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**PRODUCTION NETWORKS: LINKAGES, INNOVATION
PROCESSES AND SOCIAL MANAGEMENT TECHNOLOGIES.
A METHODOLOGICAL APPROACH APPLIED TO
THE VOLKSWAGEN CASE IN ARGENTINA**

By

Gabriel Yoguel, Marta Novick & Anabel Marin
September, 2000

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Gabriel Yoguel (*), Marta Novick (**), Anabel Marin (***)

Abstract:

The purpose of this paper -as a part of a wider research project - is to analyze the concept of production network from a methodological and theoretical viewpoint based on a three-plane perspective. These dimensions are the linkages among agents, the innovation activities, and the social management technology, including work process organization and the social agreement generation model in force. It is an experimentally methodological approach that tries to go from a theoretical conceptualization of the phenomenon to its empirical evaluation.

The questions guiding this research are as follows:

- ✓ What are the variables and dimensions to be observed in the analysis of a group of interconnected firms in order to define a production network? Is it a unique definition or, on the contrary, does it involve a range of alternatives? What are the externalities generated by the agents who belong to one network?
- ✓ What is the relationship between the network's firms' technological behavior and their organizational counterpart? How are learning processes in the business firms linked to their own training systems? Has the social management technology some differential role in the learning process and in the development of skills? How do knowledge transmission processes manifest themselves within the "network"?
- ✓ What indicators are useful for the empirical identification of the different means of manifestation of the network according to the theoretical viewpoint adopted? How can those indicators be articulated in order to elaborate typologies intended for the identification of "hybrid" models? How can a complex indicator be built in order to show the different levels of circulation of intangible assets, development of learning processes and work process organization?

In the first section, the conceptualization of the production "network" used in this paper is discussed. In the second section, most relevant variables and indicators are presented in order to feature the business firms and the network in terms of: a) type, quantity and quality of tangible and intangible exchanges among the agents; b) innovative capacity and learning; c) social management technology. Then we elaborate a typology of networks based on the consideration of the previous parameters. Lastly, in the fourth section, we discuss how the three dimensions interact in the case of Volkswagen and his forty main local suppliers.

Keyword: Innovation, production process, case study

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INTRODUCTION

This paper deals with the international debate referred to the new forms of organization of more complex production processes arisen from the appearance of new information-intensive techno-organizational paradigms which catalyse the development of globalisation and open regionalism processes. These transformations have brought about a crisis in the concept of competitiveness as a phenomenon of exclusively macroeconomic and sectorial nature, determined either by compared static advantages or by factorial resources.

Demand volatility, market segmentation, product life cycle reduction, strategic uncertainties associated to the new world scenario, and the possibility of combining scale and scope economies, also imply a considerable increase in the competitive pressure that economic agents must confront. To the traditional macroeconomic and sectorial factors which constituted the key elements of competitiveness in the previous scenario, other elements depending upon the degree of development of the local milieu, the creation of networks and the conduct of agents are to be added.

Competitiveness emerges as a systemic phenomenon. The new conceptualisation comes with the idea that compared advantages can be created and, therefore, have a dynamic nature. In the passage from static compared advantages to dynamic advantages, technology and the development of individual and collective learning processes – conceived as interactive processes of a social nature – are key factors for the economic success of countries, organizations, and regions.

That is, the effectiveness of responses goes beyond the activities carried out by an individual organization. The microeconomic assumptions in this paper are restricted rationality, imperfect information, absence of rational expectation models on the behavior of agents, strong technical change, and demand volatility. Given these suppositions, the development and appropriation of codified and tacit knowledge depend upon the possibility of interacting with other agents, the development of skills within the firms, and the work process organization form. Literature reflected these phenomena when it changed from the analysis of the individual firm to the consideration of units of analysis. These include interrelated agents: “industrial governance” (Borello, 1994), “clusters” (Humprey, 1995; Schmitz, 1995), “local systems” or “local milieu” (Camagni, 1991; Bianchi and Miller, 1994), or advanced subcontracting (Coriat, 1993).

Within this context, the purpose of this paper -as a part of a wider research project¹- is to analyse the concept of production networks from a methodological and theoretical viewpoint based on a three-dimension perspective: linkage styles, innovative capabilities and social management technology, and to study how they are reflected on a panel of Volkswagen’s suppliers in Argentina.

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¹ “Production networks in the Argentine manufacturing industry: business organization, innovation, and labor relations” which is being developed at the Industry Institute, National University of General Sarmiento, coordinated by M. Novick and G. Yoguel.

The questions guiding this research are as follows:

- ✓ What are the variables and dimensions to be observed in the analysis of a group of interconnected firms in order to define a production network? What are the externalities generated by the agents who belong to one network? What indicators are useful for the empirical identification of the different means of manifestation of the network according to the theoretical viewpoint adopted?
- ✓ How are these indicators shown in the case of Volkswagen' suppliers in Argentina? In particular, what behavior do the different categories of enterprises adopt according to the type of firms and/or suppliers' degree of importance for the car maker? Finally, to what extent do macroeconomic fluctuations influence the specific features acquired by the network in an emergent country?

Case study

With the purpose of answering these questions, a methodology was developed and applied to the study of Volkswagen Argentina and to its main structure of suppliers. It is an interesting case as an attempt to develop a modular production comparable to that carried out by the firm in Resende, Brazil.

The plant of Volkswagen in the Buenos Aires Metropolitan area (Pacheco) was built after the split-up of Autolatina in 1995, on the premises occupied by Ford's truck factory, a former partner of the German multinational company. This new industrial plant was built within the context of the investments made by Volkswagen at international level from the end of the eighties onwards, when "all German manufacturers had re-evaluated their production systems and had concluded that they needed a changed strategy oriented towards Japanese methods" (Jurgens 1998). Among the new investments the following stand out: i) the plant built in Shanghai, China in the middle of the eighties (Kiefer 1998); ii) Mossel's plant in the ex Eastern Germany (Jurgens 1998) that started operations at the end of the eighties and expanded up to 1992; iii) Martorell's plant in Barcelona that started operations in 1992 and "became the first Volkswagen factory with plant-wide teamwork, kaizen activities, visual management and just in time logistics with suppliers" (Jurgens 1998); iv) the experiences of modular production at a truck manufacturing plant in Resende-Brasil and the new plant of engines in San Carlos (Fleury and Salerno 1998); and v) the revamping of the other plants existing in Brazil (San Bernardo, Taubate, San Carlos).

In the beginning, the plant in Pacheco was thought as a modular production factory made up by a group of suppliers in the production line (painting, seats, and instruments) and in services (logistics, maintenance). This scheme had some similarities, but also differences with the truck modular production in Resende, Brazil, that started its activities practically at the same time. Unlike the plant in Brazil, the modular production in Argentina was limited to the above-mentioned areas, while the rest of the assembly operations remained in the hands of Volkswagen's workers. Another differentiating element is that there were no contracts with suppliers as in the case of Resende, where firms were granted exclusivity for a term of 5 to 10 years. A third difference is that the VW plant was installed in the Greater Buenos Aires, an area having a more important trade union tradition than Resende. In this sense, an important achievement by SMATA, the mechanics' trade union, was that

workers, whether employed by Volkswagen or not, were to be regulated by trade union's agreements. Consequently, wages collected by those who worked for the module or for VW were similar ²/.

Like in other plants, problems between the modules and the other areas directly managed by VW, especially in the logistics area were important. Therefore, from the 10 modular producers, at present there are 5, where an "insourcing" process took place. At present (five years after the start-up), VW Argentina is evolving towards a traditional model with a lower number of modules and a significant decrease in the number of suppliers. Nowadays, there are global suppliers –whether modular or not-, foreign direct investment companies, big domestic firms and SMEs.

In the first section, the concept of production "network" used along this paper is discussed. At the same time, the most relevant variables and indicators are presented in order to feature the business firms and the network in terms of: a) type, quantity and quality of tangible and intangible exchanges among the agents; b) innovative capacity and learning; c) social management technology. In the second section we discuss how the three dimensions considered are shown in the case of Volkswagen Argentina and their connections. The methodology was applied to a group of 40 suppliers with the purpose of comparing the three dimensions and evaluating the degree of strength of the network under study.

1. CONCEPTUAL FRAMEWORK

1.1 DEFINITION OF PRODUCTION NETWORK

In this paper the term "production network" is defined as a concept located in a "meso" or intermediate plane different from the sum of the attributes of the individual firms composing it. A necessary but not sufficient condition for a production network to be defined is the existence of a group of agents who establish "continuous" business relationships among them along time. These relationships, in turn, may result in the self-coordination of autonomous agents or in the presence of one or more coordinating agents ³/.

This concept is different from that applied to clusters, because its definition arises from the spatial concentration of economic agents interacting at local level and facilitating the development of collective efficiency. In this type of configuration, key factors are the existence of available skilled human resources, the economic relationships between suppliers and customers, a strong information flow among agents, institutions and individuals, the existence of a developed institutional structure, and the construction of a socio-cultural identity facilitating mutual trust among agents. (Altenburg and Meyer-Stamer, 1999).

The concept of production network used in this work moves away from the previous concept. In the first place, it does not necessarily require the geographical proximity of the

² In the case of Resende, on the contrary, wages were significantly lower than those at San Bernardo plant located at the ABC in Sao Paulo (Fleury y Salerno, op cit and Abreu y Ramallo 2000)

³ Although the globalization dynamics itself makes it difficult to establish precise limits and scopes to the network configuration, the operational definition adopted for this particular case is circumscribed to the local agents and complementarily to the possible internal commerce in the coordinating business firm.

component agents. In the second place, it includes the possibility of no-price relationships built only on the basis of economic relationships. Finally, it admits different degrees of development according to the importance of intangible flows and of no-price relationships set up within it.

From this viewpoint, a network requires some type of coordination. Therefore, it cannot be defined as a group of agents having the same weight on the economic relationships they set up, as the traditional “Walrasian” agents neither as agents who interrelate on the basis of social linkages and/or affinities of unequal type. The existence of coordinators, however, does not always imply hierarchical relationships among the agents, since a great many different situations may exist, from horizontal relationships featured by cooperation linkages to those where hierarchies and uneven relationships among agents prevail.

Its specific features are influenced by the degree of development of the firms’ technical and organizational skills, the complexity achieved in their linkages, the type of institutions acting in the agents’ environment, the synergy of the environments (local systems) where they operate, and the macrosectorial and macroeconomic regulatory framework.

