditional theories about the internationalization process, including theories of multinational corporations that could offer detailed directions for small and medium enterprises in formulating competitive strategies, has also forced SMEs to devise and test a myriad of different strategies aimed by different competitive needs and strategic drivers.

Most of these strategies show themselves as innovative even if based on the combination of well-established principles such as distinctive competencies (Hamel and Prahalad, 1990), dynamic capabilities (Teece, 1997), benefits derived from knowledge (Nonaka and Takeuchi, 1995) or collaboration and cooperation (Gomes and Casseres, 1996; Kanter, 1984; Yoshino and Rangan, 1995), useful to reduce the pressure of competition.

2) VALUE CHAIN GOVERNANCE : from vertical integration to network

Until the '70s, Italian and European companies were characterized by an higher level of vertical integration, which has been decreasing over the years. In fact, for the special features that global integrated markets present, the major nations, including Italy, started a dis- integration process due to new conditions and opportunities they faced.

Many of these activities, usually characterized by high specificity, were entrusted to external companies *(outsourcing)* allowing enterprises to focus their forces on core business and ,on the other side, to save on management and labor costs related to the externalized one. The key point for understanding this changing nature of the international and globalized scenario can be found in the notion of *value added chain*.

International business scholars defines it as 'the process by which technology is combined with material and labor inputs, and then processed inputs are assembled, marketed and distributed'.

"*A single firm may consist of only one link in the so called ' value- added chain' process, or it may be extensively vertical integrated.."* (Kogut,1985)

The previous sentence helps to understand as the *governance plays a central role* in value chain analysis. It can be defined as non-market coordination of economic activity (Gereffi and Sturgeon, 2001) and that coordination, within value chain, can take various forms.

Gereffi and Sturgeon also outline as market-based relationships among firms and vertically integrated firms (hierarchy) make up opposite ends of a spectrum, where network relationships comprise an intermediate mode of value chain governance.

Laumann (1991) and other sociologist explained network as a form of organization with its unique characteristics. The Network can be defined as a collection of actors that pursue repeated exchange relations between them but, at the same time, lack a legitimate organizational authority who could eventually resolve disputes. Thus, it differs from market because in the market relations are not repeated but episodic, and from hierarchy because there authority is legitimated. For those reasons, network requires an high level of trust (Perrow,1993), and it represents one important instrument of governance that is totally different from the adversarial posture of hierarchy and market.

The literature agrees the idea that the firm's boundaries still matter and *making and buying* strategies are reflected in qualitatively distinct forms of governance and organization (Coase,1937).

Make-or-buy question represents the central theme of different theories that attempt to explain the nature, origin and boundaries of the firm.

Thus, analyzing the characteristics of vertical integration *(make)* is possible to discern its advantages and disadvantages, especially if compared to the use of the market *(buy).* By focusing the attention on theoretical analysis, will be also possible to recognize in which situation is better relying on the hierarchal form of governance rather than the pure market; or vice versa. Furthermore, as described before, these continuative shift has laid the groundwork for a *variety of network form of governance* between arm's length markets and vertically integrated corporations.

In fact, in recent decades, there has been an unprecedented growth in corporate partnering and reliance on various forms of external collaboration *(network)* like never before: the

locus of innovation, transfer of technological know-how and upgrading can be only found in networks of learning, rather than in individual firms. (Powell,1990 and Gulati,1995)

3) HIERARCHY GOVERNANCE – 'MAKE' STRATEGY

The terms hierarchy or vertical integration describe the action taken by a company of expanding its businesses in different phases of the value chain (Gereffi,2001); in this scenario, a company can be integrated "upstream" if it incorporates activities one or more steps prior those that already played, or "downstream" if the enterprise controls subsequent steps to what already carried inside.

3.1)The advantages of hierarchy

There are several benefits related to organizational forms of this type, especially those referred to an higher protection of investments made due to the power's centralization; clearly defined authorities and responsibilities that lead to a better coordination and direct communication between managers and subsidiaries; a clear chain of command that also generates defined sets of responsibilities. Hierarchy also offers advancement paths, specialized and skilled managers for every department's specific function.

However, the specific objective of hierarchical-organization can be identified in controlling the behavior of internal providers and their performances with lower costs than using the market.

Thus, hierarchical organizational structure also eliminates problems related to transactions with other companies, so as difficulties of information asymmetry that may arise during the prior process of negotiations between company and suppliers.

Instead, by adopting an integrated structure there will also be less need of using incentives based on performances: in fact, when an enterprise chooses to consult independent providers, diverse problems could arise during their performances evaluation and, also, for establishing appropriate incentives (Williamson, 1975).

Incentives play a key role during transactions: the decision to set up low incentives for external suppliers produce negative effects due to it could push their attention in developing other products or services. In fact, in the worst case, their supply can be done for direct company competitors, especially if incentive plans of greater amounts has been offered to them. Despite this, what can be identified as the fundamental advantage of these type of organizations is the exploitation of *internal know-how*: the most important strategic variable possessed by the company.

It allows an organization to focus the attention on its resources and strengths with the purpose to protect those who are considered core businesses, namely tip activities on which build competitive advantages on.

For this reason, the importance of internal knowledge has been stressed for distinguishing one company from others and it represents the central hub for the company expansion in size. (Grant, 1997; Novak, 1999)

Knowledge is the key answer for responding to the changes in demand, always more frequent, by allowing company to differentiate its offering.

It increases the degree of vertical integration and company structure: *upstream* it pushes toward to flexibility and efficiency of response, encouraging suppliers to become more and more advanced and interactive; while *downstream* it permits to capture the value of sharing services and thus improving the distribution systems development .

3.2)The disadvantages of hierarchy

After analyzing what companies consider as advantages of operating with a vertically integrated structure instead of resorting to the market, it has also been possible to identify disadvantages that may occur with its adoption.

Companies who rely on a structure of this type can often incur in *excessive rigidity and bureaucracy* (Gereffi, 2001).

When there is a growth in size and dimension, due to integration process, company also tends to increase standardization and bureaucratization with the aim to control all stages of production, operational areas and information flow. It tends to establish standardized rules of conduct for common events that usually happen inside. Such excessive structural rigidity causes loss of flexibility and immobility on facing changes imposed by the market. The arising risks and difficulties in adopting a rigid structure can be identified in the difficulty in moving to new suppliers due to its consequent capacity to absorb internally different stages of production and, doing so, providing specific solutions rather than seeking them into the market.

Since other suppliers could represent a more affordable and innovative alternative, changes and evolutionary patterns become difficult to follow due to tight or binding relations and huge investments in ongoing activities (Gereffi, 2001).

With the increasing size of company, mainly caused by investments and specialized suppliers absorbed, increased exit barriers stand out; when the complexity of information and knowledge is difficult to transfer, the strategic activity appears highly dependent on competitors' actions and contractual obstacles bind the firm to remain in market in which it operates. Although with vertical integration companies have the ability to greatly reduce transaction costs that would have if they were operating in the markets, there are other types of costs in which they may incur. Company dimension is directly linked to fixed costs caused by different stages of production processes internally developed, higher coordination and incentives for achieving the set overall objectives.

An important example is given by the *administrative costs*: company who decides to produce by itself an input, on the one hand it saves on costs originated by transactions, but, at the same time, it increases the risks linked to production inefficiency especially when the amount of input required does not allow to achieve economy of scale.

In this case, the variable of frequency plays a key role because when an input, even an important one, is required infrequently, then it will likely be acquired externally (Micelli, Corò and Sturgeon, 2010).

Higher administrative costs can also occur on developing distinctive skills and their information-flow management. Specific and specialized knowledge about different activities are mutually independent but, if there is a relationship between them, the

mechanism of integration could enhance the development of distinctive competencies. The administrative costs rise up in linking and enhancing the smooth flow of information between these activities. The strategic management of different activities contributes to the creation of administrative costs and it can often incur during the early process of vertical integration, especially linked to the spread of the risks, when upstream activities depends on the downstream and vice versa.

Thus, if a problem that affects any stage of the value chain could also influence a subsequent stages of production, at worst, it forces the company in stopping the entire activity. Therefore, companies that integrate production, distribution and design, such as Zara or Gucci, are very rare. A merely distribution company does not have technical and strategic competencies for implementing the whole production process because managing two or more phases simultaneously requires organizational skills, human resources management, styles of management that differ widely and, very often, hard to find.

4) RELYING ON THE MARKET – 'BUY' STRATEGY

When the size of the company and the amount of purchases are not sufficient large to allow domestic production of specialized inputs, many operators rely on external suppliers.

Adam Smith in his milestone 'The wealth of nations' (1776) argued that the market can be considered as a kind of "invisible hand" which maximizes operators efficiency and,

due to the competition, incentivizes to be more productive. Thus the process of allocating resources is automatically activated.

The growing presence of active enterprises able to acquire products or services on the market, rather than producing them internally, has favored production-cost reduction and little explicit coordination at the expense of a decreased exchange of complex information and transmission of specific knowledge (Kamarck, and Donahue, 2002).

4.1) The advantages of recurring to the market

Under certain conditions, such as high competition between suppliers and the presence of standard products, advantages deriving from the market are obvious. To understand exactly what are the actual benefits achievable by this kind of strategy is important to recognize and analyze it.

First of all, when the volume of production is relatively small, it is possible to recognize *economies of variety*. In this case a supplier may enjoy economies of variety by exerting activities that are not related or co-related with those of the acquiring firm. What makes convenient to realize economies of variety is the fact that these activities are not related, so allowing enterprises to diversify their businesses.

Thus, by adopting this strategy the risk of failure will be reduced, since the failure of one of the business does not necessarily lead to the failure of the others.

Recurring to the market can be also advantageous when the amount of a given input is too small and it does not allow the achievement of an efficient level of production, better

defined as *economies of scale.* However, firms can turn to the market and look for an external supplier, even if there is no advantage from economies of scale or variety.

The crucial scope of the companies, looking externally for the production of certain products or simple components, is to find suppliers in possess of specific skills that could improve their product, assemble it quickly, or incorporate in it the latest technological innovation available.

In this scenario, the *role of suppliers and their independence in a competitive market* appears as the key factor for the companies.

On the other side, supply enterprises are encouraged to offer advantages in terms of quality and cost, to enjoy a greater profit, even if temporarily.

However, resorting to the market presents disadvantages caused by combination of factors that provoke uncertainty in exchanged goods or services, also by increasing the possibility of opportunistic behaviors between actors involved.

4.2)The disadvantages of recurring to the market

The disadvantages resulting from an organization based mainly on '*buy decisions'* are highly dependent to what are usually identified as *transaction costs.*

This theory, pointed out by Williamson (1975), identifies additional costs added up to goods or services during an exchange process. In fact, before concluding a transaction that will benefit both halves, a company must forecast every costs relating to research, exchange of information and negotiation of terms involved in the exchange itself.

All these activities linked to the central transaction between two or more firms represent costs in terms of time, money and energy.

Thus, the *transaction costs approach* offers various explanation and reasons why firms should bring certain activities in-house (Gereffi, 2011). Thanks to this approach, it has been possible to identify two types of transaction costs that represent sources of advantages for vertical integrated structures, but show them as limits for accessing the market. They are the so-called "coordination costs" that may also include costs for advertising and research, developed in order to determine consumer preferences, or possible asymmetries and incomplete information that could have a negative impact on present/future agreements.

At this purpose, Coase (1937) pointed out how transactions and related costs can differ in number of dimensions such as specific investment, complexity of the transaction, frequency with which they occur, uncertainty of performance required, difficulties in measuring performances and asset specificity. An example is given by non-standard inputs or integrated design architectures: their exchange involves in more complex transfers of design information and therefore intense interactions across enterprises boundaries. Another limitation that enterprises encounter when the exchange is turned to the market comes from the probability of an *opportunistic behavior.*

If the transaction is based on mutual trust and if the two parties are confident that the counterpart has not opportunistic attitudes, then the market does not lead to negative consequences and inefficiency. However, opportunism means searching and protecting own interests by all means, even by fraud or with the lack of dissemination of

information. So, the company that takes benefits from one important information by omitting its communication will be in a better position than the other part, which doesn't know that the transaction is inconvenient. There are *three main characteristics* of the transactions that promote the appearance of opportunistic behavior.

The first concerns the nature of *assets*, (i.e. the exchange of goods that lose part or all of their value if they are used outside of their specific context). There are cases in which the company may not use or find specific assets in an alternative way and this situation could be subjected to exploitation by third parties, only interested in taking as much advantage as possible.

The second feature of the transactions that helps the occurrence of opportunistic situations is *uncertainty*. It comes directly from bounded rationality and poorly chosen that individual performs, also influenced by external elements.

These limitations lead to a sufficient but non-optimal choice. Everything is also accentuated by the third characteristic: the *frequency of transactions*. In fact, if the frequency is low, the parts will be more likely to protect themselves, since they will be more exposed to attempts of exploitation from the other part. However, *reputation* plays a key factor in restraining the company from implementing opportunistic behavior. When a company has such a negative behavior, no one will deal with: a good reputation discourages such negative attitudes, especially for fear of not losing face (Menkhoff, 1992; Luo, 2000; Karpoff, 2010).

5) NETWORK – OUTSOURCING STRATEGY FOR INNOVATING FIRMS

Recently, different companies have been able to change their organizational paradigm.

This change has pushed towards a deeply change in business models, starting from hierarchy to systems better aligned to the path of environmental evolution. As explained before, vertical integration consists on sequential process of integrated and different production phases, upstream or/and downstream, in order to reach the development of firms.

However, from the second half of '70s, this checked and successfully vertically integrated system showed its limits. Organizations, seeking to compete globally, were stuck by a lack of agility that resulted from an 'out-of-date' management structures.

The globalization of production and trade, the growth of industrial capabilities and the rising pursuit of flexibility and creativity have been the main reasons for trying to develop new strategies and, so, focusing on so-called *"core-business competences*".

In this new firms' reconfiguration, managers had to decide which activities should have been retained in-house, while reducing their direct ownership over non-core functions.

As largely pointed out by different scholars, knowledge and access to external competencies represent key factors for growing in terms of innovation and differentiation.

A strategy based on outsourcing can contribute to the creation of added-value, not only because it allows the integration of different knowledge and competencies, but also because it represents the answer to *how and in which way* firms advance or fail in the global actual scenario (Gereffi, 2010)

Michael Porter in his book *"The Competitive Advantage: creating and sustaining superior performance"(1985)*, uses the term 'value-chain' in order to describe those activities performed by an organization and its relative competitive position.

He argued that the ability to perform activities and to manage the linkages between them is a source of competitive advantage. Vertical disintegration of Porter's value-chain has become a field increasingly interesting for understanding decisions and motivations about outsourcing and collaboration between companies.

5.1)Different perspectives : the literature

Although the literature has developed several theories about outsourcing and networks decisions, some possible perspectives can be helpful for understanding reasons and motivations that pushed firms for adopting strategies of externalization. The literature offers various causes why firms bring certain activities in-house and others outsourced.

Efficiency is a concept strictly related to the relationship between risks and benefits taken by organizations; this implies that they should outsource the activities that represent a huge investment when developed internally. This way of outsourcing exists to create value (Samuel,2004).

Some authors emphasized the importance of *core competence* as the collective skills and learning inside an organization that tries to create competitive advantage (Hamel and Prahalad, 1994). There are different definitions about what really should be named as core competences, in fact, according to others, they represent strategic capabilities that are inimitable, rare and valuable (Barney and Clark, 2007) or the building blocks of a firms'

corporate strategy (Frery, 2001). Despite this, core competencies are crucial for the development of companies because only leveraging such abilities, firms are stimulated in competing for new businesses, obtaining optimal results in terms of cost efficiencies and operational effectiveness (Money, 2007).

