SUPPLIER DEVELOPMENT, PRODUCTION ENVIRONMENT AND
THE CREATION OF COMPETITIVE ADVANTAGES: THE CASE OF
AN IRON AND STEEL INDUSTRIAL NETWORK IN ARGENTINA¹

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Introduction

In the last two decades the international economic arena underwent important transformations which had a major impact on the competitiveness of agents: i) the emergence of new information- and communication-intensive technologies, ii) globalization and opening-up processes within a framework of non-restrictive regionalism, and iii) a new significance of territorial circumstances (local systems) and learning processes.

These changes, accompanied as they were by greater competitive pressures and an increase of strategic uncertainty, have resulted in momentous transformations in the production of goods and services, and also in changes in specialization patterns that altered the factors that determine the competitiveness of enterprises, regions, and countries.

The concept itself of competitiveness as a phenomenon exclusively dominated by macroeconomic and sectoral factors and determined by static comparative advantages or factor endowment has been questioned. An idea is now spreading steadily that competitive advantages may be created (and lost), that they are dynamic in nature, and that they depend on the agents’ actions. In this transition from static to dynamic comparative advantages, competitiveness is conceived as a systemic phenomenon. Additional factors are added to traditional macroeconomic and sectoral agencies which were the key elements of competitiveness in the previous scenario: the agents’ microeconomic behaviour, the significance of production networks, the development of personnel having the skills required in the labour market, the development of local and territorial systems, and other elements that constitute the so-called business environment of a firm.

Such issues are in turn reflected in new patterns of economic activities as conceptualized in the international literature about clusters, innovative local systems, global commodity chains and production networks. Throughout recent years, a profuse literature has been published which, from various theoretical viewpoints, deals with the new organizational patterns of economic activities (Giuliani 2002). In the first place, mention should be made of works supporting the idea that agglomeration economies generate spillovers and favour collective learning. Among them, studies about industrial districts seen from Marshall’s tradition understand clusters as a cognitive laboratory that generates knowledge spillovers conceived as a public good (Bellandi 1989, Becattini 1990). Informal exchanges among agents as a source of competence development are emphasized in other approaches (Camagni 1991, Capello 1999). Here, knowledge is no longer a public good but a (restricted) club good, i.e., a good which is not easily obtainable by agents from outside the cluster, local system or network (Giuliani 2002). In passing from the first approach to this latter one, the black box (the firm itself) ceases to a certain extent to be closed. Works dealing on agglomeration economies entail a step forward because spillovers depend on the knowledge-level achieved at public and private R&D labs in the area (Audrestch, 1998, 1999, Feldman, 1994). Thus, knowledge is no longer a public or club good since tacit elements flow freely and may be appropriated by any agent. In the second place, there is another group of researchers who draw a sharp distinction between codified and tacit knowledge considering the latter as contextual and idiosyncratic (Lundvall, Johnson, 2001, Rullani, 2000), and the company or firm as the place where tacit knowledge is stored and accumulates. They think that only through the interaction of tacit, contextual knowledge and external codified knowledge the needed metabolic process of learning occurs (Nonaka, Takeuchi, 1994, Rullani, 2000) giving rise to the consequent competitive
advantages in firms, clusters, local systems and production networks. Some authors think there is a division of the cognitive labour parallel to the division of productive labour, which results in a recombination of knowledge that enables a new phase of creative knowledge (Antonelli, 1999; Gambardella, 2001).

In the third place, other authors posit the idea of an epistemic community, understood as a community of individuals who share a common codified language which cannot be understood by outsiders. From this point of view, what appears (to outsiders) as tacit knowledge may have been codified according to unwritten rules that hold within that epistemic community (Cowan, David, Foray, 2000). In this case, the dissemination of pseudo-tacit and specifically tacit knowledge in such epistemic community is not free and is subject to private appropriation. This may be the case of hierarchic production networks as those studied in the present work, which have been labelled by Gereffi as “global commodity chains” (Gereffi, 2001).

All these theories indicate that, besides the microeconomic dimension which takes into account the agents behaviour and the development of technical and organizational competence and capabilities, the relevance of meta and mesoeconomic dimensions is being perceived (Meyer-Stammer 1998). The meta dimension includes the social appraisal of learning processes, the degree of cohesion, the importance of collective memory, the ability to formulate strategies and policies, whether the society as a whole is able to generate a sustainable development profile and the prevailing competitive model. The mesoeconomic dimension includes issues such as (i) the degree of development of institutions, production and services structures, (ii) market regulatory frameworks, (iii) competitive strategies, (iv) the degree of development of other factors such as technology, education, human resources, and environment, and (v) the significance of formal and informal interrelationships between each firm and other companies and organizations, which ultimately constitute the networks where they carry out their activities.

Therefore, competitiveness is a complex concept not only because of the relevance these dimensions have acquired but also because it is no longer conceived as a phenomenon associated with an individual firm but as involving both territories and enterprise networks (Buitelar 1999, Meyer-Stammer 1999, Messner, 1995, Poma 2000, Yoguel 2000). Tangible and intangible flows between firms and/or other agents have been called in this work the "production environment" of the firms under study. This concept results from intersecting the idea of business environment in the broad sense and the so-called production networks. Each firm's specific contributions to the environment are key elements for understanding how the general business environment influences the firm's situation and dynamics. The constituents of the production environment thus defined may grouped into two main categories: i) the close production environment made up of interactions with the core firm ("internal relationships or connections") and ii) the extended production environment involving formal and informal interactions with other firms and organizations ("external relationships or connections"). As has been noted in previous works (Yoguel and Moori Koenig, 1999) the firm's endogenous capabilities have a critical influence both on the perception of the environment and on its positive or negative impact on them.

This work starts from this conceptual foundations and emphasizes tangible and intangible interrelationships within production networks. It may be seen as a study that stands on the crossroads between environment studies and those devoted to analyzing supplier and production networks. A special emphasis is placed on tangible and intangible flows between agents in the network as well as on connections between such flows and the
development of endogenous capabilities at the very heart of each company. The work is also aimed at developing a methodology apt to assess the degree of development of endogenous capabilities among suppliers and the importance of connections established between them and: (i) the core (restricted production environment) and (ii) other companies and organizations that belong to the extended production environment. A panel of 52 regular suppliers of two iron and steel production firms, SIDERCA and SIDERAR, were selected for the field study, and the survey was carried out during the third quarter of 2001.

Even though the network is not examined as a whole since the relationships between the core and its clients are not considered, the levels already included in this analysis are helpful enough to understand learning and (individual and joint) competence-development processes that are carried out by local enterprises having a stable trade relationship. In the case of the network under study, the core is based on process technologies and its endogenous capabilities are perhaps more significant than in other industrial networks where the core has a higher degree of dependence on the technical capabilities of its suppliers. However, the suppliers’ capabilities are significant for assessing the network competitiveness as a whole because services became increasingly important in recent years.

The final version and general review of the seven chapters that constitute this work has been performed by Milesi, Novick and Yoguel. In the first chapter, Milesi, Novick, Yoguel and Albornoz describe the methodology applied. The main indicators that account for the development of endogenous capabilities among suppliers are described (innovative capabilities, work organization, and training efforts). Besides, other indicators reflect the flow of knowledge and information from and towards the core (restricted production environment) and the extended production environment. In the second chapter, Milesi and Yoguel stylize the core firms and describe the major structural features of the suppliers included in the survey. In the third chapter, Milesi, Novick and Yoguel examine the development of the suppliers' endogenous capabilities: innovative capabilities, training and social management technologies. In the fourth chapter, Yoguel, Milesi, Moori-Koenig and Rotondo analyze the suppliers' relationships with core firms and other external agents. In the fifth chapter, Milesi and Yoguel offer some econometric models to assess the degree of association between competence-determining factors and each particular type of relationship with the core. Thus, a taxonomy of suppliers is provided through cluster analysis. This chapter evaluates the relative weight of the production environment for the development of endogenous capabilities. In the sixth chapter, Bisang examines the potential impact of an integral supply-service company (dependent on the core) on the competence-development process of suppliers. Finally, in the seventh chapter all the authors discuss the main conclusions and suggest some public policies that may strengthen the relationship SME-big business so as to improve the specific production environment. An appendix is included that describes the indicators applied, the products of the companies included in the survey panel, the development activities carried out, and the characteristics of fieldwork.

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2 This methodology is based on previous developments in the automotive sector (see Yoguel, Novick, Marin, 2000; Novick and Yoguel 2001, Novick et al., 2002, Albornoz and Yoguel 2002, and Albornoz, Milesi and Yoguel 2002). Throughout this paper some comparative references are made to the degree of development of the Argentine automotive network.
1. A theoretical and methodological approach for studying production networks

As has been mentioned in the introduction, many discussions have arisen in the last years about the competitiveness of agents, which resulted in a new conception and stance of micro and mesoeconomic issues. In particular, the increasing significance of information flows and learning in the agents' competence-creation processes entailed a reassessment of the business environment and the development of production networks (PNWs). In this context, the formal and informal channels through which various tangible and intangible assets flow have a special interest. Such channels connect each firm both with the network-coordinating agents (the core) and with other companies and organizations. Throughout this paper, the expression production network is applied to an economic space including an organizing firm (hereinafter, core); a group of suppliers and their interrelationships derived from purchase and sale transactions and also from the flow of information, know-how, personal experiences, and knowledge circulating across formal and informal channels.

Therefore, the elements that constitute the network are determined by the particular relationship established between core firms (end product manufacturers) and their local suppliers, plus the competence-generation process within the firms themselves. This characterization involves: (a) a commercial supplier-core relationship, (b) the development of competitive capabilities among suppliers, and (c) the generation and dissemination of knowledge inside network agents.

End product manufacturers (core firms) are conceived herein as a production unit articulating different goods and services acquired in the market. Supplier firms may share or not the same economic space which, in turn, may cover or not the actual geographical space.

The notion of network as used in this paper is both different from the concept of cluster (Scmitz, 1995; Meyer-Stammer, 1998) and from the ideas of value chain and global commodity chain (Gereffi 2002; Humphrey, Schmitz, 2001), widespread in the literature. It differs from the notion of cluster in that agents integrating a network may not be included in the same geographic location. Therefore, this notion is similar in some respects to the idea of global commodity chains but differs from it in others. It is similar insofar as both structures are hierarchical and the core's governance is crucial for organizing production: it determines what, how, when and how much is produced (Humphrey y Schmitz 2000). But it is different insofar as the emphasis on microeconomic considerations is greater: differences between the agents are taken into account, especially their uneven capabilities to generate, disseminate, and appropriate codified and tacit knowledge3. In the production network approach, knowledge flows generated between suppliers and customers as well as among the remaining agents involved in the production environment are the basic strategic variable for understanding the individual performance of the companies.

The intensity of learning processes at PNWs depends on several factors: (i) the degree of development of the suppliers' endogenous capabilities, (ii) its hierarchical structure, (iii) its

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3 As will be seen in the conclusions, these different perceptions are evident in the resulting policy recommendations.
degree of self-organization, (iv) tacit elements developed in different dimensions, (v) the exchange of experiences and joint projects is, (v) the dissemination of information across member firms, and (vi) interactions with companies and organizations included in the firm's production environment entailing a competence increase. Applying the idea of Cowan, David and Foray mentioned above (2000), the production network might be considered as an epistemic community sharing a language and a sort of "fragmented codified" knowledge difficult to understand for outsiders and thus perceived as tacit knowledge. The degree of development of the network depends on the metabolic process described by Nonaka and Takeuchi (1994), which involves different phases: internalization (transforming codified external into tacit knowledge), combination (compatibilizing and combining codified knowledge), socialization (combining different tacit pieces of knowledge), and externalization (codifying tacit knowledge). This process which generates and disseminates knowledge is influenced by the ability to absorb and generate knowledge of the PNW as whole and each of its components.

The production network may be seen as an entity included in the firms' environment apt to counterbalance the weaknesses both of the "non-productive" environment and of the agents' endogenous capabilities.

In order to satisfy competitive demands requiring an improvement in learning processes, the following items are necessary for the company: (i) a particular work organization able to optimize capabilities and develop the highest competence, (ii) a process that creates technological and organizational capabilities (innovative capabilities) enabling it to generate, disseminate, and appropriate experimental and codified knowledge and, therefore, increase its competitive advantages in the market, and (iii) a training process articulating all this, embodied in formal efforts devoted to improve knowledge.

Thus, in order to analyze the endogenous capabilities of suppliers, a three-dimensional approach is applied that considers: (i) innovative capabilities, (ii) the prevailing social management technology –basically defined by work organization modes, the role of supervisors, and the kind of multiskilling-, and (iii) training efforts which further complement learning processes. The three dimensions and their degree of interaction are determined by the level of endogenous capabilities achieved.

The connection itself between individual suppliers and the production environment is reflected in various "degrees of relationship". This notion takes into account the relevance of information and knowledge dissemination, externalities, and synergy in the network. The so-called style of relationship is conceived as connecting the development of organizational and technological capabilities inside the companies pertaining to the PNW.

**The supplier endogenous capabilities**

**1.1a Innovative capabilities**

Generally speaking, the expression "innovative capabilities" refers to the firms' potential to transform both codified and tacit generic knowledge into specific knowledge starting from

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4 A similar approach applied to clusters has been described in Giuliani (2002). Unlike traditional literature on this subject, the author defines the notion of the cluster Absorption Ability, understood as the cluster's and its member agents' abilities to identify, assimilate, and take advantage of knowledge from external sources.
its initial capabilities and their dynamic accumulation, which involves formal and informal learning (Ernst y Lundvall 1997, Lalí 1992, Yoguel y Boscherini 1996). Thus, capabilities (and competence in general) may be defined as the whole set of formal and informal knowledge plus technological and organizational skills developed by the agents to attain their goal. (Yoguel, Novick, Marin, 2000). Individual firms develop these capabilities so as to differentiate themselves and create competitive advantages.

In order to determine the agents' innovative capabilities in a network, the starting point is the idea that the creation and dissemination of knowledge inside or between firms is a complex process whose intensity is positively associated with (i) the need to solve actual problems in uncertain situations, (ii) the demand for non-codified solutions, (iii) the technical complexity of the teams involved, (iv) the agents' basic capabilities, (v) the ability for working in groups and establishing personal relationships, and (vi) to what extent workers take advantage of the technical and organizational knowledge.

In order to analyze the innovative behaviour of the companies included in a PNW, this methodology tries to capture the accumulated capabilities of the firms through a whole set of qualitative and quantitative indicators that reflect the potential ability of their human resources to carry out developments, the degree of formality of such activities and their relevance and scope as regards actual results, the level of quality assurance attained, the dissemination of information and communication technologies, and the degree of development of environmental management.

As a complement, the expenses incurred in innovative activities are estimated, even though the correlation between both dimensions is neither clear nor uniform. The relationship between both approaches to innovative processes recalls discussions about the limitations of traditional methods (closer to what we call innovation expenses), which are focused on measuring quantitatively the firms' pecuniary efforts devoted to research and development.

Research on innovative capabilities goes back to some recent works carried out in Argentina (Yoguel and Boscherini 1996 y 2001, López and Yoguel 2000, Rearte et al 1997, Moori-Koenig and Yoguel 1998), and includes both intangible factors and "visible" characteristics that involve an approximation to them.

The innovative capabilities indicator is constructed by cross-linking four different factors:

i) First, the potential of human resources for carrying out developments is estimated from three independent factors: (a) the ratio of workers dedicated to R&D over total workers, (b) the ratio of highly qualified human resources (engineers and technicians) over the total number of workers, and (c) the percentage of qualified workers dedicated to research and development ("innovative qualified workers").

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5 The purpose of these works was to find alternative indicators starting from the assumption that, once the linear innovation model was disrupted, expenses in R&D and patents were imperfect indicators of the agents' innovative capabilities and, therefore, of the learning processes involved. On the one hand, the fact that there is no direct correspondence between the efforts devoted to developments and actual results is the main focus of arguments against these indicators. On the other hand, once the new information-intensive paradigm was generally accepted, innovation has been increasingly conceived as a process across organizations (Lassini 1992) in which informal groups have increasing importance.
ii) Second, the existence of a formal R&D infrastructure is estimated through a binary indicator which takes into account the formality of such activities.

iii) Third, an indicator that accounts for the "sophistication" (or diversity) in innovative activities is an "outcome" component. Its purpose is to estimate the number of areas involved in development in each firm considering: (a) the creation, introduction and improvement of products and processes, (b) new forms of distribution and marketing, and (c) the achievement of a JIT ("just in time") relationships with suppliers. Due to limitations in empirical evidence, this indicator of "sophistication" in the firm's innovative activity does not reflect the intensity of innovations and measures only their existence and diversity. However, the resulting complementarity between different innovations (Milgrom and Roberts, 1990) suggests that the intensity of an innovation is positively correlated to other innovations being developed simultaneously.

iv) Finally, a compound indicator is estimated which accounts for the efforts undertaken towards quality assurance. The existence of quality assurance methods and standard certification practices is assessed. In other words, the significance of a rational control over the production process is assessed. Thus, the quality indicator is the simple average of 3 factors that indicate the complexity of quality control (assurance) and the relevance of external quality certifications. The degree of complexity is determined by the number of activities involved in the process, from the existence of checkpoints to the estimation of "statistical parameters" that enable improvements in particular jobs (histograms, cause-effect diagrams, variable-control graphs, statistical control, etc.). Besides, the external view over product quality is given by the acquisition of quality standards: ISO9000 certifications and other standards are specially considered.

As a complement, an indicator of environmental management is estimated, and another one which indicates the diffusion of information and communication technologies (ICT). The first one takes into account ISO 14000 certifications and the use of appropriate environmental management tools (process modifications to introduce cleaner technologies and product reformulations). As regards ICTs, the following data are taken into account: the use of e-mail with customers and suppliers, whether a regularly updated webpage exists, and the relevance of e-commerce for sales.

The final evaluation of "innovative capabilities" requires the construction of an aggregate indicator that takes into account all the factors described above through a proper weighting mechanism. It may be argued, for instance, that the potential of human resources to carry out developments is more important than the diversity of the activities carried out. However, the sensitivity analysis we carried out (following Boscherini and Yoguel, 1996) indicates that the ranking of firms according to their innovative capabilities is invariant with respect to changes in the weight of the factors included in this indicator. (Boscherini y Yoguel 1996)⁶.

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⁶ In order to test whether a "subjective appraisal" problem arises or not, an exercise was carried out by comparing the rankings that resulted from three different hierarchical organizations of the indicator's components. That is to say, the "capabilities" indicator was calculated in several different ways: as the simple average of the values of its components (neutral indicator) or as a weighted average that emphasized either productive capacity (work-oriented indicator) or innovation complexity or diversity (complexity-oriented indicator). Considering all this, a simple average will be applied in this work. As will be noted in Chapter 3, in the case of the network under study, the systemic character of these elements may be verified.
1.1b Social management technologies

New requirements in quality, cost-reduction, changes in delivery forms, plus the volatile nature of demand and the new importance of generating and disseminating knowledge are all factors that demand important transformations not only of the technical basis but also of organization. A new flexibility is required, as well as a greater involvement of workers, higher interchange of information and knowledge, and a new organizational basis that does away with hierarchies and enables a more horizontal decision-making process. The individual conception of jobs based on the idea of "operations" evolves into an organizational conception based on integrated and coordinated production systems (Zarifian, 1990). Thus, the organization of work inside each company is crucial for determining how the so-called social management technologies are involved in knowledge generation and socialization. Teams\(^7\) and interaction spaces that make it possible to exchange experiences and opinions are the most favourable for the diffusion of tacit knowledge by "observing, imitating and getting involved in empirical experiences". In this sense, these mechanisms are apt to create situations and developments that favour shared experiences (Rullani 2000). The "relational" character of knowledge is also associated with the fact that work itself becomes a matter of "interpretation". Somehow, each particular and actual task involves a "translation" that helps locate each phenomenon the worker has to cope with within a wider conceptual network (Rullani, 2000). Therefore, from the theoretical viewpoint of this paper, how work itself is organized is crucial for promoting (or not) the dissemination of the workers' tacit knowledge (Novick 1999, Novick y Gallart 1997) and ensuring achievements in development and quality. The importance of microeconomic factors for productivity involves, therefore, a parallel change in the treatment of labour relationships.

At the heart of work organization, lies not only a new autonomy and/or authority delegated on teams but also the comprehensive communicational abilities they enable and promote. Besides, the nature itself of control is changed because control through tasks is replaced by control through objectives/results. In the particular case of networks and cross-organizational structures, control passes from the isolated cell to the network (Zarifian, 1999). International literature (Durand et al, 1998) refers to such work-organizational models as "labour-involvement" models and asserts they are the basic condition for efficiency.

In all these processes, the immediate supervisor plays a key role which should be examined in order to evaluate the degree of autonomy with respect to the manufacturing model and human resource management. Traditionally, leadership –especially at the operational level– was concentrated on discipline and enforcing regulations and procedures. These functions gradually changed into more technical responsibilities on the one hand, and into coordinational activities tending to improve communication and interchange systems, on the other. Thus, depending on his/her specific profile, the supervisor may facilitate or hinder innovative tasks.

From this point of view, two extreme models may be identified: the fully-integrated system or the loosely articulated system.

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\(^7\) This notion is closely associated with organizations that start from widespread production cells, teams and/or modules where knowledge dissemination is facilitated by rotational mechanisms and an "enhanced" multiskillling.
In the first one, work is organized into modules/cells/teams and the supervisor/foreman has a technical profile rather than a disciplinary one, thus increasing the autonomy of cells themselves. It is precisely the degree of autonomy of teams, their participation in establishing standards and quality assurance procedures, as well as in planning applied technologies what actually involves an optimal use of the workers' tacit knowledge. This case is typical of situations where job-design is closely related to an "enhanced" multiskilling across sectors and levels.

In the opposite end, human resource management is based on hierarchic relationships: tasks tend to be assigned individually and cells –if they exist at all– include a small group of workers (or, on the contrary, they include such a high number of workers that their very nature is completely distorted). Multiskilling is not systematic, the role of the supervisor is almost disciplinary and cells are scarcely autonomous: the workers' tacit knowledge is not recognized.

Criteria applied to select pay systems and salaries should also be considered as a part of social management since they indicate how consistent is human resource management with the remaining organizational dimensions. Deciding whether the different aspects involved in human resource management are harmonic and consistent with other organizational considerations is crucial for studying the generation and circulation of knowledge inside the enterprise. Other authors (Durand et al, 1998) have emphasized that the "labour involvement" model results from several factors: the contents and organization of work itself, the atmosphere in which workers actually operate (hierarchic relationships), and pay systems and salary levels.

As applied in this work, the indicator of social management technologies is a weighted average of: a) the existence and scope of cellular organization; b) the cells degree of autonomy, and c) the role of the supervisor. In order to estimate cell significance, three factors are assessed: (a1) the percentage of workers organized in cells and the significance of the activities involved; (a2) to what extent workers determine production rhythms and quality standards, how they participate in programming or reprogramming automated machinery or in the design, improvement, and development of products and processes; and (a3) the prevailing style of direct supervision. Apart from this indicator, salaries are also analyzed, as well as the criteria for awarding incentives and/or benefits.