The concept of production network refers then to a wide variety of situations featured by the existence of uneven flows of “price” and “no-price” relationships. This means that the purchase and sale relationships between the agents, although constituting a necessary condition, are not the most important elements, as in the traditional input-output model. The network thus becomes a “context” (Rullani 2000) where different functions of codified knowledge specification may be fulfilled. This implies translation functions, the development of a common minimum language, and the generation and dissemination of knowledge that may be appropriated by its component agents. This concept, unlike the traditional theory ⁴/, starts with the idea that the agents do not act in isolation, but have different degrees of rationality, exert influence on the others’ decisions, and are not price takers in the market beyond the limits of the firm.

The production network is therefore inserted into a framework that does not consider the market as an exogenous factor determining the firms’ behavior. The development of the firms’ strategies and behaviors shall “build” or “transform” the market structure where they operate. It becomes a coordination instrument that, in the most advanced cases, counterbalances the uncertainties of the market, develops lacking skills, and encourages codified and tacit knowledge generation and dissemination. One of the elements distinguishing the network is the degree of development of the formal language used (Poma 2000), necessary to codify and disseminate the tacit knowledge generated by each of the links.

One of the singularities of production networks is the synergetic nature that the learning process may acquire. Such synergetic nature may be shown by the generation of a greater quantity of more complex tacit elements that may become barriers to the entrance of those agents who do not belong to the network. Thus, the added competitive advantage of the network agents will be greater than the sum of individual functions, generating efficiency

⁴ From a neoclassical perspective, the network has no theoretical space. This is due to the fact that firms are considered to have perfect information, access to the library of technical knowledge without cost, not to be influenced by or have influence on other agents’ decisions, and to maximize their benefit starting from production functions similar to those of the rest.

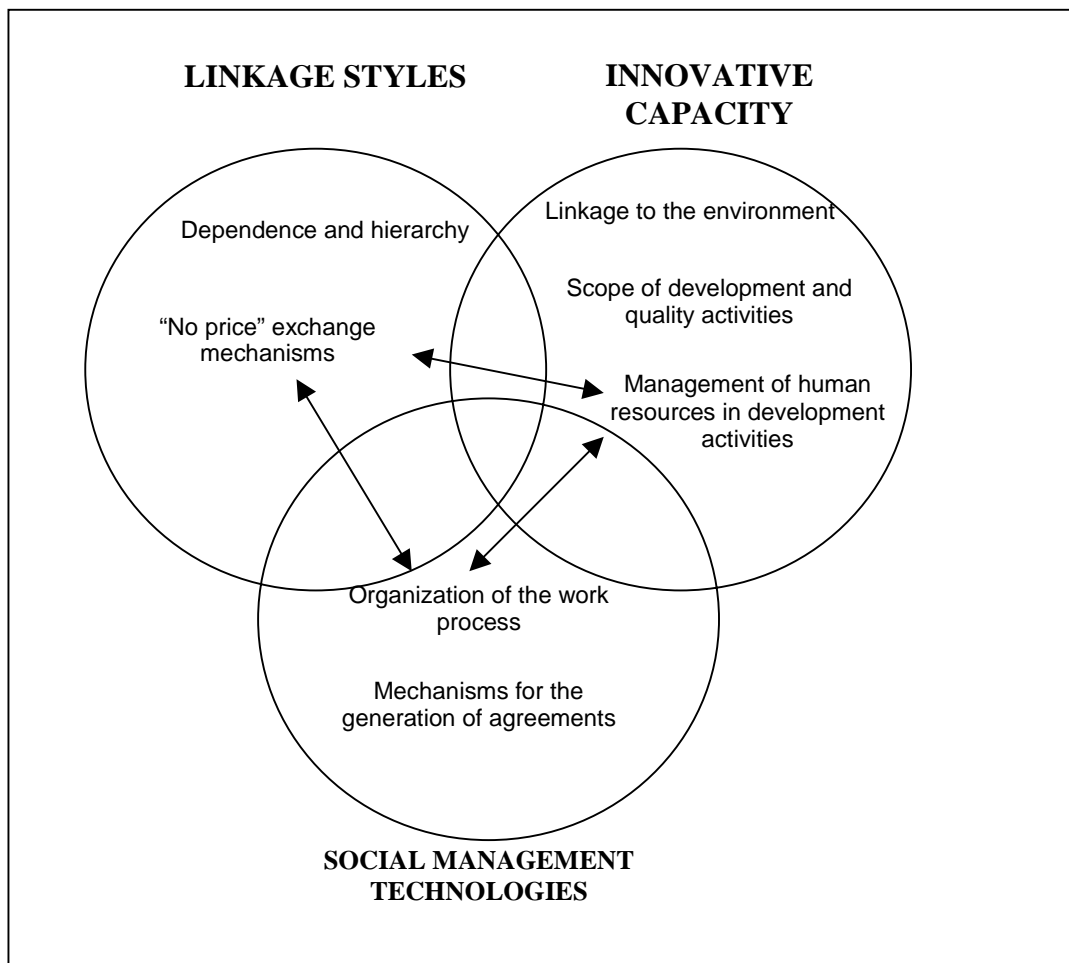
profits that may be assimilated to economies of scale and scope. Consequently, networks differentiate themselves by the intensity of the individual and collective learning process.

However, the above-described elements correspond to theoretical conceptualisations of the “ideal” network and the factors determining it, but they do not necessarily correspond to the way in which the linkages between the firms actually manifest themselves. The bibliography has already shown the heterogeneity of situations (Humprey 1995; Schmitz 1995; Knorringa P., 1997; Novick and Gallart, 1997) that need to be differentiated.

1.2. THE STUDY OF THE PRODUCTION NETWORK: ITS MAIN DIMENSIONS

In this section we discuss the variables and dimensions proposed for the study of a production network, which integrates qualitative and quantitative elements. Possible styles of linkages between agents are identified and two analytical complementary dimensions are considered: the firms’ innovative capacity and the social management technologies implemented, including the organization of the work process and the mechanisms for the generation of agreements. The following diagram shows the proposed indicators referred to the three dimensions mentioned above.

DIMENSIONS OF PRODUCTION NETWORKS



1.2.1 LINKAGE STYLES IN THE “PRODUCTION NETWORK”

The analysis of the linkage styles is focused on the degree of dependence and hierarchy existing in the no-price mechanisms of exchange between the agents, who are conditioned by the contractual dynamics in force and by the implicit regime of incentives. The way these factors are configured determine the structural features that define the network and its dynamics.

Hierarchy and degree of dependence

In order to characterize the relationships between the firms, temporal dimensions are to be taken into account. Also the vertical or horizontal relationships existing among the network's agents and with the coordinating agents.

In hierarchical relationships, intangible exchanges are limited. The relationship between the supplier/s and the coordinating firm/s, and hence, the total network dynamics, is limited to the fulfillment of the obligations and specifications established in the contract.

Medium and long-term relationships may be created only under certain special conditions, namely, when there is a long-term horizontal linkage between contractor and supplier, and both of them participate in the design process and/or in the solution of problems. Such relationship is known by the name of *systemic relationship* (Dussel, 1998).

In this case, firms with “stable” cooperation agreements and/or with informal exchanges in major issues are found. In the other case, there are agents who do not have any formal type of cooperation or relevant informal ties, that is, they operate in a strong relative isolation within the “complex”.

The indicator makes it possible to differentiate alternative linkages having an unequal degree of hierarchy. At one end, the relationships exclusively supported by the requirement of conformity to conditions – whether agreed upon or not – with no counterpart at all. At the other end, bilateral agreements, and at a middle point, it is possible to identify the unilateral transfer of specific experiences and technical assistance (for instance, quality improvement techniques).

In turn, the agents may be more or less involved and have a different degree of dependence upon the network in question. A first sign of the significance of the network for all the agents connected with organizing firms is the relationship established between the quantum of monetary purchases and sales among them and their total purchases and sales. In this way, a complementary quantitative indicator may be estimated for all the agents.

“No price” exchange mechanisms among the network's agents

One of the differentiating elements of the linkage model is the importance achieved by the intangible assets exchanges and by the terms and manners in which tangible exchanges connected with the offer of goods and services are agreed upon and programmed. Another element is related to the joint activities linked to the search for mechanisms to operate with higher relative levels of certainty in order to obtain a higher joint efficiency and rationality, above the level achievable on an individual basis. Especially in certain kinds of activities

where joint developments and proximity are needed, the information flows must be not only quantitative, but they also require a tacit knowledge. The flow and codification of such knowledge, unlike the traditional action-reaction mechanisms, imply a strong interaction among the agents.

When considering these questions as a whole, it is necessary to take into account not only the frequency of the exchanges among the firms in the network, but also the quality and degree of importance achieved in the “no price” relationships among them. Factors such as the type of information, the specific exchange mechanisms, the development and/or execution of joint actions, the agreements and cooperation mechanisms, and the possible transfer of technology become relevant.

The type of predominant contractual relationships is also contingent on the importance of these exchanges. However, literature is not homogeneous in terms of the importance acquired by the contract and the regime of incentives.

The importance of the institutionalization of relationships among agents in a network has various perspectives. One of the positions (Williamson, 1991) underlines the central role of the “contract” and the determination of incentives as a key element for the conformation of the network. Other authors, instead, emphasize the role of the “mutual trust” in the development of this kind of configurations (Bianchi and Miller, 1994; Saxenian, 1994)⁵. Both positions, however, should be analyzed within the framework of past histories (path dependence), prevailing practices and the degree of development of the local milieu where the agents act.

It is within such framework that the role of the formal or informal “contract” model established among firms and its role in the type of linkage and especially in the development and enhancement of no-price exchanges should be discussed. Thus, for example, while in a regional agglomeration linkages generate trust/distrust relationships, which in the end, regulate the exchange relationships among agents, in the case of a network, the role fulfilled by the contract and the “trust” in the regulation of exchanges is less clear. While in the local system and/or cluster, the absence of contracts may be the expression of a previous mutual trust creation process, in the second one the interpretation is more ambiguous. It may be both the expression of an extreme “dependence” model, where the coordinating firm univocally maximizes the benefits of unilateral relationships, and a vehicle generating long-term “trust” relationships.

In those networks where there are contracts, their execution and contents may gradually acquire a greater accuracy on the basis of a joint learning process. In some cases, the level reached by the agents’ learning leads to more accurate contents in the contracts, thus reducing the implicit uncertainty of transactions. But this joint learning may, in turn, be associated to a lower rate of incentives. This situation may correspond both to a unilateral maximization of benefits by the coordinating agent – reducing the transaction uncertainty and cost due to a decrease in incentives – and to joint profits obtained by the agents from the development of mutual trust relationships. In the latter case, the network may even operate without any formal contract, as the natural evolution of this process.