However, in making those huge investments, firms should not only emphasize short-term results and they have to be deeply focused in those areas which represent tangible distinction from their competitors. Outsourcing strategy has to represent the answer to difficulty on running intra-firm functions in terms of management and control. It has to be also seen as a solution for learning and increasing internal strengths.

Tangible effects deriving from this strategy reflect operative costs reduction and risk sharing in order to allow firms flexibility, dynamicity and reactivity on grabbing every opportunity that market, technological development and specific professional skill offer.

Cheon, Grover and Teng (1995) divided outsourcing theories into three main categories or clusters based on different macro perspectives: strategic, economic and social.

While the *strategic management view* is concerned with how firms formulate and implement strategies in order to accomplish a desired performance goal, such as explained in resource-based theory (RBT); *the economic view* examines the mechanisms of coordination and governance of economic agents in their transactions with one another, mainly by using transaction-cost theory (TCE) or agency-cost theory (ACT); instead, *the social/organizational perspective* focuses its attention on the organization and existing relationships between individuals, groups, and organizations (Dibbern et al., 2004).

Within *the strategic management view*, the contribution of Teece et al. (1997) has been very important for developing the resource-based theory, by implementing and transforming the notion of dynamicity that affects capabilities.

They highlighted the importance of internal resources as source of competitive advantage. In fact, mixing and deploying properly of internal resources and capabilities can only create several benefits.

The core premise of the resource-based view is that them and capabilities can vary significantly across firms, leading to differences that can remain stable for long periods of time (Barney and Hesterly, 1996). The key issues for a company who wants to be competitive in a dynamic environment must be given by differentiation from competitors and exploitation of own resources (Barney, 1991).

Thus,competitive advantage can be gained only if resources show peculiar characteristics: they have to be valuable, rare, imperfectly imitable, non-substitutable.

A resource can be defined as valuable if it allows firms' exploitation of market opportunities and permits to implement strategies that improve efficiency and effectiveness. A resource can be defined as rare if the number of firms possessing that resource in competitive arena is less than the number of firms needed to generate perfect competition. Imperfectly imitable resource depends on unique historical conditions, causal ambiguity and social complexity. The noun 'non-substitutable resource' is referred to the case in which firms can't find strategic equivalents.

The resource-based view, adapted to outsourcing theory, highlights how firms without valuable, rare, inimitable resources and capabilities should seek them from an external

provider in order to overcome this weakness. In this scenario a firm has to be able to co-operate with partners so that its knowledge can be increased and success can be achieved by taking advantage from partners distinctive capabilities and competencies.

Therefore, the most prominent use of resource-based theory is focused on the preparation phase of the outsourcing process, with the aim of defining a decision making framework and selecting the most appropriate supplier, emphasizing how the choice of partners becomes crucial and it plays a key role for future successes.

According to an *Economic perspective*, Ronald Coase, during the end of ’30s, theorized the reasons why firms should compete in an efficient way and what is required for making trades easier.

After several years Williamson extended these ideas, introducing the so called ‘*Transaction cost economy’*. He argued that every time “a good or service is transferred across technologically, separable interface there is a transaction cost”.

This cost is linked to the relative legal advancement of economic organization where the main focus is based on information of transaction and governance activities.

Grover and Teng (1995) stressed, on the one hand, the role of outsourcing for lowering production costs due to economies of scale gained thanks to external suppliers and, on the other hand, its capacity to increase expenses related to negotiating, monitoring and enforcing contracts. Therefore, transaction cost economy takes in consideration several elements as: *the presence of contracts*, which obviously present costs and time spent for bargaining; probable *opportunistic behavior*, especially for customized products or services in which transaction -specific investment can be made and all possible safeguard

must be put in place; *environmental uncertainty* that may cause continuous redefinition of contract terms; *frequency of interaction* between parties involved and *asset specificity* that could lead to greater coordination and exchange of information.

In addition, Baldwin and Clark (2003) gave also emphasis on what is called *'mundane' transaction costs*: they can be defined as the expenditures occurred in coordinating activities along the whole chain and that arise in presence of non-standard inputs, products with integral architectures and products whose output is time sensitive.

However, *sociological interest* in network form of organization is developed as a criticism to the economic view discussed above. Sociologists have often underlined the functionality of networks in promoting learning, legitimacy and as source of economic performance improvement (Podolny and Page, 1999)

"The most useful information is rarely that which flows down the formal chain or that which can be inferred from price signals. Rather it is that which is obtained from someone you have dealt in the past and found to be reliable" (Powell, 1990)

In conclusion, the shift of attention to Japanese firms during the end of '80s has highlighted the importance of managerial improvement and changes. However, it doesn't have to lead at the conclusion that complex and tightly coordinated production systems always result in vertical integration. Rather, asset specificity, opportunism and coordination costs can be managed also at inter-firms levels through different methods (Gereffi, 2005). Network actors, in many instances, can control opportunism through repeated transactions, reputation and social norms. At this purpose, networking theorists

argue that trust, reputation and mutual dependence allow to manage interdependence and complex inter-firm divisions more than what predicted by Williamson and TCE, where, he described networks only just as an hybrid forms of organization and governance between the pure markets and the pure hierarchy (1991).

Therefore, networks can be seen as channel, another means for acquiring new skills, fostering learning and perhaps, vivify new competencies and skills in those industries where knowledge is broadly dispersed and rapidly updated (Powell and Brantley 1992).

In addition, a greater technological distance between partners will conduct the firm toward a higher possibility of producing a different inventions in terms of content, respect to its previous inventions (Stuart and Podolny, 1997).

Therefore, sociologists celebrate the network forms of organization as advocate of transaction cost reduction through the reliance on trust rather than on contractual provisions. By doing so, they stress networks' quality advantages rather than costs as the primary economic benefits.

6) THE BUSINESS NETWORK CONTRACT

In classifying aggregations between businesses , they could be distinguished in relation to their degree of formalization. In fact, they can be divided into two strands, namely those based on personal, informal relationships and those based on formal contractual relationships. *The first* structures are unconventional, with precarious links. They consist in companies whose bonds are not sanctioned and regulated by law, but arise as a result of

economic and /or financial links between companies, or due to other particular types of relationship. The informal links are mainly used in uncertain economic environments, where it is necessary to respond flexibly to threats / opportunities arising from the growing change. Examples of this kind of bonds can be found in subcontracting relationships, industrial districts, where the integration of technical / production occurs between the value chains of individual participating companies, or through gentlemen's agreements based on personal relationships and mutual trust. *The second*, however, arise from a specific contract that sets and defines the contents of the agreement, or due to the legal status of membership through the purchase of shares of a company, by another company. In turn, the network recognized by contract is divided into non-equity based or equity based, which explains the presence or absence of a common asset base.

‘Non-equity based’ are bound by a contract (thus ties are supported and regulated by a legal transaction) which predefines resources, actions, constraints, responsibilities and the scope of the agreement. This leads to a higher stiffness compared with the informal collaborations, but the gain is remarkable in terms of certainty and stability of the aggregation itself.

In this case the commitment is medium or long, the agreements are real strategic plans and there is a structured relationship relative to the aspects of management and operations of the individual. An example can be provided by the joint venture.

Instead, 'equity based' presents ties into assets. In these forms, a company buys a share of the property of another and, depending on the assets purchased, the degree of control will

be defined. The company that buys a share of another company becomes therefore partner with consequent right to participate in meetings by expressing its will.

The business network contract is an agreement between enterprises, written in private form, with the scope to perform jointly activities in order to increase the possibilities in innovation and competitiveness. It allows companies to mix key elements of business enterprises by supporting collaboration on large scale projects without losing legal independence and autonomy in those business activities not part of the contract.

The ratio behind the business network contract represents a step forward from a business culture perspective. The aggregation of companies is an actual outcome of a shared business plan specifically designed to pursue the common goal of improving the potential of innovation and competitiveness. In fact, from a contractual point of view, the distinctive elements of the business network contract can be summarized as the incentive for companies to grow competitively through knowledge and information sharing, preservation of legal independence and business autonomy by overcoming of geographic segmentation. Since its introduction in Italy, in 2010, the number of companies that joined a network has increased significantly every year[1].

From a legal standpoint, this type of contract is characterized by binding effects (because the contractors are obliged to achieve a common purpose), by multilateral effects (it involves more actors),and by strategic objectives focused on enhancing the mutual innovation capacity.

[1] http://www.pmi.it/economia/lavoro/news/48981

The network contract appears interesting for those companies that are reluctant to collaborate, because it is characterized by greater flexibility for what concern the definition of purposes, the network boundaries and the degree of involvement of partners.

Therefore, individual enterprises that are focused in achieving a common goal by structuring their relationships through a mechanism of mutual dependency, can also maintain their legal and economic independence. Network contract with its characteristics may represent the solution adopted by SMEs for creating synergies with other companies with the aim to share knowledge, ideas, resources and skills; to acquire managerial skills also by improving production efficiency and by minimizing overall costs arising from transactions; especially by implementing strategies focused on technological innovation in order to seek new competitive advantages without an increase in size of company.

Therefore, these contracts also support global competitiveness on international markets and allow new opportunities outside the national territory.

In fact, they allow a better presence of companies worldwide by pushing towards internationalization and export activities, mainly through campaigns of marketing and improvement in the quality perception of national products abroad. This stimulates companies to look for new business opportunities through an adaptation of products or services to the local and environmental needs.

6.1) Critical Issues

Although networks can represent a great opportunity for growth and development, difficulties in their implementation that jeopardize strategies of development and possible

agreements should not be underestimated. The effectiveness of the network contracts in supporting the objectives of the strategic development can be undermined by diverse elements that, instead, should ensure inter-firm smooth functioning and stability. The legislature does not indicate clear rules linked to individual partners, and often there is imbalance between the jointly goal to be pursued and financial resources used. The flexibility given to this legal instrument has also highlighted the difficulty in understanding powers and duties of each partners, highlighting the fragility of the contract due to misunderstandings and/or conflicts.

Thus, diverse *problems* could arise:

- First, there is high resistance to changing by the management and distrust towards new approaches that rely on the use of new tools. Moreover, how it is difficult to leave the management models used previously, it is also problematic overcoming the fear of a loss of decision-making autonomy in the production chain.
- Second, there could be little confidence in the new partner, maybe for difficulties in accepting companies considered once rivals and at present strategic factor for creating a competitive advantage in the market.
- Third, it is not easy to balance different functions as purchasing, planning, design, production and distribution among various companies across the network.
- And finally, the hazards of using an integrated management model can lead to not achieve immediate measurable benefits, since results often are tangible in the long period.

In conclusion, the Network contracts can be considered a legal instrument with great potential, even though they do not have a specific discipline.

This potential written agreement should find support in specific legislative measures that qualify more adequately the rights and obligations of participants, methods of distribution and decision-making power, without burdening over the organization and making it too bureaucratic. About the potential applications, the network contract is also subjected to certain functional constraints and several ambiguities.

This contract can't constitute network between companies, if the object attributed to the organ is not already included in the social object of at least one partner. This statement is contradictory, especially because the network contract is thought to form complementary businesses in order to make something that cannot stand out alone.

Another aspect that needs to be discussed, is whether giving the status of legal entity to the network, so that the ability to directly contract with the customer in the relations of production and exchange may be possible, although it is very difficult to attribute results arising from the collaboration to the various participants.

Only during 2012 important innovations compared to the previous legislation were introduced. In particular, it has been recognized to the network contract the opportunity to acquire legal subjectivity in the case of the creation of a common fund asset or of a joint body intended to carry out activities with third parties. For example, without the establishment of these forms could emerge difficulties at the time of billing, leaving a negative experience to the small business owner.

CHAPTER TWO

1) THE AUTOMOTIVE SECTOR

The automotive sector can be defined as a cutting-edge sector from technological and management points of view.

The existing operational and strategic management techniques used in most manufacturing industries have been often affected by changes in this sector (Volpato, 2004). In particular outsourcing strategies, techniques for managing the supply chain, information technology (IT) and communication have been widely used to support different businesses. However, the automotive industry has seen the major changes of its production organization, especially during the last fifty years.

Summarizing, during the second half of the last century and the period following the post-war recovery, the *first phase* that affected the automotive industry reorganization was focused on the quality of work and industrial relations; the *second phase* which took place during the '80s, found in the acquisition of new technologies and new methodologies the right answers for competing with Japan's improvement in terms of division of labor and product development. During these years the dominant organizational models represented by the Fordist scheme, based on the key role of a manufacturer-assembling firms, suffered a deep crisis especially characterized by increasing Japanese car manufacturers competition (Volpato, 1997). The new Japanese organizational models were characterized by higher levels of productive decentralization from automakers to suppliers and their

sub-contractors, especially reinforced by an intense collaboration between these actors (Chiarini, 2010).

Comparing the principles and criteria of the Fordist scheme to the Japanese one, the former production system appeared largely overcome by this innovative Eastern model. Japanese central aim can be described through the sentence *"doing more with less"* (Womack, 1990) that highlights how firms should increase their flexibility of production and the quality of products offered by reducing time and costs as much as possible.

In addition, these aspects should be also supported by a flexible organizational structure, a smart production process, improved performances and new technologies (Womack, Jones and Ross, 1990). Thus, the originality and the tangible results of the Japanese production system (Shah, 2003) gave awareness to the Western companies about the necessity of an "imitation" process (Womack, Jones and Ross, 1990) through the integration of these organizational novelties within the usual productive paradigms.

In this way, during the '90s, the new path of globalization led companies to handle these new challenges, especially through a process of value chains re-engineering and division of labor across diverse and dispersed geographical areas (Sturgeon, 2008).

Thus, each of these factors converged into an increasing integration of the Japanese model in the production organization process, especially using *lean production and outsourcing strategies*.

While lean production can be described as an integrated set of practices whose purpose is to eliminate waste along the entire value chain within the company and between different companies (Holweg, 2007), outsourcing strategy want to focus its attention on the

decentralization of non-core production activities through the creation of a suppliers network (Micelli e Corò , 2004). This new configuration allows to reduce the minimal optimal size requested, so ensuring the exploitation of economies of scale through external growth, mergers and acquisitions. It appears strategically useful for automakers that do not possess necessary financial resources to open and develop potentially promising areas of research and / or do not have required skills for grabbing every opportunities from different technological fields.

Therefore, if the origin of the externalization can be strictly related to the needs of containing production costs, it is also triggered by the necessity to be innovative in designing and engineering processes (Volpato, 2003).

This tendency to be concentrated on core competencies has profoundly modified the entire supply-system and the relationships between external providers and final assemblers, also leading to a net rationalization in the number of direct suppliers.

In fact, with the 'evolution' of lean production into modular production (as will be described below), to a First Tier Supplier (FTS) was requested to provide entire modules or already assembled subsets, rather than individual components.

The trend has increasingly developed during the last years and it has also seen outsourcing strategies related not only to production phases but also for those relating to services, *including design* (Enrietti and Lanzetti, 2001). The modularity of the product has even allowed the assembly-phase postponement in order to increase company's responsiveness to consumers demand for customization.

The literature emphasizes the impact of these strategies in the industry reorganizations and how they have been able to create unexpected results. In fact, the OEMs (Original Equipment Manufacturers) effort in developing new relationships with suppliers and customers (based on the method make-and-deliver-to-order) has implied a radical transformation of the automotive industry organization, but also a reconfiguration of the supply chain members and the consequent interaction with them (Volpato, 2003).