1.1c Training efforts in network firms

Up to now, it has been assumed that innovative capabilities and work management within each network are key elements of its endogenous competitiveness. Thus, what is being assessed from two different perspectives is the best use of overall capabilities: taking into account quality assurance activities and development, and also how work itself is carried out. As a complement, formal and informal training are both central for acquiring competitive advantages.

According to this, learning is more relevant than what has been recognized in traditional literature. Training efforts may be assessed (Novick 1999) according to the following factors: (i) whether they have a systemic character or not; (ii) the percentage of personnel involved in training efforts at each level involved\(^8\); (iii) the particular issues included in

\(^8\) This involves examining how widespread training is at all organizational levels (not only managerial levels). Besides, the percentage at each level should be significant.
training and their sophistication (involving a combination of specific and general technical considerations, motivational and behavioural issues); (iv) the intensity of such efforts in terms of the minimum hours needed for the training process to be effective, (v) the methodology applied, in order to distinguish standardized learning from mechanisms apt to transform tacit and codified knowledge, and (vi) short, medium and long-term evaluation systems.

The examination of these issues through a questionnaire being quite difficult, the analysis was restricted to certain aspects indicative of formal efforts in this field and their scope. Estimations in this case have taken into account: (i) the mean qualification of the company in terms of the relative weight of professionals and technicians in its staff, (ii) the existence of a specific training structure included in the area of human resources, and (iii) the relevance of training efforts devoted to less skilled human resources.

Indicators used to estimate the development of endogenous capabilities

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<th>Innovative Capabilities</th>
<th>Training</th>
<th>Social Management Technologies</th>
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<tr>
<td>HHRR potential for development: i) percentage of workers dedicated to R&amp;D; ii) percentage of qualified workers dedicated to R&amp;D; iii) percentage of workers trained in R&amp;D</td>
<td>Company's qualification structure: percentage of professionals and technicians over total employment</td>
<td>Percentage of sectors and/or workers organized in cells</td>
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<tr>
<td>Existence of a formal or informal R&amp;D infrastructure</td>
<td>Ratio of training expenses over sales</td>
<td>Degree and type of cell autonomy</td>
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<td>Diversification of development activities: number or areas involved in development</td>
<td>Relationship between qualification structure and efforts in training</td>
<td>Role of the supervisor (leadership)</td>
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<td>Quality assurance and certification</td>
<td>Percentage of less skilled workers included in training programs over total of less skilled workers</td>
<td>Pay and salaries: traditional criteria vs. hierarchical criteria that take productivity and quality into account</td>
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<td>Relative weight of new products in total sales</td>
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<td>Itemized variable salary</td>
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<td>Innovative pecuniary effort: purchase of embedded technology, purchase of knowledge, expenses in R&amp;D, organizational changes and changes in trading channels</td>
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1.2 Production environment: degree of interrelationship between suppliers and the core, and between suppliers and other agents (non-price relationships)

The style of connection between the firm and the core, and also with other agents and entities, and the dissemination of information and knowledge thus generated are a key notion in this analysis. In other words, the density of what has been called the firm's
production environment conditions the process itself of knowledge circulation and appropriation. In this respect, the restricted production environment (connections with the core firm) should be distinguished from the extended production environment (which includes other companies and organizations).

Such an analysis emphasizes mainly the degree of dependence and the hierarchy established between the agents, their interchange mechanisms and non-price relationships.

The basic idea is that, inside the network, these situations are conditioned by the existing contractual dynamics and the implicit incentive regime, among other factors. However, contradictory opinions may be found in the literature as regards the relevance of contracts and incentive regimes9.

In the second place, issues associated with time, and the vertical or horizontal relationships between network agents and the core are also considered. For instance, in hierarchic relationships, intangible interchanges are limited: the connections between the supplier(s) and the core and, therefore, the whole network dynamics, are limited to complying with the terms and specifications required by the contracting party. On the contrary, only when systemic relationships exist (Dussel, 1998), characterized by a more horizontal long-term relationship between the contracting party and the supplier, medium and long-term confidence relationships arise. Such is the case of firms that have "stable" cooperation agreements and/or engage in informal interchanges about relevant matters.

The indicator devised for this dimension differentiates between relationships characterized by different hierarchic structures. In one of the extremes lie relationships based only on the compliance with certain –agreed or not– conditions without compensation. In the other, we find bilateral agreements; and in the midpoint, the unilateral transference of particular experiences and technical assistance (for example, techniques to improve quality assurance) and/or informal relationships and/or connections, meetings, personal visits, etc.

Considering these questions in an aggregate manner requires, thus, taking into account not only the frequency of interchanges between firms in the network but also the quality and importance of "non-price" relationships between them that may help increase the network synergy. Several factors acquire a new significance: the particular type of information, the specific interchange mechanisms, the development and/or performance of joint actions, agreements and cooperation mechanisms, and technology transfer. From this perspective, a weighted average is estimated to measure the importance of non-price relationships between suppliers and (i) the core and (ii) other agents and institutions.

As regards relationships with the core, the intensity of technical assistance is assessed by considering a whole set of possible assistance activities associated with different stages of competence development: training, quality assurance, work organization, development activities, use of infrastructure and laboratories at the core firm, and technology transfer. Generally, codified elements prevail here in the transfer of information and knowledge.

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9 There's no general agreement about the relevance of institutionalized relationships between network agents. Some authors (Williamson 1991) emphasize the central role of the "contract" and incentives as a key element for the emergence of a network. Others, instead, highlight the role of "mutual confidence" for these configurations (Bianchi y Miller, 1994; Saxenian, 1994). These authors argue that the absence of actual contracts might be a strength rather than a weakness.
Another question refers to the extent in which core firms influence the commitment of other companies with training, the thematic areas involved, the methodology applied, who are the targets, how training providers are selected and relevant evaluations. As regards development, several factors are evaluated: whether the core firm participates in developments and improves products and processes, contributes to product adaptations, distribution changes, internal JIT, and the relationship supplier-customer. With respect to work organization, the evaluation is focused on determining whether it favours interactions inside teams and between teams. As regards technical assistance, the following elements are considered: improvements in production processes, installed capacity, less nonacceptances and reworking, better use of raw materials, lay out changes, and logistic improvements. Finally, another question evaluates to what extent the core firm’s assistance enables suppliers to introduce improvements in their competitiveness such as (i) increasing their possibilities of doing business with other firms, (ii) improving their control over suppliers, and (iii) accessing information about international markets.

Other indicator that characterizes the relationship between the core firm and its suppliers which complements the aforementioned ideas, refers to technical meetings, visits to the suppliers' plants and various types of technical and commercial communications. These relationships are mainly horizontal and involve both codified and tacit aspects.

From the viewpoint of relationships with other colleagues, customers and institutions (government agencies, universities, industry chambers, etc.) which do not belong to the network itself (extended production environment), the degree of interaction is evaluated by considering i) formal cooperation agreements, ii) informal contacts and conversations about subjects that favour higher technical skills, and iii) resort to technical services provided by public or private organizations (tests, analysis and methodologies, the research of technological and market information, its processing and analysis, training seminars and courses, research and development projects). As regards informal relationships, they are examined to determine whether they are orientated towards the following issues: i) merchandising strategies in foreign markets, ii) quality assurance, iii) the possibility of carrying out joint business abroad, iv) search for possible partners, v) shared training programs, vi) shared product and process developments, etc.

In short, examining the style of relationship involves considering formal and informal questions. On the one hand, the type and degree of contractualized patterns and, on the other, situations that account for the explicit or codified development of technical assistance, either from the core or from other companies and institutions.

1.3 Main hypothesis for studying the network

The underlying hypotheses of this work state that in a well-formed network two necessary conditions hold:

(H1) A correlation may be found between factors determining the agents' endogenous capabilities (innovative capabilities, social management and training technologies) and (H2) the particular style of relationship between the core and its suppliers (restricted production environment) are associated with the degree of development of endogenous capabilities at the supplier company.
This relationship might be positive in networks having higher bi-directional knowledge flows, where knowledge generated by each party may entail a high advantage for all the remaining parties.

Evidences provided by studies of other networks and the degree of development of the technological behaviour among agents let us assume that the degree of development of the suppliers' endogenous capabilities is positively associated with:

(H3) the agents' size and (H4) ownership. In other words, greater endogenous capabilities might be expected in firms of greater size having the structure of an Economic Group (hereinafter, Group) or a Direct Foreign Investment agent (hereinafter, DFI).

Besides, (H5) it may be assumed that the level achieved by the relationship between suppliers and the core depends positively on the percentage of their sales to the core firm. Finally, (H6) the underlying idea is that endogenous capabilities are also conditioned by the intensity of suppliers' relationships with other companies and institutions which do not belong to the network under study (extended production environment). Thus, the extended production environment is conceived as having an important role in competence development. Therefore, missing relationships or their weakness might indicate an environment not in keeping with the development of endogenous capabilities among agents. A negative association might indicate that the environment counterbalances a negative competence development in the firms. On the contrary, a positive association might indicate a virtuous situation: the extended production environment complements positive competence development among agents. Finally, it should be noted that, if all these conditions are verified, the situation corresponds to the model of a "virtuous theoretical network", seldom found in actual cases where hybrid models prevail.
2. Structural Characteristics of the Core and the Surveyed Firms: Typology of the Agents - Dynamics, Specialization and Dependence

2.1 The core firms

Two companies (SIDERCA and SIDERAR) constitute the core of the iron and steel network under study. Both belong to Techint Organization (Organización Techint-OT), a highly dynamic business group with multiple interests in the steel production, engineering, energy and telecommunications industries among others, and a strong global presence (nearly 40% of the company's turnover derives from operations abroad).

One of its mainstays is steel production, especially seamless steel tubes. Recently, the group has made a powerful entrance into the international market through ten large manufacturing plants and their respective satellites.

Siderca\footnote{SIDERCA controls the following firms: SIAT SA (seamless tubes for ducts), Scrapservice SA (scrap processing), SIDERCA International ApS, SIDERCA Corporation, SIDERCA Corporation, Socover SA, Cometarsa SAIC, Confab Industrial SA (production of seamless tubes in Brazil), and Metalmeccanica SA. Besides, two strategic agreements were signed in 1999: the first one with NKK Corp. to create NKK TUBES, a new company devoted to operations with Japanese metal rollers, and the second one with Angloma Steel Inc., which included the leasing of a plant in Canada. SIDERAR controls Econocemento, Consorcio Siderúrgico Amazonia, Comesi and Comesi San Luis.} offers the widest range of seamless steel tubes in the market through developments owned by Tenaris and license agreements subscribed by NKK Tubes and Atlas Bradford. In addition, Siderar is a manufacturer of cold and hot rolled steel, and coated steel. The company's origin should be traced back to the merge of Aceros Paraná (continuation of the former state-owned Somisa), Propulsora Siderúrgica, Aceros Revestidos, Sidercrom and Bernal. This merge, completed towards the end of 1993, was the logical outcome of a former operational integration of these companies involving supplementary production and marketing activities.

Abroad, this group acquired large plants mainly focused on the manufacturing of seamless tubes: TAMSA in Mexico, DALMINE in Italy, ALGOMA in Canada and SIDOR in Venezuela, etc. Except for Siderar and Sidor, the rest of the companies are part of Tenaris, a brand under which the group operates at a global level. The group's annual sales amount to a little over 5 billion dollars, while its annual purchase volume to different suppliers amounts to about 2.9 billion dollars.

The two core firms employ around 9,000 workers and their annual sales amount to 1.9 billion dollars. Consequently, their output per worker—approximately 220,000 pesos—triples the average of the industry. During the last five years, a 10% fall in employment and a 1% reduction in sales has been recorded, attributable to a demand slowdown due to recession in the Asiatic countries and to the fall in crude oil prices. A proxy estimation of work productivity from the ratio of production per worker indicates a significant increase between 1996 and 1998, since it rose from 0.55 to 1.44 tons per worker. The minimum for this period was recorded in 1999 (0.43 tons per worker) but a clear recovery was already obvious in 2000 when it reached 0.70 tons per worker.

Another key feature of these enterprises is their intense production and commercial exchange with companies abroad. On the one hand, they duplicated their exports in the last five years and their export ratio increased from 38% in 1995 to 68% in 2000. Such an increase is mainly due to a stable export level in SIDERCA amounting to around 70% of its
total sales, and to the fact that the second core firm increased its foreign insertion, as well as to the development of specific export-promotion programs sponsored by the Argentine government. On the other hand, the aggregate amount of imports of both firms represents 40% of their total purchases, and an even higher percentage in the case of SIDERAR, which slightly increased its imports in recent years.

It should be noted that a little more than 50% of their purchases in the domestic market corresponds to small and medium-sized enterprises, this proportion being significantly higher for SIDERAR (70%) that for the second core firm (35%).

However, each of these two companies shows a different behaviour as regards the issues taken into consideration to define endogenous capabilities among network firms. In this sense, social management technologies—especially the prevailing organization of work—, their innovative capabilities, and training strategies follow totally different patterns.

Owing to its previous evolutive path and its production background, SIDERCA has achieved a higher level in competence development: cellular organization involves 100% of the activities whereas in SIDERAR it represents only 30%. The role of the supervisor is in full accordance with the activities he surveys though a technical profile prevails in SIDERCA. Besides, cell autonomy is higher: workers actively participate in (i) determining production rhythms, (ii) establishing quality standards, (iii) controlling such standards, (iv) programming or reprogramming automated machinery, and (v) designing, improving, and developing products and processes.

Moreover, training itself is significantly higher, involving 82% of the people employed against 40% in Siderar. However, the ratio of training expenses over sales indicates a lower difference: 0.2% 11 and 0.1%, respectively.

In terms of innovative capabilities, new products represent 40% of its total sales for SIDERCA against less than 5% in the case of SIDERAR. Human resources assigned to R&D are 1.3% in SIDERCA (almost 50 highly qualified people) 12 and 0.14% in SIDERAR. Significant achievements in quality certification may be highlighted in both companies. In the case of SIDERAR, flat iron & steel products are ISO9001-certified in all its plants; direct reduction products are ISO 9002-certified and the QS 9000 standard is applied to products for the automotive industry. In the case of SIDERCA, standards such as ISO9001, ISO9002, API Q1, ISO8402: 1994, and QS9000 have been applied to cold drawing and other products for the automotive industry.

In short, taking into account its higher organizational levels, innovative capabilities and efforts devoted to training, SIDERCA has a higher relative level of technical capabilities.

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11 SIDERCA has joint research and development programs to develop products, and divulge operational and merchandising practices among partners and customers, especially from the oil industry. Product-development programs are supported by the CINI-Fudetec centers (SIDERCA, Campana) and CSM centers (in Rome), permanently connected with the core firm. Joint development have also been started with the University of Buenos Aires, which has created a Master Degree in Iron and Steel Engineering.

12 SIDERCA, TAMSA and Dalmine attend the meetings of international standard-emitting organizations (ISO, API and NACE). SIDERCA is also a permanent member of work groups devoted to draw up the modifications to standards currently in force.
From the viewpoint of their degree of relationship with suppliers, connections through contracts prevail, though formally contractual aspects and plain agreements appear in combination in the case of SIDERAR. As regards criteria for selecting suppliers, core decisions are based on quality certifications (not only ISO 9000, but also QS 9000 and ISO 14000 certifications in some instances), or on a financial solvency favourable to medium and long-term trading relationships, and on guarantees that products will be delivered according to deadlines. Suppliers are usually invited to take part in annual training programs such as cost management, business planning, quality assurance, e-business, human resources, etc. 13

Concern for suppliers is not uniform, and is mainly focused on critical-product suppliers having a higher technological content, where monitoring is regular and systematic. In the case of SIDERAR, it should be highlighted that the company increased its credit-line for SEM clients by establishing a mutual guarantee company (AFIANZA). Both companies have informational channels through which customers and suppliers make inquiries about deliveries, quality assurance issues, and account balances. Besides, external customers may trace operations, and make inquiries about shipped packages and quality certifications. However, supply systems are clearly different in the two core firms: JIT supply prevails (involving 80% of the items) in the case of SIDERCA and is almost irrelevant in the case of SIDERAR (involving only 2% of the items). Unlike the Argentine automotive network, the common element in this core is that demand is not frequently reprogrammed.

Until recently, these plants made their purchases individually except for some products where negotiations were centralized. They showed very different supply cultures. However, the group has recently created a supply service company for the development of an electronic purchase platform that includes all the iron and steel companies pertaining to OT. This comprehensive supply service company (EXIROS) should tend to substantially modify the traditional connection between the specific iron-and-steel area of OT and its suppliers.

As regards outsourcing, the two core firms have advanced a great deal towards getting rid of all activities outside their "core business". The process involved had similar characteristics for both. On the one hand, the trend was towards companies with a high technological level (EXIROS for joint purchases through e-commerce, TECSIS in the sphere of system services, CEIN in the field of research and development) and, on the other hand, they seemed inclined towards companies created by people who had previously worked for the group (especially in maintenance, stove and gas fitting, air-conditioning and heating system services, gas fitting, carpentry, etc.). Both companies are engaged now in transforming their relationships with customers and suppliers by introducing ICTs. These tools facilitate e-mail communications with customers and suppliers through, make it possible to directly purchase stock items, and enable customers to query the balances of their current accounts and the companies themselves to monitor documents sent to their clients.

In short, the core firms are engaged in an effort to enhance production processes by resorting to global purchase policies apt to reduce fixed costs and improve supply

13 The importance awarded to suppliers is also made evident by the fact that, whenever diagnostic visits occur, results are also handed in to the supplier involved. In fact, this involves a methodology aimed at better disseminating codified and tacit knowledge.
management within a framework of a substantial development of endogenous capabilities, which is evident in their strong insertion in the international market.

2.2 The characteristics of suppliers

The surveyed suppliers may be clearly divided into three groups: DFI companies, those belonging to Economic Groups and national independent firms that constitute the SEM portion of the network. They are medium-sized companies with average annual sales around 6.7 millions and slightly more than 60 people employed in 2000 (in 1995, the corresponding figures were 5.6 millions and 56 workers).

Among surveyed firms, DFI companies represent 15%, those belonging to Groups represent 17% and the remaining 68% are SEMs. Strong differences may be observed between these segments in terms of scale (number of workers employed per company), size (average sales), and production per worker. These figures increase steadily in passing from SEMs to DFI companies through Groups (see Table 1). Despite production per worker differs greatly from one type of agent to another, this ratio is still considerably higher than the average among Argentine SEMs.

Table 1. Total sales (in millions of pesos) and number of employed people in panel firms according to the different types of agents

<table>
<thead>
<tr>
<th>Agent Type</th>
<th>Percentage of firms</th>
<th>Sales per company (in million pesos)</th>
<th>Employed people by enterprise</th>
<th>Production per worker (pesos)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEM</td>
<td>68%</td>
<td>2.8</td>
<td>3.7</td>
<td>37</td>
</tr>
<tr>
<td>Group</td>
<td>17%</td>
<td>13.4</td>
<td>17.3</td>
<td>110</td>
</tr>
<tr>
<td>DFI</td>
<td>15%</td>
<td>9.7</td>
<td>8.7</td>
<td>85</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>5.6</td>
<td>6.7</td>
<td>56</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

Approximately three fourths of the surveyed enterprises have a single production plant, a fact which is still higher among SEMs and DFI companies which are mostly medium-sized plants purchased during the 90s to former SEM owners. Almost 60% of the firms were established before 1980 and approximately one fifth of them were created during the 90s; the rest go back to the 80s. In other words, all of them have an important production background.

14 SEMs are defined as companies having annual sales below or equal to 18 million pesos, which do not belong to Economic Groups and are not DFI companies. Similarly, DFI companies and those pertaining to Groups were classified as such independently of their sales. Finally, DFI companies which also belong to groups were classified as DFI (i.e., the fact of belonging to a transnational corporation prevailed over other characteristics.

15 The correlation between sales level and employment is high. This is evidenced by the fact that the probability of accepting the null hypothesis (no association) is zero.

16 It should be noted, however, that sales and employment averages for each group are lower than the usual upper bound that defines small and medium-sized enterprises. Therefore, the probability of finding DFI or Group companies with a relatively low turnover is not negligible in the current scenario. Consequently, firm classifications by agent type should consider not only sales levels but also, and fundamentally, other dimensions, especially the fact of belonging to groups and/or being funded through DFI. In other words, the mere fact of being included in such categories implies a different rationale and involves that they have an easier and higher access to human and financial resources than independent SEMs.
In 1995, around 17% of their output was sold to the core, a percentage which increased to 19% in 2000 (See Tables 2 and 3). The percentage is lower for SEMs and higher for DFI companies, and such differences have become increasingly pronounced in the last five years. Besides, whereas a significant increase in the weight of exports among sales may be clearly seen (from 6.3% in 1995 to 17.7% in 2000), the relative weight of the remaining domestic customers has decreased from 76.6% to 63.7%. Within this framework, the three above-mentioned groups of agents have a clearly different behaviour and a significant increase in export rates among SEMs and groups may also be noticed (see Tables 2 and 3).

<table>
<thead>
<tr>
<th>Agent Type</th>
<th>OT</th>
<th>Exports</th>
<th>Remaining Sales</th>
<th>Total 1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEM</td>
<td>12.8</td>
<td>9.6</td>
<td>77.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Group/ Big business</td>
<td>16.4</td>
<td>5.7</td>
<td>77.8</td>
<td>100.0</td>
</tr>
<tr>
<td>DFI</td>
<td>24.1</td>
<td>2.7</td>
<td>73.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>17.2</td>
<td>6.3</td>
<td>76.6</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

<table>
<thead>
<tr>
<th>Agent Type</th>
<th>OT</th>
<th>Exports</th>
<th>Remaining Sales</th>
<th>Total 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEM</td>
<td>12.7</td>
<td>24.0</td>
<td>63.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Group/Big Business</td>
<td>16.9</td>
<td>17.9</td>
<td>65.2</td>
<td>100.0</td>
</tr>
<tr>
<td>DFI</td>
<td>33.7</td>
<td>5.1</td>
<td>61.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>18.6</td>
<td>17.7</td>
<td>63.7</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

In this context, SEMs belonging to Groups maintain their relative share in core firm purchases, amounting to approximately 40% of their total purchases (see Table 4).

Considered as an aggregate, during the crisis of the convertibility plan (1995-2000) the set of panel firms increased their sales by approximately 20%. This fact basically accounts for the increase observed among SEMs and Groups (34% and 28%, respectively). On the contrary, the reverse was true for DFI firms, which decreased 10%. Within this framework, for the suppliers involved in this study the most dynamic markets were the network core (30%) and, most of all, the external market (239%). On the contrary, stagnation was the characteristic of aggregate sales to other domestic customers (see Table 5). In other words, increased purchases from the core and exports were the key elements that account for aggregate variations in the panel's sales. This peculiar dynamics is further highlighted
when compared with the 50% increase in exports of industrial manufactures between 1995 and 2000, and a 3% fall in the industrial product 17.