⁵ These authors affirm that the nonexistence of contracts may become a strength for the network and not a weakness (for instance, Silicon Valley).

Therefore, the characterization of a network demands the analysis of the potential existence of contracts, their provisions and requirements, as well as the unilateral or bilateral nature of commitments, the existence of exit clauses, and the effects on the network development. From this viewpoint, the indicator evaluates the effect of these questions on the “no price” exchange mechanism.

In sum, the linkage models in a network do not constitute an immutable organization form. On the contrary, there are elements that determine their profile in terms of *solidity or lability*. All the questions discussed above have a strong bearing on the possibility of generating bi-directional flows in the long run and changing the terms of negotiation and the regulatory mechanisms of the relationship by all the agents.

The construction of an indicator of “linkage styles”

Taking into account the different factors developed, an index is elaborated in order to identify different situations, favoring the items linked to no-price relationships.

In this way, several situations may be differentiated. On the one hand, those where an important flow of formal and informal exchanges with the coordinating agent prevail; other firms and institutions are centered around the use of infrastructure, shared developments, technology transfer, support to innovative and managerial activities, etc. On the other hand, the linkage styles between firms featured by market relationships, where firms mainly act on an individual basis. Between both ends, a set of hybrid situations corresponding to most frequent cases may be expected.

1.2.2 INNOVATIVE ACTIVITIES AND TECHNOLOGICAL DEVELOPMENT WITHIN THE NETWORK

In the current competitive regime, featured by market segmentation, reduction in the life cycle of products, and demand volatility, special strategic responses are required in order to gain competitive advantages. Among such strategies we can mention the improvement of products and processes, the introduction of organizational changes and the development of new linkages with the market.

In their quest for differentiation, agents develop what in this paper we call a differential “*innovative capacity*”. This term refers to the firms’ potential to transform their generic knowledge into specific knowledge, starting from their initial competencies and dynamic accumulation, which involves formal and informal learning situations, both codified and tacit (Lundvall, 1992; Ernst and Lundvall, 1997, Yoguel and Boscherini, 1996). These competencies may be defined as the set of technological and organizational knowledge and skills –formal and informal- the agents generate in order to carry out the above-mentioned developments.

In order to determine the agents’ innovative capacity, we should start from the idea that the generation and dissemination of knowledge, both into and among the firms, is a complex process. Its intensity depends upon i) the need to solve concrete problems in uncertain situations; ii) the demand for non-codified solutions; iii) the degree of technical complexity of work teams; iv) the type of basic skills agents have; v) the capacity to relate and work as a group, and vi) the degree of exploitation of the technical and organizational knowledge of firms’ workers.

In particular, the generation and dissemination of codified and tacit knowledge would be positively associated to the characteristics of the firm's human resources, and to the way work process ⁶ is organized and the external codified knowledge is adapted. This set of factors turn the tacit knowledge into particular specific elements not easily appropriated by others. This becomes more significant in the network because an important amount of transactions are conducted out of it (Yoguel, 2000).

Operationally, we try to identify: a) the existence of human resources responsible for incremental developments, the importance and rating of this nucleus, as well as the extent and scope of training; b) the type of product and technical and organizational process development carried out by the firm, the degree of progress in the quality assurance processes, and c) the type of linkage with the environment expressed by the type and frequency of the exchange with other agents and institutions not belonging to the "network" (Yoguel and Boscherini, 1999).

Management of human resources in development and training activities

a) Human resources involved in development activities

The quantitative importance of formal and informal teams devoted to incremental and/or radical developments, the degree of skill prevailing in them (especially professionals and technicians) and the degree of exclusivity in those tasks are key elements for the development of the agents' innovative activities. In this way, the importance attached by the firms to human resources involved in innovative activities is another key dimension. The indicator differentiates a range of situations which goes from the firms where there are no teams up to those where there are informal groups and/or laboratories involved in these tasks with a certain degree of relevant exclusivity.

b) Training

Learning at an organization is a complex process and it has a greater scope than the economic investment made in training. Nonaka (1995) affirms that "an organization that learns is that where the development of new knowledge is not a specialized activity of a particular group, but a way of behavior in which any person is a knowledgeable worker."

The training-learning relationship links the innovative capacity to the development and recognition of workers' tacit and codified knowledge and to the work process organization method. Therefore, it becomes a major element in the firm's achievement of competitive advantages.

Whether at the company or in the network, learning is more relevant than usually shown in the traditional bibliography and through the firms' practice. Therefore, training at the firms –within the new paradigms- cannot be exclusively analyzed through the strategies conceived as specific or general knowledge transmission policies, or through the degree of formality or duration of training activities.

The analysis of training may be carried out at least from five viewpoints (Novick, 1999):

⁶ This dimension is developed in detail in the next heading.

a) the systemic nature of training^{7/}; b) the proportion of personnel involved in each level^{8/}; c) the subjects included and their complexity, that requires a combination of specific and general behavioral and motivational technical aspects; d) the intensity, that refers to the minimum number of hours needed for the training process to be effective; e) the learning methodology, in order to differentiate the pieces of knowledge given on a standardized basis from those using mechanisms to transform tacit into codified pieces of knowledge; and f) the evaluation systems used in the short, medium and long term.

Scope of development and quality assurance activities

a) The scope of development activities

The learning process in the firms is shown in developments (improvements) of very different products and processes, organizational changes, modes of linkage to the market and quality assurance levels. As far as products and processes are concerned, the intention is to know the incremental or radical nature, and fundamentally the participation –and/or cooperation- of organizing agents with the firms in the development of these activities.

Also taken into account is the *weight of new products or invoicing*, which constitutes an approach to the innovative product that evaluates the importance achieved by the introduction of technically improved products and/or those which are new for the firm.

These indicators show the technological capacity of the network's agents, their organizational transformations, and the production profile to adapt to the new demands of organizing firms. Their degree of relative autonomy in the achievement of a more active position within the whole network helps to distinguish those agents characterized as “independent subcontractors with little or no development capacity” from those identified as “autonomous subcontractors with an advanced development capacity.”

b) Quality assurance processes

The degree of quality assurance achieved by the firms may be assessed through a set of elements. These elements are referred to the existence of quality controls along the production process, to the use of quality control tools, to the use of forms at the checkpoints, and to the estimated “statistics” degree of complexity. The indicators distinguish a range of situations. At one end, there are those firms with a high quality assurance level: those which check the instruments along the production process, have different checkpoints along each production line, and keep records of estimated “statistics” on specific forms. At the other end, there are those firms having no quality assurance, featured by the lack of verification of products being elaborated or the implementation of controls without measurement instruments.

c) Linkages with the environment: formal and informal exchange with other agents

⁷ Systemic are those training models applied by a firm on a continuous basis, incorporated to the strategic planning, as a major component of human resources management, in comparison to those applied sporadically due to specific and immediate needs, or to respond to specific demands.

⁸ This dimension investigates the extent of training at all levels of the organization, and not only at top levels. It is also based on the need that the percentage of training at each level involved be significant.

Formal and informal exchanges with agents not belonging to the network is a key dimension to evaluate the degree of development of interactions oriented towards the generation of technological and managerial capacities.

In this direction, the indicator takes into account both formal and informal linkages with agents unconnected to the network (firms, consulting companies, public and private institutions, universities, etc.). The objectives of these linkages are: i) developing and improving products and processes; ii) carrying out changes in the firm's management organization; iii) modifying the distribution channels; iv) developing and improving quality management; v) improving management and work process organization. The firms' membership to other networks is also included, as well as direct foreign investment companies' permanent exchange with their head offices.

The construction of an indicator with innovative capacity

The innovative capacity of the network's agents is the result of considering the factors associated to the development of capacities as a whole: quality assurance, training efforts, the extent of development activities, and the participation of skilled personnel in the development team. It includes the degree of codified and tacit knowledge dissemination and the degree of mutual trust development between agents (Yoguel and Boscherini, 1999).

The rate of innovative capacity allows the evaluation of different alternatives in terms of the levels reached in each of the above-mentioned factors. At one end, we can find those firms having a high quality assurance level, frequently introducing new products and carrying out a systemic training. They have (formal and informal) development teams with skilled human resources and some degree of exclusive dedication and strong linkages to other firms outside the network and to institutions who offer technological services. On the contrary, those agents having a reduced innovative capacity are characterized by poor quality and training efforts, reduced weight of new products or sales, lack of human resources devoted to development, weak linkages to other agents and institutions offering technological support. Between both ends, there is a marked heterogeneity of situations.

1.2.3 SOCIAL MANAGEMENT TECHNOLOGIES: WORK ORGANIZATION AND MECHANISMS FOR THE GENERATION OF CONSENSUS-BASED AGREEMENTS

New quality requirements, cost reduction, changes in delivery methods, the volatile nature of demand, and the importance acquired by the generation and transmission of knowledge require important transformations not only of the technical base, but also of the work process organization. This requires a greater flexibility, a greater involvement of workers, a greater exchange of knowledge and information, a new organizational base that eliminates hierarchies and sets up horizontally-based decisions in relation to the firm's functions. It implies a turn from the individual conception of jobs based on the concept of "operation" to an organization based on integration and coordination of production systems (Zarifian, 1990).

The way work process is organized in the firms is essential to identify how social management technology acts in the process of knowledge generation and socialization. Teams⁹ and interaction spaces, which permit the exchange of experiences and opinions,

⁹ This conception is closely related to the work process organization arisen from the dissemination of

are the elements which facilitate the dissemination of tacit knowledge among individuals through “observation, imitation and empirical experiences.” In this sense, these mechanisms are the vehicle to develop procedures and situations oriented towards experience sharing among individuals (Rullani, 2000).

The importance of microeconomic factors in the determination of productivity also implies a change in the treatment of labor relations. Unlike the Fordist model in which the institutional forms were based on collectively bargained agreements – at a branch or sector level –, the new scenarios tend to move the bargaining mechanisms to the firm’s level. The heterogeneity of technological strategies, market insertion, and the different performance of production units even within the same sector lead to the decentralization of bargaining levels.

Strategies bifurcate and those trying to transform labor relations management into human resources management are identified. “Individual agreements” are favored against those that continue generating “collective bargaining” mechanisms, although of a different scope from the Fordism model. Some authors (Leborgne and Lipietz, 1994) build up a typology that combines work organization flexibility with a certain degree of recognition of collective stakeholders in the negotiation of these changes.