2) THE LEAN MANUFACTURING

During the ‘50s, in Japan, a new way to manage and understand the company had been developed. It was a clear answer to new market demands and macroeconomic problems that affected the country in that period (Hopp and Spearman, 2004). However, this new management philosophy caught the attention of worldwide scholars only since the early ‘70s. It sanctioned the Japanese carmakers’ success (Womack et al., 1990).

The definitely dissemination of these *lean methods* was impressed by Womack, Jones and Ross with their publication "The Machine That Changed the Word", whose content described the basic principles of the lean production (whose birth has to be identified as internal to the Toyota company) and its productivity benefits.

However, the definition of lean production is not always clear, and even less unequivocal, between different authors:

- The Toyota Production System can be described as the attempt to produce as much as possible in a continuous flow (Ohno, 1988).

- Lean manufacturing uses half of humans'effort in factories, half space, half of investments in equipment and half hours to develop a new product. It also needs a halved requirements of warehouses which involves in fewer defects and an increasingly variety of products (Womack et al., 1990).
- The Toyota Production System includes the standardization of work in continuous flow, a direct link between supplier and customer, and continuous improvement based on a scientific method (Spear and Bowen, 1999).
- Lean manufacturing is an integrated system that carries out the production of goods and services with minimal cost of stocks (Hopp and Spearman, 2004).

Therefore, after having obtained largely success in Japan, the lean production spread within Western companies. The main goals of this innovative system of production are based on continuous research about technical management conditions that allow small size-lots production by lowering the time required for tool changes and by improving the focus on applications. It guarantees a perfect synchronicity of operations such as the minimization of wastage and downtime. It also generates positive effects in terms of labor where workers develop a natural involvement in their activities and a greater sense of loyalty (Womack et al., 1990).

The necessary involvement of workers in the lean production models has been reinforced above all by the analysis results carried out by Womack, Jones and Roos (1990), whose research represents a key contribution in describing the evolution occurred in production systems and organization of work, especially in the automotive sector.

According to these authors, the path of production- evolution has followed mainly three stages: *craft, mass and lean production*.

The first uses skilled workers and generic/flexible technologies; it has been adopted in highly decentralized structures and highly competitive markets where production is based on small scale influenced by the wishes of the consumer.

The second production process tends to develop parceled organization of work often employing unskilled workers or semi-skilled ones; it is performed by using expensive equipment for producing high amounts of output; it is often used in oligopolistic markets and large factories mainly characterized by vertical structure with the aim to achieve economies of scale.

Instead, the lean production combines the advantages of both production systems by reducing the costs of the first and the rigidity of the second through less human contribution, hours of design, space and investment in production facilities.

It is characterized by skilled and motivated workers due to an optimal human resources management and firm's self-identification as an integrated community (Dore, 1987).

In fact, the active contribution of the stakeholders community -workers, managers, suppliers- allows the realization of diversified and flexible productions, reinforced by *just-in-time* (JIT) methods and total quality objectives.

Just-in-time represents a method that affects company organization and management. It can be considered the pillar of the Toyota system for its principal purpose to achieve the total elimination of wastes (Wamack, 1995). It also wants to align the actual company production to the fluctuations in consumers demand (Kral, 1997).

This method allows the production of a given output at the right time and in the required amounts so that strong reduction in inventories and superfluous labor can be obtained.

Therefore, on the one hand, companies need to contain the stocks of all production process stages by eliminating warehouses and reducing periodically intermediate products; on the other hand, they must have an *information system* able to coordinate all various phases, also specifying the type of product required, quantities and lead time.

The JIT is also identified as a *pull method* because the production is "pulled" by the consumers rather than being driven by the company to the market. In fact, the system of pull-type is not based on programs formulated at central level whose time reference is generally indicated by the lead time of the product; rather, it is based on daily sales orders which are collected and sent to the final assembly-phase.

Quite apart from JIT and its implications, even *the development of human capital* represents a fundamental element in restructuring the working relationships, both collectively with trade that at individual level with a more sophisticated human resource management.

Womack and Jones (1996) in their studies have identified five principles that characterize lean manufacturing success. They played a leading role for overcoming the mass production systems:

- *The definition of value*. The central theme of lean production is undoubtedly the elimination of wastes (muda). Lean thinking is the true antidote to 'muda' because it indicates how to better perform using less work, equipment, time, space… etc. In the perspective of lean production, the value is defined in terms of specific

products, with specific features, offered at specific prices through continuous dialogue with qualified customers. In this way only the final customer can define the real value of a given product, if it is able to meet certain requirements.

T. Ohno, the father of Toyota production system, identified seven types of waste and their causes: product defects, overproduction, warehouses and unnecessary processes, exhausting wait, needless movement of people and transport of goods.

In addition, Womack et al. identified an eighth one: the design of goods / services that do not meet the real needs of customers.

- *Flow of value identification*. Value chain can be defined as the set of activities required to bring the product from its conception to the actual availability, through different stages as design, engineering, manufacturing, sales and delivery to the customer. The identification of each stage of the value chain should be directed to eliminate those activities that do not create value. It advises companies in rethinking their organizational approaches based on both, intra and inter-relationships.

- *Slide the flow*. Once the value is defined in terms of customer satisfaction and its relative flow, the product must continuously flow through those value-creating activities. The transition from a small lot-size based logic to the flow-based logic pushes the worker at having a complete vision about all those processes that affect the creation of products and in which way they contribute to any advancement.

According to Womack and Jones, this can be only possible being concentrated over the real objects, ignoring the traditional organizational boundaries that tasks, professionalism and the functions involve.

- *Pull*. The basic thought suggests that the company does not have to push the product towards customers because it could result undesired; otherwise the new methodology proposes that possible clients have to pull the product from the company. In fact, the best way to reduce 'muda' is to start from the concrete customer requests in order to produce at the required moment. Timing is fundamental.

- *Perfection*. Companies can pursue perfection through incremental (kaizen) and radical (kaikaku) improvements in all phases of their flow of value.

3) THE STRATEGIC REORIENTATION

The increased competitiveness of Japanese automakers came from the extensive external supply of component parts, the mechanisms of delivery based on programming and assembling components through the JIT system.

The response of Western automakers took place trough different organizational upheavals, as reducing the number of suppliers and the level of vertical integration.

At the same time the changes in the global automotive demand were increasingly evident.

In mature markets the multi-engines phenomenon that affected all families began to emerge; it pushed from one side to the expansion of the offer and the launch of new car models, from the other one there was a targeted-segmentation strategy.

However, one of the most tangible competitive element was given by an higher degree of innovation required and its crucial importance, especially if compared to the past. In other words, if in the past price differences between different products drove consumers choices, during those years innovative contents polarized the interest of the demand within the various market segments (style, technology and performance mainly in terms of drive- ability and safety). Another important strategic shift of those years referred to the reorganization of the overall supply-chain-structure and supply-chain-management between OEM and suppliers.

The *main causes* associated to these phenomena can be traced into:

- The systematic reduction of the supply components expenditure through the *relocation of suppliers in low cost areas.* Thus, the competition between car-manufacturers for their market shares growth tend to gamble on the quality and innovation of their offerings and the pressure exerted by them over their networks of supply continued to be spasmodic in an attempt to obtain higher margins possible. For reducing operative costs the plants' relocation to countries with lower labor costs seemed to be the most effective one. However, the precise quantification of the advantages and disadvantages associated with the relocation to these countries raises many questions. In fact, if the differential in wage rates

between developed and developing countries is known, their weight over the total cost of production in the auto-industries depends on several variables such as the technological level possessed, the competence level of the new staff and their actual labor productivity, which in the emerging markets it may be significantly modest. Saving on labor costs could be counterproductive when logistic costs have a large impact over total ones, mainly caused by the greater distance from decision-making and operating centers (design and distribution centers).

In conclusion, the relocation to these markets sounds good for context in which the engine production is taking-off. In addition, higher levels of competitiveness can be reached also giving to products a 'domestic image' and reduced delivery time.

- The development of a product architecture based on *assembling modules* for reducing the amount of investment and time spent in assembly-plants.
- The *automakers' specialization in designing the general architecture* of the cars, so assigning to direct suppliers the task of developing innovation and coordination with their hierarchical chain of subcontractors;

These causes led to different *effects* in terms of:

- Automakers' delegation to First Tier Suppliers (FTSs) for organizing the underlying pyramid of subcontracting in order to simplify business relationships;
- The establishment of organizational *common platforms and components* between different models, both belonging to controlled brands of the same automotive group or between models from different groups. The suppliers ability for achieving

economies of scale and scope could be adequately supported through forms of product standardization also implemented by automakers. However, the development of new sophisticated and complex methods was possible using a ‘partial standardization’: it was adopted for using and sharing common components, without affecting the car models and their needs for maintaining high margins of customization, both referring to the various national markets and to individual consumers’ desires. This process developed through the design of "common platforms", able to use a significant number of common subsystems and also leaving freedom to realize differentiated products for each individual markets.

It has to be considered a crucial step in order to obtain strong cost advantages; a passage towards which all are moving aware due to its predisposition to solve the current trade-offs between variety, standardization and high quality of production advantages. For these reasons, this trend has led to an endowment of a wide range of models, also provoking concentration and consolidation of brands in always fewer global players’ hands.

Although producing common components involves higher complexity during the design-phase and greater difficulty to differentiate between several products, it also exhibits significant advantages for reducing the levels of spare parts stored in different markets, increase speed within the supply networks and even services reserved to end-users.

4) FROM LEAN PRODUCTION TO MODULAR PRODUCTION

The XXI century has been characterized by constant changes in consumers' demand and higher degree of market complexity. A market is defined as complex when it is composed by numerous and interdependent variables whose trajectories make it unpredictable.

As a natural consequence, the increasing market sophistication has led to the emergence of:

- New competitive models that reflect flexibility and speed in introducing new products and updating existing ones;
- New models of globalization characterized by high integration of knowledge and processes among dispersed manufacturers and suppliers across the world;
- Technological development and/or improvement in terms of innovative products or processes, especially for satisfying consumers' needs of customization

The shift from the mass production-based to the Japanese production systems generated several benefits in terms of sensitiveness to market fluctuations; shorter time from product-design to the launch of new models (time to market); improvement in the quality of products sold; reduced defects and/or additional production costs; cooperative and collaborative atmosphere…etc.

Sanchez (1995) listed and described what features and strategies new organizational models should implement for improving their competitiveness:

- *Market researches in real time*. The companies should be less oriented to evaluate the changes in consumer demand through traditional marketing techniques; they must be geared towards new learning models. Nowadays, reduced quantities of products can be really manufactured and marketed only with the aim to assess consumers' first reaction. It has been possible through production processes based on lower costs and shorter time.

- *Intensive market segmentation*. The process of product proliferation is caused by the variety of offering in reduced, but more specific market segments. The company orientation toward an intensive market segmentation reflects the laws of capitalist production and mass customization as the emerging competitive management paradigm. It is characterized by the design, production, mass marketing of differentiated and customized products for niche markets.

- *Performances improvement*. The companies have to be oriented to the rapid upgrading of their own products, by making them obsolete before the action of competitors. The phenomenon of product cannibalization, due to rapid technology improvements, explains the willingness of firms to maintain control over their markets, so discouraging imitations by current and/or potential rivals.

Thus, the proliferation of new competitive models, that strongly affect market competition and globalization, and the new features of technological progress have represented the source of *two types of innovations:*

- *Technological innovations* that influence product development, production and marketing. In particular, processes flexibility and rapidity over the realization of products have significantly increased;
- *Organizational and management innovations*: by using technological innovations, companies can increase the range of their offering and, at the same time, they can improve in efficiency expanding their geographic borders and so generating further innovations.

While technological and managerial innovations increase production discontinuity making company activities more complex, new competitive models push towards the integration of global production through the interaction of highly specialized units.

The breakthroughs produced by technology generate further changes that accelerate the cycles of innovation, creating a relentless spiral of market turbulence.

For all these reasons, the explanation of the transition occurred in the manufacturing processes from lean production to modular production appears quite easier.

This shift can be identified parallel to the changing competitive paradigm from flexible mass production to mass customization .The modular production can be identified as the natural evolution of the organizational lean-production model where companies adopt modularity in production only after passing through structural and management

streamlining. Hence, lean production is the foundation on which stands the modular one (Volpato, 2004).

5) MODULARITY

In its basic principle, modularity implies an approach whose scope is to simplify complex systems, breaking them down into constituent parts (Simon, 1962). A modular system can be characterized by functional partitioning into discrete, scalable, reusable modules, rigorous use of well-defined modular interfaces, and use of industry standards for interfaces. In other words, these standardized interfaces make possible to assemble and re-assemble any modules so that a complex system can be created. For the creation of industrial products, this approach is clearly more complex to be implemented. Usually, the creation of an industrial output starts with the clear perspective of the desired final performance (the final output as a complex system) and then are defined which modules have to be involved as well as their interactions, in a way that allow them to achieve a series of global functionalities. It explains how modular architecture has been introduced as a powerful tool for reducing product-systems complexity by managing the break-down of a system into autonomous and independent subsystems, and through their interconnection via relatively stable interfaces.

These self-organized interfaces allow single module alteration without modifying any other complex system. Therefore, this cutting off between the entire system and its

constituent parts can be highlighted as one of the major modularity's economic advantages (Ulrich, 1995).

Once the architecture has been stabilized, incremental innovations become easier to achieve since they only involve certain modules.

It even becomes possible, as is the case with electronic products, to redefine certain product characteristics *ex post*, in a way that reflects the diverse expressed demands in the marketplace (Langlois and Robertson, 1992).

Modularity also makes accommodate heterogeneous demand easier by differentiating its supply-chain through the differential structuring of the modules' varying layers (Schilling, 2000). Moreover, since the basic architectures are widely shared, supply-differentiation becomes cheaper by generating economies of scale and scope through a proliferation of shared components, especially when such components have survived from one product generation to the next.

On the downstream side, modularity is fundamental for end users that can improve modular products by changing their outdated components (i.e. hardware upgrading).

They can also reduce maintenance and repair costs by simplifying handling operations, thus cutting the costs of any components they need to change (Ulrich, 1995). Thus, these advantages affect the market relationship.

Modularity makes also possible to work in a parallel and relatively in autonomous ways various modules during their design phases, so reducing time-to-market and cuts design costs (Ulrich, 1995; Baldwin and Clark, 2000).

Another crucial point for modularity is that it enables a widespread re-utilization of technologies that were already deployed in the past, thereby decreasing the intensity of problem-solving procedures.

In their industrialization phase, modules can be produced separately, and even by different firms. This means that assembly lines are reduced to mere integrators of pre-assembled modules. Lastly, after-sales service can be more readily delegated to the entity in charge of manufacturing any module. In short, modularity's varying qualities have significantly increased the opportunities for dividing work amongst different tasks (design, production, maintenance) and within each task (working separately on each module design, enabling separate production of different modules that are then assembled during a work of final integration). In this sense, modularity is portentous because it permits a deeper inter-firm division of labor (Langlois, 2003; Sturgeon 2002; Baldwin and Clark, 2000; Sanchez and Mahoney, 1996). In fact, the 'final assembler' takes advange from the greater intra and inter-division of tasks: it means for him to refocus his attention on basic competencies like overall architecture design and the final integration of modules (Sturgeon et al. 2002)

It is the path to which most carmakers have committed and, in turn, this has brought about a transformation in auto suppliers status

5.1) The specialization of car manufacturers in the architecture design.

The automakers decentralization of production involves FTSs' frequent manufacture of components and huge investment in R&D. In fact, the ultimate goal of the automakers is

to develop the overall architecture of the models, thus delegating much of innovative research and industrial development to suppliers. Moreover, technologically advanced suppliers can rely on their businesses by providing services to a plurality of OEMs.