Table 5. Sales variations by target and number of employees between 1995 and 2000, according to agent type

<table>
<thead>
<tr>
<th>Agent Type</th>
<th>Variation in Sales to the Core</th>
<th>Variation in Exports</th>
<th>Variation in Remaining Sales</th>
<th>Variation in Total Sales</th>
<th>Variation in Number of Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEM</td>
<td>31.6%</td>
<td>231.0%</td>
<td>7.5%</td>
<td>32.0%</td>
<td>27.2%</td>
</tr>
<tr>
<td>Group/Big Business</td>
<td>32.2%</td>
<td>301.0%</td>
<td>7.6%</td>
<td>28.5%</td>
<td>11.5%</td>
</tr>
<tr>
<td>DFI</td>
<td>25.9%</td>
<td>68.0%</td>
<td>-24.8%</td>
<td>-10.1%</td>
<td>-23.4%</td>
</tr>
<tr>
<td>Total</td>
<td>29.8%</td>
<td>239.0%</td>
<td>-0.4%</td>
<td>19.8%</td>
<td>10.6%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

Such a differential dynamics, in which SEMs appear to have a better relative performance, is evidenced inside each typology through a marked heterogeneity. Whereas the overall sales increase among SEMs may be accounted for by the individual performance of half the stratum firms or slightly over, in the case of Groups this dynamics is much more all-encompassing (83%). The same might be said of the DFI segment, where the overall fall may be explained by 15% or the firms involved (see Table 6)18.

Table 6. Sales dynamics between 1995 and 2000 according to agent type

<table>
<thead>
<tr>
<th>Agent Type</th>
<th>Sales variations 1995-2000</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Decreased</td>
<td>Stagnant</td>
</tr>
<tr>
<td>SEM</td>
<td>36%</td>
<td>8%</td>
</tr>
<tr>
<td>Group Big Business</td>
<td>17%</td>
<td>0%</td>
</tr>
<tr>
<td>DFI</td>
<td>14%</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>31%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

While sales to the core do not show significant differences among the different strata involved, the increase in exports is mainly based on Groups and SEMs which, as have been mentioned above, reached highly significant export ratios in 200019. The exporting drive of the SEMs included in this panel is similar to that of a recently studied subset of successful exporters that based their competitive advantages on the development of important technological and organizational capabilities (Moori-Koenig, Milesi and Yoguel 2001).

During the later 90s, almost half the firms also increased the number of employees, 24% maintained it and only 27% reported a level below that recorded at the earlier nineties.

17 Sales to the core increased even more than variations in the iron and steel output during the same period (16%).
18 It should be noted that the recessive phase of the cycle is being analyzed. When the whole 90s are considered, the percentage of firms whose sales have increased raises to 75% approximately, while the remaining 25% is evenly shared by companies that suffered some falls and companies with no variation. Among the latter, half the cases of stagnation may be explained by sales decreases during 1995-2000.
19 Nevertheless, such a remarkable dynamic drive in the market from 1995 onwards was accompanied by a decrease in profitability levels in 79% of the network firms, especially in the case of SEMs (84%) and Groups (75%).
The companies' performance during the crisis of the convertibility plan that started in 1995 should also be highlighted. Thus, the mean employment level increased by 10% against the aggregate behaviour of the whole industrial sector. As a consequence of differential increases in sales and number of employees, the productivity of the panel increased by 7.8% between 1995 and 2000, the most significant growth being recorded among Groups and DFI companies (15 and 17%, respectively) with lower values among SEMs (4%).

It should also be noted that network firms are somewhat specialized in their production, within a general framework of relatively sophisticated goods and services. On average, the first product line represents 55% of network sales, independently of agent typology. If we add the second product line (33%) almost 90% of the output is covered. Finally, the third and fourth lines account for 9% and 3% of the sales, respectively.

The relatively specialized structure of supply (see Appendix 3) is complemented by a certain degree of concentration in sales and purchases among a limited number of customers and suppliers. This obviously favours formal and informal relationships between firms that tend to increase their production capabilities (see Chapter 3). Thus, on average, the top client accounts for 30% of the sales. This proportion is relatively lower in the case of SEMs and slightly higher for DFI s, which are more concentrated. Besides, the top five customers are responsible for 68% of the sales, the concentration being lower in the case of SEMs. Moreover, the most important supplier accounts for 28% of total purchases, the highest degree of relative concentration corresponding to DFIs. Finally, the 5 most important suppliers account for 51% of the purchases which, in the case of DFIs, represent 72% of total purchases.

As will be clearly seen in the next chapter, network firms pay special attention to developing technical capabilities and work-organization styles that create synergy between human resources and thus favour the creation and dissemination of codified and tacit knowledge. In this sense, it is important to emphasize that the stability of human resources is relevant and becomes evident in: i) a reduced weight of workers with temporary contracts, few internships, trainees and people subcontracted through agencies, etc. (5%, differences according to firm-size are negligible), and also in ii) a very low labour turnover affecting only 2.5% of the employed people.

The ratio intermediate purchases/sales among panel firms (50%) does not indicate differences according to agent-type, and is significantly lower than the average of the industry. This is made evident by an added value index higher than the industrial average. Among purchases, imports amount to 28%, which is slightly higher than the average in the manufacturing sector, where imports represent 25% of intermediate purchases (Wierny and Yoguel 2001). In this context, the weight of imports on intermediate purchases is lower than the average in the case of SEMs and Groups (22%), and significantly higher in the case of DFI firms (47%). This indicates a stable pattern of behaviour that tends to foreign supplies which might be found in other production networks dominated by these type of agents, such as the automotive complex (Novick et al 2001, Alborno z and Yoguel 2002, Yoguel et al 2000).

An interesting remark should also be made: since 1995, only one fourth of the firms involved increased considerably the imported contents of their purchases in raw materials, parts and spares, etc., whereas 17% showed slight increases in their import rates. On the other hand, in 58% network firms this percentage decreased or remained equal. Taking into account the previously relevant import rate among DFIs, it is understandable that
more than 25% of the SEMs involved significantly increased their imports content while no equivalent increase was found among DFIs.

2.3 Dependence on the core

Besides classifying agents according to ownership (foreign, national Group, or national independent company), another classification was introduced to take into account the relative weight of sales structures orientated towards the core. Such a distinction identifies differential behaviours and dynamics inside the surveyed panel. Thus, panel companies were divided into three groups: i) firms that show a high dependence (more than 40% of their sales were to core firms), ii) firms that show a moderate dependence (sales to core firms are between 15% and 39%), and iii) firms that show a low dependence (less than 15% of their sales are orientated towards the core).

As may be seen in the following table, this classification adds a supplementary dimension to those considered up to now. Throughout all the different types of ownership, firms having various degrees of dependence with respect to the core may be found. However, DFIs and, to a lesser extent, companies that belong to Groups are over-represented in the lower dependence segment. On the contrary, DFIs are sub-represented in the segment of highly OT-dependent firms. Besides, panel SEMs are evenly distributed in the three groups and no significant deviation from the panel's average has been detected.

Table 7. Weight of OT in sales according to agent type

<table>
<thead>
<tr>
<th>Agent Type</th>
<th>Degree of dependence on the core</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Moderate</td>
</tr>
<tr>
<td>SEM</td>
<td>38</td>
<td>34</td>
</tr>
<tr>
<td>Group</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>DFI</td>
<td>71</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>30</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers

According to this classification, it is obvious that –within a framework of a positive sales dynamics in the panel– firms that show a moderate or low dependence on OT have significantly increased their sales, whereas the performance of top sellers is negative and has decreased by 30% since 1995. Nevertheless, this fact may be explained by a peculiar combination of a steep fall in sales to other national companies (-71%) and an increase in sales to OT (43%) and the external market (58%). By contrast, companies included in the two lesser dependent groups showed a positive dynamics across all markets (see Table 8).

Table 8. Sales variations among panel firms according to their degree of dependence on the core (1995-2000)

<table>
<thead>
<tr>
<th>Degree of dependence on the core</th>
<th>Variation in Sales to Techint</th>
<th>Variation in Exports</th>
<th>Variation in Other Sales</th>
<th>Total Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>33%</td>
<td>279%</td>
<td>10%</td>
<td>35%</td>
</tr>
<tr>
<td>Moderate</td>
<td>13%</td>
<td>165%</td>
<td>38%</td>
<td>37%</td>
</tr>
<tr>
<td>High</td>
<td>43%</td>
<td>58%</td>
<td>-71%</td>
<td>-30%</td>
</tr>
<tr>
<td>Total</td>
<td>30%</td>
<td>242%</td>
<td>-1%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers
Another issue that should be remarked is that, within a framework of a generalized profitability decrease, the firms showing the highest reduction are precisely those that most depend on the core (see Table 9).

Table 9. Variation in margin rates among panel firms according to their dependence on the core (1995-2000)

<table>
<thead>
<tr>
<th>Degree of dependence on the core</th>
<th>Variations in margin rates</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increased</td>
<td>Remained equal</td>
</tr>
<tr>
<td>Low</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>Moderate</td>
<td>8%</td>
<td>23%</td>
</tr>
<tr>
<td>High</td>
<td>0%</td>
<td>18%</td>
</tr>
<tr>
<td>Total</td>
<td>9%</td>
<td>16%</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers

Among companies showing low dependence on OT, those that proportionally sell more to SIDERAR are over-represented, whereas in the group of high and mainly moderate dependence, companies orientating their sales to SIDERCA are prevalent 20 (see Table 10). Therefore, dependence involves something very different for each of the core firms.

Table 10. Core firm towards which sales are targeted according to the supplier degree of dependence

<table>
<thead>
<tr>
<th>Degree of dependence on the core</th>
<th>Core firm towards which sales are targeted</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SIDERAR</td>
<td>Both</td>
</tr>
<tr>
<td>Low</td>
<td>45%</td>
<td>35%</td>
</tr>
<tr>
<td>Moderate</td>
<td>15%</td>
<td>23%</td>
</tr>
<tr>
<td>High</td>
<td>27%</td>
<td>18%</td>
</tr>
<tr>
<td>Total</td>
<td>32%</td>
<td>27%</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers

It may be useful to remark that firms showing the highest dependence on the core are much more specialized than the remaining companies (see Table 11). In such cases, the first product line accounts for 78% of their sales. On the contrary, among firms having moderate or low dependence, the weight of the first line on sales is significantly lower (43% and 56%, respectively). Among most dependent firms, the first product line accounts for 78% of their sales.

Table 11. Specialization level according to dependence on the core

<table>
<thead>
<tr>
<th>Degree of dependence on the core</th>
<th>First Line</th>
<th>Second Line</th>
<th>Third Line</th>
<th>Remaining products</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>56%</td>
<td>34%</td>
<td>7%</td>
<td>3%</td>
<td>100%</td>
</tr>
<tr>
<td>Moderate</td>
<td>43%</td>
<td>37%</td>
<td>16%</td>
<td>4%</td>
<td>100%</td>
</tr>
<tr>
<td>High</td>
<td>78%</td>
<td>21%</td>
<td>1%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>55%</td>
<td>33%</td>
<td>9%</td>
<td>3%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers

20 It should be noted that no association exists between the degree of dependence with respect to OT and the company’s share in sales to each of the two core firms. The probability of accepting the null hypothesis that there’s no association between the two variables (Kendall’s Tau) is 64%. Within this framework, direct foreign investment companies prevail slightly in the category of those that less depend on the core. Besides, firms that show the highest dependence on the core are relatively older. However, the probability of accepting the null hypothesis is 14%.
With respect to the number of employees, there is an inverse relationship between the degree of dependence and: (i) the percentage of workers hired through employment agencies, and (ii) personnel's turnover (see Table 12). Consequently, the firms that most depend on OT have the lowest percentage of workers hired through agencies (0.6%) while their turnover is only 0.9% of the total staff. On the contrary, in the companies which are least dependent, workers hired through agencies represent 26% of the staff and the turnover increases to 6%.

**Table 12. Workers hired through agencies and personnel turnover according to dependence on the core**

<table>
<thead>
<tr>
<th>Degree of dependence on the core</th>
<th>Personnel hired through agencies</th>
<th>Turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>26.0%</td>
<td>6.0%</td>
</tr>
<tr>
<td>Moderate</td>
<td>4.6%</td>
<td>6.2%</td>
</tr>
<tr>
<td>High</td>
<td>0.6%</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

Finally, as regards supply, the weight of imports on intermediate purchases among highly dependent firms is significantly higher than the panel's average and also higher than in the two remaining groups: it reaches 66% of total purchases in raw materials and inputs. On the contrary, in the lesser and moderately dependent groups, this percentage is 28% and 13%, respectively.

In short, the surveyed panel includes specialized suppliers belonging to a production network which –beyond their heterogeneity in terms of size and agent typology– have had a very good performance not only during the 90s but also along the critical phase of the convertibility plan. Besides, both scales and plant mean sizes are mainly below 100 people and 18 million pesos per year, respectively, and the relative weight of DFIs in sales to the core is slightly over one third of the total. A sharp difference may be noted as regards scales and dynamics with respect to the Argentine automotive network.

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21 Thus, from the viewpoint of size (sales) this sample of suppliers is equivalent to one fourth the sample of car-suppliers surveyed for the automotive network. Secondly, in the Argentine automotive network, DFI suppliers represent 54% of all the firms and almost 75% of the sales involved, against 15% in the iron-and-steel network. Thirdly, car-suppliers showed a most negative dynamics from the crisis of the convertibility plan onwards: whereas DFI companies reduced their sales by 8%, purchased firms and new enterprises reduced them by 25%, and supplier SEMs by 61%. Again, these figures contrast sharply with the significant sales concentration of the suppliers examined in this paper.
3. The Endogenous Capabilities of Network Suppliers

This chapter evaluates the degree of development of endogenous capabilities in terms of the areas deemed most important in the analytical model presented in the first chapter: i) innovative capabilities achieved, ii) the predominant model in relation to social management technologies and iii) the extent and breadth of training efforts. These dimensions are analyzed from two complementary methodological strategies. The first derives from the simple statistical distribution of factors. The second derives from specific indicators created for each analyzed dimension, combining differentially weighted factors (see Methodological Appendix.) The scale of these indicators is from 0 to 1, where 1 represents the most "virtuous" situation and, 0 the weakest (see Appendix 2.)

3.1 Technology, innovative capabilities and environmental management

Both in terms of product technology (89% of cases) and, to a lesser extent, in terms of process technologies (66%), the majority of the surveyed firms perceive themselves at the leading edge of international development. Aside from the subjectivity implicit in this appraisal, there are some elements that suggest that there has been a rather considerable development of technological capabilities in these companies. This can be seen in the efforts that have been made to introduce technology, and in the dynamics of various factors that determine innovative capabilities.

Firstly, in recent years almost all the firms have striven to acquire embedded technology in machines and capital equipment: this was the case for 94% of SMEs and all firms belonging to groups or DFIs. However, from the perspective of soft technologies such as acquisition of licenses and/or software the firms' efforts have been relatively lower: 54% of all firms, 52% of SMEs, 62% of groups and 57% of DFIs. Nor was the proportion of firms whose spending was orientated towards organizational changes particularly high (56% of the total.) In this area the greatest proportion of spending came from DFI businesses (71%) followed by SMEs (55%) and groups (43%). This may be due to the greater relative delay in firms that were converted into DFIs in the 1990s. 67% of firms reported spending on R&D, without any distinction according to size.

In order to have a general idea of the firms' technological and innovative efforts, the average pecuniary innovation indicator is rather high (0.64) This indicator was devised from four instrumental variables (purchase of capital goods related to new products and/or processes, manufacturing licenses, consultancy and software, expenses in Research & Development and organizational channel changes.)

Other indicators of the development of technological capabilities in these firms are levels of quality assurance and certification of standards, organizational changes and the actions taken by a stable group –not necessarily constituted of a laboratory of research and development– which is responsible for the firms' innovative activities: improvement and development of products and processes, the search for new relationships with the market, internal JIT, etc.

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22 The corresponding percentages are 90% in the cases of SMEs, 88% in big business and economic groups and 83% in the case of DFIs. The lower proportion in this kind of firm may be due to the fact that – as was noted earlier – these are businesses that were bought in the 1990s.

23 While 73% of SMEs report that they are on the leading edge of process technology, this is only the case in 50% of economic groups and DFIs.
The considerable weight of the firms’ quality assurance can be seen in various aspects. 87% of firms have written quality control procedures and 83% manufacture products that meet national and international quality standards. 66% of businesses are ISO 9000/2 certified, while several businesses also comply with other norms (i.e., Din Qs9000, Ciqp, Jic, ASTM, IRAM, API6d, Cti, Nepa, Agma, ISO14000.) All DFI firms and two thirds of firms belonging to groups and SMEs meet ISO 9000 standards, which constitutes a large proportion for this group of agents.

With regard to quality assurance steps, 85% of firms have follow-up worksheets in every checkpoint, where diverse statistical parameters are calculated. Around 72% have variable statistical controls and frequency distribution (histograms,) 69% have attribute statistical controls, 64% use variable control graphs, and 56% use cause & effect diagrams. As a result, the total evaluation of these aspects reveals that over half the firms (53%) have a level of at least 0.6 in the quality assurance indicator (see Methodological Appendix.). Finally, in 91% of cases, firms have standardized written procedures for production programming and control.

New products represent on average 26% of firms’ sales, although it must be noted that among the companies’ innovative activities these are not the most prevalent. The proportion of new products in these companies’ sales does not depend on the weight of sales to OT, nor on the size of agents, nor on the presence of laboratories. This suggests that strategies linked to new products depend on the specific or particular characteristics of each firm.

As regards organizational changes (see Appendix 5,) actions were centered fundamentally on strategic management and / or planning (72% of firms) and on improvements in company organization structure (70%). Activities of lower importance were those tending to more professional profiles and / or management development (59%), and reorganizing administrative processes (47%).

It must be noted that 68% of firms –with greater relative weight in those belonging to groups– have “formal or informal” stable teams dedicated to development, made up of, on average, 7.4% of staff. The presence of development teams is independent of the weight of SIDERCA and OT in suppliers’ sales.

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24 This is the case in three thirds of SMEs and in all firms belonging to Groups or DFIs.
25 In the case of the automotive network the proportion of ISO 9000-certified firms is slightly higher (72%). In turn, these companies have additional, even more complex norms, demanded by car makers.
26 For example, in a panel of successful SME exporters studied recently that have significantly higher microeconomic capabilities than the rest of this sector of firms, the proportion of ISO 9000-certified firms was 25% (Milesi et al, 2001.)
27 The proportion is slightly higher in the automotive complex where two thirds of the firms comply with this condition.
28 The probability of accepting the hypothesis of no association (Kendall’s Tau) is significantly higher than 5% in all cases: 86% in the case of size and laboratories, 61% in the case of weight of sales to Techint, and 42% when bearing in mind the proportion sold to each core firm. This behaviour differs significantly from firms in the automotive network where, due to continuous changes in models, the products sold are less than five years old in almost half of the firms.
29 59% of SMEs; 71% of DFIs and all groups have a formal or informal development team.
30 The probability of accepting the null hypothesis in regression analysis considering these as independent variables, and the size as control is 29% and 64%, respectively.
However, only 31% of these teams take the form of formal R&D laboratories, with considerable differences between agent sizes: 28% of SMEs; 43% of groups and half of DFIs have formal R&D groups. Of the firms in which development groups take the form of R&D laboratories the degree of dependence on core firms does not constitute a relevant variable: 36% of firms that have R&D laboratories sell more than 90% to some of the core firms. On the other hand, of the firms in which development activities are not carried out in specific laboratories the most intensive SIDERCA suppliers are predominant: while 45% of these firms sell more than 60% to SIDERCA, only 20% allocate a similar proportion to SIDERAR.

The relatively high innovative capacity and the low weight of formal teams highlight the importance of informal development activities spread across the whole organization (Lassini, 1992.) However, the scope of development activities depends positively on the presence of formal research and development teams and on the level reached in quality assurance. The interrelation between such indicators highlights, once again, the systemic nature of these firms’ activities.

Over a third of the human resources involved in these development teams (36%) are exclusive. The weight of skilled human resources in R&D (technical professionals, other professionals and technicians involved in supervision, quality, security and logistics) accounts for 91% of human resources involved in these activities. This means that 28% of technical professionals in the companies take part in development activities, a proportion that is reduced to 17% for other professionals and 20% for technical staff. On the other hand, the proportion of other technicians, skilled and unskilled workers in development teams is significantly lower: 1.4%, 0.9% and 0% respectively. It can be seen then that these firms have small development teams with a high technical level, and low participation of lesser-skilled staff, a fact which might constitute an obstacle for the dynamics of learning and innovation processes.

The majority of firms on the panel undertook development activities that can be seen in their competitive dynamics. 87% of the firms developed and improved products and optimized production processes. 72% of firms also carried out development activities centered around product adaptation. 53% of firms undertook development innovations to find new ways of distributing products and marketing. Significantly fewer firms (34%) carried out internal JIT (supplier-client relations within the company.) These innovations allowed firms to reduce stock levels; train suppliers; reduce costs; reduce business hours; improve daily communication with users; improve teamwork; have on-line information; adjust raw material stock; improve machine distribution; etc.

The aggregate analysis of these activities makes it possible to grasp their synergetic nature. Around two thirds of firms undertake product development and improvement and process development along with changes in distribution and marketing types. This can be seen in that the innovative activities scope indicator, which shows the number of areas in which firms undertake developments, is at least 0.7% in around two thirds of the cases (64%).

The level reached by the quality assurance depends positively on the influence of OT, on the one hand, and the presence of laboratories on the other. The size of agents does not constitute a distinguishing variable\textsuperscript{31}.

\textsuperscript{31} In all cases the probability of accepting the hypothesis of null association between variables is below 5%.
The indicator used to analyze the development of the firms' innovative capabilities is qualitative and quantitative, as it estimates formal innovation activities as well as those spread across the organization as a whole. On average the innovative capabilities index is 0.50, with lower variance than in other areas. In this context, 53% of firms have an at least average level, while only a quarter report a low level (below 0.33.)

3.1.1 Innovative capabilities and sales-concentration exposure

The group of firms with high sales-concentration exposure have on average greater innovative capabilities than those with less exposure (64% and 45% respectively (table 13.)) However, this average reflects marked differences. While over 20% of firms with low exposure reach the higher levels of innovative capabilities, the proportion is reduced to 9% among highly dependent groups.

<table>
<thead>
<tr>
<th>Innovative Capabilities</th>
<th>Under 30%</th>
<th>30 - 50%</th>
<th>50 - 70%</th>
<th>Over 70%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>15%</td>
<td>40%</td>
<td>25%</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>Medium</td>
<td>23%</td>
<td>31%</td>
<td>23%</td>
<td>23%</td>
<td>100%</td>
</tr>
<tr>
<td>High</td>
<td>18%</td>
<td>18%</td>
<td>55%</td>
<td>9%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>18%</td>
<td>32%</td>
<td>32%</td>
<td>18%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

There is no statistical association between the degree of dependence on the core and two interconnected factors: the scope of development activities and the presence of laboratories. In 45% of the most dependent firms the scope of development activities is very limited.