Common work practices disseminated throughout the countries allow other authors (Katz and Darbishire, 1998) to identify different human resources management and “bargaining” models in industrialized countries. These practices are referred to the more or less agreed upon nature of labor practices; the type and amount of remuneration; work organization models; rotation; and unions’ policy.

The social management technology implemented is characterized by the particular combination of the prevailing work organization and the model of consensus-based agreements generated in the firms belonging to the network,

a) Work Organization

Work organization (Novick, 1999) is the whole of technical and social aspects participating in the production of a certain object. It refers to work division among persons and between them and machines. Work organization is the result of a set of standardized and tacit rules and regulations that determine how production is carried out and the exchange of information and knowledge within the firm. From this perspective, work organization is a social, historic, modifiable and changing construction.

In this century, work organization patterns changed –in a theoretical way- from the classic model proposed by the Taylorism-Fordism, in which productivity was obtained from the individual worker’s job (Coriat, 1992) to Fordism (assembly line) and to a model of work organization in which productivity is sought through polyvalence and mobilization of all human resources involved.

The indicator of this item is built by the following elements: 1) The method of job assignment (individual vs. work cell, team/module); 2) The cell’s form of organization (number of workers and hierarchical position in the labor organization); 3) the methods of

production cells, work teams and/or modules, in which the dissemination of knowledge is facilitated by the development of rotation mechanisms and “enriched” polyvalence.

category assignment; 4) the type of polyvalence (as a mere addition of tasks or as a growth of skills); 5) the supervisor's role analyzed from a dichotomous perspective of a disciplinary against a technical role^{10/}.

b) Mechanisms for the generation of consensus-based agreements (Labor Relations)

This variable refers, on the one hand, to the recognition of stakeholders different from the firm, who collectively represent the whole of the firm's workforce. On the other hand, it takes into account whether this recognition is based on any type of collective -formal or informal- "contractual" mechanism, and the degree of bilateralness existing in this bargaining.

Based on this characterization, the indicator takes into account the recognition of the trade union as stakeholder; the system of remuneration, remunerative amounts and non-remunerative allowances in force, and the specific regulatory framework in terms of bargaining agreements or accords referred to the production systems.

The construction of a social management technology indicator

In this dimension, two extreme models were outlined: we call the first one "**systemic integration**" and the second one "**isolated and fragmentary**" (nearer to Taylorism-Fordism although with a microelectronic base in the organization of work and a low degree of recognition of labor representatives). Between both ends, there is a group of firms (indeed the majority) which will allow us to classify this variable as a "continuum" and not as isolated segments.

The firms having a **systemic integration** show an important coordination between the design/conception and execution areas; the firm is conceived as an integration of all its aspects and not a mere optimization of some of its resources in isolation^{11/}. Human resources are considered as a key element for competitiveness and are valued in terms of salaries, employment stability, development of potentialities and recognition and improvement of skills. This "systemic" conception is linked to the neo-Schumpeterian view of the firm and to the technology conceived not only as a set of machines and tools, but also as a learning process and the way it is disseminated. In this "type" of firm, there is a certain degree of workers' participation and/or responsibility in incremental innovative activities, because the firms recognize the contribution of their knowledge to the generation of competitive advantages.

From the work organization perspective, the main features are expressed through the preponderance of modules/teams/cells in the work process organization and through the technical, rather than the disciplinary, nature of the supervisor's role, thus enhancing the relative autonomy of work teams. The greater relative autonomy of cells, their participation in the determination of standards, paces, quality assurance, and machinery programming, promote a better use of workers' tacit knowledge. Job design corresponds to the cases of "enriched" polyvalence: jobs in different sectors, categories and complexity levels.

¹⁰ Indicators relatively similar to those considered in social management technology have also been proposed by Durand, Stewart and Castillo (1998).

¹¹ The contrary, and common, case occurs when only one of the factors is sought to be maximized through the exclusive reduction of labor costs or the increase in work intensity.

From the viewpoint of mechanisms for the generation of consensus-based agreements (labor relations), the involvement of workers' representatives in the negotiation of changes and transformations stands out. This is shown in recognized agreements and/or accords, whether to regulate specific aspects of labor provision or crisis and special situations. Another complementary dimension includes a remuneration system recognizing the contribution of workers' knowledge to the building up and increase of productivity.

At the other end, the firms *close to the isolated and fragmentary model* are those where the human resources management model is still based on hierarchical relationships. From the work organization viewpoint, the individual assignment of jobs predominates, and if cells exist, they have a low number of workers (or, on the contrary, their number is so high that they cannot be considered cells either) and they are scarcely spread. Polyvalence acquires an improvised nature and the supervisor keeps his disciplinary role. These cells have a poor autonomy, showing that workers' tacit knowledge is not taken into account. Workers have no say in the determination of production or quality standards or in the machinery programming. Training, if any, is given to specific workers and its nature is merely motivational or behavioral.

As regards the mechanisms of consensus-based agreements, workers' representatives' recognition or involvement is poor. The old collective bargaining agreements are usually kept (they are generally based on a specific activity), with no update. Remuneration systems are centered on incentives for productivity and job attendance, rather than for quality or involvement dimensions. On the other hand, non-remunerative allowances are mainly centered on those reducing the employer's contributions (i.e. shopping tickets).

1.2.4. PRODUCTION NETWORK THEORETICAL TYPOLOGIES: THE COMBINATION OF THE LEVELS CONSIDERED

As a result of the different intersections between the dimensions discussed above, different types of networks are shown, underlining the differences between the theoretical extremes and intermediate situations which are more likely to be found in the empirical evidence.

In the "virtuous" network: a) linkages among the agents tend to be long-termed and b) there are joint developments of processes and products among the firms; c) the relationship regulatory mechanisms are subject to negotiation by all the agents and not only by the organizers; d) the innovative capacity is high and not exclusive of a reduced number of firms; e) there is a certain homogeneity in the labor and technical skills, which facilitates the generation of a common language; f) there is strong relationship between the development of the network's innovative capacity and the form adopted by the work process organization and the mechanisms for the generation of consensus-based agreement. In this sense, in the virtuous networks, the generation and dissemination of codified and tacit knowledge would be linked to the development of personnel's skills, to the methods of work organization, and to the recognition of social stakeholders; human resources are a relevant factor.

In these networks, the innovative activities reach their maximum level, a phenomenon associated with quality assurance, training processes, the implementation of incremental developments of products and processes, and a strong interdependence among the agents. The evolutionary path of contracts converges on the development of mutual trust and/or informal relationships. This is due to the major importance of no- price exchanges, to the

development of joint activities that generate lower collective uncertainty levels, to the development of informal discussions, and to a common language that creates a permanent tacit knowledge and new competitive advantages. Simultaneous coordinators and/or bilateral relationships that would facilitate training through a continuous codification systematic process could exist. This requires the implementation of a systemic-type social management technology. In sum, it is an open context strongly linked to other “networks” and technological and educational institutions

The characteristics of the “weak network” are opposite to the former one: a) low linkage level among the firms; b) significant predominance of hierarchical and radial relationships, centered on the organizer/s, contractual or agreed upon conditions within frameworks of strong dependence; c) poor dissemination of cooperation and information and knowledge exchange mechanisms, by the lack of a common language or by the exclusive ownership of such language by some members; d) “Intangible” assets flows are limited and, if any, they are unidirectional; e) where almost no joint developments exist, f) the design of products is virtually centered on the coordinating agent on an exclusive basis; g) there are strong heterogeneities in the development of innovative capacities of individual firms and in the manner social management technology is implemented. Even when there are some isolated virtuous cases in the implementation of these technologies, a preponderance of work intensity in the form of its organization and a low or absent recognition of labor stakeholders could be expected. Relationships among agents would exclusively be supported by the requirement to fulfill conditions –whether agreed upon or not- with no counterpart of no-price exchange flows. Innovative activities are scarce and circumscribed to a limited number of firms. In addition, the verticality of relationships makes knowledge dissemination difficult, and in this sense, the existing heterogeneity of the innovative capacity increases.

Unlike the above case, they can be found in weak institutional contexts (Rullani, 1999). They remain closed or isolated in relation to other networks and institutions, thus making their economic and social dynamics difficult.

Between both ends, “hybrid” models of network^{12/} are frequently found where a combination of factors places them near one or the other theoretical extreme. Thus, for instance, hybrid models closer to the “virtuous” network and others to the “weak” network can be found. Therefore, the “actual” networks keep a strong heterogeneity in terms of a) linkage styles, b) innovative capacity, and c) social management technology.

The studies carried out in Latin America (Novick and Gallart, 1997; Dussel, 1998; Leite, 1999; 1998; Carrillo, 1997; Abramo et al, 1997; Atenburg and Meyer-Stammer, 1999), show that the most usual situation in the region is the presence of networks close to the “weak” model.

2. THE CASE OF VOLKSWAGEN ARGENTINA: THE WEAKNESS OF THE NETWORK. THE ANALYTICAL DIMENSIONS CONSIDERED IN THE ARGENTINE AUTOMOBILE NETWORK

The research carried out on the Argentine automobile complex along recent years (Novick

¹² This denomination was taken from the conceptualizations made by Abo (1993 y 1998) and Boyer (1998).

and Catalano, 1998, Kosacoff et al, 1999; Motta et al 1998; Novick and Buceta, 1998; Novick and Yoguel, 1998 and 2000; Lugones and Sierra 1998, Bastos Tigre et al 1999), show a certain uniformity of conclusions. In sum, all these papers tend to question the very existence of the network and/or to characterize the interfirms' linkage models as hierarchical and heterogeneous. These features associate the network to the characteristics of a "weak model".

In this sense, the purpose of this section is to discuss how the three theoretical dimensions addressed in the first part are manifested on a significant group of Volkswagen suppliers internal and external to the plant (40 industrial firms). In the first place, the formation of these dimensions within the network is shown in a stylized way. Then, specific added indicators are created in order to evaluate the interconnections and feature the network under analysis.

2.1 Linkage styles

An analysis of the direct and indirect *purchase and sale relationships* of the agents in the network^{13/} and their link to the coordinating firm reveals that: a) the links to the coordinating firm are of a radial type; b) the weight of imports on total purchase at the car maker is high and this behavior is repeated among the main suppliers^{14/}; c) the importance of purchases and sales from suppliers to other vehicle parts and accessories suppliers is low^{15/}; d) exclusive networks are nonexistent. This may be explained by the dispersion of vehicle parts and accessories suppliers' sales structure^{16/}; e) TNCs have increasingly gained importance in detriment of local agents; f) there is a marked asymmetry between the proportion of smaller agents in the total number of suppliers and their participation in the car maker's's total purchases. The data justifying these features are shown in the Appendix and in Tables 1 through 3 in the Statistical Annex (hereinafter SA).