In this way, FTSs are best placed to take advantage from high levels of specialization that modern components conception require. On the other hand, OEMs' desire to minimize their investment undoubtedly plays a key role, even if, this strategy also entails negative aspects. Reducing the number of specialized technicians and researchers can lead to the depletion of knowledge and skills or ,even worse, errors during the OEMs' evaluation phase about suppliers' offer and its technological validity, and also during the subsequent negotiation and purchase stages (Volpato, 2004). Consequently, in order to maximize economies of scale and the return of their investment, the number of suppliers tends to decrease due to strategies of absorption and melting that should secure future survival.

5.2)The supply chain – FTSs' role

The production decentralization effectiveness is based on the assumption that the supply system is able to substitute the OEMs in their direct production. In fact, by adopting a single supplier has resulted in a highly hierarchical structure, in which only the FTSs have direct contacts with the OEM. They are also responsible for organizing on their own a hierarchical system of specialized sub-suppliers.

FTSs were forced during this initial phase to develop their technological, organizational, material and immaterial means and competencies. For different scholars, the shift to

modularity has supported the evolution of vertical relationship practices, engendering a new generation of so-called “0.5” tier suppliers (Volpato, 2004).

However suppliers could manage their network only enhancing their competency levels along four different lines (Fourcade and Midler, 2005; Lara et al., 2005).

First, greater module design responsibilities have forced suppliers to improve their R&D competencies. In modularity’s most advanced configurations, suppliers use functional specifications as a basis for proposing a complete architectural and technical solution for any module that may be crucial to a future vehicle. These investments in R&D have required more resources and have also increased the staff members working as researchers and engineers.

Second, the production of module requires a wide range of technologies and capabilities. Becoming a modular-supplier requires a mastery of dissimilar technologies. FTSs are forced to find those knowledge and ‘know-how’ before their potential competitors, in order to quickly respond or anticipate carmakers requests. This has often led to acquisitions, strategic alliances and collaboration with companies offering complementary competencies due to every technological improvement affects every module.

Third, suppliers of modules have to be, both, responsive in coordinating other suppliers in their vertical relationship and collaborative with other modular-suppliers. They manage a network composed by many suppliers and upstream partners. This also affects the rise in transaction and internal governance costs (plus in R&D spending) since second tier suppliers often lack relevant competencies. Modular-FTSs are asked to ensure the reliability of the whole of the value chain, ranging from their own sourcing to the delivery

of modules to clients. To ensure the lower tiers' complete integration into the delivery chain, FTSs have had to develop competencies in areas like project management, purchasing, sourcing, engineering , quality techniques and logistics.

Fourth, first-tier suppliers competitiveness is mainly dependent on the ability to offer a complete and innovative range of modules. It means the ability to anticipate carmakers specifications by devising innovative solutions. However, this does not mean to maximize the range of products offered; in fact if in the past this strategy could be useful for assessment and selection phases, now, in the supply-hierarchical-structure, this aspect is no longer a factor of advantage but it is a weakness due to higher investment incurred and/or inability to develop an adequate level of innovative solutions for carmakers. Therefore, an effective technological development of the parts, that will be included in the new car-models, can only be achieved through a work based on a strong exchange of information with the automaker designers, so supporting and encouraging the application of co-design strategies .

6) SYSTEM INTEGRATOR

The concept of modularity incredibly supports product innovation and introduces innovative principles about division of labor. Modularity is primarily based on coordination between OEM and suppliers where the company does not conduct and does not control all stages of product design.

Rather, by standardizing the interfaces between component and subsystem, their design and industrialization can be conducted independently by different organizational units.

OEM manages suppliers primarily based on controlling standard interfaces and performance. In addition, the definition of interfaces and standards regarding the characteristics of the price/performance introduces a process of selecting suppliers based substantially on the market reliance (Sturgeon, 2002). Therefore, thanks to the modular concept and network innovation, literature expands its research by introducing the concept *of system integrator*. The system integrators are those companies that combine high-tech components, subsystems, software, skills , capabilities, managers and engineers in order to achieve a competitive product. This requires the design and integration of systems coupled to the management of a network of suppliers provider of components or systems (Hobday et al., 2005).

Obviously, outsourcing strategies arise diverse problems related to the possession of core competencies and the transfer of know-how. Takeishi (2001; 2002) in his work explains how the system integrators are able to optimize the integration capacity in the presence of an outsourcing strategy.

The author makes a distinction between *two kinds of knowledge*: one relating specifically to the components and the architectural one. The technology related to the components' project represents the key criterion in assessing the level of knowledge required. In fact, for projects that present low technological innovation, the carmaker just have high levels of *architectural knowledge* to coordinate the various components of the vehicle. Conversely, when the project is characterized by the need to integrate advanced

technological components, the auto-manufacturer must possess high levels of knowledge *about specific components* for providing its suppliers the engineering solution required.

In this way, for innovative projects the breakdown of knowledge often requires overlap between OEM and supplier roles and knowledge, rather than a clear smooth identification of boundaries (Volpato, 2004; Zirpoli 2010)

In both cases, the basic idea emphasizes how integration capacity is a priority for managing a successful innovation network. By the way, system integrators strategy presents different risks linked to the higher degree of outsourcing within the innovation process. In fact, the ability of integration must be considered as a key point of OEMs activity and more appropriately it must be understood as *integration of knowledge*. Higher levels of outsourcing on the one hand increase the ability to access new knowledge beyond enterprise boundaries ,but on the other hand, they also increase the complexity of integrating this knowledge in a flexible manner within the organization.

Zirpoli (2010) identifies several problems based on Fiat experience and higher levels of outsourcing strategies :

- *Risk of competences' hollowing out.* This risk is especially possible in the extreme case where companies have improved their skills over the architectural production, delegating specific knowledge of components to FTSs. Consequently, the most obvious problems are caused by the difficulty in assessing the single components and in identification of the most qualified offers; by the impossibility to support suppliers during their activities and by the inability to produce in-house. Moreover,

this involves great difficulties in the activity of coordination and management. As actually happened in the case of Fiat, the activities of the engineers mainly consisted of assigning to FTS their performance expectations about the production of components or systems and then monitoring that these objectives were achieved in terms of cost and time. Often, these goals were limited to simple assignment of target price and performance that the suppliers had to respect. But manage the performance of each system does not involve the effective management of system integration.

- *The modularity trap*. This dynamic problem is the result caused by misalignment between enterprise's core competencies and those required by the evolutionary dynamics of the industry (Chesbrough and Kusunoki, 2001). The literature found the link between modular architectures and decentralized organizations. This link directly leads to the modularity trap: a successful enterprise with a decentralized organization continue to have confidence in this approach even when it faces problems related to integral technologies. In the case of changing the dominant architecture of the product, enterprises do not have enough knowledge to understand and manage required interdependencies for the development of the technology, therefore they are not able to specify their needs to suppliers. (Chesbrough and Kusunoki, 2001). Furthermore, the decentralized organizational structure involves problems about the allocation of responsibilities and the specification of tasks. In the case of Fiat, the manager of platform (organizational

units responsible for the development of new products) were responsible for the economic and project management, and at the same time they were also responsible about all technical solutions.

- *Excessive focus over architectural knowledge*. By focusing on a small number of core competencies, so outsourcing those activities defined as non-core, is definitely a cost-effective strategy in terms of cost reduction and increased strategic flexibility. Therefore, this approach leads to outsource the development and production of entire modules and components, by developing only skills in terms of system integration. However, this decision involves significant limitations. In fact, the more compromising one stresses that the integration of components and subsystems can only happen through a specific knowledge of the component (Lincoln et al. 1998).

- *The loss of control over pre-development phase.* Developing a complex product is possible to distinguish *two main stages*: the first one is the *pre-development phase* in which the vehicle is "designed" and where are defined characteristics of components/systems and expected performances; the second one is the *development stage* in which the design and engineering of the vehicle are specified. Between these two phases lies *the industrialization phase* of the vehicle. In the case of Fiat, the losing know-how in some technical areas and having scarce competence for the *design-phase about particular systems*, has prompted the OEM

to involve suppliers in the pre-development stage. Unfortunately, automaker engineers' lack of knowledge has caused problems in defining also specifications about components. In this scenario, FTSs had been forced to manage and to lead the integration work, by defining also objectives and specifications. Thus, they also improved their responsibilities in the pre-development stage. Subsequently, the process of system integration (executed by OEMs) was done during the development phase, while the vehicles' final performances were tested at the end of the process. This OEMs executive delay also caused difficulties of achieving the desired product performance at the expected cost and problems in lead times and quality levels: therefore the resulting project performance did not meet expectation. These were the results of a so called 'black box supply' strategy where suppliers had to design the concept of the component and delivery it when necessary for integration purposes, often during the terminal phase of the whole process (development phase). In this way, not controlling the phase of pre-development and 'by leaving' to suppliers decisions of major importance, has produced significant problems with large repercussion to the whole cycle of production.

6.1) Integration of systems and related performances

Product complexity has a fundamental impact over the organizational dynamics of a company because the products development are the result of decisions often irreversible.

According to Takeishi (2002), there are strong interdependencies between the activities carried out in-house, the knowledge developed and performance obtained. By outsourcing certain activities, such as designing whole systems, dramatically reduces learning opportunities and decision-making abilities. This shows how learning by doing seems to be an inimitable mechanism (Zirpoli, 2010).

In the automotive sector, a vehicle is designed for providing specific and different performances in terms of crash tests, handling, consumption and so on. These performances are generated by the integration of the physical components and systems. For example, the security system for passengers is composed by several systems such as brakes, airbags, seats, safety belts. Therefore, the final performance is the integration result of more than one system. The main problem stemmed from the fact that the systems integration was misinterpreted as mere physical composition, based on positive feedback obtained by different providers: performance cannot be completely decomposed and it is closely related to the composition of the final system itself. In other words, for designing a high-performance vehicle, with reference to the security system, is not sufficient the design of individual systems and components and relating good single performances.

For this reason, the underestimation that the good design of individual systems does not necessarily imply a product with excellent overall performance could lead to a mistake: the physical integration alone is not enough.

The modularity of the product is not the solution to *integration performance problems*; it offers benefits in solving problems of suppliers' coordination by allowing to develop

independent components or systems that will be integrated through standard interfaces. It is effective because assigns tasks to the external providers.

Despite this, the final performance of the vehicle requires diverse skills to manage trade-off of performance between different systems. Hence, a profound knowledge of the interaction between the single sub-systems and the ability to take advantage of that know-how are still fundamental requirements for achieving expected target: in this sense, learning by doing appears as a critical key for managing this trade-off. The erosion of skills through outsourcing activities only leads to the exclusion of OEM engineers and, consequently, an increasing lack of *absorptive capacity* (Cohen and Levintahl, 1990), especially during the pre-development stage. In fact, not being more carried out this stage, the increasingly disruptive technologies that affect component specifications are no longer understood by the OEMs and this affects their integration capacity.

In this scenario the literature emphasizes the direct correlation between learning by doing and absorptive capacity for managing innovation in networks contexts. Appear a difficult challenge to acquire tacit knowledge without a direct exposition (Polany,1966; Nokata and Takeuchi,1995). Therefore, the OEMs should develop expertise over component key technologies which have a strong impact on the overall product performance and present higher level of interdependence.

"When a project requires managing a new technology, the car manufacturer should develop higher levels of competencies in order to solve designing and engineering complexity with their suppliers. In the innovative projects the division of knowledge requires also a collaborative approach rather than borders" (Takeishi,2002)

7) OUTSOURCING OR INSOURCING?

Do outsourcing strategies have really brought the expected benefits?

The analysis of system integration problems in terms of knowledge required reinforces recent decisions made by OEMs for insourcing strategies. However, the literature also emphasizes how the outcome of insourcing strategies leads firms to face difficulties such as time and cost relative to the amount of design and engineering activities re-carried out in-house (Mac Duffie, 2008).

Theoretically, complex products always requires a complete specialization of competencies over components as a crucial pre-condition for sharing innovation with external partners, without losing performance control both in terms of project and product. Companies, in order to accumulate knowledge, must be directly involved in the activities about components and systems design.

Based on these observations the mechanisms that determine the trade-off between *'make or buy'* appear increasingly clear, even if a balancing method appears always difficult to find. Zirpoli (2010) has investigated on the FIAT-case and how the Italian automaker has been able to manage over the years this dilemma. In the older schema of outsourcing implemented by this company, Fiat new-product development process was completely outsourced to different suppliers. For example, dashboards were always outsourced to external providers and Fiat did not design the system in-house for any of its models. When Fiat faced excessive problems caused by externalization, it tried to in-source dispersed competences and activities even not having time, capitals and sufficient

engineering resources to staff on each single project. In this context, Fiat changed its approach by *modifying its organizational structure* (Zirpoli, 2010): it decided to develop key systems only for selected models. These selected ones were defined as a *Template models*.

During the development of a template model, FIAT was fully responsible for the design and engineering processes of the vehicle, always by maintaining collaboration with first tier suppliers. In this way, Fiat controlled and managed all development phase of projects, also by designing and by industrializing only a small part of components and systems.

On the other hand, *derivative product* development projects could either be led by Fiat or by Engineering Suppliers (ES), while design or engineering of components and systems were allocated to suppliers (FTS). The most *important difference* between template and derivative models regarded the processes of engineering, design and even the complete integration of systems whose could be outsourced to external ES.

More specifically, ES contribution was extremely important *only* for derivative models. They were responsible for systems and functions integration realized in collaboration with FTS, always involved in activities for developing new products.

ES provided engineering services to OEMs according to carmakers' contingent needs. They had an important role for developing mass production models with high expected production volumes. However, their more complex tasks were those to re-use and re-invent components, company procedures and possible new archetypical solutions, (afterwards adopted by FIAT engineers for template projects if 'innovative').

In other words, during the development of a template model, internal engineers developed archetype that were supposed to be reapplied to other models.

It gave rise to a family of variant models (derivative models) assigned to external ES,

The difference between derivative and template model makes also an important distinction over the relationship OEMs-FTSs. In the template model, 'learning from suppliers' plays a key role: it gives emphasis on mutual and cooperative collaboration between first tier suppliers and hired engineers. Both work to find solutions for long term applications in a truly cooperative fashion. In fact, in these projects, *suppliers* are asked to offer innovative design solutions, while *internal engineers* are responsible for achieving the overall project, product performances and its technological contents. They are also important for the integration of systems with the rest of the vehicle. For those reasons, the Template-model appears as a good instrument for managing and understanding the technical interdependences, performances trade-off and system integrator requirements. This happened because Fiat understood the importance of component-specific knowledge for the achievement of systems integration performance.(Volpato, 2004; Zirpoli, 2010).

By the way, Fiat's derivative projects development also benefited from this approach.

In fact, the competences accumulated by learning about interdependences and performance trade-offs covered an important role for improving not just product final performance, but also the efficacy of control over suppliers responsible for developing systems, components, and derivative models (Zirpoli,2010).