In turn, the proportion of firms with laboratories is slightly higher in groups of lower dependence. Nor does the degree of dependence explain the proportion of skilled staff in research and development activities nor the existence of a stable group. In turn, the most exposed firms are those that report a lower proportion of new products in total sales and a lower relative proportion of ISO 9000 certification. Thus, while three quarters of firms with low exposure are ISO certified, the percentage is reduced to 45% in the case of the most exposed. However, the proportion of firms with better quality assurance does not maintain this tendency and it in fact increases in more exposed firms.

The firms make little effort in environmental management. Only slightly more than a third of firms carry out checks at the end of the process, and the best environmental control methods are used by a lower number of firms. Over a third have modified processes and technologies using cleaner techniques and have substituted inputs and raw materials, while only 15% have reformulated their products. The most frequent activity is training of human resources to improve pollution control (55% of firms.) As a result, the average environmental indicator is only 0.29 (see Methodological Appendix.)

3.1.2 Use of information and communications technologies

61% of the firms on the panel are connected by e-mail with all their national suppliers, rising to 70% in the case of clients. The proportion, as expected, is greater still in the case of foreign clients and suppliers (73% and 76% respectively.) The degree of computerization within companies is considerably higher in administration and sales than in production. Thus, while a significant percentage of human resources in administration and sales work with PCs and in a network (90% and 83% respectively,) the proportion is significantly lower in production, although numbers are nevertheless reasonable (39% and 37%, respectively.) These differences remain –although with
lower absolute levels— in relation to the proportion of human resources that have e-mail (79% and 34%, respectively) and those with Internet access (66% and 24%, respectively.)

Almost all firms (98%) use Internet for various activities. The companies assign most importance to obtaining information (92 of cases,) communicating with clients (88%) and communicating with suppliers (86%). Less importance is attached to issues connected with increasing firms’ market awareness: market research (64%) and advertising and marketing (50%). 58% of firms have a webpage and 89% of these update it regularly.

33% of firms have made purchases via electronic means, representing around 5% of the panel’s total purchases. Likewise, 54% of the firms have made sales via electronic means, making up around 7% of the panel’s sales. In turn, less than a quarter of these companies (23%) have already decided to increase electronic transactions, both in domestic and foreign markets. One third of firms have not made any purchases or sales using electronic means.

The firms that have not used electronic means to make purchases and/or sales give various reasons for this, arguing in particular that their products are not suitable for electronic trading and that electronic payment mechanisms are not secure.

Table 14. Extent of information and communications technologies in the production network compared with a panel of successful exporters

<table>
<thead>
<tr>
<th>Panel</th>
<th>Use of mail clients/suppliers</th>
<th>ICTs in administration</th>
<th>Webpage</th>
<th>E-commerce</th>
<th>General Indicator ICTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIDERCA/SIDERAR Network</td>
<td>0.75</td>
<td>0.87</td>
<td>0.53</td>
<td>0.49</td>
<td>0.66</td>
</tr>
<tr>
<td>Successful exporters</td>
<td>0.56</td>
<td>0.72</td>
<td>0.48</td>
<td>0.14</td>
<td>0.48</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers, and Moori-Koenig, Milesi and Yoguel (2001).

3.2 Social management technologies: how work is organized

As was mentioned in the first chapter, organization models of predominant work, the characteristics it acquires, the type of multiskilling in practice, the existence of leaders or foremen and pay systems that make up a human-resource model are all important factors in evaluating the generalization and circulation of knowledge in the production network.

With regards to how work is organized, it must be accepted that although the concept of work-team is polysemic, it is possible to distinguish some “typologies” characterized both in the literature and by emblematic characteristics of some countries. They are characterized by “strong” characteristic features such as: i) the traditional Fordist team, with simple tasks and operating systems imposed by times and movements; ii) the “Japanese”™ work team model, which adds to the former one a minimal internal autonomy and times that must be reduced, usually under the responsibility of leaders; iii) the “lean production” model, more widespread in general outside Japan, in which increases in productivity are contractualized; iv) “semiautonomous” groups in which work is organized internally within the group, and times and improvements are negotiated (Durand et al, 1998.) In the actual circumstances of different firms and countries there are models

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32 It is well known that each Japanese firm implemented different work organization models and even Toyota, from where the name originated, varied it over the years.
characterized as hybrids (Abo, 94; Boyer, Novick et al, 2001,) in which some of the models are adapted to the implementation situation.

Something similar is found in the role of supervisors, closely linked to the predominant work organization model. In western firms –the product of the Fordist model– their principal function is disciplinary, watching workers’ behaviour. At the other extreme, a strictly technical function may be found with economic objectives (reducing costs) and a mainly evaluating role in relation to staff.

The predominant work organization model identified in companies in the network indicates that organization is predominantly based on production cells. 72% of workers in the panel are involved in some kind of team or module system. All personnel are organized in such a way in one quarter of the firms surveyed, and in 30% of firms over 60% of staff are organized thus. This data could indicate a clear tendency towards the incorporation of new work organization methods along the lines of Japanese or lean production types. At the same time, however, 9% of firms do not organize work in groups or cells, and 15% use this model for less than 30% of the staff (which constitutes a fourth of the panel with models based on assigning work posts individually.) Therefore, the distribution of firms in accordance with the importance given to the organization of work follows the shape of the “normal distribution,” where 25% have an extensive work organization profile, 25% have an extremely low or non-existent work organization profile, and 50% fluctuate in between. Considering that these are on the whole small and medium-sized enterprises, the performance is positive in terms of the introduction of new production organization methods.33

The autonomy of the cells is low to moderate34. The term "autonomy" refers here to the capacity delegated to workers and/or groups to undertake activities linked to the work posts’ basic operative tasks, with greater or less autonomy in decision-making. This means that there is workers intervention in determining production rhythms (considerably higher than that analyzed in the automotive industry) and there is also a possibility of programming or reprogramming automated machinery by the work team. However, the importance of cell activities in checking quality standards is the predominant task , with a much lesser presence of operators in determining rhythms or adjusting machinery. Intervention in design and/or improvement of products or processes is limited, a restricted activity which is scarcely applied (only in 20% of firms does the cell have a continuous and permanent participation in the design and/or improvement of products and/or processes.) In 44% of cases, such interventions are sporadic. However, it is important to point out that in 42% of firms workers never intervene or participate in determining quality standards nor, more significantly, do they participate in programming or reprogramming automated machinery or tools. In conclusion, it can be stated that only 8% of firms work with high cell autonomy, 44% with low to moderate autonomy, and the rest with almost no autonomy.

33 The methodology of iron-and-steel industry supply firms acquires great relevance if compared with the sample of suppliers in the automotive network referred to above, where only 64% of firms had this organization model, and where half of these were of reduced relevance or limited scope.

34 High autonomy corresponds to a delegation of responsibilities in the cell in areas such as determining production rhythms and/or quality standards, programming and/or tuning-up automated machinery. Autonomy is intermediate when these activities take place only occasionally, and low or limited when the main activities are reduced to quality checks and other routine activities.
With the same aim of finding out models of workers’ involvement in relation to work efficiency, transformations to work posts were analyzed, to see if the general trend was towards a simplification of tasks (the introduction of mechanisms—usually technical—that within the rationale of a new process organization leaves little margin of choice to the human operator,) or if new activities or operations (regulating and/or conditioning automated machinery, coordinating activities with other posts, determining some operative criteria, etc.) which enhance the task had been introduced—which would indicate a process aimed at generating and stimulating multiskills, and requiring greater capabilities and qualifications, etc.

More than half of the firms have undertaken task-enhancement processes. In turn, half of that group (25% of firms) have extended it to more than half of all posts. However, there is a considerable number (49%) of companies that have, in contrast, simplified tasks. This does not imply a division between firms that opted for one technique and the rest for another, but rather that the same companies—although it may seem contradictory—simultaneously use both strategies. This process is distributed heterogeneously, as there are few firms where such procedures have reached a large proportion of operative tasks.

Table 15. Interrelation between techniques of task enhancement and simplification

<table>
<thead>
<tr>
<th>Task simplification</th>
<th>Task enhancement</th>
<th>Total</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>High</td>
<td>0.0%</td>
<td>37.5%</td>
<td>62.5%</td>
</tr>
<tr>
<td>Medium</td>
<td>8.3%</td>
<td>41.7%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Low</td>
<td>12.5%</td>
<td>50.0%</td>
<td>37.5%</td>
</tr>
<tr>
<td>Total</td>
<td>7.1%</td>
<td>42.9%</td>
<td>50.0%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

The above table establishes that few firms have a strategy focused exclusively on task enhancement (7%.) Paradoxically, there is no large amount of groups that have focused exclusively on a task simplification policy. The majority of firms use a mixed strategy, in which both procedures take place simultaneously.

Although it may appear contradictory, this tendency has also been established in other research work (Novick, 2000; Quijano, Stolovich, 1998,) and in other countries, where companies tend to simplify key posts, automating quality control, in an attempt to avoid human error in key or critical situations. At the same time, they undertake task enhancement or task widening processes, the product of adding complementary tasks,

A recent study (Novick, 2001) of capabilities and qualifications in the New Economy sector based on a sample of companies from the software sector and from conventional industries showed that the main difference between both types of firms was not the predominant work-organization model, but rather the extent and depth of the model. The difference, then, is found in the degree of importance that team work attains, being more extensive and deeper in the knowledge sector than in the conventional sector. While in 80% of knowledge-based firms, this work methodology is extensive and predominant, in conventional firms it is more limited or developing. This could mean in fact a predominance in the software sector of a work process that would facilitate the circulation of knowledge and information within the firms, in a general framework of work-organization transformations. The common argument in knowledge-based firms is that this methodology constitutes a fundamental tool for responding to “clients” and markets that is expressed, consequently, in a demand for team-work capabilities.
such as procurement, etc, which do not necessarily imply the re-qualification of tasks or operators.

Another factor used in analyzing workforce management policy, social management technology, is based on characteristics attributed to task rotation. Rotation arises as a mechanism that on the one hand tends to reduce the consequences of monotonous, repetitive jobs, but on the other hand as a learning mechanism for multiskill training, while also attempting to avoid the inconveniences of absenteeism or other problems. When rotation takes place between different sectors and/or workshops within the company, or between different posts of differing complexity, the subjects’ qualifications can be improved while facilitating greater flexibility in task organization. In the sample of companies analyzed, although there are rotation mechanisms, the way in which the majority of firms undertake task rotation shows that tasks tend to be restricted to the same work team, dominating the model of homogenous rotation which impedes the acquisition of capabilities linked to occupational families.

The identified model of work organization has its natural counterpart in the role of the supervisor. Few companies are characterized by comprehensive transformation processes of their social management policies, although a considerable proportion of modifications, most notably as regards work-organization, have been introduced.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Mentioned by (*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absenteeism checks</td>
<td>34.0%</td>
</tr>
<tr>
<td>Production checks</td>
<td>85.0%</td>
</tr>
<tr>
<td>Compliance with labour norms</td>
<td>68.1%</td>
</tr>
<tr>
<td>Quality supervision</td>
<td>70.2%</td>
</tr>
<tr>
<td>Leading team work</td>
<td>82.9%</td>
</tr>
<tr>
<td>Link between worker level and higher levels</td>
<td>80.8%</td>
</tr>
<tr>
<td>Production statistics</td>
<td>42.5%</td>
</tr>
<tr>
<td>Training efforts at the post</td>
<td>55.3%</td>
</tr>
<tr>
<td>Stimulating, encouraging and checking compliance with security standards</td>
<td>76.5%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

The group of activities considered for analyzing the role of the supervisor makes a distinction between the principal functions that characterize different possible kinds of leadership. On the one hand, those that are linked to a traditional disciplinary nature, based on absenteeism checks, compliance with labour regulations, standardized or routine production checks, etc., and on the other hand, those of a more technical nature (production statistics, training, coordinating groups) characteristic of post-Fordist organization models. There is lastly an idea of a group of intermediate situations, combining these two areas.

The analysis of overall supervisor activities shows that in only one fifth of firms do supervisors undertake complex post-Fordist tasks where a more technical role is predominant – due to the autonomy of the teams– and less linked to discipline and compliance with labour regulations and standards. In spite of this, and considering the activities separately, it can be stated that for all the surveyed firms there is an increased importance in production checks, leading team work and complying with security norms, while less importance is attached to the more traditional role linked with absenteeism.
checks. However, it is noticeable that only 42.5% assign tasks linked to production statistics. This behaviour could be partly due to the fact that these are not chain-production industries. In conclusion, 50% of firms are in an intermediate position in terms of supervisor role, which is coherent with the process of transformation in terms of work organization, where the beginning of change can be seen, albeit in limited or restricted strategies\textsuperscript{36}.

3.2.1 The relation between different social management indicators

When analyzing the association between different dimensions, no relations of close association are evident in the survey so as to clearly identify a predominant social management technology. Relations can be characterized as hybrid forms, intermediate “types” in the continuum from absolutely prescribed situations (the classic Fordist system) to quasi-autonomous situations.

For example, the group of companies that score highest in relation to work organization does not have a similar score in relative indicators of cell autonomy, nor in the type of supervisor role. This would appear to show non-systemic policies in terms of work organization\textsuperscript{37}.

The behaviour of different social management indicators makes it possible to make out a tendency centered on a widespread cellular model of work organization, unaccompanied by autonomy margins and a supervisor whose functions imply a mix between a disciplinary figure and a more technical figure with an important training role.

<table>
<thead>
<tr>
<th>Agent Type</th>
<th>Work organization</th>
<th>Cell autonomy</th>
<th>Supervisor role</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Relative</td>
<td>Low</td>
</tr>
<tr>
<td>Isolated SMEs</td>
<td>50.0%</td>
<td>18.7%</td>
<td>31.2%</td>
</tr>
<tr>
<td>SMEs in a group</td>
<td>50.0%</td>
<td>25.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>DFI</td>
<td>42.9%</td>
<td>28.5%</td>
<td>28.5%</td>
</tr>
<tr>
<td>Total</td>
<td>48.9%</td>
<td>21.2%</td>
<td>29.8%</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

\textsuperscript{36} Comparing this group of firms with the automotive sector suppliers, some similarities may be found (in spite of some methodological differences,) although the components are different. In the automotive sector, 64% of supply firms use team or group-work techniques, which suggests that teamwork is somewhat higher in this group of iron-and-steel industry SME suppliers. However, in terms of the relevance of this methodology, although autonomy was low in more than a fourth of the automotive panel, and considerable in 40% of it, in the case of iron-and-steel suppliers autonomy was high only in a quarter of firms. All this information indicates that the tendency to organize work in cells or teams is greater among iron-and-steel suppliers, although the autonomy of these groups is higher in the automotive industry. Also, the kind of multiskilling seems rather more sophisticated in the automotive group. The role of the supervisor, which was studied in less detail in the motorcar parts industry, also takes on a more technical, less disciplinary nature than in the iron-and-steel industry. Nevertheless, it must be considered that the comparison is relatively valid as this is a case of generally medium-sized DFI enterprises, in many cases subsidiaries of global suppliers, and in the case of SIDERCA and SIDERAR, suppliers are a group of small and medium-sized firms, mostly of national capital.

\textsuperscript{37} For example, in only 20% of firms with a high percentage of workers in cells is cell autonomy high; and in barely more than a quarter the supervisor’s role is centred around technical and training leadership.
The scarce relation between the different dimensions can be seen in tables 18 and 19. There is no close relationship between the extent of work organization in cells and their respective autonomy.

Table 18. Distribution of firms by degree of cell autonomy according to importance of work organization

<table>
<thead>
<tr>
<th>Cell autonomy</th>
<th>Importance of work organization</th>
<th>Total</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>High</td>
<td>75.0%</td>
<td>25.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Relative/ Medium</td>
<td>55.6%</td>
<td>22.2%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Low</td>
<td>66.6%</td>
<td>0.0%</td>
<td>33.3%</td>
</tr>
<tr>
<td>Nil</td>
<td>31.8%</td>
<td>27.3%</td>
<td>40.9%</td>
</tr>
<tr>
<td>Total</td>
<td>48.9%</td>
<td>19.1%</td>
<td>31.9%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

A similar situation is seen in the association between the degree of cell autonomy and the supervisor’s role. The econometric analysis confirms this lack of association. The importance of the organization of cell-work is not associated with the role of leadership nor with salary supplements. Nor is the degree of autonomy of cellular models connected with the type of supervision or pay systems.

Table 19. Cell autonomy and supervisor’s role

<table>
<thead>
<tr>
<th>Cell autonomy</th>
<th>Role of supervisor</th>
<th>Total</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Technical coordination</td>
<td>Intermediate</td>
<td>Disciplinary action and checks</td>
</tr>
<tr>
<td>High</td>
<td>25.0%</td>
<td>50.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>Moderate</td>
<td>44.4%</td>
<td>33.3%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Low</td>
<td>25.0%</td>
<td>50.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>Nil</td>
<td>27.3%</td>
<td>31.8%</td>
<td>40.9%</td>
</tr>
<tr>
<td>Total</td>
<td>29.8%</td>
<td>38.3%</td>
<td>31.9%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

The relation with the core (SIDERCA/SIDERAR) is not a significant variable to explain the types of social management present. It is useful to point out that, in relation to the aggregate indicator of social management technology, firms with higher exposure are at a marked disadvantage compared to the other suppliers. Thus, while around 60% of firms with lower dependence score more highly, indicating more systemic social management policies, among firms with greater relative exposure this proportion is near to 18%

If only the proportion of workers in cells is considered, the difference between the groups with greater sales-concentration exposure (more dependent) and the remaining groups is quite significant. Work organization in teams involves 60% of the people employed only in a small percentage (9%) of the companies of higher sales exposure. However, among companies of lower sales exposure, this percentage is significantly higher (60%). In relation to autonomy –relevance- of the cell, the differences are also significant: in 73% of the most exposed firms, autonomy is fairly insignificant. Finally, in relation to the activities that define the direct hierarchy model, the existing differences are less conclusive, which demonstrates that both the functions and the role of the supervisor are independent of the autonomy of work teams. In turn, the weight of the variable part of salary in pay as a whole is also significantly lower in firms with greater dependence on the core.
3.2.2 Pay and labour relations

Furthermore, from the labour relations perspective, more than half of the firms reported they had signed collective labour agreements (60%) although it is not clear whether these are business or sector agreements. Nevertheless, it is interesting to note that the concentration of firms that reported working currently with a low number of occupational categories (66% report between 2 and 4 such categories) evidences autonomous business criteria that are not negotiated conventionally or by consensus. It is mentioned in the survey that salaries and pay are negotiated (51% of firms) and so too, to a lesser extent, are work organization, training plans, etc. In fact, negotiation concerning the issue of occupational categories is mentioned only by five companies.

With regards to pay, traditional incentives such as full-attendance bonuses are still in place (80% of firms,) while few firms have introduced new criteria linked to quality (9%), skills (17%), etc. However, a significant percentage of firms have introduced special bonuses, which show some kind of recognition for workers who meet the targets (42%).

In only 20% of the firms is the variable salary higher than 15% of the total, while in 44% the incentive is below 10%, with the remaining 35% between 10 and 15%.

Table 20. Average salary of labourers and proxy productivity index

<table>
<thead>
<tr>
<th>Productivity proxy</th>
<th>Average salary of labourers</th>
<th>Total</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Over 1000</td>
<td>751 - 1000</td>
<td>500 – 750</td>
</tr>
<tr>
<td>High</td>
<td>9.1%</td>
<td>0.0%</td>
<td>72.7%</td>
</tr>
<tr>
<td>Medium</td>
<td>9.1%</td>
<td>27.3%</td>
<td>54.5%</td>
</tr>
<tr>
<td>Low</td>
<td>5.0%</td>
<td>35.0%</td>
<td>35.0%</td>
</tr>
<tr>
<td>Total</td>
<td>7.1%</td>
<td>23.8%</td>
<td>50.0%</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers

Total salary amounts are significantly homogenous both for rank-and-file operators and supervisors. The average for the former is 687 pesos while this increases to 1267 pesos for the latter. There are no noticeable important differences between different types of companies. Nor does productivity appear as a variable that determines different salary bands. This may mean that pay and bonuses can be the result of collective negotiations or previously established mechanisms but not the result of productivity (nor proxy productivity, as this is a quotient of sales over the number of employees. Although it can be seen that in very general terms the firms with greater production do not pay the lowest salaries, a correlation cannot be found between the two variables.

In the case of supervisors, there would appear to be a somewhat closer connection between these variables, as firms with lower production are clearly those that pay lower salaries.

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38 Many sectors (heavy engineering industry, sophisticated chemical industry, etc.) represented in this group of suppliers have not negotiated collective labour agreements in recent years. In fact, informal agreements established with work committees or delegates that are not necessarily approved by the Argentine Department of Labour are very common.

39 Total salaries correspond to traditional averages from the manufacturing industry but do not appear to have suffered the reductions that average salaries show.
Table 21. Supervisor’s salary according to a proxy estimation of productivity

<table>
<thead>
<tr>
<th>Proxy estimation of productivity</th>
<th>Supervisor’s salary</th>
<th>Total</th>
<th>Participation in the total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Over 1500</td>
<td>1000 - 1500</td>
<td>Below 1000</td>
</tr>
<tr>
<td>High</td>
<td>9.1%</td>
<td>63.6%</td>
<td>27.3%</td>
</tr>
<tr>
<td>Medium</td>
<td>27.3%</td>
<td>54.5%</td>
<td>9.1%</td>
</tr>
<tr>
<td>Low</td>
<td>15.0%</td>
<td>50.0%</td>
<td>35.0%</td>
</tr>
<tr>
<td>Total</td>
<td>16.9%</td>
<td>54.8%</td>
<td>26.2%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

Total salary amounts might be correlated with other variables, though further research is needed in this line. For example, it can be seen that the supervisor’s salary is not associated with the role and activities that are his/her responsibility. Nor does the analysis of salary averages according to business type show any significant differences.

The analysis of perks in general reveals that 80% of firms give some kind of non-rewarding perks which is significant, as the majority of these are small or medium-sized businesses. While food tickets are part of an extended payment method to avoid increases in labour costs, almost 50% of firms also provide health insurance and a subsidized canteen. This shows the weight of a “social” policy in terms of pay.

3.2.3 Social management summary

The areas analyzed concerning prevailing social management in the sample studied gives a profile that, despite the large proportion of staff working in groups, can be characterized as intermediate or “hybrid” type management. System policies have not been identified and, furthermore, the different areas do not appear to be highly inter-connected. The economic context, with a lengthy recession and high unemployment in the job market, could be a factor that explains, albeit partially, this type of management. The economic situation in general and the manufacturing sector’ situation in particular hinder the development of systemized, long-term labour force management policies. These circumstances combined with idle capacity make it difficult to establish productivity parameters and associate them with salary policies.

With regard especially to pay, although data in the survey do not involve very low salaries (except for some exceptions), this situation is not associated with the type of business nor with a productivity proxy. Neither is it associated with the differential function performed by supervisors, when it comes to this group.