This weakness in the structure of purchase and sale relationships within the network conditions the development of no-price linkages among the agents. Factors opposed to the view of the "virtuous" network, such as the little importance of the subcontract, the lack of

¹³ With the purpose of carrying out a clearer identification of Volkswagen's different suppliers, agents were differentiated according to two criteria. On the one hand, a dichotomic classification was made on the basis of the importance of suppliers from the terminal's viewpoint. On the other hand, taking into account the changes produced in the local automobile complex, firms were classified according to the size and proportion of foreign direct (FDI). The following groups were thus established: i) transnational corporations (hereinafter TNC) with 100% FDI, ii) direct foreign investment enterprises (FDI above 50%), iii) big domestic firms (FDI below 50%) and iv) SMEs.

¹⁴ TNC's external purchase equal 53% of their total purchases against 20% in the case of SMEs. The high export coefficient that reaches 23% of total sales, is significantly higher in the case of TNCs. Replacement market is nonexistent for them and reaches one fifth of SMEs' sales.

¹⁵ Purchases from other vehicle parts and accessories suppliers amount only to 1% of total purchases by TNCs and 6% in the case of SMEs. On the contrary, purchases from other non-vehicle parts and accessories producers amount to almost half of total TNCs' purchases and three-fourths of SMEs' purchases (see Table 2 SA).

¹⁶ This feature, that may be grasped through the high proportion of firms having more than two quality standards, is more evident in TNCs (73% of the cases) than in SMEs (18%) (see Table 9 SA). Suppliers of Volkswagen Argentina panel allocate only 12% of their sales to this car maker on the average, 15% to the replacement market and 11% of total sales to other vehicle parts and accessories suppliers (see Table 3 SA).

contracts with the car maker and the permanent reprogramming of purchases, generally prevail. However, there are some features that boost the development of collective competitiveness, such as informal relationships, technical assistance by the car makers, use of laboratories, etc.

Subcontracting with other industrial firms is reduced because two thirds of the panel does not outsource any type of activity and when it does, the activity is usually oriented towards low complexity services. This fact, jointly with the low percentage of purchases from other vehicle parts and accessories suppliers and the high weight of imports already mentioned, is an indicator of the limited relevance of potential “backwards” linkages to the firms in the second and third level that, in the previous model and with a different degree of competitiveness, had an important weight on the complex (see Table 4 SA).

Likewise, the assemblers’ style in their purchase from local suppliers generally is not based on explicit supply contracts, but in agreements – usually unilateral – with important requirements of quality and price and with a strong instability reflected by a constant reprogramming due to market fluctuations¹⁷. Almost 80% of the firms surveyed have no contract, but purchase orders, The items agreed upon include price, quality, term, place and delivery conditions, quantity and improvement requirements. This case contradicts the positions that suggest that reciprocal trust between agents may be developed without explicit contracts.

Complementarily, 75% of suppliers anticipate the programming of volumes to be delivered on a weekly or monthly basis. While SMEs and the big domestic enterprises on the average have a monthly programming, the TNC’s horizon is usually greater (quarterly). The network’s instability is even greater because 87% of the firms in the panel, from SMEs to TNCs, receive a permanent reprogramming of the production previously agreed upon. This requirement from suppliers acts as an adjustment variable upon the occurrence of macroeconomic changes and minimum market variations, introducing additional microeconomic perturbations and revealing the existence of a strong hierarchy from the car makers to the vehicle parts and accessories suppliers, even for global suppliers who would ex - ante have higher degrees of freedom¹⁸.

To continue being a supplier of an assembly plant, not only implies production and financial flexibility, but JIT deliveries –with the presence of a consolidator (80% of firms)-involve the introduction of significant changes in distribution and logistics. This is an additional restriction on the survival of smaller local offerors.

In sum, this set of factors would place the network at the weak end. However, a type of no-price relationship among the agents that would partly counterbalance these features may be discerned. For instance, car makers give advice to vehicle parts suppliers on techniques to improve quality (60% of cases) and, to a lesser extent, on development and product design and work organization. On the same line, almost 43% of the firms in the panel receive technical assistance from VW for quality improvement, with a higher proportion in SMEs than in TNCs due to more unfavorable initial conditions of the former (see Table 6 SA).

¹⁷ These fluctuations are a limiting aspect for the development of advanced linkage styles between car makers and vehicle parts and accessories suppliers.

¹⁸ This way of operation of the market restricts the entry of an important number of SMEs that have a lesser possibility of technical and financial flexibility to bear market oscillations.

The use of car makers' infrastructure and laboratories by their suppliers is another activity where the incipient presence of no-price linkages can be observed (almost one fourth of suppliers use these laboratories). At the same time, informal linkages with other agents are increasingly important. A significant proportion of firms (41%) in the panel keep contact with other agents, including the treatment of relatively complex issues¹⁹. These informal relationships also show the incipient development of the network.

As regards "outward" linkages, the system of relationships with public and/or private institutions offering technological services is hardly developed. On the one hand, there is a low identification of institutional agents. On the other hand, the identified institutions are not a potential source of development to improve firms' competitiveness²⁰. Only 26% of linkages are established with technological institutes and/or Universities (above all, to offer internships and/or fellowships to recruit personnel).

2.2 Innovative capacity

Agents' innovative capacity is one of the central aspects in the development of capabilities of the network analyzed. This section examines its dimensions: *the degree of quality assurance, the weight of new products on sales, the development, improvement adaptation of new products and processes, new marketing modes, implementation of internal JIT and new management styles, and the quantum of human resources involved in these activities.*

Meeting quality assurance requirements is basic in order to become a supplier of car makers in the new scenario. This is shown by the high proportion of firms that have received quality standard certifications: ISO 9002, Qs9000, AQF, EAQF, VDA and Formel Q. Seventy-six per cent of the firms has received ISO 9002 standard certification with very few differences among different types of agents, SMEs and TNCs²¹.

The significant decrease in the life cycle of goods has compelled the firms to carry out a continuous updating of elaborated products, and to make design and process adaptations (particularly for the firms having a closer relationship with the car maker, and therefore, the new products represent over 80% of the sales for more than one third of the firms in the panel (see Table 10 SA). Data allow us to affirm that, in terms of products and processes, design and development is centered around incremental changes and adaptations²².

¹⁹ Among them, we can identify contacts linked to the possibility of carrying out joint developments of products and processes, implementing shared training programs, looking for partners to enter into different kinds of agreements, developing joint business abroad, questions related to the rationalization of the production process and to the management of the enterprise, marketing strategies in external markets, new automobile regimes for the year 2000, etc.

²⁰ This is explained by two complementary reasons. On the one hand, the technological assistance of institutions is not appropriate and it frequently involves complicated procedures (Yoguel et al 1998). On the other hand, the firms' potential demand has a very specific profile that a great number of official institutions would not be in a position to offer.

²¹ In turn, almost all suppliers have a reasonable number of control points where at least 3 statistics are estimated. Among them, frequency distribution, cause-effect diagrams, variable control charts, statistical control of attributes, etc., stand out. Within this context, TNCs and FDI firms, most of which use more than 3 statistics, stand out (see Table 8 SA).

²² However, for some parts, assembly and subassembly (domestic or global) suppliers require a high adaptation and design capacity.

Almost all of the suppliers have carried out developments and improvements in their products. In turn, the proportion of suppliers who made changes in their products and internal JIT was high (72% and 60% respectively).

When analyzing the development activities carried out by the firms (development and improvement of products, adaptation of products, development of new processes, improvement of processes, development of new distribution methods and internal JIT) it should be pointed out that over 50% of suppliers have fulfilled activities in this sense (see Table 11 SA).

Car makers have an influence on the product and process development and improvement activities, strengthening the idea developed above on the incipient no-price exchanges between the coordinating agent and the suppliers. This demand-advice is focused on the product development and improvement areas (70% of cases), process improvement^{23/} and product adaptation (45% of cases). On the contrary, the coordinating agent has a very limited influence on the important organizational transformations carried out by suppliers. This anticipates the little importance attached to the social management technologies in relation to the agents' competitiveness.

Improvement and innovation activities are carried out by groups of a stable character in most cases. Almost half of such groups, which have different degrees of formality, are organized as R&D laboratories. This reveals the extent to which innovation processes are spread, even among relatively small-sized agents. While FDI/TNC firms have a higher tendency to carry out development activities in R&D laboratories, among local small-sized suppliers informal development activities, similar to those performed by SMEs from other sectors, predominate (Yoguel and Boscherini 1999).

The importance of human resources allocated to these tasks should also be underlined. Thus, in 25% of the firms, the personnel exclusively devoted to development tasks is above 10% of total occupation, a proportion that reaches a significantly higher level among the TNCs (see table 12 SA).

A distinctive feature of the panel of firms integrating the production network is that all the agents make great training efforts. This is highly relevant because in almost 80% of the firms this activity has a structure of its own and a person from the human resources area is specifically in charge of the diagnosis, planning and development activities (see Table 14 SA). The importance attached to this subject is shown by the efforts addressed to all levels, covering a significant part of the personnel in the facilities^{24/}. In spite of this positive aspect, it should be noted that this is a basically individual activity carried out by the firms with a limited participation of the coordinating agent. This reflects the reduced association existing between the plane of innovative capacity and the plane of linkage styles^{25/}.

²³ In this line, continuous improvement programs (such as Volkswagen's KVP2) act directly on the economy of time, savings of materials, changes in the lay-out and improvement of relationships in production teams.

²⁵ Although in an important proportion of the panel, the car makers has some influence on the decision to implement training, it is not very significant in key aspects such as the election of the methodology, the identification of recipients and the evaluation. That is, participation is limited to the requirement and to a generic definition of the areas involved, without extending to significant areas for determining the efficacy of the activity.

The value attached to training is a dimension relating the innovative capacity to the importance assigned to human resources, that is, the plane of social management technology.

2.3 Social management technologies

In connection with social management technologies, the situation found is heterogeneous and varied. The research made shows transformations in work organization tending to a predominance of production cells (61% of firms and 65% of workers). At the same time, there is an important tendency towards an increase in the enrichment of tasks (72%), although a significant 28% of cases have introduced a simplification of tasks. Most of the Foreign Direct Investment (FDI) firms seem to have inclined to techniques related to the former.