CHAPTER THREE

1) INTRODUCTION TO THE ANALYSIS

In the last years a lot of studies have been conducted about inter-firm cooperation and the consequent level of trust that this synergy implies, the level of R&D activities and their crucial impact over the firm final performances. These studies have mainly focused their attention on collaboration aims and their contribution to added-value. Different features of cooperation show interesting aspects of analysis such as partners' selection - in terms of geographical location or occupied position in the value chain (Levie and Miller, 2008) - and the intensity of R&D activities (Annand and Khanna, 2000) due to their fundamental role in developing highly technological products or innovative production processes. In fact, a crucial step for collaborating in R&D is represented by the selection of relevant partners (Santamaria, 2007): it can involve foreign suppliers but also, at the same time, with domestic customers and universities (van Beers and Zand, 2014). Cooperation with a diverse set of partners often leads to learning opportunities, accumulation of specific know-how, innovative strategies, reduction of transaction costs…etc, due to exchange of complementary information and the implementation of shared activities (Levie and Miller, 2008).This section examines four research questions about these themes, explored within the automotive industry:

1. *Which aspects of governance help to overcome innovation development obstacles?*
2. *In which way are the organizational practices correlated to the cooperation goals?*
3. *In which way are R&D activities related to the supply-chain position?*
4. *How do R&D activities support innovation purposes?*

The empirical analysis comes out of data from the research project "SMEs' competitiveness and innovation through inter-organizational networks in the automotive industry" - led by Zirpoli, Moretti, and supported by CAMI and Anfia - through the administration of an online questionnaire to a sample of Italian automotive Suppliers from June to September 2014.

Several models have been estimated using the Principal Component Analysis (PCA) ,the Correlation matrix, the Regression Analysis, the Contingency matrix and Chi-square index.

The dataset is composed by 313 observations of 163 variables. For simplification, they can be divided in a quite number of macro-areas. More specifically, the questions in the dataset are focused over:

- *the list of companies*: company name, email, CF, IP, registered office address, zip code, Istat code, headquarters data, ANFIA code, ATECO code and description;
- *the balance sheet data referred to the year 2012/13*: sales, EBITDA, profit, total assets, net assets, financial position, ratio of EBITDA over sales, ROS, ROA, ROE, debt / equity ratio, debt / banking ratio, debt / EBITDA ratio and capital turnover, number of employees, ROI;
- *the description of the company*: it refers to those activities carried out by the supplier (if it is provider of modules, systems, components, services), the position that it holds in the supply chain, if it belongs to a group or network, the percentage

of employees graduates working within the company and the percentage of employees involved in R&D activities.

- *the market in which the company conducts its business*: it is identified through questions about the percentage of the total sales invested for the internal market, for export, for original equipment or aftermarket; through questions about the final destination of the market / product (cars, buses, etc.), also identifying which are the distinctive features possessed by the company if compared to those of competitors (in terms of quality, price, etc.)
- *The degree of innovative performances achieved*: in terms of product, production process, logistics and supporting activities to the processes; who develops innovation (R&D conducted in house or outsourced) ; the percentage of turnover invested in these activities and the obstacles encountered during the process of innovation.
- *The inter-organizational relations:* it refers to possible cooperation or merger and acquisitions (M&A) between companies; the presence of a worldwide network between enterprises (both, with suppliers or customers) and its principal scope (to achieve internationalization, access to new areas, reduction of costs , improvements in R & D, production, innovation processes…etc.)
- *The actual trend:* short-term strategies and possible worldwide growth.

2) METHODS AND ANALYSIS

2.1) Variable reduction - Principal Component Analysis (PCA)

Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called Principal Components.

The number of principal components has to be less or equal to the number of original variables (Spector,1992). Principal components will account those with higher values of variance within the set of observed variables. This method appears useful when redundancy is present within the set of variable. In fact, redundancy means that some of those variables are correlated with one another. In other words, PCA wants to diminish them into a smaller number of new uncorrelated 'artificial' variables. Principal component can be defined as a linear combination of optimally-weighted observed variables (Stepanski,2005) where the greatest variance of the data set is captured by the first principal component and the second greatest variance by the second one…etc.

By setting a principal component analysis is possible to compute scores for each subject on a given principal component.

Here the general formula:

$$PC_1 = b_{11}(X_1) + b_{12}(X_2) + \dots b_{1p}(X_p)$$

Where:

- PC_1 = the subject's score on principal component 1 (the first component extracted)
- b_{1p} = the regression coefficient for observed variable p,
- X_p = the subject's score on observed variable p

An observed variable p "loads" on a factor if it is highly correlated with it. In other words, it means large eigenvalue: if the regression coefficient strongly 'loads' (b_{1p}) the subject's score on observed variable (X_p) , it will determine more of the variance explained by PC1. Note that "X" variables represent the questions (X_1 represents the question number 1, X_2 represent the question number 2…etc of the questionnaire).

It has been possible to compute each subject's score on principal component 1 using the previous formula. The regression coefficients (or loadings) are determined using a type of equation called as eigenequation: these weights produced by the eigenequation are optimal because no other set of weights could produce a set of components that are more successful in explaining the variation in the observed variables.

2.2) Characteristics of principal components.

The first component extracted in PCA accounts for a maximal amount of total variance (the sum of the variances) in the observed variables, while the second extracted component will account for a maximal amount of variance in the data set that was not accounted for by the first component.

Principal component 2 is correlated with some of the observed variables that did not display strong correlations with component 1. Of course, the second component can't be correlated with the first one.

3) ILLUSTRATION OF VARIABLE REDUNDANCY

The questionnaire in the section *'Inter-organizational relationships'* examines diverse mechanisms of governance during a collaboration and how they are influenced by mutual trust between involved partners (Q30) and by inter-organizational practices (Q31).

3.1) Question Q30: correlation Matrix and PCA

Taking in consideration a collaborative relationship, how much do you agree with the following statements related to the trust?

_____ 1. The performance of the partner is generally excellent

_____ 2. The partner could have an opportunistic behavior 'thanks to' collaboration

_____ 3. According to previous collaboration appears difficult to have trust in a partner

_____ 4. There have been situations of disagreement with the partner

_____ 5. The partner is trustable

_____ 6. There is hesitation in cooperating when the specifications are vague

_____ 7. The partner has been always correct during the negotiation phase

In making your ratings, use any number from 1 to 5 in which 1= "slightly agree" and 5 ="strongly agree"

Figure 1- Q30

The question Q30 presents 7 items relating to 'trust/distrust' in a cooperative relationship. Notice, the concept of trust has been object of great attention in literature for what concern its measurement. In fact, there is not one single approach to measure it[2].

[2] Trust has been treated by the literature both as a one-dimensional variable or as multidimensional variable (Anderson and Weitz 1989; Anderson and Narus 1990; Crosby, Evans and Cowles 1990; Ganesan,1994; Zaheer and Venkatraman 1995; Geyskens et al. 1996; Doney and Cannon, 1997)

By applying a multidimensional approach in treating 'trust' (as Zaheer, McEvily, Perrone, 1998), it has been possible to observe as the items 1-5-7 belong to the same construct: *something positive* linked to cooperation practices. Similarly, the items 2-3-4-6 also all seem to deal with the same topic: *the level of reliance in the partner during collaboration*.

Correlation Matrix

By computing all possible correlations between the 7 items, the resulting Matrix of correlation is reproduced in Table 1:

	Q30_1	Q30_2	Q30_3	Q30_4	Q30_5	Q30_6	Q30_7
Q30_1	1.000	-0.035	-0.020	-0.015	0.727	-0.194	0.569
Q30_2	-0.035	1.000	0.489	0.424	0.016	0.288	0.256
Q30_3	-0.020	0.489	1.000	0.228	0.038	0.659	0.075
Q30_4	-0.015	0.424	0.228	1.000	-0.002	0.124	0.103
Q30_5	0.727	0.016	0.038	-0.002	1.000	-0.110	0.683
Q30_6	-0.194	0.288	0.659	0.124	-0.110	1.000	-0.078
Q30_7	0.569	0.256	0.075	0.103	0.683	-0.078	1.000

Table 1- Correlation Matrix

The rows and columns of Table 1 correspond to the seven variables included in the analysis: row 1 (and column 1) represents variable 1, row 2 (and column 2) represents variable 2...etc. Where a given row and column intersect, there will be found the

correlation between the two corresponding variables. The correlation coefficient of the table measures the degree of agreement (if positive) or disagreement (if negative) between the variables. It is always measured between -1 and 1.

A correlation equal to 0 indicates there is no relation between the two variables[3].

PCA – Different steps

Initial extraction of the components. In this step will be extracted 7 components. However, only those with greater amount of total variance will be analyzed. The first principal component presents a large amount of the total variance (2.37) , while each succeeding component will progressively show smaller amounts of variance (2.17)

```
Call: principal(r = Q30_inv, nfactors = 2, rotate = "varimax", scores = T)
Standardized loadings (pattern matrix) based upon correlation matrix

        PC1   PC2    h2   u2  com
Q30_1   0.87 -0.10  0.76 0.24 1.0
Q30_2   0.12  0.77  0.60 0.40 1.0
Q30_3   0.00  0.85  0.72 0.28 1.0
Q30_7   0.07  0.54  0.29 0.71 1.0
Q30_8   0.91 -0.01  0.82 0.18 1.0
Q30_12 -0.22  0.73  0.58 0.42 1.2
Q30_15  0.85  0.16  0.75 0.25 1.1

                       PC1  PC2
SS loadings           2.37 2.17
Proportion Var        0.34 0.31
Cumulative Var        0.34 0.65
Proportion Explained  0.52 0.48
Cumulative Proportion 0.52 1.00
```

Figure 2 - PCA

[3] The correlation *does not include the concept of cause and effect*, but only to the possible relationship between variables. The correlation defines a systematic relationship between two variables, but not that one causes the other. Thus, more the value is away from zero, there will be a stronger correlation between them

This test confirms the hypothesis that 2 components are sufficient: they must be retained because present eigenvalues (SS Loadings) greater than 1.00[4]. This leads to the interpretation of only these two components.

The Scree test (Figure 3)

It makes possible to look the eigenvalues (SS Loadings) associated with each component also visually observing the “break” between the components with relatively larger eigenvalues and the others. Thus, those components that appear before the "break" are assumed to be meaningful for interpretation; on the other hand, those appearing after the "break" are classified unnecessary and not retained.

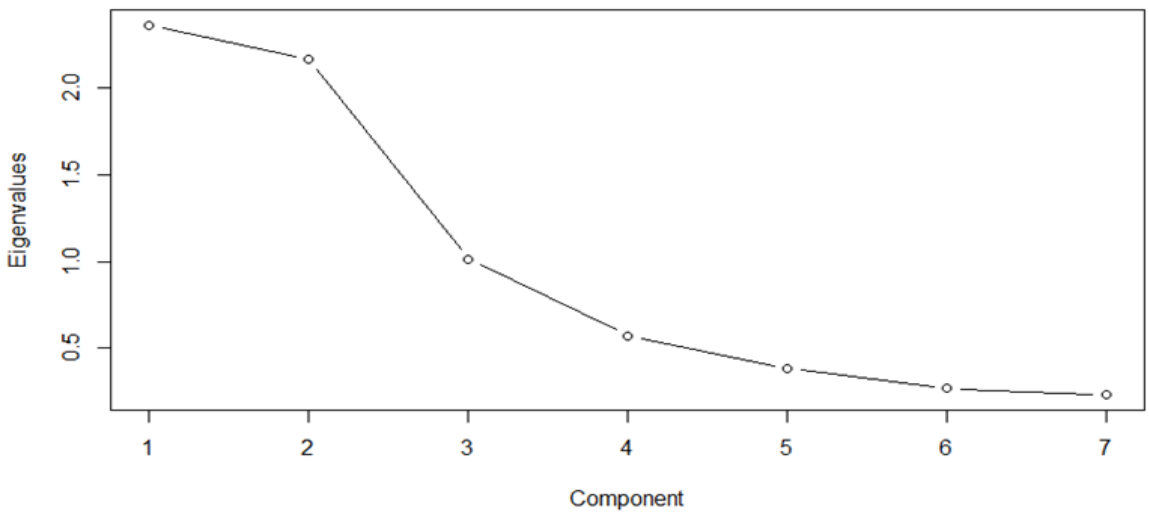

Figure 3

The scree-plot visually suggests that two components are sufficient. Using the first two components it has been possible to explain the 65% of the variability (cumulative percent of variance) so reducing the complexity of the dataset from seven variables to just two.

[4] The eigenvalue-one criterion (Kaiser, 1960)

This method takes *cumulative percent of variance* for solving the number of components problem[5]

Interpretation of results

After having performed a *varimax rotation*[6], it has been possible the interpretation of the first and the second principal components.

By reading the Figure 2, Principal Component 1 is positively correlated with items 1-5-7:

1. *The performance of partner is generally excellent,*
5. *The partner is trustable,*
7. *The partner has been always correct during the negotiation process.*

This component shows the positive aspects of a collaborative relationship, so it makes sense to label this as "*Good relationship"*.

On the other hand, items 2-3-4-6 load for component 2. These items are:

2. *The partner could have an opportunistic behavior thanks to collaboration,*
3. *According to previous collaborative experiences appears difficult to have trust in a partner,*
4. *There have been situations of disagreement with the partner,*
6. *There is hesitation in cooperating when the specifications are vague.*

In this case, it makes sense to label this as "*Reliance*" component.

[5] Cumulative Var , Figure 1
[6] Orthogonal rotation for obtaining uncorrelated components

3.2) Question Q31: correlation matrix and PCA

Taking in consideration a collaborative relationship, how much do you agree with the following statements related to organizational practices?

_____ 1. The relationship has generated formal organizational structures (team, task force…etc)

_____ 2. The relationship has required to share operative and technical know how

_____ 3. The relationship has required to set up formal rules for coordination purposes

_____ 4. The partnership involves also social relationships between employees

_____ 5. The relationship has required transfer or job rotation between partnering companies

_____ 6. The relationship has required shares of techniques or operative information

_____ 7. The relationship has required to implement shared practices (profit-sharing, target costing…etc)

In making your ratings, use any number from 1 to 5 in which 1= "slightly agree" and 5 ="strongly agree."

Figure 4- Q31

The question Q31 presents also seven items relating to *organizational practices* in a cooperative relationship. They cover an important role in a network governance because imply the definition of rules, exchange of competencies, social interaction and so on.

Correlation Matrix

This question also presents the problem of redundancy within variables. By computing all possible correlations between these seven items, the resulting matrix of correlation is reproduced in Table 2:

	Q30_1	Q30_2	Q30_3	Q30_4	Q30_5	Q30_6	Q30_7
Q30_1	1.000	-0.035	-0.020	-0.015	0.727	-0.194	0.569
Q30_2	-0.035	1.000	0.489	0.424	0.016	0.288	0.256
Q30_3	-0.020	0.489	1.000	0.228	0.038	0.659	0.075
Q30_4	-0.015	0.424	0.228	1.000	-0.002	0.124	0.103
Q30_5	0.727	0.016	0.038	-0.002	1.000	-0.110	0.683
Q30_6	-0.194	0.288	0.659	0.124	-0.110	1.000	-0.078
Q30_7	0.569	0.256	0.075	0.103	0.683	-0.078	1.000

Table 2- Correlation Matrix

The rows and columns of Table 2 correspond to the seven variables included in the analysis: row 1 (and column 1) represents variable 1, row 2 (and column 2) represents variable 2, and so on. Where a given row and column intersect, there will find the correlation between the two corresponding variables.

The correlation coefficient of the table measures the degree of agreement (if positive) or disagreement (if negative) between the variables.

It is always between -1 and 1. Thus, more the value is away from zero, there will be a stronger correlation between the variables.

PCA – Different steps

Initial extraction of the components

In this step will be extracted 7 components (as the variables taken in consideration). However, only those with greater amount of total variance will be analyzed.