In conclusion, the central issues here are the partial application of new forms of social management, predominantly orientated towards the organization of work in groups with little autonomy, and supervisor roles that combine traditional and new dimensions. Curiously enough, the companies most dependent on the core are those with the lowest parameters.
3.3 Training

Considerable efforts have been made in terms of training. 87% of the surveyed companies provide training activities. Of these, 45% (38% of the sample as a whole\textsuperscript{40}) have their own separate training structure within the area of human resources, evidencing some concern about these matters though not widespread enough.

Considering only the group of firms that carried out training in 2000, the annual amount dedicated to these activities rose from the 1995 average of around US$17,700 to US$29,000 in 2000 (an increase of 64%, representing 0.41% of income from sales in the last year,) which shows the same tendency of relative importance. Training courses in that year reached on average 43 people per firm, approximately 70% of total staff.

In terms of the occupational characteristics of those trained, in 43% of firms where training took place it mostly involved the high levels of the firm: managers and supervisors. It is important to note that 40% of firms do not concentrate training activities on operations staff, be it administrative staff or labourers.

Table 22. Training activities per post according to percentage of firms, people involved and kind of training

<table>
<thead>
<tr>
<th>Posts</th>
<th>Percentage of firms with training</th>
<th>Average percentage of people involved</th>
<th>Percentage of firms according to kind of training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>General Specific Both</td>
</tr>
<tr>
<td>Managers</td>
<td>79%</td>
<td>84%</td>
<td>32% 32% 36%</td>
</tr>
<tr>
<td>Supervisors</td>
<td>85%</td>
<td>87%</td>
<td>21% 30% 49%</td>
</tr>
<tr>
<td>Labourers</td>
<td>62%</td>
<td>86%</td>
<td>17% 29% 54%</td>
</tr>
<tr>
<td>Administrative</td>
<td>62%</td>
<td>77%</td>
<td>17% 33% 50%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

In training by category, most workers throughout the whole staff are involved (77%-87%). In the case of managers' training activities, there is a balance of general and specific training, while in other categories specific training is more common, i.e., based on particular technical issues required by the posts.

The influence of core companies in the firms' training activities can be seen in the decision to have training in 32% of cases, and to have training in specific thematic areas in 25%. The relatively greater weight of the core firm in terms of training, in comparison with its influence in other areas, is related to certain weaknesses in the firms of the network in this area. In this sense, it is significant that the proportion of firms whose training activities show some influence from SIDERCA and/or SIDERAR – considering all the aspects – is

\textsuperscript{40} This percentage is higher than the 66% registered among a group of "successful SME exporters" in 1999, and the 62% of the whole SME group in the 1997-1998 period. Yoguel and Moor-Koenig, 1999 and also 26% given by the Encuesta Nacional de Conducta Tecnológico (National Survey of Technological Behaviour) for this business sector in the 1992-1996 period. The explanation may be that, in effect, SIDERCA and SIDERAR's suppliers actually appear to be more inclined towards training than SMEs on average. Given that such increases in training have been noticed over subsequent time periods, this information might imply that training activities that have been gradually included into SME's behaviour in the nineties, possibly at the same time that the training market has been refined and developed. However, this is still considerably lower than training efforts seen in the automotive industry where 100% of firms provide training, 90% of which have their own training structure.
46%. In terms of training methodology, target groups, choosing bidders and evaluation, the influence is far lower, around 10% in the firms.

When analyzing the associations between the type of dependence on the core and training efforts, the most dependent firms stand out due to the greater presence of their own training structure (64%).

Considering the agent type, it can be seen that Techint’s greatest influence on training activities is found in DFIs (see Table 23.)

<table>
<thead>
<tr>
<th>Type of agent</th>
<th>Influence of OT</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Influence</td>
<td>No influence</td>
</tr>
<tr>
<td>SMEs</td>
<td>44%</td>
<td>56%</td>
</tr>
<tr>
<td>Groups</td>
<td>43%</td>
<td>57%</td>
</tr>
<tr>
<td>DFIs</td>
<td>57%</td>
<td>43%</td>
</tr>
<tr>
<td>Total</td>
<td>46%</td>
<td>54%</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers

A comparison of training activities in firms that have some influence from Techint and those that do not shows differences in amounts and people involved. In firms where some influence is present, the invested amount is greater and, in terms of sales, even doubles the figures of firms with lower OT influence. However, the number of employees that participate in these activities is lower both in absolute and relative terms. As a result, the amount per employee invested in training by Techint-influenced firms is almost double that of firms without such influence. This dynamic shows an ongoing process that can be considered not yet completed, where training strategies require greater focus and significance.

<table>
<thead>
<tr>
<th>Techint Influence</th>
<th>Amount allocated to training</th>
<th>People involved in training</th>
<th>Pesos per trained person</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pesos per year, on average</td>
<td>Percentage of sales</td>
<td>Average number of staff</td>
</tr>
<tr>
<td>Influence</td>
<td>37,038</td>
<td>0.61%</td>
<td>41</td>
</tr>
<tr>
<td>No influence</td>
<td>23,887</td>
<td>0.31%</td>
<td>45</td>
</tr>
<tr>
<td>Total</td>
<td>29,068</td>
<td>0.41%</td>
<td>43</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers

Another variable that gains significance when explaining the diversity of training strategies is the type of agents. Groups and DFIs invest more on average than SMEs, although for the latter the amount invested in terms of sales is four times that of Groups and doubles that of DFIs, a fact which highlights the efforts made by SMEs. The firms that train the most people on average are the groups, but in relation to the occupational total the three strata train a similar proportion of staff (around 70%). Finally, the highest investment per trained person is made by SMEs- reinforcing what was said before- followed by DFIs and the groups.
In conclusion, what can be seen from all this is an area in which behaviour varies according to the type of firm, where efforts can be considered as relative, with an exception perhaps in the case of SMEs that show greater pecuniary efforts and greater expenditures in relation with sales. Training is focused on the manager / supervisor level and considerably lower at labourer level.

### Table 25. Average investment in training in 2000 according to agent type.

<table>
<thead>
<tr>
<th>Agent type</th>
<th>Amount allocated to training</th>
<th>People involved in training</th>
<th>Pesos per trained person</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pesos per year, on average</td>
<td>Percentage of sales</td>
<td>Number of people on average</td>
</tr>
<tr>
<td>SMEs</td>
<td>27,329</td>
<td>0.75%</td>
<td>33</td>
</tr>
<tr>
<td>Groups</td>
<td>32,400</td>
<td>0.19%</td>
<td>80</td>
</tr>
<tr>
<td>DFIs</td>
<td>32,666</td>
<td>0.37%</td>
<td>45</td>
</tr>
<tr>
<td>Total</td>
<td>29,068</td>
<td>0.41%</td>
<td>43</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers
4. The Production Environment: Degrees of Relationship with the Core, other Firms and Organizations

This chapter discusses how codified and tacit knowledge is exchanged among suppliers themselves and also with external agents, and the relevance of such exchanges, which is evidenced in what we have called the production environment.

In order to analyze the dissemination of information and knowledge, several characteristics are examined: the scope and length of contracts about technical assistance provided by the core to its suppliers, how they are evaluated, and less formal bilateral exchanges involving technical meetings and visits to plants. The contributions of suppliers to the core are also considered, as well as the recognition received. For studying exchanges between suppliers and agents outside the core, various factors that may increase their technical capabilities are taken into account: cooperation agreements, informal conversations, and relationships with private and public institutions. The purpose of this chapter is to envisage the different relationships that determine how intense is the stream of codified and tacit knowledge circulating in this network.

4.1 Restricted production environment: relationships with the core

For most suppliers in this network, contracts are the prevalent form of regulating procurement to both SIDERCA and SIDERAR. In more than two thirds of the cases under study, the quantity of products provided, their price, quality assurance level, and shipment and delivery conditions are established through formal contracts. However, for one third of the firms involved, commitments and obligations are dealt with through non-contractual bargains.

Table 26. The relevance of contracts and bargains in the network

<table>
<thead>
<tr>
<th>Terms</th>
<th>Bargaining</th>
<th>Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SIDERCA</td>
<td>SIDERAR</td>
</tr>
<tr>
<td>Quantity of traded products</td>
<td>33%</td>
<td>34%</td>
</tr>
<tr>
<td>Price</td>
<td>27%</td>
<td>27%</td>
</tr>
<tr>
<td>Quality assurance</td>
<td>33%</td>
<td>31%</td>
</tr>
<tr>
<td>Shipment and delivery</td>
<td>29%</td>
<td>30%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

In most cases (two thirds), no additional demands are made besides those stated in the contracts, except for —generally urgent— services where informal dealing is frequent. In a limited number of cases additional demands are made involving different questions such as the need for technical assistance from SIDERCA/SIDERAR, equipment traceability controls, monitoring quality assurance and procurement management, etc.

Contracts are annual in more than half the cases studied (55%), whereas quarterly and half-yearly contracts were found in 25% of the cases. The remaining 20% is covered by other types of dealings. Considering current conditions for doing business in Argentina, such contracts generally involve relatively long terms and obviously decrease the strategic uncertainties of the agents.

41 This is a significant difference with respect to the automotive network, where contractual relationships are scarce.
Most surveyed firms indicated that, in case of failure to comply, various penalties are foreseen in the clauses: fines (44% of the cases) and formal disownment of the contract (36%). About 80% of the people surveyed reported that SIDERCA / SIDERAR apply penalties to suppliers that fail to comply with delivery dates or technical specifications agreed upon.

Reprogramming demand is not frequent, though differences are apparent between the two core firms. 55% of SIDERCA's suppliers indicate that demand reprogramming is not usual, but this percentage rises to 62% in the case of SIDERAR. This is another feature that generates certainty and differentiates this network from the automotive industry, where changes in schedules are frequent and distorting for plant efficiency (Yoguel et al 2000). However, when reprogramming occurs, most suppliers report that SIDERCA/SIDERAR do not share the additional costs involved.

The study examined the delivery / procurement of products and services. A difference was established between JIT (just in time) methodologies involving a coordinated relationship with the core firm and traditional methodologies that involve a greater stock. It should be noted, however, that analyzing supply procedures in serial production is very different from analyzing them in this sector, characterized by process technologies. In the case of the automotive industry, for instance, JIT delivery is critical for internal procurement. In the iron-and-steel industry, on the contrary, significant differences in procurement were noticed between the two companies of the OT group.

<table>
<thead>
<tr>
<th>Delivery Type</th>
<th>SIDERCA</th>
<th>SIDERAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>28.6%</td>
<td>36.8%</td>
</tr>
<tr>
<td>JIT</td>
<td>65.7%</td>
<td>45.8%</td>
</tr>
<tr>
<td>Others</td>
<td>5.7%</td>
<td>17.4%</td>
</tr>
<tr>
<td>Total</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

Among SIDERCA's suppliers, 66% deliver their products in a synchronized manner (JIT), less than 30% deliver them in the traditional way and less than 6% follows other methods. In the case of SIDERAR, traditional delivery is more frequent (37%), JIT delivery is lower (45%), and the percentage of other methodologies is higher.

4.1.1 Technical assistance from the core

The technical assistance provided by core firms is perceived as rather limited by their suppliers. Their conclusion derives from two considerations: whether they received assistance or not, and whether it was significant for the firm. Only 24% of SIDERCA's and 16% of SIDERAR's suppliers receive technical assistance. Firms that consider this assistance as very or moderately significant are very few indeed (13% and 12%, respectively).

These limitations considered, SIDERCA's suppliers highlight assistance focused on process organization and quality assurance techniques, whereas SIDERAR's suppliers mention quality assurance and assistance in product development (see Table 28).
Table 28. Percentage of suppliers receiving technical assistance from SIDERCA and SIDERAR in different areas

<table>
<thead>
<tr>
<th>Assistance in:</th>
<th>SIDERCA</th>
<th>SIDERAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Techniques to improve quality</td>
<td>23.8%</td>
<td>17.5%</td>
</tr>
<tr>
<td>Product development and design</td>
<td>19.0%</td>
<td>17.5%</td>
</tr>
<tr>
<td>Work organizational techniques</td>
<td>26.2%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Average</td>
<td>24.0%</td>
<td>16.0%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

4.1.2 Characteristics of the technical assistance provided by the core

Fifteen different alternatives were considered, six of them associated with improvements in technical procedures, four related to improvements in human resource management, four associated with a greater competitiveness in the market and the remaining one related to the use of infrastructure.

As regards assistance for the improvement of technical procedures\(^{42}\), the percentage of SIDERCA's suppliers receiving support is slightly higher than that of SIDERAR's. Anyway, both are included within a framework of limited impact (see Table 29), mainly assigned to production processes and, to a lesser extent, to reduce reworking and improve logistics.

Table 29. Percentage of suppliers receiving technical assistance to improve technical procedures

<table>
<thead>
<tr>
<th>The core provides assistance in the following technical procedures:</th>
<th>SIDERCA</th>
<th>SIDERAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved production processes</td>
<td>26.2%</td>
<td>16.7%</td>
</tr>
<tr>
<td>Better use of the installed capacity</td>
<td>16.7%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Less nonacceptances and reworking</td>
<td>19.0%</td>
<td>14.3%</td>
</tr>
<tr>
<td>Better use of raw materials</td>
<td>14.3%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Improved lay-out</td>
<td>9.5%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Improved logistics</td>
<td>26.2%</td>
<td>14.3%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

Notes: A, percentage of firms receiving technical assistance; B, percentage of firms describing such assistance as moderately or highly significant.

In terms of assistance tending to improve human resource management\(^{43}\), efforts devoted to improve staff training has been especially highlighted both among SIDERCA and SIDERAR's suppliers.

Table 30. Percentage of suppliers receiving technical assistance for an improved management of human resources

<table>
<thead>
<tr>
<th>Core's assistance to improve the management of human resources:</th>
<th>SIDERCA</th>
<th>SIDERAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved internal interaction in teams</td>
<td>21.4%</td>
<td>14.3%</td>
</tr>
<tr>
<td>Improved interaction between teams</td>
<td>21.4%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Improved staff training</td>
<td>38.1%</td>
<td>27.5%</td>
</tr>
<tr>
<td>Others</td>
<td>2.4%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

Notes: A, percentage of firms receiving technical assistance; B, percentage of firms describing such assistance as moderately or highly significant.

\(^{42}\) Process improvement, better use of the installed capacity, less nonacceptances and reworking, better use of raw and other materials, improved lay out and improved logistics.
As regards assistance tending to improve competitiveness⁴⁴, a positive evaluation may be noticed in all the suppliers surveyed, especially when compared with other dimensions. The suppliers of both core firms highlight the development of improved capabilities that enable them to supply big companies and engage in business with other enterprises (see Table 31).

Finally, the percentage of suppliers resorting to laboratories, machinery and equipment that belong to the core is significantly low (7% and 5%, respectively).

Table 31. Percentage of suppliers receiving technical assistance to improve their competitiveness in the market

<table>
<thead>
<tr>
<th>Core's assistance to improve the firm's competitiveness in the market:</th>
<th>SIDERCA</th>
<th>SIDERAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better chances of doing business with other companies</td>
<td>26.2%</td>
<td>19.0%</td>
</tr>
<tr>
<td>Improved abilities as providers of big enterprises</td>
<td>28.6%</td>
<td>23.8%</td>
</tr>
<tr>
<td>Stricter supplier controls</td>
<td>26.2%</td>
<td>16.7%</td>
</tr>
<tr>
<td>Better access to international information</td>
<td>23.8%</td>
<td>16.7%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers
Notes: A, percentage of firms receiving technical assistance; B, percentage of firms describing such assistance as moderately or highly significant.

4.1.3 Relationship between technical assistance and sales-concentration exposure

The evaluation of technical assistance by suppliers is closely associated with their sales-concentration exposure. In effect, between the companies that have a high dependence on SIDERCA and SIDERAR, about 26% receive assistance of every kind, which is appreciated as highly or moderately significant. This percentage doubles the panel's average (13%) and is, besides, higher than that of firms having moderate or scarce dependence on the core⁴⁵.

In the case of SIDERCA, 80% of the firms whose sales-concentration level does not involve a high exposure does not receive support at all. This percentage decreases to 45% among suppliers with a relatively higher exposure (Table 32). When factors tending to improve technical procedures are considered, the percentage of firms that either receive no assistance or receive an assistance considered as slightly significant for their business is lower among companies that depend heavily on OT (45%) than in the two remaining groups (76%). Besides, when considering the assistance tending to improve the management of human resources, differences are slightly significant, indicating a lower relevance of such questions for the core. A similar situation may be noticed in the case of focalized assistance to improve the suppliers' competitiveness.

Within the highest exposure group, the most relevant assistance in relative terms is concentrated in: improved training, improved capabilities as suppliers of other big companies (55.6%) and improved production processes, less nonacceptances and

⁴⁴ Better chances of doing business with other companies, improved abilities as providers of big companies, stricter supplier controls, and better access to international information.

⁴⁵ Whereas only 9% of the less dependent companies receive the 15 assistance alternatives mentioned herein, in the intermediate group this percentage increases to 13% in the case of SIDERCA's suppliers, and is only 5% in the case of SIDERAR's suppliers.
reworking, and enhanced possibilities of doing business with other companies (44%). Among suppliers with a moderate dependence on the core, the following topics are mentioned as exclusively relevant: assistance for training personnel (38.5%), for improving the firm’s capabilities to act as a supplier of other big companies and controlling other providers (23.1%). Finally, in the case of suppliers with very low relative dependence, the only relevant topic is the assistance to improve logistics, which was mentioned by 17.6% of the firms included in this group.

Table 32. Suppliers’ distribution by exposure degree according to the relevance of technical assistance provided by SIDERCA.

<table>
<thead>
<tr>
<th>Sales-concentration exposure</th>
<th>None</th>
<th>Moderate</th>
<th>High</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>80%</td>
<td>5%</td>
<td>15%</td>
<td>100%</td>
</tr>
<tr>
<td>Moderate</td>
<td>46%</td>
<td>38%</td>
<td>15%</td>
<td>100%</td>
</tr>
<tr>
<td>High</td>
<td>45%</td>
<td>27%</td>
<td>27%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>61%</td>
<td>20%</td>
<td>18%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers

On the contrary, in the case of SIDERAR no difference was noticed as regards technical assistance between firms having unequal exposures (see Table 33). Besides, when the assistance for improving production processes and human resource management is considered, the differences between more and less exposed firms are significantly lower than those reported for SIDERCA.

The analysis of indirect benefits associated with improved competitiveness indicates that conditions are slightly better among companies with a higher relative exposure. Within the group most dependent on SIDERAR, the most relevant assistance is focused on the following areas: a) better chances of doing business with other companies, b) improved abilities as providers of big companies; c) improved production processes, d) stricter controls over their own suppliers, and e) better access to international information. Among suppliers with a moderate dependence, the only item highlighted was assistance tending to improve training, whereas in the case of suppliers with a low relative dependence, assistance in logistics was emphasized.

Table 33. Suppliers’ distribution by exposure degree according to the relevance of technical assistance provided by SIDERAR.

<table>
<thead>
<tr>
<th>Sales-concentration exposure</th>
<th>Relevance of the assistance</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
<td>Moderate</td>
</tr>
<tr>
<td>Low</td>
<td>80%</td>
<td>5%</td>
</tr>
<tr>
<td>Moderate</td>
<td>77%</td>
<td>23%</td>
</tr>
<tr>
<td>High</td>
<td>64%</td>
<td>18%</td>
</tr>
<tr>
<td>Total</td>
<td>75%</td>
<td>14%</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers

In short, among assistance alternatives exceeding the average and perceived as effective, those devoted to improving production processes, logistics and training are outstanding. Other alternatives positively evaluated on account of their indirect effects include those

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46 While 73% of the most exposed firms report that they have received no assistance or rank it as hardly significant, this percentage increases to 82% among the other two categories considered as a whole.
associated with greater opportunities to increase the clients’ portfolio, improved capabilities of acting as suppliers of big companies, and achieving a higher control over their own providers. It should be noticed that, whereas the three former alternatives involve the possibility of increasing the suppliers' technical capabilities, the remaining alternatives enable them to achieve a better position in the market, particularly abroad. Besides, the technical assistance of both core firms increases considerably from less exposed firms (companies whose sales to OT do not prevail in their business) to those whose sales to OT are prevalent. Such increase is evidenced not only in the number of companies that receive assistance but also in the number of actual actions carried out in this sense.

4.1.4 Technical meetings, visits to plants and information flows: another way of transferring knowledge

Even though the formal technical assistance provided by the core (see previous section) is perceived as limited, suppliers identified in their answers other communications channels. Technical meetings and visits to plants appeared in the survey as situations where suppliers receive some kind of assistance from SIDERCA and SIDERAR. This mechanisms entail a two-way flow of information and knowledge between suppliers and the core.

There is a great heterogeneity as regards the regularity or technical meetings. Almost one half of SIDERCA's (46%) and SIDERAR's (42%) suppliers hold very frequent (weekly/daily) technical meetings with the core firms, whereas other group reports that monthly or quarterly meetings prevail (32% and 40%, respectively). The remaining companies rank these meetings as merely sporadic (22% and 18%, respectively).

The personnel involved in such meetings is not homogenous. About 10% of the suppliers human resources are very close to the average (between 6 and 7 individuals), whereas the core firm is represented by 2 or 3 individuals. Agendas are varied and have different degrees of complexity, involving questions such as detailed technical assistance for various projects, quality assurance, development of new products, etc. More "general" questions are associated with merchandising. There is a clear association between the sophistication of the topic involved and the number of technical meetings appointed to it. In other words, as sophistication or complexity increases, the frequency of these meetings also increases. 47

<table>
<thead>
<tr>
<th>Topics in the agenda</th>
<th>SIDERCA</th>
<th>SIDERAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>29.3%</td>
<td>26.3%</td>
</tr>
<tr>
<td>Complex</td>
<td>70.7%</td>
<td>73.7%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

The development of the suppliers' endogenous capabilities is relevant for evaluating technical assistance because it partially confirms –especially in the case of SIDERCA– the correlation between endogenous capabilities themselves (innovative capabilities, social management technologies, and efforts devoted to training) and a proxy estimation of interrelationships within the network.

47 The probability of accepting the null hypothesis (no association) is 1.8% (Square-Chi test).
The number of technical meetings between SIDERCA and its suppliers is maximum in the case of senior companies with the highest capabilities (scope of development activities, average social management technologies, relevance of cellular organization). In the case of SIDERAR, interrelationships are less significant and increase for older firms which receive more technical assistance and have the highest sales-concentration exposure.