The prevalence of work organization in cells or teams – somewhat greater in FDI firms – is not necessarily associated to greater a delegation of responsibilities to the workers in these groups. Some bibliography mentions the importance attached to workers in the new production models. However, in the panel analyzed, - and confirming the results of previous research (Novick et al, 1998) – delegation is usually limited to quality control tasks. In fact, the responsibility of these cells is focused on quality controls (67%), and to a much lesser extent to the determination of standards and work pace. Significantly, in spite of the extensive use of machinery based on electronics, there are a few cases in which the responsibility of machine programming is assigned to workers (in 82% of the firms surveyed, team members do not make any program or do it only occasionally).

A similar scene is evidenced in relation to the issue of polyvalence. The predominating model seems to center around rotation of different jobs, but of similar categories, of a similar complexity and exchangeable among work teams, far from multi-skills models and involvement in the different stages of the process as proclaimed by some literature (Coriat 1993).

As regards the management of cells, we could observe the coexistence of traditional supervision, cases in which emergent facilitators of the same work team act and others where the supervisor acts with a more technical character and is in charge of several cells (this is the situation in 44% of cases with a higher frequency in national capital enterprises than in FDI firms). Anyway, these data (in which only 24% has a traditional supervision) would be showing a transformation process in the work control systems which are changing their disciplinary character to become more technical and professional.

The heterogeneity of work organization by the firms in the network shows restricted processes of transformation at the microsocial level. From the “networks” viewpoint, there is a limited interference of coordinators in this subject, and it is not considered as a priority subject. On the contrary, the issues of work intensity, time improvement, and “died times” elimination along the working day, constitute the dimensions of interest both of coordinating agents and of the firms autonomously.

In accordance with the attitude of low valuation of the new human resource organization “models”, the remuneration system is based on traditional or Fordist assignments. Most enterprises reward “attendance” and productivity – that in many cases is only an increase

in production – and it is neither evidenced in incentives nor in those aspects linked to team work or training nor in quality improvements or polyvalence. This behavior is shown in the low percentage of variable wages (in most cases it is not above 10%).

Is this set of aspects explained by the little importance attached to human resources in the new productivity bases? Or is it simply the consequence of the weak mechanisms of exchange among the firms, what would constitute a new sign of the network's fragility? Or is it a model of “non-canonical” wage relationship (Durand, Stewart and Castillo, 1998) in line with any of the “pure” neo-Fordism models with embryonic signs of lean production?

In relation to the mechanisms for the generation of social agreements, we found several situations arisen both from the firms' strategies and from the existing sectorial labor relationship patterns. The car makers and the corresponding trade union succeeded in entering into consensus-based agreements related both to techno-organizational flexibility and to ad-hoc mechanisms for the solution of critical situations. On the contrary, in the vehicle parts and accessories enterprises, the situation is not uniform. Different behaviors were found according to the origin of capital, on the one hand, and to the type of trade unionism acting as a counterpart, on the other hand ^{26/}. FDI enterprises' rate of generation of specific agreements per firm is higher than the rates prevailing at national capital firms and SMEs. However, in spite of the relatively low number of enterprises with collective bargaining agreements and/or agreements adapted to the new work processes, the professional categories in force are, in general, specific to each enterprise and are not related to the existing agreements. This would be showing an important margin of entrepreneurial power in the determination of work process organization.

2.4. Linkage among the dimensions featuring the network

In addition to the behavior of each plane and of each factor determining it, it is important to know the interrelationship existing among them. The starting hypothesis – as developed in item 1.2.4 - was the existence of certain coherence in the behavior of the different dimensions

For this purpose, added indexes of each of the aspects were elaborated to summarize their most important features and evaluate the degree of linkage among them and to some variables considered along the work, such as the suppliers' hierarchy and the type of agents involved.

In order to summarize the set of elements that determine the “linkage style” among agents, an indicator from some of the above-mentioned factors, especially those referred to no-price mechanisms, was built ^{27/}. This indicator was analysed from the point of view of the

²⁶ In particular, the metallurgical trade union has not accepted a bargaining per enterprise; this made generation of agreements between the parties more difficult.

²⁷ The estimated index is an aggregate of the scores attributed to each of the following 10 factors: i) car makers technical assistance, ii) use of infrastructure and laboratories, iii) car makers support of development activities, iv) car makers support of management activities, v) car makers participation in training activities, vi) cooperation with other agents, vii) technology transfer, viii) depth of linkage with other institutions, ix) fulfilment of activities of Volkswagen's KVP2 program and x) informal linkages with other agents for the development of innovative activities. Each of the factors has –in general- values ranging from 0 to 4 and the maximum level reached by the indicator is 35 points. The maximum level of linkage is assigned to the agents who reach more than 60% of the maximum score, the minimum level corresponds to those reaching less than 30% and the medium level to those included between both ends.

type of enterprise and the degree of the supplier's importance for the car maker.

Table 1. Distribution of firms according to their importance as suppliers and development reached in their “linkage style”.

| Importance | Linkage intensity | | | |
|-------------|-------------------|----------|--------|---------|
| | Low % | Medium % | High % | Total % |
| Priority | 26 | 58 | 16 | 100.0 |
| Secondary | 31 | 50 | 19 | 100.0 |
| Grand Total | 29 | 54 | 17 | 100.0 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

As it can be observed in the above table, the distribution of linkage intensity does not depend on the suppliers' hierarchy. It means that the indicator is not associated to the importance attached by the car maker to its agents²⁸/. On the other hand, only 17% of firms in the network have a high linkage index. This confirms the statements made in relation to the weakness of the network.

Table 2. Distribution of firms per type of agent and development reached in their “linkage style”.

| Category a/ | Linkage intensity | | | |
|--------------|-------------------|--------|------|-------|
| | Low | Medium | High | Total |
| SMEs | 18 | 64 | 18 | 100 |
| Big firms | 0 | 50 | 50 | 100 |
| FDI over 50% | 33 | 67 | 0 | 100 |
| TNC | 50 | 30 | 20 | 100 |
| Total | 29 | 54 | 17 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Note: a/ SME's, small and medium enterprises; FDI foreign direct investment; TNC transnational corporations

Significantly, the linkage style is not associated to the type of agents being considered either, although it increases slightly in relation to the SMEs²⁹/, as a reflection of these agents' need to increase their capabilities by resorting to assets that are found outside the firm. On the other hand, the weakness of TNCs' relationship with local agents is explained by the greater frequency and intensity of linkages to their head offices.

The indicator of innovative capacity takes into account a set of combined answers given by the firms³⁰/. Individually analyzed, almost 40% of suppliers reach the maximum level of

²⁸ The probability of accepting the hypothesis of non-association between variables using non parametric statistics (Kendall's τ) is 91%.

²⁹ The probability of accepting the hypothesis of negative non-association is 19% and the Kendall correlation coefficient is -0.20, showing that there is a weak inverse relationship. That is, the depth of the linkage increases as we go from TNC to SME agents.

³⁰ It gives priority to 6 qualitative and quantitative factors: i) training, ii) number of quality standards, iii) number of development activities, iv) proportion of exclusive human resources in development activities, v) development activities linked to organization and management, and vi) weight of new products on the firms' sales. Each factor is assigned a possible score on the basis of the answers given by the firms in the network.

the indicator, revealing that this is a necessary condition to be able to become a part of the network. Within this framework, there is an inverse relationship between the level reached by the indicator and the size of agents^{31/}.

Table 3. Distribution of firms per category according to their level of innovative capacity

| Type of supplier | Innovative capacity | | | Total |
|------------------|---------------------|--------|------|-------|
| | Low | Medium | High | |
| TNC | 0 | 33 | 67 | 100 |
| FDI | 0 | 0 | 100 | 100 |
| Big firms | 0 | 40 | 60 | 100 |
| SMEs | 47 | 35 | 18 | 100 |
| Total | 23 | 40 | 37 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Unlike linkage styles, the proportion of priority firms having a great innovative capacity is much higher than in secondary suppliers: 71% and 14% respectively^{32/}.

Table 4. Distribution of firms per category according to their level of innovative capacity

| Type of supplier | Innovative capacity | | | Total |
|------------------|---------------------|--------|------|-------|
| | Low | Medium | High | |
| Priority | 0 | 29 | 71 | 100 |
| Secondary | 38 | 48 | 14 | 100 |
| Total | 23 | 40 | 37 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Finally, an indicator of the plane of "Social Management Technologies" that takes into account the percentage of production organized in cells or work teams, the role played by hierarchy, the type of generation of consensus-based agreements and the system of remuneration in force was estimated.

Table 5. Distribution of firms per category according to their level of social management technology

| Type of supplier | Social management technology | | | Total |
|------------------|------------------------------|--------|----------|-------|
| | Fragmentary | Medium | Systemic | |
| Priority | 27 | 47 | 27 | 100 |
| Secondary | 35 | 60 | 5 | 100 |
| Total | 31 | 54 | 14 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

The most important and outstanding feature is that only 14% of the firms reach a systemic

The indicator results from the sum of the points assigned to each factor, reaching a maximum value of 31 points. Firms obtaining more than 70% of the maximum value are assigned a high value; those obtaining less than 58% are assigned a low value, and the rest are assigned an intermediate value.

³¹ The probability of accepting the hypothesis of absence of association is only 0.9% and Kendall's correlation coefficient is 0.38.

³² The connection between both variables is revealed in that the probability of accepting the hypothesis of absence of association is only 0.1% and Kendall's correlation coefficient is 0.49.

social management technology level, a proportion somewhat higher in priority suppliers than in secondary suppliers. This is related to the fact that the firms having a certain degree of direct foreign investment – most of which are found in the group of priority suppliers – have implemented work organization models nearer to the “systemic” type, including the component of consensus-based agreement generation, also linked to a decentralized collective bargaining with an important discussion on work organization issues and new professional categories.

Table 6 Distribution of firms per type of supplier according to their level of social management technology

| Type of supplier | Social management technologies | | | |
|------------------|--------------------------------|---------|----------|-------|
| | Fragmentary | Medium | Systemic | Total |
| TNC | 40 | 50 | 10 | 100 |
| FDI | 0 | 83 | 17 | 100 |
| Big firms | No data | No data | No data | ND |
| SMEs | 41 | 53 | 6 | 100 |
| Total | 31 | 54 | 14 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

The nonexistence of differences (for linkage styles and social management technologies indicators) between the levels of importance assigned to suppliers by the car maker would be confirming that it is a weak network, with a light-weighted “tier” structure. This gives rise to questions on the possible synergy of the network and therefore, on the dynamic competitive advantages that may be reached.