The first principal component presents a large amount of the total variance (2.41) , while each succeeding component will progressively show smaller amounts of variance (2.12)

```
Principal Components Analysis
Call: principal(r = Automotive.Q[, 7:13], nfactors = 2, rotate = "varimax
", scores = T)
Standardized loadings (pattern matrix) based upon correlation matrix

      PC1  PC2    h2   u2 com
Q31_1 0.57 0.51  0.58 0.42 2.0
Q31_2 0.10 0.91  0.84 0.16 1.0
Q31_3 0.63 0.40  0.55 0.45 1.7
Q31_4 0.75 0.03  0.56 0.44 1.0
Q31_5 0.71 0.07  0.51 0.49 1.0
Q31_6 0.11 0.92  0.86 0.14 1.0
Q31_7 0.78 0.13  0.62 0.38 1.1

                       PC1  PC2
SS loadings           2.41 2.12
Proportion Var        0.34 0.30
Cumulative Var        0.34 0.65
Proportion Explained  0.53 0.47
Cumulative Proportion 0.53 1.00
```

Figure 5 - PCA

This test in figure 5 confirms the hypothesis that 2 components are sufficient: they must be retained because present eigenvalues (SS Loadings) greater than 1.00[7]. This leads to the interpretation of only these two components. Notice, the item Q30_1 shows difficulty in its interpretation because it loads both over PC1 (0.57) and PC2 (0.51).

It will be excluded from the rotation analysis: its exclusion leads to a new PCA (table 3).

[7] As before, the eigenvalue-one criterion (Kaiser, 1960)

(New) Correlation matrix and extraction of components excluding item_1

	Q31_2	Q31_3	Q31_4	Q31_5	Q31_6	Q31_7
Q31_2	1.000	0.339	0.160	0.211	0.772	0.208
Q31_3	0.339	1.000	0.429	0.299	0.389	0.449
Q31_4	0.160	0.429	1.000	0.364	0.149	0.420
Q31_5	0.211	0.299	0.364	1.000	0.167	0.462
Q31_6	0.772	0.389	0.149	0.167	1.000	0.238
Q31_7	0.208	0.449	0.420	0.462	0.238	1.000

Table 3- New correlation matrix

```
Principal Components Analysis
Call: principal(r = Automotive.Q[, 8:13], nfactors = 2, rotate = "varimax
", scores = T)
Standardized loadings (pattern matrix) based upon correlation matrix
        PC1  PC2   h2   u2 com
Q31_2  0.12 0.92 0.86 0.14 1.0
Q31_3  0.63 0.39 0.55 0.45 1.7
Q31_4  0.76 0.03 0.58 0.42 1.0
Q31_5  0.72 0.07 0.52 0.48 1.0
Q31_6  0.13 0.93 0.88 0.12 1.0
Q31_7  0.79 0.13 0.64 0.36 1.1

                       PC1  PC2
SS loadings           2.15 1.89
Proportion Var        0.36 0.31
Cumulative Var        0.36 0.67
Proportion Explained  0.53 0.47
Cumulative Proportion 0.53 1.00
```

Figure 6 – PCA no item Q30_1

The Scree test (figure 7)

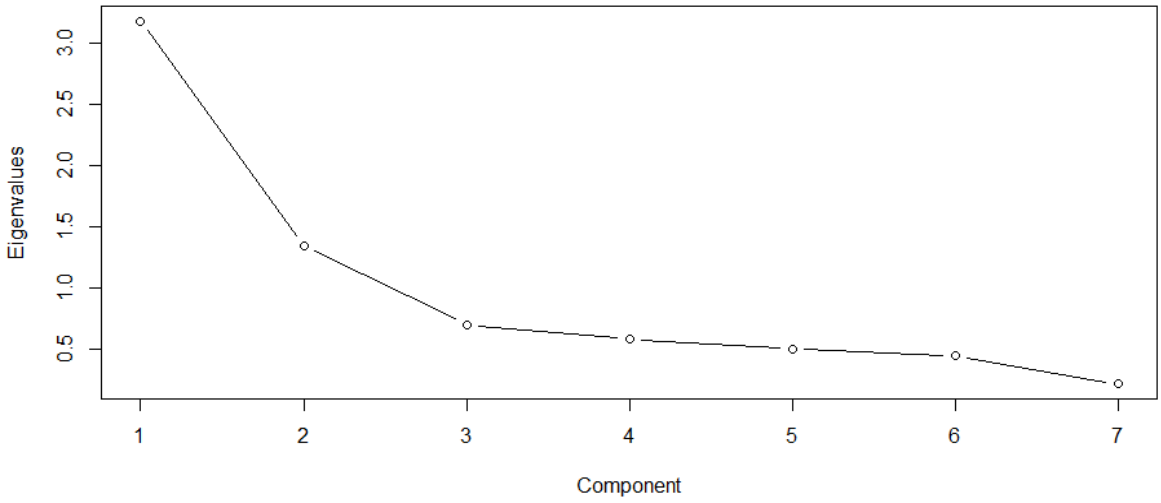

Figure 7

The scree-plot visually suggests that two components are sufficient. Using the first two components it has been possible to explain the 67% of the variability (cumulative percent of variance) so reducing the complexity of the dataset from seven variables to just two. This method takes the *cumulative percent of variance* for solving the problem of number of components[8]

Interpretation of results

After having performed a *varimax rotation*[9], it has been possible to interpret the first and the second principal component and which items belong to them.

Reading Figure 6, Principal Component 1 is positively correlated with items 3-4-5-7

[8] Cumulative Var , Figure 2.1
[9] Orthogonal rotation for obtaining uncorrelated components

3. *The relationship has required to set up formal rules for coordination purposes*
4. *The partnership also involves social interactions between employees*
5. *The relationship has required transfer or job rotation between partnering companies*
7. *The relationship has required to implement shared practices (profit-sharing, target costing…etc)*

Intuitively, this component can be labeled as "*Organizational Management"* because it highlights what collaboration involves in terms of rules, social interactions and common practices.

On the other hand, items 2-6 load for principal component 2.These items are:

2. *The relationship has required to share operative and technical know how*
6. *The relationship has required shares of techniques or operative information*

This PC2 has been labeled as *"Sharing"*

3.3) Results of PCA for question Q30 and Q31

PCA has allowed to synthesize 14 redundant items into four variables called "*good partnership", "reliance", "organizational management" and "sharing".*

They have been introduced in the dataset as new variables. In fact, their extrapolation was useful for a second analysis, in which it has been possible to respond the first two research questions linked to network governance, its final purposes and the obstacles for obtaining innovative outputs.

4) RESEARCH QUESTION 1

- *Which aspects of governance help to overcome innovation development obstacles?*

	Internal financial resource	Extern financial resource	High costs	Qualified personnel	Info on techno	info on market	Volatile dmand	In finding partner	Competit
Organiz. Mgmt	-0.0519	0.0546	0.0420	0.0020	-0.0065	-0.0111	-0.0981	-0.0123	-0.026
Sharing	0.1477	-0.0100	0.0048	-0.0124	0.0240	0.0283	-0.0886	-0.0508	0.0602
Good Partnersh.	-0.0443	-0.0780	-0.1032	0.0195	-0.0938	-0.1278	-0.0421	0.0159	-0.007
Reliance	-0.1068	-0.1616	**-0.2902**	-0.1584	-0.1410	**-0.3080**	**-0.2213**	-0.1726	-0.158

Table 4[10] - Correlation matrix

	Internal financial resources	External financial resource	High costs	Qualif. Person.	Info on techno	Info on market	Volatil dmnd	In finding partner	Competit
Organiz. Mgmt	0.5610	0.5405	0.6374	0.9818	0.9415	0.9006	0.2705	0.8900	0.7650
Sharing	0.0962	0.9107	0.9570	0.8898	0.7880	0.7510	0.3202	0.5692	0.4997
Good Partnersh	0.6199	0.3813	0.2462	0.8269	0.2925	0.1507	0.6369	0.8590	0.9349
Reliance	0.2301	0.0685	**0.0009**	0.0742	0.1124	**0.0004**	**0.0121**	0.0514	0.0736

Table 4.1- *p*-values

[10] The significant correlations determined by p-values below 5% are highlighted.

Table 4 shows the correlation coefficients. They measure the degree of agreement (if positive) or disagreement (if negative) between the variables and they are always between 1 and - 1[11].Thus, more the value of *r* is away from zero, there will be a stronger correlation (dependence) between the variables.

Table 4.1 shows the 'p-values'. They result complementary with the correlation analysis. In fact, this matrix wants to exclude the possibility of making an erroneous conclusion during the interpretation of results. Basically if the p-value associated to the coefficient is low, the interpreted correlation is 'significant' and the probability of failure appears also to be low. Conversely, if the p-value is higher than 5%, the correlation could not be 'significant' and therefore ignored.

Table 4 and 4.1 show 9 items in the first row. They represent possible impediments:

1) *Lack of internal financial resources,*
2) *Lack of external financial resources,*
3) *High costs for innovating,*
4) *Lack of qualified personnel,*
5) *Lack of information on technologies,*
6) *Lack of market information,*
7) *Volatile demand for innovative products and / or innovative services,*
8) *Difficulties in finding partners to carry out innovation activities,*
9) *Consolidated technological leadership of other enterprises*

[11] Also known as Person's r (correlation coefficient)

These items are present in the demand X22[12] in which is asked to assign their level of importance/contribution (in a scale from 1 to 5 where 1= " min importance" and 5 = "max importance") for innovation activities development during the years 2011-2012-2013

Interpretation of results

The results and relative interpretation of the correlation matrix (Table 4) can confirm that there is a *negative* relation between items 3-6-7 and the level of *reliance* in the partner. Thus, having *more reliance* in the partner, the costs of innovation, lack of market information and volatile demand for innovative products or services tend to decrease.

5) RESEARCH QUESTION 2

- *In which way is the governance of collaboration correlated to cooperation goals?*

	New R&D project	Marketing activities	Production collaboration	Innovation processes	Less production costs	To become internat.	Access to new markets	New resources
Organizational Management	**0.2293**	0.0280	**0.2452**	0.0385	0.0999	0.0902	0.1564	**0.1857**
Sharing	0.1200	-0.0035	0.0694	0.0212	-0.0469	-0.0308	-0.0383	-0.0120
Good Partnership	0.0596	0.1076	0.1143	0.0530	-0.0381	0.1077	0.0611	-0.0273
Reliance	-0.0224	-0.1166	-0.0490	-0.0064	-0.0554	0.0018	-0.1255	-0.0406

Table 5 - Correlation matrix

[12] Questionnaire: "SMEs' competitiveness and innovation through inter-organizational networks in the automotive industry" conducted by Zirpoli and Moretti

	New R&D project	Marketing activities	Production collaboration	Innovation processes	Less production costs	To become international	Access to new markets	New resources
Organiz. Management	**0.0092**	0.7540	**0.0053**	0.6661	0.2621	0.3113	0.0778	**0.0358**
Sharing	0.1773	0.9683	0.4361	0.8125	0.5993	0.7297	0.6678	0.8928
Good Partnership	0.5036	0.2265	0.1989	0.5526	0.6692	0.2261	0.4931	0.7600
Reliance	0.8016	0.1900	0.5826	0.9432	0.5349	0.9836	0.1581	0.6489

Table 5.1- *p values*

As before, only those variables interpreted as 'significant' have been taken in consideration. The eight items present in the first row on Table 5 and 5.1 represent different possible answers given to the question X24 in which is asked to grade from 1 to 4 (where 1="no"; 2 = "occasionally"; 3 = "often" and 4 ="always") what have been the main goals of the partnership over the period 2011-2012-2013.

Interpretation of results

The results and the relative interpretation of the correlation matrix (Table 5) can confirm that there is a *positive* relation between items 1-3-8 and '*Organizational Management'* variable of the company in cooperating.

More specifically, the level of Organizational management between partners tends to increase when the interests in developing new R&D projects, in having collaboration for production processes and in acquiring new resource tend to be higher.

6) INTRODUCTION TO CONTINGENCY TABLES

The descriptive statistic deal with the analysis of two jointly variables in order to know if exists a relation of dependency or independency between them. Thus, statistical data can be collected in a double entry table, also called as *contingency table* (or frequency table). This table shows the absolute frequencies of each class taken into account and its general form is *r x c* as shown in Table 6.

Y

X	y_1	y_2	y_j	y_c	**sum Σ**
x_1	$\mathbf{n_{11}}$	$\mathbf{n_{12}}$			$n_{1.}$
x_2	$\mathbf{n_{21}}$	$\mathbf{n_{22}}$			$n_{2.}$
Xi			$\mathbf{n_{ij}}$		ni.
x_r				**Nrc**	$n_{r.}$
Sum Σ	$n_{.1}$	$n_{.2}$	*Nj*	$n_{.c}$	n

Table 6 - Contingency table (*r x c*)

In Table 6, the sample of *n* units is classified with respect to two variables X and Y.

X presents modes $x_1, x_2, x_3 \ldots x_r$; while Y modes $y_1, y_2, y_3 \ldots, y_c$. The frequency on the i-th row and j-th column is represented by n_{ij} , i= 1,2, 3... r ; j = 1,2,3 ... c.

The frequencies listed above are subject to the following reports:

1. $n_{i.} = \sum_{j=1}^{c} n_{ij}$ (sum per row)
2. $n_{.j} = \sum_{i=1}^{r} n_{ij}$ (sum per column)
3. $\sum_{i=1}^{c} n_{i.} = \sum_{j=1}^{r} n_{.j} = \sum_{i=1}^{c}\sum_{j=1}^{r} n_{ij} = n$ (sum per row and column)

The most important issue regards the presence of independence or dependence between variables. Assuming that the probability of extracting an observation defined as p_{ij} that belongs to the i-th category of X and at the *j-th* category of Y; the *Expected Frequency* (E_{ij}) in the cell ij will be equal to:

4. $E_{ij} = n \cdot p_{ij}$, $\quad i = 1,2,3\ldots r;\ j = 1,2,3..c$

If $p_{i.}$ is identified as the probability to extract an observation belonging to the *i*-th category of X and $p_{.j}$ as the probability to extract an observation belonging to the *j-th* category of Y, *the independence* between the two variables implies that:

5. $p_{ij} = p_{i.} \cdot p.j$

In terms of frequency:

6. $Eij = n \cdot p_{i.} \cdot p_{.j}$

The probabilities are estimated from the observed frequencies:

7. $p_{i.} = \frac{ni.}{n}$ *and* $p.j = \frac{n.j}{n}$

8. $Eij = n \cdot p_{i.} \cdot p_{.j} = \frac{ni. \cdot n.j}{n}$

where the E_{ij} is the Expected frequencies *under the hypothesis of independence*.

Under this hypothesis expected frequencies (E_{ij}) and observed frequencies (n_{ij}) should differ slightly. Therefore, it appears reasonable to use the test of independence based on the difference between them

Chi - square index

The presence of statistical independence or connection between two variables X and Y is measured by the Chi - square index χ^2.

Starting from the null hypothesis $H_0 : p_{ij} = p_{i.} \cdot p.j$ *(5.)* it is based on a comparison between the absolute observed frequencies nij (contained in the contingency table) and the expected frequencies Eij (which would be observed in the case of independence between X and Y).

Pearson (1904) suggested the following formula for the calculation :

9. $$\chi^2 = \frac{\sum_{i=1}^{r}\sum_{j=1}^{c}(n_{ij} - E_{ij})^2}{E_{ij}}$$

At this point the calculation of χ^2 will explain how the observed data differ from those estimated under the assumption of independence. A low value of χ^2 explains that the

variables do not affect each other (independence); while an higher value of χ^2 proves connection between the variables (dependence). Thus, if the theory explains well enough the reality, the chi-square will have a small value, otherwise it will have a high value.