Another relationship mode, though less frequent, are visits of SIDERCA's and SIDERAR's personnel to suppliers' plants. In 75% of the cases surveyed, such visits are sporadic and mainly focused on monitoring, inspecting or auditing (70% for SIDERCA, and 77% for SIDERAR). Both core firms entrust these activities to 2 or 3 individuals, while providers assign to them more or less the same number of people, generally selected from the executive levels.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Meetings with suppliers</th>
<th>Visits to plants</th>
<th>Exchange of technical information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SIDERCA</td>
<td>SIDERAR</td>
<td>SIDERCA</td>
</tr>
<tr>
<td>Sporadic</td>
<td>22.0%</td>
<td>18.4%</td>
<td>73.3%</td>
</tr>
<tr>
<td>Monthly/Quarterly</td>
<td>31.7%</td>
<td>39.5%</td>
<td>16.7%</td>
</tr>
<tr>
<td>Weekly/Daily</td>
<td>46.3%</td>
<td>42.1%</td>
<td>10.0%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

A third way of informal relationship is derived from activities involving both a unidirectional (e.g., quotations, delivery periods, etc.) and a bi-directional, more complex, information flow (e.g., technical aid for improving products, quality, etc.). The former, unidirectional style prevails in the two core firms (62.9% and 64.7%, respectively) over the second, (which represented 37.1% and 35.3% of the cases surveyed) with a predominance of weekly and daily frequencies (57.1% in the case of SIDERCA and 61.8% in the case of SIDERAR). The two core firms dedicate between 7 and 8 individuals to these activities, whereas suppliers usually assign to them 2 or 3 people from their staff.

On the part of suppliers, the amount of human resources assigned to meetings, visits, and communications is very high and evidences they need a minimum threshold of qualified human resources, and also indicates the significance they assign to such activities for a bi-directional exchange of knowledge (See Table 36). However, the qualification level of people from the core involved in these activities is lower than that of the suppliers' human resources engaged in them. For instance, when SIDERCA/SIDERAR supervisors and/or division heads are involved, on the part of suppliers the people assigned belong to management levels. Similarly, when the core appoints managers for these meetings, their counterpart is represented by the president or a director of the supplier firm.

---

48 Such a significant amount of human resources devoted to these activities does not imply personal contacts because communication and information technologies are quite widespread (telephone, fax, e-mail).
Table 36. Average number of employees involved in network-relationships

<table>
<thead>
<tr>
<th>Average number of people involved</th>
<th>Meetings with suppliers</th>
<th>Visits to plants</th>
<th>Exchange of technical information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SIDERCA</td>
<td>SIDERAR</td>
<td>SIDERCA</td>
</tr>
<tr>
<td>From the core</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>From suppliers</td>
<td>5.8</td>
<td>5.1</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers

In principle, there is a positive correlation between the frequency of these meetings with SIDERCA and SIDERAR and the degree of sales-concentration exposure. A positive correlation has also been found between such exposure and the complexity or sophistication of the subjects discussed. As suppliers intensify their relationship with SIDERCA and SIDERAR, the number of meetings increases and their character is more technical. However, there’s no correlation between sales-concentration exposure and the number of people involved in these activities, either on the part of the core or on the part of its suppliers.

4.1.5 The suppliers contributions to SIDERCA/SIDERAR

94% of the surveyed firms report they have positively contributed to improve core performance through cost reductions, an increased competitiveness, improved logistics and other techno-productive matters.

Table 37. Suppliers contributions to SIDERCA/SIDERAR

<table>
<thead>
<tr>
<th>Suppliers contributed to...</th>
<th>Mentioned by...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce costs</td>
<td>98%</td>
</tr>
<tr>
<td>Improve quality</td>
<td>82%</td>
</tr>
<tr>
<td>Increase competitiveness</td>
<td>73%</td>
</tr>
<tr>
<td>Introduce product and/or process improvements</td>
<td>70%</td>
</tr>
<tr>
<td>Improve specific technical knowledge</td>
<td>57%</td>
</tr>
<tr>
<td>Simplify tasks or procedures by delegating functions</td>
<td>36%</td>
</tr>
<tr>
<td>Improve relationships with other suppliers</td>
<td>23%</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers

As may be noticed in table 37, the surveyed companies consider they have made contributions to SIDERCA/SIDERAR mainly by helping to reduce costs, improve quality, increase productivity, and introduce product and/or process enhancements. Contributions are deemed less significant in matters such as improving relationships with other suppliers (indicating that radial relationships between the core and suppliers prevail) and simplifying tasks and procedures at the core (by delegation of such functions to the suppliers).

About two thirds of the firms in the panel consider that SIDERCA/SIDERAR acknowledge their contributions. However, according to interviewees, in very few cases such

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49: The probability of accepting the null hypothesis (no association between these variables) is 3.6%.

50: In this case, the probability of accepting the null hypothesis is 4%.

51: 73% of the suppliers that maintain weekly/daily meetings with the core have a high sales-concentration exposure.

52: The suppliers contribution to reduce SIDERCA and SIDERAR’s costs may result from a fall in prices accompanied by lower profit margins (80% of the cases surveyed) rather than from efficiency improvements.
acknowledgement is explicit and they regard their position as suppliers as vulnerable \(^{53}\). In this sense, some suppliers—not all of them—consider that the mere fact of selling a product or service uninterruptedly constitutes a recognition, whereas others feel appreciated because they have been awarded quality certifications, have been approved as suppliers or have signed longer-term contracts. Besides, some suppliers feel recognized because their ideas are appreciated in informal conversations. Nevertheless, some suppliers complain that when changes occur at the managerial level, all their previous efforts are lost.

4.1.6 Difficulties in the supplier-core relationship

In most cases, the relationship SIDERCA/SIDERAR—suppliers does not involve difficulties for providers. Those that report difficulties attribute them to asymmetries in size which require from them an adaptation to OT work style, involve the compliance with certain quality standards, and require the development of new or wider product lines, as well as quick responses in case of unforeseen circumstances.

In discussions about the difficulties encountered in their relationship, the supplier firms identify three main problems. The first one is the bureaucracy in communication channels with the core, which is detrimental for interactions. Suppliers emphasize the lack of interest at the core in discussing their problems\(^ {54}\). The second problem involves limitations in the schedules of SIDERCA/SIDERAR, which result in technical difficulties, higher production costs, engineering problems and, even, delivery delays due to changing deadlines. Always according to suppliers, the third problem is the high staff turnover at core firms, which interrupts dialogues and involves a resumption of negotiations with subsequent changes in the style and type of relation previously established. It should also be highlighted that many firms in the panel indicate that supplier-selection criteria are exclusively based on prices\(^ {55}\) and that, sometimes, difficulties in collection arise.

The surveyed companies do recognize there is a fluid exchange of technical information between the core and its providers (especially through meetings, visits to plants, and informal exchanges). However, the widespread use of information and communications technologies (ICT's)\(^ {56}\) involves the absence of "face to face" relationships in favour of contacts through computerized channels, especially Internet\(^ {57}\).

The e-marketplace launched through EXIROS (see Chapter 6) is not favourably seen by some providers. On the one hand they suggest that the e-marketplace makes it

\(^{53}\) In this sense, expressions such as "we're just another supplier among many others", "our profitability is very low; they put pressure on prices without considering services and quality"; "when the slightest difficulty arises, they threaten to start dealings with a new supplier"; "you improve your quality and, as soon as another provider crops up offering his products one peso lower, they turn their back on you"; "SIDERAR continuously changes its personnel and your relationship with previous contacts actually comes to nothing", "nowadays, your background and career are not recognized"; "they are a multinational corporation that turns a deaf ear to SEMs".

\(^{54}\) "Dialogue is often laborious"; "they devote almost no time to supplier care"; "they pay no attention to the problems of suppliers".

\(^{55}\) "You lose a business just for a difference in price rather than quality"; "they put on pressure to lower prices down".

\(^{56}\) "[...]
Daily communications are made through Internet, e-mail or by phone; personal meetings occur only when they are deemed indispensable"; "daily communications by phone about business, technical, and quality matters"; "e-mail and fax messages", and so on.

\(^{57}\) "[...]
Business communications are increasingly made through Internet and face-to-face relationships are almost nonexistent."
impossible i) to include the added value suppliers introduce in their products; ii) favour bi-directional learning processes; iii) appreciate services as a key element clearly distinct from the product they sell; iv) include such intangible elements in price; v) differentiate suppliers that provide the same product in terms of the relevance and sophistication of their services.

No positive association is apparent between the suppliers' perception and their degree of commercial relationship with the core. On the contrary, their opinions are remarkably heterogeneous when they make comments about their more or less smooth relationships. On the one hand, some companies that allocate a high percentage of their sales to OT report arduous relationships\textsuperscript{58}, whereas others with equally important operations express more favourable opinions. Similarly, suppliers whose transactions with the core are not intense show a parallel heterogeneity in their appreciations.

There is an implicit though strong complaint from suppliers aimed at recovering some values associated with interpersonal relationships and verbal agreements where the parts feel honour bound, which tend to disappear or become depreciated through the intensive use of information and communication technologies. Obviously, the easiness of "face to face" interactions cannot be matched by contacts via e-mail or EXIROS. In this sense, the increasing use of ICTs and the e-marketplace implies an important loss of critical knowledge in terms of the most intimate workings of production processes, not only at the core but also throughout the whole network.

4.1.7 The ambiguous nature of relationships with the core

In order to summarize the information collected about relationships with the core, it might be said that these interactions have some favourable and other unfavourable aspects which arouse some ambiguities when it comes to analyzing results. This situation results from the confluence and combination of different factors. On the one hand, actual contracts decrease the firms' uncertainty and improve their expectations as regards strategic planning: in this sense, they are certainly a positive element. On the other hand, the prevailing focus on information and knowledge exchanges involves weaknesses and a certain indefiniteness since, even though the afore-mentioned technical meetings and visits do generate an information flow which is significant for the development of capabilities among suppliers, the scope of specific technical assistance is very limited.

4.2 Extended production environment: degrees of relationship with other companies and organizations

When the relationships of network firms with external agents is examined, results are more clean and homogeneous. These companies have established a significant amount of cooperation agreements with colleagues, customers, and providers. They maintain a high degree of informal relationships with those agents and, besides, they have contacts with public and private institutions that support production activities, especially with those belonging to the Science and Technology System (S&T) and sectoral chambers. A detailed account of these different interconnections is given below.

\textsuperscript{58} "Some personal meetings are held, but only when demand is critical, for example when SIDERCA has committed some export"; "there had been an encouraging step forward in relationships with Techint group as a whole, but lately contacts have deteriorated"; "SIDERCA and SIDERAR are always changing their elected delegate".
4.2.1 Cooperation agreements with other companies

In the last years, about 40% of the suppliers signed cooperation agreements with other companies\(^{59}\). Among the areas included, the following should be mentioned: techno-productive issues, questions that refer to competence generation (technology acquisitions, training, and laboratories) and business matters associated with purchase and sale activities (merchandising, input procurement, and exports).

In about 50% of the cases, such agreements covered both thematic subsets, whereas in 20% they were limited to business matters, and in the remaining 30% they included techno-productive and competence-related questions. These figures clearly indicate that the mere existence of cooperation agreements is the focus, rather than the thematic sophistication of the clauses. However, as may be seen in table 38, techno-productive considerations prevail, and the most outstanding among them are those relative to the use of laboratories and the purchase of technology. Besides, in the case of agreements about sales and purchases, the main activities involved are merchandising and input procurement.

Table 38. Areas included in formal cooperation agreements

<table>
<thead>
<tr>
<th>Areas</th>
<th>Percentage of firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Techno-productive questions and capabilities</td>
<td>44%</td>
</tr>
<tr>
<td>- Technology acquisitions</td>
<td>46%</td>
</tr>
<tr>
<td>- Laboratories</td>
<td>46%</td>
</tr>
<tr>
<td>- Training</td>
<td>38%</td>
</tr>
<tr>
<td>Purchase and sales</td>
<td>28%</td>
</tr>
<tr>
<td>- Merchandising</td>
<td>46%</td>
</tr>
<tr>
<td>- Input procurement</td>
<td>31%</td>
</tr>
<tr>
<td>- Exports</td>
<td>8%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

4.2.2 Informal relationships with other companies

70% of the surveyed firms maintains informal conversations with colleagues about various subjects\(^{60}\), as may be noticed in the following table (Table 39).

The most recurrent subjects are the general conditions of the country and the region, difficulties related to labour, issues/problems associated with industry chambers and the demands of the main clients. On the contrary, questions relative to merchandising in foreign markets (h, i, l) and technical or production considerations (k, ň) are less frequently mentioned.

\(^{59}\) This percentage is higher than the corresponding one for successful SEM exporters (30% - Moori-Koenig, Milesi and Yoguel, 2001) and is much higher than the average for Argentine industrial SEMs (14%, Milesi 2000).

\(^{60}\) However, there is no certainty about the remaining 30%: they may also maintain such type of conversations with colleagues, since the only question they are required to answer in the survey asks whether they talk with colleagues about certain subjects within a wide range of options. May be this percentage involves, to a certain extent, a "no answer" phenomenon.
In most cases, the other part in the dialogue is another OT supplier (70%), another company (52%), other customers (45%), and salesmen/women (39%). The average number of interlocutors is 4 and meetings are usually held once a month. The frequency is weekly when the other part is a merchandising company or a client.

4.2.3 Relationships with institutions

Almost 80% of the surveyed firms is connected with two or more institutions, a percentage which is clearly higher than the SEMs average and the corresponding percentage for a panel of successful SEM exporters studied recently (see Table 41). On the other hand, only 11% of the firms involved are not connected with an institution of some kind; another 13% is associated with only one of such organizations.  

---

61 It should be noted that results may be compared because the same question was asked in the three surveys.
Table 41. Relationship between network firms and institutions compared with a) a panel of successful SEM exporters and b) the industrial SEMs average

<table>
<thead>
<tr>
<th>SIDERCA/SIDERAR network</th>
<th>Successful SEM exporters</th>
<th>Industrial SEMs average</th>
</tr>
</thead>
<tbody>
<tr>
<td>One or none</td>
<td>24%</td>
<td>63%</td>
</tr>
<tr>
<td>None</td>
<td>11%</td>
<td>N/A.</td>
</tr>
<tr>
<td>One</td>
<td>13%</td>
<td>N/A.</td>
</tr>
<tr>
<td>Two or three</td>
<td>38%</td>
<td>23%</td>
</tr>
<tr>
<td>Four or more</td>
<td>38%</td>
<td>14%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers, Moor-Koenig, Milesi and Yoguel (eds.), UNGS-FUNDES, 2001 and Moor-Koenig and Yoguel (eds.), UNGS-FUNDES, 1999

Among the first-ranked institutions in the survey, universities and other S&T organizations are outstanding, as well as sectoral chambers and state agencies. In 70% of the cases reported, these relationships have a permanent character. The frequency of contacts partially decreases when the relationship is less relevant. The same holds when the regularity of the interaction passes from continuous to sporadic (Table 42).

Table 42. Interaction frequency with institutions according to the relevance assigned to them by the surveyed companies

<table>
<thead>
<tr>
<th>Relevance</th>
<th>Permanent</th>
<th>Sporadic</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Place</td>
<td>72%</td>
<td>28%</td>
</tr>
<tr>
<td>Second and third place</td>
<td>59%</td>
<td>41%</td>
</tr>
<tr>
<td>Forth and fifth place</td>
<td>54%</td>
<td>46%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

Considering the whole set of institutions –in any order– most intense interactions occur with S&T organizations (37%), followed by sectoral chambers (27%), and state agencies that do not belong to the S&T area (15%). It should be noticed, besides, that contacts with consultants, foundations, and certifying agencies are less important.

Table 43. Frequency of the interactions according to the type of institution

<table>
<thead>
<tr>
<th>Institutions</th>
<th>Frequency</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Permanent</td>
<td>Sporadic</td>
</tr>
<tr>
<td>Certifying agencies</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>State agencies</td>
<td>4%</td>
<td>11%</td>
</tr>
<tr>
<td>Sectoral chambers</td>
<td>20%</td>
<td>6%</td>
</tr>
<tr>
<td>Consultants</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Foundations</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>S&amp;T</td>
<td>22%</td>
<td>15%</td>
</tr>
<tr>
<td>Total</td>
<td>58%</td>
<td>42%</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

Likewise, if the frequency of interactions is analyzed according to the type of institution involved, chambers and certifying agencies are those at the top of the listings, whereas contacts with foundations and state agencies are more sporadic, a fact which might indicate that the surveyed firms hardly resort to public SEM-supporting programs. Besides, 20% of the firms involved have stable contacts with institutions in the S&T area (see Table 43).
On the other hand, as may be seen in Table 44, the main objective in these contacts is focused on technological and production matters such as analysis, tests and R&D projects (almost 50%), followed by seminars and training courses (almost 30%).

<table>
<thead>
<tr>
<th>Institution</th>
<th>Tests</th>
<th>Analysis</th>
<th>Research and Development Projects</th>
<th>Technical and Market Information</th>
<th>Seminars and Training Courses</th>
<th>Financing</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certifying Agencies</td>
<td>20%</td>
<td>20%</td>
<td>0%</td>
<td>20%</td>
<td>40%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>State Agencies</td>
<td>9%</td>
<td>0%</td>
<td>27%</td>
<td>9%</td>
<td>36%</td>
<td>18%</td>
<td>100%</td>
</tr>
<tr>
<td>Sectoral Chambers</td>
<td>9%</td>
<td>9%</td>
<td>18%</td>
<td>27%</td>
<td>30%</td>
<td>7%</td>
<td>100%</td>
</tr>
<tr>
<td>Consultants</td>
<td>13%</td>
<td>13%</td>
<td>0%</td>
<td>25%</td>
<td>50%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Foundations</td>
<td>0%</td>
<td>18%</td>
<td>18%</td>
<td>36%</td>
<td>18%</td>
<td>9%</td>
<td>100%</td>
</tr>
<tr>
<td>S&amp;T</td>
<td>36%</td>
<td>11%</td>
<td>16%</td>
<td>11%</td>
<td>23%</td>
<td>4%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>20%</td>
<td>10%</td>
<td>16%</td>
<td>19%</td>
<td>28%</td>
<td>6%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: Author’s development on data from a survey carried out among SIDERCA and SIDERAR’s suppliers

When data are dis-aggregated by type of institution, it may be seen that institutions included in the S&T area are contacted envisaging assistance for techno-productive aspects (more than 60% of the cases). Consultants, in turn, are seen as offering services predominantly associated with training and information research. In all the other cases, services are perceived as covering the same three aspects - techno-production, training, and information research – without a clear dominance of any. In the case of state agencies assistance through financing is the main concern.
5. The Degree of Development of a Production Network: a Model

This chapter presents the development of the SIDERCA/SIDERAR production network in terms of the statistical and econometric considerations discussed in Chapter 1. First, a test is performed to assess the degree of association between the different variables that determine the agents' capabilities. A second question is then evaluated: to what extent the dominant style of relationships is associated with the technical capabilities of suppliers. In the third place, the main differences between the two core firms as regards their relationship with suppliers, their technical capabilities and organizational characteristics are also discussed. Lastly, a taxonomy of network suppliers is offered, based on cluster statistical analysis techniques.

This production network may be identified by a characteristic of its own: the association between the three spheres determined by the agents capabilities when size is a controlled variable. Unlike what has been evidenced in studies about other industries (Yoguel et al 2000, Novick et al 2001, Albornoz and Yoguel 2001), in this network there is an association between innovation capabilities, social management technologies and efforts in training (see equations 1 and 2).

Another virtuous element in the endogenous capabilities of these agents is the positive association between the application of specific ITC tools (e-mail to contact customers and suppliers, regularly updated webpage, e-commerce, etc.) and the innovative capabilities of the firms involved (see equations 3, 4 and 5). The existence of permanent teams dedicated to research and development is also an interesting characteristic because their role is more significant than that of specific laboratories where certain tasks are carried out. The existence of permanent R&D teams, therefore, is not associated with the mere existence of a formal R&D lab but rather with widespread innovative capabilities disseminated throughout the whole organization.

The relevance of environmental management is associated with the implementation of ISO9000 standards, with the existence of R&D labs, and with the average indicator of innovative capabilities (prob. 4.7%). All this indicates a synergy of the different elements included under the heading of innovative capabilities.

Degrees of relationship

At first sight, the correlation between the degrees of relationship with the core and the suppliers' capabilities is rather ambiguous.

First, the technical assistance provided by SIDERCA and SIDERAR is not associated with: a) innovative capabilities, b) social management technologies, and c) training when groups of firms of a similar size are analyzed (see equations 6 and 7). However, some associations were verified which deserve a special mention:

62 Throughout this section, mention is made of several variables and indicators which are defined in Appendix 1. So as to reduce the number of models offered in some cases, the text indicates between brackets the probability of accepting the null hypothesis (no association between the variables considered).
63 A better fit is obtained when the sales variable is replaced by dummy variables representing different types of agents (SEM, Group, and DFI).
64 The probability of accepting that there is no association is 8%.
65 Likewise, the weighted indicator of innovative capabilities is associated with the estimator of pecuniary effort devoted to innovation. The probability of accepting that there is no association in a model controlled by size is 3%.
SIDERCA's technical assistance is negatively correlated with the size of suppliers and positively associated with the quality assurance indicator. It indicates a partial correlation with one of the factors that determine the innovative capabilities of the firms under study (see equation 8).

In the case of SIDERAR, technical assistance is associated with quality assurance only.

For both core firms—as for many other networks mentioned in this paper—quality assurance plays a key role in the selection of suppliers.

In short, the technical assistance provided by SIDERCA and SIDERAR to their suppliers is limited though systemic, i.e., whenever technical assistance is provided, it affects different areas or dimensions and no significant differences may be found between the two core firms. Technical assistance from the core is positively associated with sales volume to Techint and with the existence of R&D teams in the supplier organization.

Second, other elements that also determine the degree of relationship with the core (such as technical meetings, visits to plants, and specific contacts) are associated to a certain extent with factors that determine the suppliers’ endogenous capabilities. Thus, for instance, the frequency of formal and informal meetings (sporadic, moderately frequent, regular) of SIDERCA’s personnel with its suppliers is positively associated with: a) the innovative capabilities of suppliers (the probability of accepting the null hypothesis is 3%), b) the relevance of new products (prob. 0.2), c) the percentage of qualified workers dedicated to R&D (prob. 5.5%), and d) how old is the firm as a supplier (prob. 3.3). Therefore, it is possible to conclude indirectly that in the case of SIDERCA there is some kind of association between informal connections and the development of endogenous capabilities. However, the number of meetings and their sophistication are not in keeping with the significance of OT for its suppliers neither with the volume SIDERCA purchases from OT providers.

The positive association between the number of visits SIDERCA’s technicians pay to its suppliers and their innovative capabilities indicates—emphasizing what has just been said—that the purpose of such visits is not necessarily control (prob. 3%). They are also associated with the relative weight of new products in turnover (prob. 0.25%) and with the ratio of qualified workers dedicated to R&D (prob. 5.5%).

Visits to plants are not in keeping either with the development of social management technologies or with the dissemination of training efforts.

In the case of SIDERAR, neither the number of technical meetings, visits, and information communicated nor their sophistication fits in with endogenous competitiveness, a fact which clearly differentiates SIDERAR’s informal relations with its providers from those of the other core firm.

In neither of the two core firms, the quantity and sophistication of information and communications exchanges are associated with the suppliers’ use of ICTs. This involves that communications with suppliers are not put to good use as a means for developing capabilities. In the case of SIDERAR, a paradox is even made evident: there is an inverse
relationship between the quantity of communications and information exchanged with suppliers and the level of ICTs used by these firms in management or production.