The linkage among the three dimensions taken into account is very limited (see tables 15 through 17 of the SA). This strengthens the idea of the lability of the industrial network analyzed³³. Especially, the null association existing between the innovative capacity and the linkage styles would reflect that the higher values obtained in the first index correspond to the firms' individual strategies. Consequently, the endogenous capabilities generated do not flow along the network without synergistic mechanisms being produced.

The analysis of these indexes and the set of data described along the document would affirm that the focus of these firms' competitiveness is restricted to the “hard” aspects, that is, to quality improvements, increasing developments in products and processes and training – essential elements to survive in the market nowadays. On the contrary, the lesser importance of linkage styles and social management technologies – that would boost learning and knowledge among the firms and a greater involvement of human resources – imply the neglect of “soft” factors that would enhance the development of agents' competitive advantages, both individually and collectively.

3. FINAL REFLECTIONS

³³ The analysis of non-parametrical correlation among the three aspects allows us to reject the hypothesis of association. Thus, the probability of rejection of this hypothesis reaches 93% between the innovative capacity and linkage styles, 59% when connecting the first plane mentioned above and that corresponding to social management technologies, and 10% when comparing linkage style to social management technologies.

In this paper we have presented a theoretical reflection on the three dimensions taken into account to define a production network (linkage styles, innovative capacity and social management technologies). We started from the idea that, as the current change from an individual competitiveness conception to a systemic view, these dimensions and their interaction are key elements for the development of agents' capabilities, and for the creation of dynamic competitive advantages. In order to evaluate this set of questions, we applied the methodology elaborated to a representative group of Volkswagen's suppliers in Argentina.

In the first place, it should be underlined that the development of no-price relationships and the generation of synergy among the agents is weakened by the high weight of the car maker and the main suppliers' imports, the radial links between the different agents, the low weight of purchase and sale relationships of vehicle parts suppliers among themselves, the nonexistence of contracts and the delivery agreements subject to unilateral reprogramming. On the other hand, in stylized terms, the firms' innovative capacity is medium and has a strong heterogeneity, while work organization is predominantly neo-Fordist with some aspects of lean production. The degree of development reached by the linkage styles between agents and the social management technologies does not depend upon the suppliers' hierarchy from the car maker's's viewpoint nor upon the size and weight of suppliers' direct foreign investment.

The limited relationship among the three dimensions of analysis also allows us to qualify the network analyzed as nearer to the weak end, with a significant lability and efforts devoted to the achievement of a static short-term efficiency rather than to the search for a dynamic efficiency (Schmitz, 1995). However, there are some elements that lessen such lability. An important effort made by all the firms in connection with their innovative capacity is detected in relation to quality (enhanced by the car maker's's' assistance-requirement), training and particularly in some enterprises, to interesting advancements in development and product and process adaptations. The number of personnel involved in R&D activities is also relatively significant. An incipient use of assembly plants' laboratories and infrastructure by suppliers can be observed. However, it should be emphasized that these factors are a necessary condition for the survival of agents as suppliers of car makers.

The role of transnational corporations is critical to the network, as they are the agents with the highest innovative capacity. In this sense, the model of network is nearer to the "relationship between big firms" than any other model among those described in literature. The strong linkage of these firms with their head offices – of a radial and hierarchical nature, might be added– is an element that boosts their individual capabilities, but weakens their linkages with the other local agents in the network.

In sum, this complex network of partial relationships questions the concept of "modular consortium" for the Argentine case, not only due to the insourcing mechanisms and vertical integration processes already mentioned, but also because of the absence of different linkages between the associated firms and the rest of the enterprises. As a final reflection it must be pointed out that the answer to these dilemmas does not depend either on the firms' micro strategies or on the network's meso level only. The network's evolutionary path in the nineties has shown that the macroeconomic elements constitute the core that conditions its degree of weakness or virtuosity. At the same time, macroeconomic stable scenarios in the countries of the region are a necessary, but not sufficient condition.

APPENDIX 1: MAIN FEATURES OF THE PANEL

The dynamics of the Argentine automobile complex in the nineties resulted in a process of strong purchases, mergers, acquisitions, strategic agreements and closures that changed the structure of the automobile sector. Consequently, the number of companies was significantly reduced and capital internationalization increased. These tendencies are reflected on the panel of vehicle parts and accessories suppliers analyzed in this paper, where bigger agents, both in terms of occupation and sales, with a significant proportion of direct foreign investment and high productivity levels, became more important (see next Box).

Features of the panel of firms surveyed

- ✓ An average of 236 workers per plant
- ✓ 35 million pesos of average annual sales per plant
- ✓ 48% of the firms have more than one plant
- ✓ Production value per worker is \$146,600
- ✓ Half of the firms have FDI
- ✓ Predominant activities are stamping, electrical and electronic parts, forging, aluminum, plastic parts, machining and painting^{34/}

Transnational corporations (TNC) are a bit less than one third of all suppliers, but they account for around 80% of local purchases and almost half of total purchases by the automobile car maker analyzed (see Table 1 SA). On the contrary, subcontracting SMEs are a bit less than half of the suppliers and represent one tenth of domestic purchases and 6% of total purchases. In turn, the marked difference between the amount of domestic and total purchases is reflected on the considerable weight of imports, that would represent around 40% of total purchases of raw materials, assembly and subassembly for the automobile complex^{35/}.

It is interesting to underline SMEs' limited participation when suppliers' hierarchy is analyzed from the viewpoint of their importance as evaluated by the car maker. Forty-six per cent of suppliers are SMEs and one fourth of them are the most important suppliers for the car maker, while two thirds of them have the least relative importance. In the case of TNCs, the situation is exactly opposite. Forty-four per cent of them are the most significant suppliers and only 19% have the least relative importance for the car maker.

³⁴ With the exception of painting, machining, big plastic parts and upholstery, where most firms are direct foreign investors, in the rest of the items national and foreign firms coexist. National firms' participation is higher in plastic parts, rubber, tires, standard parts and stamping.

³⁵ This relationship, which arises from still preliminary information on the 1997 input-product matrix, was applied to the car maker analyzed in order to calculate the weight of local suppliers belonging to the different groups on the total purchases by the firm.

APPENDIX II: METHODOLOGICAL

1) Innovative Capacity Index

Factors considered:

- Training: The Index vary between 0 and 4. It takes a value 4 when there are training and own structure, 1 when there is training without own structure and 0, when the enterprise doesn't do training activities.
- Standards of quality pondered: The index varies between 0 and 7. It takes a value 7 when the firm has ISO 9002 (3 points) and the others 5 norms considered and it takes a value 0 when the firm doesn't have norms
- Activities of development The index varies between 6 and 0. It takes the maximum value when the firm does all the activities considered in the form and 0 when it doesn't do none
- Human resources in development activities: It varies between 0 and 5 and takes the maximum value when the percentage is higher than 10% of the occupation, 4 when it is higher than 5%, 3 when it is between 1 and 5%, 2 if it is less 1% and 1 when it is 0.
- Development activities linked with the management: The index varies between 0 and 4 it assumes the maximum value when the firm carries out all the activities considered in the form and 0 when it doesn't carry out none
- Percentage of new products in the total sales: The index varies between 6 and 1. It takes a value 6 when the percentage is 100%, 5 when the new products are more than 80%, 4 when the percentage is between 50 and 79%, 3 when it is between 21 and 49%, 2 if it is less or 20% and 1 when it is 0.

2) Linkage styles

Factors considered:

- Car makers's Technical Assistance: The index varies between 0 and 4, it takes a value 4 when Volkswagen gives assistance in quality, product development and design, work process organisation and production, and falls when the technical assistance dimensions decreases.
- Laboratory and infrastructure use: The index can take three values, 4 when the supplier uses infrastructure and laboratories, 2 when it uses some of them and 0 when it doesn't use none of them.
- Volkswagen's support in development activities: the index can take values between 6 and 0, assume a value 6 when the car maker participates in product development, new process development, changes in the distribution, intern JIT, etc. and it falls when the assistance dimensions decreases.
- Volkswagen's support in management activities: the index can take values between 0 and 5. It assumes the maximum value when the car makers support the supplier in management activities and strategic plans, betters in the organizational structure, management development, etc., and fall when the assistance dimensions decreases.
- Volkswagen's support in training activities: the index can take values between 0 and 7. It assumes the maximum value when the car makers influences the supplier's training decisions, the subjects, the methodology, the personal which take the training, the offerings, the evaluation, etc., and decreases when the assistance areas falls.
- Cooperation with others agents: the index can take values between 0 and 4, it is 0 when the firm doesn't have cooperation relationships with other agents, it is 2 when the relationships are in commercialisation and/or inputs buy and it is 4 when the

relationships are in buy technology/ training or exports.

- Technology transfer: The index is 0 when the firm doesn't receive transfer, it is 2 when received transfer from the headquarter and 4 when the firm received technology transfer from the cars makers, technology suppliers, etc.
- Informal conversations with others colleges: It index consider a minimum number the areas and the subjects talked. It assume values between 0 (without conversations) and 4 (more than three subjects and more than 80% complexes).
- Linkage with others institutions: The index can take values between 0 and 5: the maximum value is when the firm uses the institutions to a) essays, methodology and analysis, c) market and technological information process and analysis, d) training, R&D projects.
- KVP2 (a VW programme to suppliers assistance). It index assume the value 0 when the firm didn't use the programme and it grow when grow the subjects with important incidence.