6.1) Research question 3

- *In which way are R&D activities related to the supply-chain position?*

	R&D activities	Supply position	X^2	Df	*p- values*
1	More R&D employees	Only one	20.996	15	0.137
2	New product on the market	Only one	5.517	3	0.1376
3	Internally developed	Only one	24.137	15	0.0628
4	Externally developed	Only one	13.496	15	0.564
5	**Filings of patents**	**Only one**	**8.538**	**3**	**0.0361**
6	New projects	Only one	9.258	9	0.4138
7	New production processes	Only one	3.328	3	0.3438
8	New systems, methods, products or services	Only one	0.441	3	0.9316
9	Supporting activities	Only one	7.313	3	0.0626
10	**More R&D employees**	**More than one**	**34.103**	**20**	**0.0254**
11	**New product on the market**	**More than one**	**10.884**	**4**	**0.0279**
12	Internally developed	More than one	27.349	20	0.1257
13	Externally developed	More than one	13.3	20	0.8642
14	**Filings of patents**	**More than one**	**18.644**	**4**	**9e-04**
15	New projects	More than one	14.029	12	0.2989
16	New production processes	More than one	6.969	4	0.1376
17	New systems, methods, products or services	More than one	0.714	4	0.9496
18	**Supporting activities**	**More than one**	**12.766**	**4**	**0.0125**

Table 6.1 – Matrix of results

Taking in consideration items 5-10-11-14-18 (they show higher degrees of significance because < 5%[13]), it has been possible to develop the following contingency tables:

a. contingency table - item 5 : supply-position and filing of patents

	Tier I	Tier II	Tier III	Others
Yes	28 (32%)	5 (15%)	4 (18%)	1 (5%)
No	60 (68%)	28 (85%)	18 (82%)	18 (95%)
TOT	88	33	22	19

Table 6.2 – Frequencies and % column

	Tier I	Tier II	Tier III	Others	TOT
Yes	28 (74%)	5 (13%)	4 (11%)	1 (3%)	38
No	60 (48%)	28 (23%)	18 (15%)	18 (15%)	124

Table 6.3 – Frequencies and % rows

Results

Chi Square index shows a statistically significant relationship between the main position of the company in the supply chain and the filing of patents in 2011-2013. The frequencies show that *the filing of patents decreases* as the position in the supply chain changes from Tier I to other.

[13] P-value confirms the significance of correlations

b. contingency table - Item 10: possible other supply position and percentage of R&D employees during the year 2013

	Tier I	Tier II	Tier III	Only one supply position	Other
0%	0 (0%)	6 (13%)	3 (27%)	39 (38%)	0 (0%)
1-4%	3 (60%)	19(42%)	6 (55%)	41 (39%)	3 (50%)
5-9%	0 (0%)	14(31%)	1 (9%)	13 (13%)	2 (33%)
10-19%	2 (40%)	1 (2%)	1 (9%)	6 (6%)	1 (17%)
20-39%	0 (0%)	4 (9%)	0 (0%)	4 (4%)	0 (0%)
> 40%	0 (0%)	1 (2%)	0 (0%)	1 (1%)	0 (0%)
TOT	5	45	11	104	6

Table 6.4 – Frequencies and % for column

	Tier I	Tier II	Tier III	Only one supply position	Other	Total
0%	0 (0%)	6 (13%)	3 (6%)	39 (81%)	0 (0%)	48
1-4%	3 (4%)	19 (26%)	1 (8%)	41 (57%)	3 (4%)	72
5-9%	0 (0%)	14 (47%)	1 (3%)	13 (43%)	2 (7%)	30
10-19%	2 (18%)	1 (19%)	1 (9%)	6 (55%)	1 (9%)	11
20-39%	0 (0%)	4 (50%)	0 (0%)	4 (50%)	0 (0%)	8
> 40%	0 (0%)	1 (50%)	0 (0%)	1 (50%)	0 (0%)	2

Table 6.5 – Frequencies and %for rows

Results

Chi Square index shows a statistically significant relationship between the possible other position held by the enterprise in the supply chain and the percentage of R&D employees during the year 2013. However, the frequencies appear difficult to interpret because they are significantly different from each other.

c. contingency table - Item 11 : possible other supply- position and the market introduction of new or significantly improved products.

	Tier I	Tier II	Tier III	Only one supply position	Other
Yes	5 (100%)	33 (80%)	11 (85%)	60 (61%)	2 (40%)
No	0 (0%)	8 (20%)	2 (15%)	38 (39%)	3 (60%)
Total	5	41	13	98	5

Table 6.6– Frequencies and % for column

	Tier I	Tier II	Tier III	Only one supply position	Other	Total
Yes	5 (5%)	33 (30%)	11 (10%)	60 (54%)	2 (2%)	111
No	0 (0%)	8 (16%)	2 (4%)	38 (75%)	3 (6%)	51

Table 6.7 – Frequencies and % for rows

Results

Chi Square index shows a statistically significant relationship between the possible other position held by the firm in the supply chain and the market introduction of new or significantly improved products. The frequency shows that those who carry out any other function and take up another position in the supply chain are those *most frequently introduce new and/or upgraded products.*

d. Contingency table - Item 14 : possible other supply position and filing of patents

	Tier I	Tier II	Tier III	Only one supply position	Other
Yes	3 (60%)	17 (41%)	0 (0%)	16 (16%)	2 (40%)
No	2 (40%)	24 (59%)	13 (100%)	82 (84%)	3 (60%)
Total	5	41	13	98	5

Table 6.8 – Frequencies and % for column

	Tier I	Tier II	Tier III	Only one supply position	Other	Total
Yes	3 (8%)	17 (45%)	0 (0%)	16 (42%)	2 (5%)	38
No	2 (2%)	24 (19%)	13 (10%)	82 (66%)	3 (2%)	124

Table 6.9 – Frequencies and % for rows

Results

Chi Square index shows a statistically significant relationship between the possible other position held by the firm in the supply chain and the filing of patents in the period 2011-2013. It may be said that companies that hold a second position in the supply chain tend to *file more patents* than those which occupy only one position (except for Tier III)

e. contingency table - Item 18 : possible other supply position and new/or improved supporting activities to production processes.

	Tier I	Tier II	Tier III	Only one supply position	Other
Yes	1 (20%)	22 (54%)	10 (77%)	42 (43%)	5 (100%)
No	4 (80%)	19 (46%)	3 (23%)	57 (57%)	0 (0%)
Total	5	41	13	98	5

Table 6.10 – Frequencies and % for column

	Tier I	Tier II	Tier III	Only one supply position	Other	Total
Yes	1 (1%)	22 (28%)	10 (13%)	42 (53%)	5 (6%)	80
No	4 (5%)	19 (23%)	3 (4%)	57 (68%)	0 (0%)	82

Table 6.11 – Frequencies and %for rows

Results

Chi Square index shows a statistically significant relationship between the possible other position held by the firm in the supply chain and new or improved supporting activities to production processes. More specifically, these supporting activities concern the management of purchasing, the management of information systems, administrative systems and accounting systems. Those who hold a second position in the supply chain tend *to improve supporting activities linked to the production processes* and related support activities much more than those present in only one supply chain position.

7) REGRESSION ANALYSIS

The linear regression analysis is a technique useful in analyzing the linear relationship between a dependent variable (or response variable) and one or more independent variables (or predictors). The linear regression analysis is a methodology which is based on the assumption asymmetrical existence of a relationship of *cause-effect relationship* between one or more independent variables and the dependent variable.

The study of this relationship may have a dual purpose:

- *explanatory*: in order to understand and weigh the effects of the independent variables (IV) on the dependent variable (DV) as a function of a particular theoretical model;
- *predictive*: identifying a linear combination of independent variables in order to predict the value assumed by the dependent variable.

In terms of function:

- $Y = f(X1, X2, \ldots Xk) + \varepsilon$

It indicates the existence of a functional link between the *quantitative* dependent variable Y and the repressors represented by the component f (X1, X2, ... Xk) also known as *systematic component.*

ε component represents the variability of the dependent variable that is not easily identifiable: it has a random nature and it is not considered by the regression model.

7.1) Research question 4

- *How do R&D activities support innovation purposes?*

Multiple regression

Notice that, '*Innovation' variable (filing of patents)* has to be considered as dependent variable[14], while '*R&D activities'* is composed by a quite number of independent variables. This work analyze 'filing of patents' as explanatory variable for innovation development. The automotive sector has seen the number of patent filings around the world grow by double-digits year-on-year over the past five years: according to Germany's Center of Automotive Management (CAM), the 18 biggest global carmakers registered more than 57,000 patents in 2014[15].

The number of patents issued and the technical and scientific literature citations on them have been used to develop quantitative measures of innovative output and science - technology linkages. Gallini (2001), for example, provided a survey about patents as instruments for measuring innovation. McAleer, Chan and Marinova (2002) were among the first to explore the time series properties of patent activity for the leading inventive countries by modelling the volatility inherent in monthly US patent shares. Instead, Adam Jaffe (1997) pointed out advantages of using patent data by specifying how they are readily available, contain considerable details and can be used to develop time series analysis. However, their limitations are well known: some important technologies are not

[14] It refers to Question X21 in which it is asked if the company has been able for filing new patents in 2011-2012-2013

[15] http://www.automotiveit.com/study-automotive-patents-up-7-pc-in-2014/news/id-0010679

patentable (i.e. software is protected by copyright) or replaced by secrecy. Patents represent only the practical application of ideas, not more general advances in knowledge. They also represent inventions, not activities and investments to commercialize new technology. Patenting activities can be also targeted for protecting an invention from imitation, to block competitor actions or *to evaluate the productivity of R&D activities* (Cooper and Merrill, 2000). Thus, by starting from the latter definition, patents provide an objective measure of the application of technological new knowledge obtained through R&D activities, considered as independent variable of this analysis and able to boost patenting through innovative outcomes. Analytically, the analysis has been done by using a *multiple regression* where the dependent variable '*innovation*' regresses on at least two independent variables that belong to the same construct *'R&D activities'*.

These variables refer to[16]:

1) *the percentage of workers employed in the R&D in 2013;*
2) *the market introduction of new or improved products;*
3) *experimental R&D activities entirely developed within the company*
4) *the acquisition of services and/or goods for R&D activities*
5) *the development of R&D activities*
6) *innovation and/or technological improvement of production processes*
7) *innovation and/or technological improvement of logistics systems, supply systems and distribution systems (innovative processes)*
8) *innovation or improvement of supporting activities to the production processes such as purchasing management, maintenance activities and the management of information and administrative systems (innovative processes)*

[16] They represent the question number Q28; X14 ; X20_9 , X_14 ; X24_2 ; X17_1,4,6

```
Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)        -0.085188   0.085807  -0.993   0.3225
Variable 1          0.069811   0.032937   2.120   0.0358 *
Variable 2          0.093240   0.081260   1.147   0.2531
Variable 3          0.005602   0.027432   0.204   0.8385
Variable 4         -0.021451   0.036467  -0.588   0.5573
Variable 5          0.031454   0.042903   0.733   0.4647
Variable 6          0.099093   0.074396   1.332   0.1850
Variable 7          0.171800   0.079092   2.172   0.0315 *
Variable 8         -0.122442   0.069187  -1.770   0.0789 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Residual standard error: 0.4004 on 143 degrees of freedom
  (161 observations deleted due to missingness)
Multiple R-squared:  0.1655,      Adjusted R-squared:  0.1189
F-statistic: 3.546 on 8 and 143 DF,  p-value: 0.0001
```

Figure 8- F-test

The F-test on the model indicates that it is significant (p = 0.001). Adjusted R-squared measures the *goodness of fit* of a multiple regression model: it is able to explain 11.89% of the variability of Innovation; it represents an acceptable result. Finally, it has been possible to eliminate the variables with higher p-values and therefore not very meaningful to improve the model.

```
Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)        -0.005534   0.073355  -0.075 0.939964
Variable 1          0.104602   0.028410   3.682 0.000322 ***
Variable 7          0.185064   0.074535   2.483 0.014125 *
Variable 8         -0.090166   0.067280  -1.340 0.182203
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.4028 on 151 degrees of freedom
  (158 observations deleted due to missingness)
Multiple R-squared:  0.1301,      Adjusted R-squared:  0.1128
F-statistic: 7.527 on 3 and 151 DF,  p-value: 9.981e-05
```

Figure 9 - F-test

Results and interpretation

The F-test (Figure 9) on the multiple regression model shows an high level of significance (p-value= 0). The test has also been able to explain 11.3% of the variability of "Innovation". In fact, the coefficients indicate how the independent variable 1 and 7 have a positive impact on the dependent variable. Therefore, by *increasing* the percentage of employees working in R&D (Var.1) and by *improving* the logistics systems, the supply systems and the distribution systems through the development of innovative processes (Var.7), there is an increase in patent filings (X21).

Logistic regression

The logistic regression is applied in those cases where the dependent variable Y is dichotomous.[17] The dichotomous variable X21 requests to answer positively or negatively to the question regarding the introduction of new patents[18].

```
Coefficients:
                    Estimate Std. Error z value Pr(>|z|)
(Intercept)          -3.5630     0.7351  -4.847 1.25e-06 ***
Variable 1            0.3880     0.1994   1.945   0.0417 .
Variable 2            0.8189     0.6396   1.280   0.1004
Variable 3            0.0186     0.1755   0.106   0.9156
Variable 4           -0.1570     0.2294  -0.685   0.4936
Variable 5            0.1930     0.2554   0.756   0.4499
Variable 6            0.7477     0.5155   1.450   0.1469
Variable 7            0.9528     0.4721   2.018   0.0436 *
Variable 8           -0.6411     0.4538  -1.413   0.1578
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Figure 10 - F test

[17] It presents 2 modes : 0 and 1

[18] The positive response is associated with value 1 while to the negative one is associated value 0

The coefficients indicate that the variable 1 and 7 have a positive impact in terms of probability to X21. By Increasing the percentage of employees working in R & D (Var 1) and by improving technological innovation of processes in logistics or supply, distribution methods and those related to the products / services offered (Var 7) there is an increased probability of filing of patents by the company (X21). Thus, excluding those variables that have a modest level of significance, the variables 1,2 (although close to 10%) and 7 have been taken into account for analysis of the next model.

```
Coefficients:
                   Estimate Std. Error z value Pr(>|z|)
(Intercept)         -3.4543     0.6593  -5.239 1.61e-07 ***
Variable 1           0.4646     0.1703   2.727  0.00638 **
Variable 2           1.1699     0.5859   1.997  0.04583 *
Variable 7           0.7494     0.4237   1.768  0.07698 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Figure 11- F test

Results

The new model confirms the results of the previous, with the addition of the new variable 2. Therefore significant variables 1,2 and 7 have a positive impact on 'Innovation' variable. In fact, even the introduction of new products (var. 2) reports an *increased probability* that the company will file patents (var.' Innovation'). The coefficients of the model should be understood as log of odds-ratio predictors given by the ratio of the probability *p* (filing of patents) and its complementary *1-p* (no filing of patents).

The general formula is:

$$10.\quad \ln\left(\frac{p}{1-p}\right) = b_0 + b_1x_1 + \cdots + b_nx_n \quad \rightarrow \quad \frac{p}{1-p} = e^{b_0+b_1x_1+\cdots+b_nx_n}$$

For example, in presence of :

a) the value 4[19](the percentage of employees working in R & D varies between 10% and 19%) in the variable 1,
b) value 1[20] (yes, the company has introduced new /upgraded products on the market) in the variable 2 ,
c) value 1[21] (yes, the company carried out process innovations on systems of logistics, distribution ... etc) in the variable 7;

There will be an odds-ratio equal to:

$$11.\quad \frac{p}{1-p} = e^{-3.4543+0.4646\cdot 4+1.1699\cdot 1+0.7494\cdot 1} = 1.382$$

where the probability *p* to file patents will be equal to p = 1,382 / (1 + 1,382) = 0.58 that means 58%.