Box 1. Main econometric models estimated herein

<table>
<thead>
<tr>
<th>Model</th>
<th>Equation</th>
<th>R²</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Y80</td>
<td>$0.28 + 0.04Y2 + 0.3Y12 + 0.18Y14$</td>
<td>0.29</td>
<td>4.3 (4.1) 2.1 2.6</td>
</tr>
<tr>
<td>2) Y3</td>
<td>$0.27 + 0.004Y2 + 0.27Y12 + 0.16Y14$</td>
<td>0.25</td>
<td>4.02 (1.4) 1.9 2.3</td>
</tr>
<tr>
<td>3) Y101</td>
<td>$0.09 - 0.007Y2 + 0.95Y3$</td>
<td>0.16</td>
<td>0.5 (-0.89) 2.8</td>
</tr>
<tr>
<td>4) Y99</td>
<td>$0.51 + 0.001Y2 + 0.45Y3$</td>
<td>0.13</td>
<td>4.9 (0.35) 2.2</td>
</tr>
<tr>
<td>5) Y98</td>
<td>$0.37 - 0.002Y2 + 0.52Y3 - 0.12Y12 + 0.05Y14$</td>
<td>0.13</td>
<td>4.4 (-0.7) 3.2 (-0.79) 0.67</td>
</tr>
<tr>
<td>6) Y83</td>
<td>$0.03 - 0.007Y2 + 0.17Y3 + 0.22Y12 + 0.05Y14$</td>
<td>0.09</td>
<td>0.28 (-1.5) 0.9 (1.1) 0.5</td>
</tr>
<tr>
<td>7) Y84</td>
<td>$0.03 - 0.003Y2 + 0.15Y3 + 0.08Y12 + 0.02Y14$</td>
<td>0.09</td>
<td>0.32 (-0.9) 0.8 (0.5) 0.03</td>
</tr>
<tr>
<td>8) Y83</td>
<td>$0.05 - 0.008Y2 + 0.39Y11$</td>
<td>0.26</td>
<td>0.94 (-2.1) 3.7</td>
</tr>
</tbody>
</table>

5.1 Towards a taxonomy of network suppliers

We discuss in this section the results of a statistical cluster analysis that classified suppliers according to their innovative capabilities, social management technologies, and type of relationship with the core. Thus, several groups of companies were identified within this network, with different capabilities and profiles.

Two different criteria were applied for grouping the companies. The first one included three clusters derived from variables involving endogenous characteristics. The second one includes two clusters that reflect the degrees of relationship: one of them is based on the core's technical assistance (involving a significant amount of codified knowledge) and the other is more focused on the interaction dynamics between suppliers and the core through various meetings (where tacit and codified elements prevail). Finally, a general cluster analysis is performed including only the variables identified as significant for classifying firms individually into each one of the previous dimensions.

5.2 Endogenous capabilities

5.2.1 Identifying groups with different innovative capabilities

The first cluster analysis included all the indicators related to the innovative capabilities of suppliers. As may be noticed in table 45, two clearly different groups arose. It is evident, thus, that the existence of a R&D lab or a stable team appointed for such activities constitute a differentiating element in this panel. Besides the ratio of qualified personnel dedicated to R&D over total workers and, to a lesser extent, the weight of these activities
with respect to total employment (the ratio of workers exclusively dedicated to R&D is not relevant) are also significant.

Table 45. Cluster analysis according to innovative capabilities – Final cluster centers

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Significance^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D lab</td>
<td>.000</td>
<td>.417</td>
<td>.000</td>
</tr>
<tr>
<td>Stable group dedicated to R&amp;D</td>
<td>.381</td>
<td>.917</td>
<td>.000</td>
</tr>
<tr>
<td>Ratio of qualified workers dedicated to R&amp;D over total workers</td>
<td>.286</td>
<td>.979</td>
<td>.000</td>
</tr>
<tr>
<td>E-commerce</td>
<td>.300</td>
<td>.650</td>
<td>.003</td>
</tr>
<tr>
<td>Regularly updated webpage</td>
<td>.310</td>
<td>.708</td>
<td>.005</td>
</tr>
<tr>
<td>Scope of development activities</td>
<td>.556</td>
<td>.764</td>
<td>.009</td>
</tr>
<tr>
<td>Use of e-mail in contacts with customers and suppliers</td>
<td>.637</td>
<td>.844</td>
<td>.013</td>
</tr>
<tr>
<td>Quality assurance</td>
<td>.362</td>
<td>.558</td>
<td>.043</td>
</tr>
<tr>
<td>Ratio of workers dedicated to R&amp;D</td>
<td>.070</td>
<td>.177</td>
<td>.092</td>
</tr>
<tr>
<td>ISO9000 certification</td>
<td>.714</td>
<td>.542</td>
<td>.243</td>
</tr>
<tr>
<td>Use of computers in management and production</td>
<td>.580</td>
<td>.645</td>
<td>.420</td>
</tr>
<tr>
<td>Relative weight of new products</td>
<td>.200</td>
<td>.227</td>
<td>.494</td>
</tr>
<tr>
<td>Ratio of personnel exclusively dedicated to development</td>
<td>.050</td>
<td>.033</td>
<td>.699</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

^a The F (Fisher's) test was applied. The groups are considered as significantly different if and only if the probability is below 0.1.

As regards quality, assurance 66 appears as a significant variable, even more relevant that ISO9000 certification. The relative weight of new products in total turnover is not relevant. With respect to ICTs, the use of e-mail, the existence of a regularly updated webpage, and the use (or not) of e-commerce clearly distinguishes the different groups but the same is not true for the use of computers in management and production, a characteristic that both groups share to a high level.

Considering the whole set of indicators, the second group shows higher values than the first one for the variables where differences are relevant: this is clearly indicative of a systemic character in the elements involved in innovative capabilities. In other words, companies that emphasize R&D activities are also those that prioritize quality and use ICTs intensively.

5.2.2 Identifying groups with different levels of social management

Indicators referred to social management technologies were used for the second cluster analysis: two groups were identified. Two indicators relative to work organization (percentage of workers organized in cells and cell-autonomy) were constructed besides one indicating the role of the supervisor and another one indicating the relationship between salary supplements and productivity. The result was that the variables associated with work organization and the role of the supervisor are relevant, whereas salary supplements are irrelevant (see Table 46).

Table 46. Cluster analysis according to social management technologies - Final cluster centers

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Significance^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of workers included in cells</td>
<td>.164</td>
<td>.837</td>
<td>.000</td>
</tr>
<tr>
<td>Scope of the technical role of supervisors</td>
<td>.211</td>
<td>.688</td>
<td>.000</td>
</tr>
</tbody>
</table>

^a This term refers to the application of various quality assurance mechanisms, whether certified standards exist or not.
As has been previously discussed in the chapter devoted to social management technologies, the current crisis and the idle capacity of the companies involved account for such results. Similarly, the second group shows higher values than the first one in all relevant variables, thus indicating that social management technologies also have a systemic character. Therefore, the percentage of workers organized in cells is positively associated with autonomy (greater participation of cell workers in significant operational decision-making) and the role of the supervisor.

5.2.3 Identifying groups engaged in training efforts

The last cluster connected with endogenous capabilities involves training efforts as reflected by two indicators: the existence of a specific training structure in the company and the percentage of workers that received training during the last year. These indicators complement each other and are relevant for grouping firms according to their efforts in training (see Table 47).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existence of a training structure in the firm</td>
<td>.000</td>
<td>1.000</td>
<td>.000</td>
</tr>
<tr>
<td>Percentage of workers included in training</td>
<td>.436</td>
<td>.658</td>
<td>.063</td>
</tr>
</tbody>
</table>

In this sense, two groups of firms might be identified, clearly-differentiated by the existence (or not) of an independent training structure of their own and –whenever it exists– by a higher percentage of workers participating in such activities.

5.3 Relationships with the core

5.3.1 Identifying groups that receive different levels of technical assistance from the core

The first cluster involving relationships with the core is based on 13 indicators that show the significance of the technical assistance received by panel firms in different areas (production, labour, and trade). Results reveal that a small group of companies (less than 25%) rank the technical assistance received as significant in every respect, whereas the remaining firms consider it as almost nonexistent.
Table 48. Cluster analysis according to technical assistance from the core - Final cluster centers

<table>
<thead>
<tr>
<th>Technical assistance effects</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Significance*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved production processes</td>
<td>.056</td>
<td>.705</td>
<td>.000</td>
</tr>
<tr>
<td>Better use of the installed capacity</td>
<td>.000</td>
<td>.432</td>
<td>.000</td>
</tr>
<tr>
<td>Less nonacceptances and reworking</td>
<td>.042</td>
<td>.500</td>
<td>.000</td>
</tr>
<tr>
<td>Better use of raw and other materials</td>
<td>.021</td>
<td>.341</td>
<td>.000</td>
</tr>
<tr>
<td>Improved lay out</td>
<td>.000</td>
<td>.205</td>
<td>.000</td>
</tr>
<tr>
<td>Improved logistics</td>
<td>.069</td>
<td>.614</td>
<td>.000</td>
</tr>
<tr>
<td>Improved internal interaction in teams</td>
<td>.028</td>
<td>.614</td>
<td>.000</td>
</tr>
<tr>
<td>Improved interaction between teams</td>
<td>.000</td>
<td>.591</td>
<td>.000</td>
</tr>
<tr>
<td>Better chances of doing business with other companies</td>
<td>.069</td>
<td>.750</td>
<td>.000</td>
</tr>
<tr>
<td>Improved abilities as providers of big enterprises</td>
<td>.069</td>
<td>.886</td>
<td>.000</td>
</tr>
<tr>
<td>Stricter supplier controls</td>
<td>.014</td>
<td>.795</td>
<td>.000</td>
</tr>
<tr>
<td>Better access to international information</td>
<td>.014</td>
<td>.750</td>
<td>.000</td>
</tr>
<tr>
<td>Improved staff training</td>
<td>.208</td>
<td>.682</td>
<td>.001</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

* The F (Fisher's) test was applied. The groups are considered as significantly different if and only if the probability is below 0.1.

These data apparently indicate that technical assistance from the core is targeted at a limited group of their suppliers and that—in such cases—it has an integral character including technical procedures, human resource management, and other questions associated with market competitiveness.

5.3.2 Identifying different levels of interaction with the core

The last partial cluster is based on formal and informal interactions between suppliers and the core in terms of meetings, visits from core personnel to supplier plants, other communications and technical and commercial information received. In each of these areas, the following data are taken into account: contact frequency, number of people involved from both sides, and subjects dealt with (sophistication).

Again, two neatly distinct groups are evident. The first one shows a strong interaction with the core both in terms of quantity and sophistication of the exchanges involved, and a second group involving less intense contacts. However, unlike what was observed for technical assistance, most companies belong to the group with highest scores as regards informal relationships. This is not to be neglected, since these indicators capture the dissemination of tacit knowledge between the core and its suppliers, a fact which is elusive when the analysis is focused on specific technical assistance.

Table 49. Cluster analysis according to interactions with the core - Final cluster centers

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Significance*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of meetings</td>
<td>.175</td>
<td>.778</td>
<td>.000</td>
</tr>
<tr>
<td>Meeting sophistication</td>
<td>.325</td>
<td>.907</td>
<td>.000</td>
</tr>
<tr>
<td>Visit sophistication</td>
<td>.200</td>
<td>.796</td>
<td>.000</td>
</tr>
<tr>
<td>Amount of information</td>
<td>.225</td>
<td>.806</td>
<td>.000</td>
</tr>
<tr>
<td>Information complexity</td>
<td>.150</td>
<td>.481</td>
<td>.015</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

* The F (Fisher's) test was applied. The groups are considered as significantly different if and only if the probability is below 0.1.

5.4 General approach including all the areas

Finally, a general cluster was estimated that involved all the areas previously considered, including indicators of innovative capabilities, social management technologies, training,
technical assistance, and informal interactions. According to the theoretical considerations discussed in Chapter 1, these results provide a quantitative view of the relationships from different areas that characterize the production network under study.

Average indicators were used in this exercise. Consequently, four groups were identified with different degrees of development in their endogenous capabilities and style of relationship with the core.

Excluding social management technologies, the remaining areas involved in cluster definition were significant (see Table 50). The first group (38%) is characterized by high levels in innovative capabilities and training efforts but low levels of technical assistance from the core and a poor relevance of technical and commercial meetings, visits to plants and communications. The second group (36%) has similar characteristics as regards relationships with the core but indicators corresponding to their endogenous capabilities are lower. The third group (15%) shows a combination of variables indicating fluent relationships with the core, high innovative capabilities and training efforts. Finally, the fourth group shows high values as regards relationships with the core but poor endogenous capabilities.

This figures indicate that, besides the systemic internal character of each area taken apart, endogenous capabilities and relationships also have a systemic nature. That is to say, the companies showing the higher innovative capabilities are also those dedicating most efforts to training. Likewise, the firms that receive more technical assistance are precisely those that maintain more informal interactions with the core.

Thus, a new typology may be devised by combining positive and negative endogenous capabilities with strong and weak degrees of relationship. Table 51 shows the main characteristics of the companies included in each group: size, capital source, sales dynamics (either domestic or foreign sales), background and exposure due to sales-concentration to OT as a whole and to each of the core companies, etc.

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**Table 50. Cluster analysis. Endogenous capabilities and degrees of relationship with the core**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1 (38%)</th>
<th>Group 2 (36%)</th>
<th>Group 3 (15%)</th>
<th>Group 4 (11%)</th>
<th>Significance*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training efforts</td>
<td>.849</td>
<td>.127</td>
<td>.918</td>
<td>.122</td>
<td>.000</td>
</tr>
<tr>
<td>Technical assistance from the core</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meetings, communications, and visits of core personnel to the plants</td>
<td>.056</td>
<td>.038</td>
<td>.497</td>
<td>.571</td>
<td>.000</td>
</tr>
<tr>
<td>Innovative capabilities</td>
<td>.532</td>
<td>.417</td>
<td>.673</td>
<td>.393</td>
<td>.029</td>
</tr>
<tr>
<td>Social management technologies</td>
<td>.374</td>
<td>.329</td>
<td>.411</td>
<td>.390</td>
<td>.817</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

This indicates that, even though the resulting groups are different as regards innovative capabilities, training efforts, technical assistance, meetings, and visits to plants, they do not show significant differences as regards the social management techniques they put into practice.

---

67 This indicates that, even though the resulting groups are different as regards innovative capabilities, training efforts, technical assistance, meetings, and visits to plants, they do not show significant differences as regards the social management techniques they put into practice.
Table 51. Main characteristics of the groups that show positive (negative) endogenous capabilities and strong (weak) relationships with the core

<table>
<thead>
<tr>
<th>Structural characteristics</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>9.5</td>
<td>5.6</td>
<td>4.9</td>
<td>4.9</td>
</tr>
<tr>
<td>Number of employed workers</td>
<td>83</td>
<td>45</td>
<td>42</td>
<td>69</td>
</tr>
<tr>
<td>Relative productivity</td>
<td>102</td>
<td>111</td>
<td>104</td>
<td>64</td>
</tr>
<tr>
<td>Ratio Group/DFI</td>
<td>28</td>
<td>31</td>
<td>43</td>
<td>0</td>
</tr>
<tr>
<td>Moderate-High dependence</td>
<td>44</td>
<td>50</td>
<td>71</td>
<td>80</td>
</tr>
<tr>
<td>Sales increase in the 90s</td>
<td>81</td>
<td>69</td>
<td>71</td>
<td>60</td>
</tr>
<tr>
<td>Exports</td>
<td>1.9</td>
<td>0.23</td>
<td>1.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Export ratio</td>
<td>20</td>
<td>4</td>
<td>21</td>
<td>40</td>
</tr>
<tr>
<td>Founded before 1980</td>
<td>65</td>
<td>69</td>
<td>57</td>
<td>80</td>
</tr>
<tr>
<td>Founded in the 90s</td>
<td>29</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sales to Techint / Total sales</td>
<td>17</td>
<td>24</td>
<td>32</td>
<td>45</td>
</tr>
<tr>
<td>Sales to SIDERCA / Sales to Techint</td>
<td>52</td>
<td>51</td>
<td>65</td>
<td>60</td>
</tr>
</tbody>
</table>

Source: Author's development on data from a survey carried out among SIDERCA and SIDERAR's suppliers

The above data evidence that most of the companies surveyed belong to groups (the two former ones) which do not confirm the hypothesis of a virtuous network (third group) neither do they correspond to a hypothetical network where the core tries to improve the endogenous weaknesses of its suppliers (fourth group).

The first group includes firms with high competitive capabilities and weak relationships with the core. They are the largest companies in the panel in terms of sales and number of workers although their productivity is close to the mean. A relatively small proportion of these companies show a high level of dependency on the core. On average, their sales to Techint amount to 17% of their total sales. Companies in this group belong to various sectors and produce goods or provide services of different kinds: heavy engineering industry (38%), chemicals (19%) and, to a lesser extent, plastics, control devices, electronic devices, technical and production assistance, and non metals. These companies showed the best performance during the 90s and have an export rate slightly above the average. The relative weight of SEMs in this groups is high (72%), and the percentage of companies founded during the 90s is the highest in the whole panel. However, on account of their weak connections with the core, the group might be formed by suppliers with paths of their own for building up capabilities which are autonomous with respect to the network.

The second group has limited endogenous capabilities and weak interactions with the core. Smaller plants are predominant and they show the highest productivity. The percentage of SEMs and their degree of dependence with respect to the core are similar to the previous group. These companies are predominantly orientated to the domestic market, and have an export rate of 4%. The main products manufactured are control devices (29%) and metallic machined parts and goods, non-metallic minerals and timber (50% as a whole). They might be considered as companies that evidence weaknesses in their evolutive path, whose inclusion in the network does not represent for them a supportive factor of development.

The third group has both a high level of endogenous capabilities and strong relationships with the core, thus validating the model suggested. It may serve to illustrate the strong synergy between the individual capabilities of these agents and the way relationships are established, mostly in a bi-directional way, both with core companies and with the
business environment in general. They are companies with sales, employed personnel, and productivity levels relatively similar to the panel's average, and represent the group with the highest influence of DFI (direct foreign investment) agents or economic groups. Their sales-concentration exposure is substantially higher than that of the two previous groups, and their export rates are similar to the average. The goods and services they provide cover a wide range of industries with various degrees of sophistication, among which the heavy engineering industry (metal machining), control and measurement devices (31%) and chemicals (23%) are outstanding.

The last group illustrates the case of a strong relationship with core companies and lesser endogenous capabilities and, therefore, also validates the hypothesis of a negative association between these factors. It might be seen as an example of a strong relationship with the core aimed at improving the suppliers' capabilities. The group is entirely formed by SMEs with the highest level of sales dependence, especially upon Siderca. Most of them have been in the market for more than 20 years and belong to a wide range of industries. They are mainly heavy engineering industries (60%) and, to a lesser extent, companies that deal in non-metallic minerals (28%). Their weak capabilities are evidenced by a productivity level which is 36% lower than the panel's average.

E-commerce has made a strong impact on the international business scene in recent years, through B2C (business to consumer), which is the most remarkable in daily life, but principally through B2B (business to business) which, according to statistics and analyses is the sector which carries greater weight, with greater growth and scope. The development of this new method for trading products has spread geometrically with the growth of the Internet over the last decade. From the perspective of consultants, governments, businesses and even academic studies the main area of interest has been to evaluate the potential of this method as a way of increasing the sales of various economic actors.

However, since the late 1990s the appearance of a number of electronic purchase platforms has made it necessary to study this area from a different perspective. These platforms, generically identified as e-marketplaces in international literature, place electronic methods as a fundamental instrument, more for procurement than for sales. Although by necessity there will always be an e-seller for every e-buyer, the peculiarity of e-marketplaces is that product characteristics and transaction times are set by the buyer, generally large firms or groups of large firms, who seek to improve the efficiency of their procurement structures through this method including a variety of factors that result in considerable financial savings.

In broad terms, e-procurement consists in the automation of company purchases, both in the case of office equipment and manufacturing inputs from a supplier chain such as the one studied in the present work. This kind of system implies, among other issues, the presence of electronic data transactions, automatic decision-making and approval procedures, and the reduction or elimination of paperwork and its associated costs. Estimates vary as to how much costs can be reduced with e-procurement, but Gartner puts it at around 50-60%.

Internationally this phenomenon has been clearly seen in the automotive sector, notably in the Covisint group, set up in late 2000 by several leading automotive companies (General Motors, Ford, Daimler Chrysler, Nissan, Renault and Peugeot) to make their purchases via electronic means. The group also includes two software companies, Commerce One and Oracle, supplying the necessary technological know-how.

In Argentina, this tendency is not yet found in automotive subsidiaries and is all too uncommon in other sectors. However, one example is EXIROS, a service company dedicated to setting up an electronic purchase system for all TECHINT group iron-and-steel companies, with the intention of expanding to other companies.

This chapter analyzes the workings of EXIROS, particularly the impact that the appearance of this e-marketplace may have on the dynamics of the Siderca/Siderar production network presented in previous chapters. Some relevant questions that will be discussed in this chapter relate to the competitiveness of the organization (defined as the network made up of a dozen central companies, their satellites and various suppliers):

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68 In WITI- Women in Technology International- (www.witi.org)
69 See Gereffi (2001)
i) Does the presence of EXIROS substantially improve the possibilities of networking within Techint? Does it increase the possibility of joint profits between this organization and its suppliers in a global market context? If this is the case, and given the various aspects involved, what conditions are necessary to achieve this?

ii) Does e-commerce tend to create a new form of relationship between big business and supplier networks (especially SMEs?) What are its main characteristics (opportunities for future advantages, stability, personnel turnover, learning processes, etc.?)

iii) What profile should the supplier have (especially at SME level) in order to become integrated into a virtual purchase platform? How is a SME support agenda then formed?

This chapter is organized with these issues in mind. Firstly, EXIROS’ general characteristics as a purchase platform will be identified, along with its functional structure, resources, operation methods and development potential. The analysis will then focus on suppliers, examining reasons for access to this type of mechanism, its potential and limitations.

6.1 A historical review of OT procurement patterns and their most recent developments

Until recently all OT business made their purchases individually, pooling their operations in only a few cases, with the result that there were in total around 600 posts dedicated to such activities. Broadly speaking, the following procedure was used: The end user identified his/her needs and sent orders to the procurement manager, who carried out the purchase using various mechanisms. At the other end, a sales manager completed the operation and sent supply instructions to another company. There were various levels in the decision-making process, depending on the complexity of the product and the size of each intervening company.

An overall look at the procurement system, prior to the launch of EXIROS and other previous pilot schemes70, indicates that each company had its own purchasing methods, based on the requirements of various internal departments. With this institutional network, each company had a local supplier group providing a wide selection of products and services.

Moreover, the earlier dynamics of the different production plants meant that each requirement corresponded to specific processes with strongly idiosyncratic characteristics. This led to each business in turn being able to develop, in some cases, processes that were similar to other companies but with specific traits of their own. The result of this was that highly similar processes created incompatible demands, due to environment specifications and differing cultures among businesses in the iron-and-steel sector. In this context, the interaction between buyers and sellers created a mechanism with various company levels participating with dissimilar degrees of techno-economic information.