3) Social management technologies

Factors considered:

- Employees percent organized in cellules
- Rol played for the supervisor.
- Accords consensuses generation.
- Remuneration system

APPENDIX III: STATISTICAL

Table 1. Participation of the different types of suppliers in the car maker's's purchases

| Type of firm | % of total number of suppliers | % of car maker's's local purchases | % of car maker's's total purchases |
|--------------------|--------------------------------|------------------------------------|------------------------------------|
| TNC c/ | 30 | 79 | 48 |
| FDI over 50% c/ | 19 | 6 | 3 |
| Big domestic firms | 5 | 4 | 3 |
| SMEs a/ | 46 | 10 | 6 |
| Total | 100 | 100 | 60 b/ |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Notes: a/ Firms with sales below 18 million pesos per year that do not belong to economic groups and have no direct foreign investment; b/ It is considered that the proportion of imports on the total purchases of the automobile complex reaches 40% c/ FDI foreign direct investment; TNC transnational corporations

Table 2. Purchases by the car maker's's suppliers from other agents.

| Type of firm | Other vehicle parts suppliers | Other suppliers | Imports | Total |
|------------------------|-------------------------------|-----------------|---------|-------|
| TNC | 1 | 46 | 53 | 100 |
| FDI between 50 and 99% | 16 | 48 | 35 | 100 |
| Big domestic firms | 0.4 | 45.5 | 54.1 | 100 |
| SMEs | 6 | 74 | 20 | 100 |
| Total | | | | |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 3. Sales by the car maker's's suppliers from other agents.

| Type of firm | VW | Other car makers | Exports | Local vehicle parts suppliers | Replacement | Other sectors | Total |
|------------------------|----|------------------|---------|-------------------------------|-------------|---------------|-------|
| TNC | 20 | 39 | 30 | 3 | 2 | 7 | 100 |
| FDI between 50 and 99% | 7 | 35 | 17 | 25 | 1 | 15 | 100 |
| Big domestic firms | 5 | 22 | 36 | 0 | 36 | 0 | 100 |
| SMEs | 24 | 40 | 3 | 10 | 20 | 3 | 100 |
| Total | 12 | 33 | 23 | 11 | 15 | 7 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 4. Distribution of firms per type by the importance of subcontracting with other agents

| Type of firm | No subcontract | Services | Services and industry | Total |
|------------------------|----------------|----------|-----------------------|-------|
| TNC | 11 | 67 | 22 | 100 |
| FDI between 50 and 100 | 0 | 40 | 60 | 100 |
| Big domestic firms | 0 | 100 | 0 | 100 |
| SMEs | 31 | 31 | 38 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 5. Distribution of firms per type according to their delivery method

| Type | Traditional | Consolidator | JIT | Total |
|------------------------|-------------|--------------|-----|-------|
| TNC | 20% | 55% | 25% | 100 |
| FDI between 50 and 100 | 50% | 25% | 25% | 100 |
| Big domestic firms | 0% | 20% | 80% | 100 |
| SMEs | 25% | 25% | 50% | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 6. Distribution of firms per type according to the advice received from VW in various areas

| | Quality | Developments | Work process | Others |
|------------------------|---------|--------------|--------------|--------|
| TNC | 65% | 41% | 29% | 12% |
| FDI between 50 and 100 | 0% | 0% | 0% | 0% |
| Big domestic firms | 43% | 29% | 29% | 0% |
| SMEs | 18% | 9% | 36% | 0% |
| Total | 43% | 27% | 30% | 5% |

Table 7. Distribution of firms per type of agent according to the importance and area of cooperation

| | With agreements | | |
|------------------------|--------------------|-------------------|--------------------|
| | Without agreements | Lesser complexity | Greater complexity |
| TNC | 59% | 12% | 24% |
| FDI between 50 and 100 | 0% | 0% | 100% |
| Big domestic firms | 43% | 14% | 14% |
| SMEs | 55% | 0% | 27% |
| Total | 51 | 8 | 27 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 8. Distribution of firms per type according to the number of statistics estimated

| Type of firm | Up to 3 statistics | Over 3 statistics |
|--------------------|--------------------|-------------------|
| TNC | 10 | 90 |
| FDI over 50 | 0 | 100 |
| Big domestic firms | 50 | 50 |
| SMEs | 24 | 76 |
| Total | 17 | 83 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 9. Distribution of firms per type according to the number of quality standards

| Type of firm | Up to 2 standards | Over 2 standards | Total |
|--------------------|-------------------|------------------|-------|
| TNC | 27 | 73 | 100 |
| FDI over 50 | 50 | 50 | 100 |
| Big domestic firms | 57 | 43 | 100 |
| SMEs | 82 | 18 | 100 |
| Total | 59 | 41 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 10. Distribution of firms per type according to the weight of new products on invoicing during the last 4 years.

| Type of firm | Over 80% | 50-80 | 30-50 | Less than 30% | Total |
|--------------------|----------|-------|-------|---------------|-------|
| TNC | 33% | 11 | 22 | 44 | 100 |
| FDI >50 | 40 | 20 | 20 | 20 | 100 |
| Big domestic firms | 100 | 0 | 0 | 0 | 100 |
| SMEs | 33 | 27 | 13 | 27 | 100 |
| Total | 35 | 19 | 16 | 29 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 11. Distribution of firms per type of agent according to the number of development activities they carried out

| Type of agent | Up to 2 activities | 3 and 4 | 5 and over | TOTAL |
|---------------|--------------------|---------|------------|-------|
| TNC | 10 | 40 | 50 | 100 |
| FDI | 0 | 33 | 67 | 100 |
| Big firms | 0 | 0 | 100 | 100 |
| SMEs | 18 | 29 | 53 | 100 |
| Total | 12 | 32 | 56 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 12. Distribution of firms according to the proportion of exclusivity in development teams

| | Above 10% | From 5 to 9.9 | From 1 to 4.9 | Below 1 | Zero | Total |
|-----------|-----------|---------------|---------------|---------|------|-------|
| TNC | 57 | 0 | 0 | 14 | 29 | 100 |
| FDI | 0 | 20 | 60 | 20 | 0 | 100 |
| Big firms | | | | | | |
| SMEs | 19 | 31 | 6 | 0 | 44 | 100 |
| Total | 25 | 21 | 14 | 7 | 32 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 13. Distribution of firms per type of agent according to the number of development activity in the management area a/

| | 0 | 1 | 3 | 4 | Total |
|-----------|----|----|----|----|-------|
| TNC | 0 | 0 | 30 | 70 | 100 |
| FDI | 0 | 0 | 33 | 67 | 100 |
| Big firms | 0 | 50 | 0 | 50 | 100 |
| SMEs | 12 | 12 | 24 | 53 | 100 |
| Total | 6 | 9 | 26 | 60 | 100 |

Note: a/ Alternatives were management and/or strategic planning; improvement in the firm's organization structure; professionalization and/or managerial development, and re-engineering of administrative processes

Table 14. Distribution of firms per category according to training activity

| Type of supplier | No activity | Without own structure | With own structure | Total |
|------------------|-------------|-----------------------|--------------------|-------|
| TNC | 0 | 9 | 91 | 100 |
| FDI | 0 | 17 | 83 | 100 |
| Big firms | 0 | 0 | 100 | 100 |
| SMEs | 0 | 35 | 65 | 100 |
| Total | 0 | 23 | 77 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 15. Distribution of suppliers per linkage style according to innovative capacity

| Linkage index | Innovation index | | | Total |
|---------------|------------------|--------|------|-------|
| | Low | Medium | High | |
| Low | 30 | 18 | 36 | 29 |
| Medium | 70 | 55 | 43 | 54 |
| High | 0 | 27 | 21 | 17 |
| Total | 100 | 100 | 100 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 16. Distribution of suppliers per linkage style according to social management technologies

| Linkage index | Social management technologies | | | Total |
|---------------|--------------------------------|------------|------------|------------|
| | Fragmentary | Medium | Systemic | |
| Low | 46 | 28 | 0 | 29 |
| Medium | 36 | 67 | 60 | 56 |
| High | 18 | 5 | 40 | 15 |
| Total | 100 | 100 | 100 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

Table 17. Distribution of suppliers per social management technology according to innovative capacity

| Innovative capacity | Social management technologies | | | Total |
|---------------------|--------------------------------|------------|------------|------------|
| | Fragmentary | Medium | Systemic | |
| Low | 23 | 13 | 0 | 29 |
| Medium | 9 | 41 | 31 | 31 |
| High | 68 | 46 | 69 | 40 |
| Total | 100 | 100 | 100 | 100 |

Source: Own elaboration on the basis of a survey addressed to VW's suppliers.

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Danish Research Unit for Industrial Dynamics

The Research Programme

The DRUID-research programme is organised in 3 different research themes:

- *The firm as a learning organisation*
- *Competence building and inter-firm dynamics*
- *The learning economy and the competitiveness of systems of innovation*

In each of the three areas there is one strategic theoretical and one central empirical and policy oriented orientation.

Theme A: The firm as a learning organisation

The theoretical perspective confronts and combines the resource-based view (Penrose, 1959) with recent approaches where the focus is on learning and the dynamic capabilities of the firm (Dosi, Teece and Winter, 1992). The aim of this theoretical work is to develop an analytical understanding of the firm as a learning organisation.

The empirical and policy issues relate to the nexus technology, productivity, organisational change and human resources. More insight in the dynamic interplay between these factors at the level of the firm is crucial to understand international differences in performance at the macro level in terms of economic growth and employment.

Theme B: Competence building and inter-firm dynamics

The theoretical perspective relates to the dynamics of the inter-firm division of labour and the formation of network relationships between firms. An attempt will be made to develop evolutionary models with Schumpeterian innovations as the motor driving a Marshallian evolution of the division of labour.

The empirical and policy issues relate the formation of knowledge-intensive regional and sectoral networks of firms to competitiveness and structural change. Data on the structure of production will be combined with indicators of knowledge and learning. IO-matrixes which include flows of knowledge and new technologies will be developed and supplemented by data from case-studies and questionnaires.

Theme C: The learning economy and the competitiveness of systems of innovation.

The third theme aims at a stronger conceptual and theoretical base for new concepts such as 'systems of innovation' and 'the learning economy' and to link these concepts to the ecological dimension. The focus is on the interaction between institutional and technical change in a specified geographical space. An attempt will be made to synthesise theories of economic development emphasising the role of science based-sectors with those emphasising learning-by-producing and the growing knowledge-intensity of all economic activities.

The main empirical and policy issues are related to changes in the local dimensions of innovation and learning. What remains of the relative autonomy of national systems of innovation? Is there a tendency towards convergence or divergence in the specialisation in trade, production, innovation and in the knowledge base itself when we compare regions and nations?

The Ph.D.-programme

There are at present more than 10 Ph.D.-students working in close connection to the DRUID research programme. DRUID organises regularly specific Ph.D-activities such as workshops, seminars and courses, often in a co-operation with other Danish or international institutes. Also important is the role of DRUID as an environment which stimulates the Ph.D.-students to become creative and effective. This involves several elements:

- access to the international network in the form of visiting fellows and visits at the sister institutions
- participation in research projects
- access to supervision of theses
- access to databases

Each year DRUID welcomes a limited number of foreign Ph.D.-students who want to work on subjects and projects close to the core of the DRUID-research programme.

External projects

DRUID-members are involved in projects with external support. One major project which covers several of the elements of the research programme is DISKO; a comparative analysis of the Danish Innovation System; and there are several projects involving international co-operation within EU's 4th Framework Programme. DRUID is open to host other projects as far as they fall within its research profile. Special attention is given to the communication of research results from such projects to a wide set of social actors and policy makers.

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