[19] This question presents 6 possible answers associated to 6 values: 0%(1) , 1-4% (2) , 5-9%(3), 10-19%(4) , 20-39%(5), > 40% (6)
[20] Dichotomous variable : yes (1), no (0)

[21] Dichotomous variable : yes (1) no (0)

DISCUSSION

The aim of this work is to answer to four research questions, that are mainly focused on the central role of the innovation and cooperation in the automotive industry. Nowadays the automotive industry is fiercely competitive and mutable, due to continuous technological improvements and, often, by the changing consumer expectations and needs. For these reasons, OEMs and suppliers alike need to keep up with the technological path because the most successful innovators target more breakthrough and radical innovation (Sturgeon, 2002).

Innovative approaches need to take into consideration actual megatrends like urbanization, shift of global wealth and demographic changes. Innovating also means to improve older business models. Actually, outsourcing practice linked to the new idea of global supply chain can be seen as a strong boost for developing innovation, by helping companies to establish new form of network and collaboration where the exchange of know-how and competencies are essential to reach technological progress. This is why, a key aspect of these research questions is focused on 'governance modes' in the field of cooperation between enterprises

Collaboration suppliers – car-manufacturers and relative obstacles

The first research question of this paper is: *which aspects of governance help to overcome innovation development obstacles?*

Before proceeding with the correlation analysis of the variables belonging to the construct "aspects of governance" and "innovation development obstacles", it has been possible to adopt another statistical procedure to reduce the battery of items.

Principal Component Analysis has been carried out through a process aimed to obtain solutions more and more satisfactory, leading to the reduction of 'redundant' items into only four 'artificial' variables able to explain different aspects of the network governance. These 4 principal components have been called "good partnership", "reliance", "organizational management" and "sharing". In other words, these 4 variables belong to the construct network governance taken into consideration as object of analysis. The first two express two opposite flaps of having trust/distrust in another company during a collaborative relation. Different studies investigated the importance of trust and its direct relation with the final performance in inter-organizational exchange context.

Zaheer's studies (1998) about this topic expand the analysis over different mechanisms that mediate this relation (transaction costs, relational governance, and transaction value) and other moderating factors that enhance, reduce or are complementary to the effect of trust on performance. In our study, by putting in correlation "good partnership" and "reliance" (in the partner) with those items identified as impediments for innovative development, negative dependence between the level of reliance and *(i)* costs of innovation (-0,29), *(ii)* lack of market information (-0,30) *(iii)* and volatile demand for innovative products or services (-0,22)[22] came to light.

[22] They have been chosen after having utilized the 'p-values' matrix. P-value is the most popular index for assessing the overall goodness of fit of a model.

Thus, by having more reliance in the partner tend to decrease the costs of innovation, lack of market information and volatile demand for innovative products or services. This result appears concordant with the literature that exalts trust, reputation and mutual dependence as mechanism able to reduce both environmental and inter-firm complexities (Lorenz, 1988; Powell, 1990)

Collaboration between suppliers – car-manufacturer and common goals

Another aspect of collaboration looks at the existing organizational practices and their importance for pursuing final goals linked to the cooperation itself . starting from this idea it has been possible to develop the second research question: *how are collaborative organizational practices correlated to the cooperation goals?* The analysis begins by reducing the multi-items scale question in the dataset into two principal components: "Share" and "Organizational management".

The *first principal component* synthetizes how a cooperative behavior has implied the sharing of operative/technical know-how and information, while the *second principal component* summarizes what a cooperative behavior requires in terms of the setting up of formal rules for coordination purposes, transfer or job rotation between partnering companies and the implementation of shared practices (profit-sharing, target costing…etc.). In other words, these two variables want to explain those actions that are generally linked to relational governance mechanisms between actors involved in a partnership. The literature often emphasized the central role covered by governance in the global supply chain field (Gereffi, 1994; Dolan and Humphrey,2000; Knorringa, 2000;

Humphrey and Schmitz, 2002; Sturgeon, 2002). Thus, this topic appears really interesting when applied to this work: it clarifies how governance and organizational practices in the new configuration of the automotive industry (based on network of enterprises) can influence the achievement of diverse established goals. In fact, computing *a correlation matrix* the 'organizational management' variable has mainly shown a positive dependence with the accomplishment of three different goals: *(i)* interests in developing new R&D projects (+0,23), *(ii)* in having collaboration for improving production processes (+0,24) and *(iii)* for acquiring new resource (+0,18)[23].

In other words, when the interest in pursuing these goals tend to increase (decrease), also organizational management practices tend to increase (decrease). If we apply these results in the automotive context, assuming from the literature the strong impact of modularity and suppliers' central role (Gereffi, 1994; Baldwin and Clark 2000) in its industrial re-configuration, this positive correlation shows the necessity to establish a collaborative approach through the definition of rules, common practices and social interactions between partners for achieving targeted goals. Although highly specialized suppliers that offer full packages and/or entire modules have simplified interaction and explicit coordination also by reducing component variation and process specification, the organizational management practices appear still fundamental for the exchange of knowledge and competencies, increasing productivity and quality of products, to control costs by leveraging globalization to capture economy of scale effects, to increase

[23] They have been chosen after having utilized the 'p-values' matrix. P-value is the most popular index for assessing the overall goodness of fit of a model.

manufacturing flexibility while capturing learning curve effects and to efficiently manage supply chains.

In addition, in case of complex transaction (i.e. product specification can't be specified) the exchange of tacit knowledge between car manufacturer and suppliers also require the establishment of mutual dependence regulated also by trust, reputation and social interaction (MacNeil, 1980). Furthermore, modularity and its possible negative consequences linked to outsourcing activities exalts the importance of collaborative organizational management because it can tackle different problems such as re-design activities and expected performances (Thomke, 1998; Thomke and Fujimoto, 2000).

If a relational governance in the supply chain can also be identified as a mode of organizing exchange in a network context that involves the integration of activities – such as decision making, planning, and problem solving – across the relationship in an effort to reduce transaction costs (Williamson, 1983; Heide and John, 1990; Zaheer and Venkatraman, 1995), the improvement of organizational practices becomes crucial for developing parallel sourcing between suppliers and carmakers through forms of joint price setting, target costing and profit sharing that also allow an organized collaboration based on information sharing, collaborative design personal exchange and job rotation (Waller, 2004).

The organizational practices linked to collaboration allow to face existing technological challenges and emerging needs through the development of new ideas and acquisition of new skills. this way, it could be possible to increase the R&D development for improving

efficiency in the execution of innovative projects and production processes by integrating outsourced activities to those carried out in-house.

R&D activities and supply-position

The rationalization of the network of suppliers from the automotive companies, on the one hand has led to the reduction of direct suppliers number, while on the other side has pushed to a redefinition of the relationship between supplier - subcontractor. For these reasons to the first tier supplier was not only required an extreme quality of its products/services offered, but also an improvement of its supporting activities (they cover a fundamental role of supporting the primary ones) that includes those processes that ensure effective coordination and systems of accounting, governance, human resource management, research and technology development, purchasing, information flows management (by using ITC)..etc.

However, if the first tier supplier covers the most important role of a supply chain by supplying components directly to the original equipment manufacturer (OEM), being present in multiple positions in the supply chain could be a crucial opportunity to improve internal processes and to develop innovation. In fact, it presents a huge chance for suppliers to increase their businesses opportunity, by consolidating their competitive position and by increasing their internal and technological know-how, especially through strategies of co-location (Lamming, 1993) that conduct to knowledge transfer and absorptive capacity (Cohen and Levinthal, 1990). Holding different supply chain position could also have a positive impact in terms of quality of modules provided, risks related to

the management and coordination of other sub-contractors, competition and global opportunities for reaching new potential customers.

In our analysis, answering to the third research question: *in which way are R&D activities related to the supply chain position?*, have been used contingency tables. They helped to identify and to interpret the existing relation between variables in terms of frequencies. The assessment of the model explained the possible dependence or independence between R&D activities and (one or more) supply-positions occupied by interviewed suppliers. this involved first the use of the "chi-square index", along with the corresponding "p-value". Then, this work considers only those contingency tables in which 'p-value' can confirm (if < 5%) a significant relation between two variables. The results of the models showed how *(i)* the filing of patents decreases when the position in the supply chain changes from Tier I to others (from 32% to 5%).

In addition, *(ii)* covering the role of first tier supplier increases the possibility to perform and filing of innovative outputs (74% > 48%). However, *(iii)* a company that holds a second position in the supply-chain tends to file more patents than those which occupy only one position.

In fact, *(iv)* holding only one position in the supply chain increases the possibility of not patenting(66% > 42%). This strategic choice appears also *(v)* inconvenient for those companies that want to improve their supporting activities to production processes (68% of possibilities that supporting activities don't improve) or *(vi)* want to introduce new or upgraded products (75% of none introduction).

R&D activities and Innovative outcomes

The last research question of this work analyzes how R&D activities support innovation purposes. Research and development activities increase the probability of the introduction of innovations that are new to the market (Mojón and Waelbroeck, 2003) and are very useful in the development of high tech technologies and research located at the technological frontier (Van Looy et al., 2003; Miotti and Sachwald, 2003). In this work, the 'innovation' variable has been explained by recurring to the dataset-question about *patenting activities* filed by suppliers. For the literature, patents are available, related to inventiveness and based on what appears to be an objective and only slowly changing standard (Griliches 1990). Among different measures of innovation, patents are unique in both the richness of the information they contain and in the breadth of their coverage. Patent documents contain detail about the characteristics of individual innovations (e.g., its technological area, or its citation to related innovations) and their inventors (both the inventor per se and the owner or the assignee of the patent) not available anywhere else (Lanjouw et al. 1996). Thus, this work took into consideration the 'filing of patents' as measure of innovative outcomes and as direct consequence / tangible effect of R&D activities (independent variables). This choice has also been supported by the fact that it fits well with the automotive industry trend: according to the latest studies of the global automobile industry's patent activity, the patents awarded in this industry have increased by 10% since 1999 respect to 2-3% of the other manufacturing industries (Center for auto research, 2014). Analytically, it has been analyzed the impact of seven independent variables, belonging to the same construct 'R&D activities' have on the dependent

variable ‘innovation’, by using a fitting linear model (F-test) for a multiple regression. Then, a low ‘p-value’ has confirmed the observed significance levels for the f statistics (it explains if the dependent variable has a statistically significant predictive capability in the presence of other variables), while R-squared has measured the proportion of the variance explained by the model (11%). In other words, the variability of ‘Innovation’. After removing nonsignificant variables, results proved that (i) by increasing the percentage of employees working for R&D activities and (ii) by innovating or improving supporting activities as logistic systems, supply systems and distribution systems, there is an increase of innovative outcomes (filing of patent).Thus, production process improvement through structural changes of business processes and the logic of business management allows to the supply-company more efficiency and more quality of its offering, even by introducing novelties. The innovation of processes involves a better technological management and human resources management of the various production stages. In fact, results confirm that it is related to the increase of technological progress (patenting) in providing a new product or service.

CONCLUSION

This work provided a description of the evolution in the last fifty years of outsourcing strategies, networking between different companies and related aspects of its governance, especially in the automotive industry. It highlights the strategic importance of governing the value chain at the inter-firms level through diverse methods, in relation to the global actual scenario.

Value-added chain has been defined as the process in which technology is combined to the entire production system (starting from buying input materials to the final distribution) in which a single firm can consist in only one link in this process or it may be vertically integrated (Kogut, 1985). According to the literature, the key points are represented by activities and technologies that a firm should retain in house, those ones that should be outsourced to other firms, and where the various activities should be located. The globalization paths have led the “integration of trade” with the “disintegration of production” (Feenstra, 1998) in the global economy by allowing companies to outsource non-core functions both domestically and abroad. This highlighted positive and negative aspects of outsourcing activities and coordination mechanisms in a network context. This is why, starting from the differences between Western and Japanese manufacturing approach in the automotive industry and its consequently shift toward Eastern practices during the end of '90s, the work tried to explain how the vertical old relation between OEMs and OESs has upgraded into a mutual cooperation form supported by a strong interaction, by trust and by reputation between these actors. In most cases, this has led towards an improvement of competencies and knowledge through reciprocal exchange of

information and practices and, further, has consolidated the partnership by allowing to work together in different phases of the production process (i.e. engineering or co-design) and by solving common problems (defects in supply, efficiency losses, re-design), which could emerge over time.. The different changes occurred in this sector have been based both on the managerial methods and on the actual innovation of manufacturing strategies. In fact, this 'upgrading' also conducted towards a cut in the number of direct suppliers: OEMs selected a limited number of first tier suppliers (FTSs) with whom having systematic relations, while the supply chain was organized on a multilevel structure in which every FTSs had to deal with coordination problems of a group of suppliers belonging to the tier below. Starting from this scenario, this study has analyzed the results of the research project "SMEs' competitiveness and innovation through inter-organizational networks in the automotive industry" - led by Zirpoli, Moretti, and supported by CAMI and Anfia – obtained through the administration of an online questionnaire to a sample of Italian automotive suppliers from June to September 2014.

Thus, first, the work developed an analysis about governance mechanisms related to collaboration in which the importance of having trust in partners and organizational management that belong to a cooperative behavior cover a fundamental role. These variables have shown higher levels of importance in terms of developing innovative common goals and for overcoming possible obstacles linked to. In fact, if having reliance/trust on partners (as opposite of opportunistic behavior) can even substitute vertical integration (Williamson 1985), it also allows to perform innovative outputs by reducing transaction costs and problems linked to the volatile demand. Results have also

shown that coupling it with organizational practices composed by formal rules for coordination purposes, shared practices and social interaction between employees, appear strongly dependent to the achievement of expected cooperative targets.

Second, it has been shown how R&D activities cover an important role in businesses because they allow accelerating innovation by integrating technology planning into business strategy. According to the findings, they permit to produce innovative outcomes through the filing of patents. In fact, the number of employees working for R&D and upgraded supporting activities (logistics, supply, distribution), in which R&D still appears fundamental for improving their performance, highly impact the filing of patents. In addition, patenting appears to be also stimulated by the possible multiple supply-position covered by the FTS.

R&D represents an investment in technological know-how and it allows the future introduction of new products, processes or services: it permits to gain competitive advantage, technological innovation and expected performance. In this sector, R&D intensity extremely required even to low tier supplier for granting their permanence on the global market: this highlights its importance and how transfer-knowledge between partners is seen as one principal opportunity deriving from cooperation. Thus, evidence shows how intensity in R&D (even for low tier suppliers managed or merged with FTS) in developing innovative outcomes has become a fundamental requirement; it is also explained by the increased importance of suppliers in the value added chain: nowadays they perform almost the half of R&D activities and are considered partners in the innovation and production process. These contributions stimulate further research for

developing and implementing diverse strategic decisions about innovation management, supply chain management and its governance aspects. The ability to manage supporting activities to production, quality, needs, suppliers and customer expectation - by trying to integrate acquired information, knowledge and innovative solutions proposed by partners - is something indispensable and it represents an absolute necessity for the production process of a competitive enterprise. Further, the need to organize and support the quest for innovation represents a key element that guarantees the company success in the global market. If the innovative development shows itself as a crucial aspect, especially thanks to the cooperative contribution between multiple actors, it also involves a challenge in terms of inter-firm management: an enterprise has to be able to engage, motivate and integrate innovative solutions, trying to take full advantage from all its available resources and from the power of cooperation through networking activities.

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