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70 In early 1999 a Global Procurement Office was set up with the launch of a Global Sourcing project, the implementation of door-to-door logistics services, and the production of joint catalogues for different plants’ products. Subsequently, and in the context of the world e-B2B boom, a license was obtained from ORACLE to establish an e-marketplace, and agreements were reached with various consultants to promote different aspects of e-commerce, cataloguing and transaction rounds. Poor results led to the creation of EXiROS as a unified procurement agent.
Such a sequence affects efficiency and costs in a number of ways, but mainly in terms of high inventory levels and low purchase scales. Furthermore, additional costs arise from traditional purchase processes that add no further value to the chain (paperwork, making up tenders, time dedicated to negotiations, etc.) That is to say that additional costs are incurred from the moment when a product is ordered until the moment when it reaches the end of the production line. Lastly, in the context of a closed economy, supply patterns had taken on a notably local profile, which could be extended within the framework of new regulatory conditions in the economy.

Under these circumstances, the development of an e-marketplace as the last step in a multi-stage sequence (creation of a global procurement office, efforts to standardize products and processes and to develop full procurement services) is aimed at both reducing the above-mentioned inefficiency and broadening the supplier network.

6.2 Characteristics and operation of the OT e-marketplace

EXIROS is an OT company controlled through Lomond Holdings of Rotterdam, dedicated to providing comprehensive procurement services for the industry through electronic means. It has head offices and branches in Argentina, Italy, Mexico and Venezuela (in line with OT’s main iron-and-steel plant locations.) Each national EXIROS has a structure consisting of the following offices: Trade, Operations, Management and Finance.

In Argentina EXIROS has a workforce of some 45 staff and a turnover level that, in the first quarter since the launch, is estimated at around 50 million auctioned pesos, the most part of which (approximately 80%) comes from business with OT companies. Though the enterprise is in its infancy, it is forecast that in the near future it will become the central purchasing company for OT iron-and-steel businesses.

With regard to the purchases made for OT companies (SIDERCA, SIDERAR and SIDOR, which will be joined by the other companies in the near future,) EXIROS has identified three input sectors based on its specific characteristics, standardization possibilities and economic relevance. This distinction is important, since the levels of supplier - buyer interaction in the joint business network depend on them.

The first goods sector corresponds to a large number of standard articles, such as office equipment, with a low total cost impact, but which require high procurement costs (around 60 - 70% of the final price.) These are various non-specific articles for the final sector (steel), generally of low unit value and whose use requires little supplier - user contact. For this group of goods, applying a centralized, an open electronic purchase pattern permits considerable and quick price reductions.

A second sector corresponds to commodified (low design-intensive) inputs and raw materials: a restricted number of frequent-use goods with a strong impact on the total purchase amount. As in the previous case, the process of accessing e-commerce is made easier by the high possibility of standardization, and the possibility of concentrating goods

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71 In the case of EXIROS Argentina, the Operations Area has national and international jurisdiction while the others only have local jurisdiction.

72 Defined as costs incurred from the initiation of the purchase process until the finished product reaches the user.
in high volumes in supply contracts of wider scope. The procurement costs in these cases are in the region of 5-10% of the final price.

Lastly, there is a third group of goods and services that are indirect in the cost structure, which are highly specific and therefore have some standardization difficulties. This group traditionally generates close links between the supplier and the user, since technical efficiency is related to modes of use, which sustain the presence of tacit knowledge and network-style relationships. In traditional models, the procurement of these articles entails a cost of 20-25% of the final price.

The EXIROS strategy varies for each sector. Broadly speaking, for the first sector (standardized, not very specific goods, development of end activities,) EXIROS aims at substantially reducing procurement costs by broadening demand and attempting to outsource procurement to a comprehensive supplier (end-to-end service.) In the case of the second sector – based around raw materials – the strategy is centered around increasing the number of long-term contract suppliers based on complete logistics in the international sphere. Lastly, in the third sector the purpose of EXIROS is to improve ordering classifying procedures and increase the number of suppliers.

The way the system works is based on a simultaneous auction mechanism which runs through a computer program, resulting in the transaction of a perfectly specified product. The organization then places an order of the product (specifying amounts; delivery method, place, and time; and also payment mechanisms, etc.) keeping the price as the unknown variable to be determined. Auction mechanisms are applied to group of goods that are fully specified, and their characteristics loaded on a database. The specification and standardization of the products included in the electronic purchase mechanism requires a great internal effort involving a dozen industrial plants (gradually being integrated into the system) in various countries. Unlike other electronic purchase models, the standardization is in this case centralized, and thus tends to supranational-scale operations.

This purchase pattern has certain key elements to ensure that it operates smoothly. It is necessary from the beginning that the system users (suppliers) accept and know, entirely and ex ante, a set of ground rules. Furthermore, it is vital to have a clear and accurate identification process of tradable products, which implies lengthy groundwork beforehand (and becomes an asset for companies in the long term.)

From then on and from a dynamic viewpoint, it is essential to have a network of reliable bidders fulfilling established norms (of system operation, quality control, ensuring the products’ technical standards) which in turn gives stability and reliability to the system as a whole. Any deviation from the rules, any actions that might unbalance positions of power within the company, or any disloyal conduct, is soon noticed by the system actors and tends to reduce the system’s credibility and undermine the basis of any future action. In other words, in conventional transactions part of the trust involved in any agreement is founded on personal acquaintance. When this contact between negotiators is removed, it becomes vital that both parties are clear, consistent and keep to the rules agreed on ex ante, which are the only bases sustaining the action in this type of market. Trust grows from the non-violation of the ground rules.

73 Generally the suppliers referred to in other chapters of the present work are included in this group.
Lastly, as in conventional cases support for the system is rooted in the shared perception of mutual profits between buyers and sellers. From this perspective it is essential to identify the reasons that lead to Techint adopting EXIROS as a purchasing tool in its procurement pattern, bearing in mind that this forces a re-evaluation of the previous network’s operation (in later sections this will be dealt with in greater depth from the suppliers’ perspective.) In this respect, profits made by OT are obtained through the reduction of internal purchase costs, profits from serial-purchase scales, the reduction of procurement times and the improvement of purchase decisions that widen the supplier spectrum.

6.3 Suppliers and the electronic purchase platform

Firstly it must be pointed out that changing from one procurement mechanism to another implies a high degree of inflexibility from the supplier’s point of view since the implementation of an electronic purchase platform is the buyer’s (OT) policy. Therefore, SMEs have less freedom to accept (or reject) the new program, especially in the recent years’ background of recession. Faced with the need to sell in order to maintain a minimum usage of their equipment, and aware of the fact that OT is a sound business that plans its operations, its suppliers can hardly afford to ignore changes in OT’s purchase methods.

In this context, operating electronically has a double effect. On the one hand it facilitates a reduction in operational sales costs, since as long as activities related to formal presentation in tenders are eliminated. On the other hand, it tends to reduce the structure of the sales area, in the context of an administrative structure that, given the size of the firm,\(^{74}\) is generally small.

At the same time, the dynamics imposed by e-commerce encourages suppliers to speed up and refine the costing process since electronic quoting requires a smooth-running costing system (both for the product being tendered and other products, in order to evaluate cross subsidization. This forces companies working with a wide range of products and product variants to systematize the entire process\(^{75}\). In other words, as the company enters the electronic sales system, it tends to modify its system of data entry and processing for all its activities (indirectly influencing the better usage of these tools in the decision making process.)

Another aspect associated with the use of e-marketplaces developed by core companies is the opportunity to open up foreign markets for those providers still limiting themselves to the domestic market. In many cases, SMEs operated nationally without considering, for various reasons, their export options. To that effect, as EXIROS incorporates purchases of OT businesses abroad into its system (as in the case of SIDOR in Venezuela or TAMSA in Mexico,) a local supplier can through this means access the procurement of these plants.

\(^{74}\) This last aspect, however, must be considered with some care given that: i) in general, sales to OT (absorbed through EXIROS) represent a very small part of their total sales. Therefore, the sales team has to be maintained for the rest of the operations; ii) the sales teams are made up of two or three people dedicated to various activities (including technical advice and even production) so that any reduction would affect other activities.

\(^{75}\) This is partly due to EXIROS’ presence, and partly due to a previous OT policy which tended to computerize the administration system of its suppliers.
In foreign trade the use of this tool also facilitates the logistics of international operations. On the one hand, the size of the SMEs' operative structure hinders the inclusion of foreign trade experts, while on the other hand contracting the service can also operate as a fixed cost that can prevent foreign operations that have a low absolute amount but are nevertheless important for SMEs as a complement to domestic sales. In this sense, EXIROS is a useful tool for accessing new markets as it offers banking services, advice on foreign markets and the management of international product logistics.

Again, these potential benefits are not shared equally among suppliers, since some already operate in foreign markets. In fact, this tendency is noticeable in the panel of businesses analyzed in previous chapters, especially small and medium-sized enterprises.

Lastly, belonging to the procurement register of a globalized company, whose requirements necessitate the development of high standards of quality and the standardization of products and services, can give suppliers a kind of international shop window which could prove to be highly important.

6.4 Results, challenges and possibilities

In practice, aside from the potential benefits which justify both the setting up of an e-marketplace by OT and suppliers' participation in it, it is possible to show, albeit tentatively given the recent nature of the activity, a group of concrete results in two different areas: OT operations and the process of generating competitive advantages throughout the production network as a whole.

In the first of these areas, it must be pointed out that during the first ten months of the year in question there were 3,000 tenders, 80% of which corresponded to OT purchases, with the remainder from other companies. Business sources state that these operations represent a saving of around 8% on purchases (projected annually this would mean a total saving in the region of 170 million dollars), and also reveal a considerable reduction in stocks in the group. In the same way, it is estimated that there was a 30% saving in man hours spent on the make-up of purchase tenders.

In the second area, the effect on the competitiveness of the network as a whole, the results are somewhat vaguer. There are always various specific matters to consider when faced with the questions that this kind of procurement poses about the possibility of strengthening or generating production networks.

To a great extent, for small businesses the e-marketplace constitutes a challenge that they must accept, bearing in mind OT's growing relevance in their sales. For most companies, even though OT may not be a vital client, it is nevertheless quite relevant, especially in the current climate of recession. Normally, the following rationale is ultimately imposed: the supplier segments its markets between products sold to OT (through conventional or electronic means) –where the mechanism in place leads it to adjust variable costs to nearest values– and the rest of the market, where the firm sells at total cost plus a variable margin. Due to the type of client involved, the former market provides financial

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76 It must be remembered that the SMEs on this panel exported 6.3% of their sales in 1995 and 17% in 2000.

77 Given the current global economic environment, the new scheme tends to strengthen efforts in an identical direction, increasingly so in recent years within the organization. At the same time these results are in line with the main results on e-procurement reported at the international level.
certainties and future planning possibilities, but no great profitability, while the latter, more random market, allows improvements in global profitability.\textsuperscript{78}

In this global context where operations are stylized, the climate of recession in the domestic market presents an additional restriction to supplier growth and tends to make them more sensitive to operating with EXIROS. In this sense, a broadening of the mix of bidders with constant price reductions tends to reduce the speed of suppliers growth, given the low profitability it entails.\textsuperscript{79}

The possibility of concentrating the entire client-supplier relationship through an electronic channel is tempered by the specificity of the product. When this involves products that cannot easily be serialized and the results of which depend on their use (opening the doors for a mechanism of interaction based on tacit knowledge) there is a need for an additional communication channel to tune up operation details. In a stylized way, as the specificity (defined as the inherent services – products relationship for efficient use) of traded goods grow, the possibilities of basing all supplier – user interaction in an electronic mechanism decrease.

At the same time, these types of products (with a high service – product ratio) are characterized by short series and tailor-made features, making them central to SME strategies. From the EXIROS point of view, this forms a more complex part of standardization whose operation –in the previous model– is tied up with extra-commercial relationships. The SME builds a competitive advantage based on both product-type and relationship styles while simultaneously establishing an extra-commercial contact with the client.

A stylization of both relationships can be sketched by analyzing how, in the above-mentioned context, electronic tools applied to procurement influence the suppliers’ growth.

Firstly there is an inverse relationship between the possibilities of exchanging products through this channel and product specificity, defined as the ratio service / product\textsuperscript{80} required for an efficient use. At the same time, a greater specificity pushes prices up and improves profitability (not only because part of the tacit knowledge transferred tends to be included into the price but also because of the greater negotiation power that a specific product gives to its supplier.) Greater levels in the ratio price / cost provide (under certain circumstances) the basis for supplier growth. In principle, there are sustainable combinations between such different ratios. Central results indicate an indirect correlation between the weight of e-commerce and the level of supplier development.

At the same time, some tension arises between modes of operation that determine the conduct of direct suppliers on the one hand and buyers on the other. In effect, the supplier

\textsuperscript{78} This behaviour dynamics should be qualified considering the supplier profile. It generally works out quite accurately in the case of SMEs –around 70% of suppliers- while suppliers which are subsidiaries of multinational businesses or belong to economic groups are in a better strategic position in the new merchandising scheme.

\textsuperscript{79} Note that for the panel of businesses analysed, the last five years saw reductions in profit levels: 75% of the 50 businesses analysed declared reductions in their margins. Reductions were greater in the group of businesses with greater dependence on OT. It must be remembered that, at the same time, these companies have increased their sales, both in placements to OT and in foreign trade.

\textsuperscript{80} Here the term services is used to mean all procedures of creation, adaptation and instructions of usage that the implementation of a product entails. This definition covers all non-price relationships described in previous chapters and only partially reflected in contracts.
will try to be centered on highly specific products which allow them to incorporate increasing proportions of tacit knowledge to the traded price in order to improve their profitability through product differentiation. Buyers, on the other hand, will try to standardize traded goods so as to find a greater number of new bidders, who push the price down. In a process tempered by the economic size of the agents, technological asymmetries and product relevance, there is likely to be operation areas where both agents satisfy a minimum of expectations, and thresholds above (or below) which they decide not to operate further.

It is possible that the “institutional” handling of these tensions will lead to the necessity of establishing, for this product sector, additional channels where non-price information may circulate. At the same time, some doubts arise about the final results of operations. Although costs can be reduced as a result of auctioning, if this derives from a reduction in quality, results would be noticed in the process as a whole and, in the medium-term in they are likely to end in reduced equipment durability, increased faults, etc. However, such a situation would not be reflected in short-term indicators, which are rather focused on savings, isolated costs, and specific areas, but do not offer an overview of the process as a whole.

6.5 Final reflections

Returning to the initial concern of the present chapter – the way in which the network is affected by the massive introduction of electronic methods as a form of procurement – it is possible to review some of the ideas seen earlier including them into a wider context.

The central idea is to analyze how overall network competitiveness varies according to the following rationale: a greater network density implies greater competitiveness (expressed in physical terms) but, on the other hand, the network tends to be weakened because electronic tools reduce the specificity of traded goods. As a result, as e-procurement reduces the proportion of specific services that a product requires, it tends to decrease competitiveness. In other words, extensive pressures towards standardization and price reductions tend to dilute attitudes of cooperation and complementation and genuine competitiveness along with it.

The opinions of several suppliers interviewed further support this perception. They argued that strong competition tends to reduce the passing-on of tacit knowledge from suppliers to users. Even though this is something positive in terms of short-term costs estimated by specific areas or sectors, it is equally true that in the medium-term, it is detrimental for overall operations.

In addition, although the above-mentioned tension introduces a new element in network relations, it is equally true that there are two factors that tend to arise: i) the possibility of increasing business volume, be it from access through the e-marketplace to other OT plants or equally from entrance to foreign markets; ii) the maintenance of the medium and long-term contract, as a transaction-sustaining instrument. In regard to this second factor, although in relation to the previous mechanism some businesses reported reductions in contract lengths, contract terms continue to be very attractive for suppliers in the local business context. Furthermore, having some sales not only secured but also connected to an internationally competing business gives a stable planning framework that is highly valued in the development of supplier capabilities.
In conclusion, in order that the analyzed network be engaged in a virtuous dynamics, for there to be a future integrated dynamic in the analyzed network (in the new context of supplier-core relationships resulting from the establishment of the e-marketplace) it is vital that some kind of balance is struck between two aspects: i) the widening-up of the supplier spectrum through electronic means; ii) the upholding of non-price competitive conditions such as product quality. In this respect, the question remains as to how, and within what kind of time scale, core firms can find a balance in the network, given that the e-marketplace can facilitate access for new suppliers who face a lengthy operative validation process, during which time the original supplier is superseded and risks disappearing. In other words, the selection of suppliers through this means (and the associated learning process) can be extremely successful but also very risky and expensive, as much from the perspective of core firms as from the network as a whole.
7. Conclusions

The present work lays open a new field of interest in studies about business environments, by associating them with research on the development of new production and supplier networks.

Firstly, a production network is conceptualized as an economic space where capabilities are created, a space that includes an organizing firm (hereinafter, core); its suppliers and customers and their interrelationships derived from purchase and sale transactions and also from the flow of information, production experiences, as well as coded and tacit knowledge (“non-price based relationships”), across formal and informal channels. In this context, the formal and informal channels used by the firms to interchange various intangible assets acquire a special significance. Such channels communicate the companies in the network not only with the coordinating agents or core but also with the other firms and organizations with which they interact. From this perspective, the production network is a “meso” notion that cannot be reduced to the mere sum of the attributes of individual firms. Its development depends both on the endogenous capabilities of the core suppliers, and on the degree of interrelationship between them and the core.

Secondly, the overall capabilities of the network considered as an economic entity, the relationships of supplier firms with companies an institutions outside the network itself entail information and knowledge flows that contribute to increase their endogenous capabilities. In the present work, we refer to such flows as the degree of relationship between the firm and other organizations, excluding the core.

Both types of relationships (with the core and with agents outside the core) constitute what is called the production environment of a firm. Whereas the relationship of suppliers with the core may be conceptualized as the restricted production environment, their relationship with other agents may be seen as their extended production environment. In other words, the production environment may be defined as the whole set of formal and informal channels connecting a company with the network core and also with other companies and institutions whenever such channels involve exchanges beyond mere purchase and sale transactions.

From this theoretical perspective, this work develops a specific methodology for studying production networks, their profile, and the processes that generate knowledge appropriation and dissemination across the network. In other words, the development of endogenous capabilities among suppliers, and the influence of the restricted and extended production environment are both assessed.

From a practical perspective, this work evidences that the companies included in this production network share some characteristics that clearly differentiate them from agents of similar size operating in Argentina, such as those belonging to the automotive network. On the one hand, their dynamics has been highly positive during the 90s, including the crisis of the convertibility plan. Such positive traits were not only limited to the domestic market –basically determined by their relationships with the core– but also extended to the foreign market, where these firms achieved an actually high export rate (17%) considering they are indirect exporters. This behaviour is similar to a recently studied panel of successful exporters (Moori-Koenig, Milesi and Yoguel 2001).
The companies included in the current panel are highly specialized in their production within a framework of diversified domestic and foreign markets which favours relations with other networks and decreases therefore the sales-concentration exposure. On an average, for all these companies, sales to the core and exports are the most dynamic market though the least profitable in relative terms. This is evidenced by a decrease in profitability margins during the last years in 75% of the firms involved, which is still worse in the case of firms that depend more heavily on OT.

Another specific characteristic of this group of firms, which also makes them different from other networks analyzed in the country, is their high level of technological and organizational expertise, that also operates on a systemic basis. Therefore, innovative capabilities (quality assurance, formal and informal research and development teams, the scope of development activities involving products and processes, the level of qualified human resources, usage of information and communication technologies, etc.); social management technologies (e.g., cell-based organization, enhanced multiskilling, and personnel rotation, etc.); and training (the proportion of employed people engaged in formal and informal courses, training structures of their own, etc.) are strongly interrelated in all these companies. In general, these efforts are not isolated, and therefore entail a significant synergy. In other words, the creation of coded and tacit knowledge derived from innovative capabilities is leveraged by the nature of working processes, where a cell-based organization tends to be predominant. In turn, training strengthens the capabilities created at these levels.

Within this framework, the size of agents –both from the viewpoint of sales and ownership (SEMs, Group, DFI)– is not a differential trait as regards their capabilities\textsuperscript{81}. With respect to their own capabilities, the most outstanding characteristic is the development of innovative capabilities represented in formal and informal development teams, quality assurance, and actions tending to taylorize and improve products and processes, introduce organizational changes and find new styles of relationship with the market. All these activities are further leveraged by interconnection among enterprises. As regards social management technologies, the level achieved is slightly lower and the synergy among the different factors involved is scarce. Although a cell-based organization of work prevails, the autonomy of workers is low or nil and the role of the supervisor tends to be traditional. It is possible that the general economic situation, especially the particular circumstances of manufacturing discourage policies aimed at improving human resource management inside companies. The high level of unemployment and idle capacity might explain the scarce significance assigned to social management technologies for the development of capabilities. As for training, it is a widespread practice in all the firms surveyed and involves a high percentage of workers.

The degree of relationship between suppliers and the core firms –i.e., their restricted production environment– as it may be estimated from the existence of contacts, formal technical assistance, and a whole set of more informal interactions (technical meetings, visits to plants, communications) has an ambiguous character. In the first place, the existence of medium-term contracts represents a positive feature that lowers the strategic uncertainties of suppliers. In the second place, technical assistance is limited, according to the evaluation of suppliers about assistance alternatives for training, technical and

\textsuperscript{81} This is their distinctive characteristic with respect to other networks previously studied (Yoguel et al 2000, Novick et al 2001, Albornoz and Yoguel 2001) and research works that assess the factors determining a firm’s technological capabilities (Bisang et al 2001).
technological matters, competitiveness, the organization of human resources, etc. That is to say, the percentage of firms that do not receive technical assistance of any kind is significant, whereas the percentage of firms ranking assistance as moderately or highly significant is very low. In this respect, the average assistance of SIDERCA and –to a lower extent– SIDERAR increases significantly when the companies show a high dependence on OT. Besides, technical assistance from the core is not associated primarily with any of the three spheres that determine the endogenous capabilities of the firms, a fact which clearly indicates the network’s weakness.

In the third place, it should be noted that this research reveals an unknown style of relationship between network firms and the core which is more relevant than formal technical assistance and is materialized in: i) regular technical meetings, ii) visits of core personnel to suppliers’ plants, and iii) various forms of information and communications flows. A significant number of technicians from the core and the supplier firms participates in such interactions. These relationships depend positively on various elements that constitute the firm’s innovative capabilities (quality assurance, relative weight of new products, and the ratio of qualified workers dedicated to R&D). Therefore, the third element taken into account to estimate the degrees of relationship with suppliers is closely linked with the development of their capabilities. That is to say, the existence of personal bonds, formal and informal technical meetings, and visits to plants is the essential characteristic of relationships with the core and was highlighted and ranked higher than specific technical assistance during the survey.

The capabilities of panel firms is also increased through formal and informal relationships with other colleagues and institutions, either public or private, which constitute the extended production environment. In this sense, an outstanding feature is the relationship of these suppliers with state agencies and institutions that belong to the S&T system, as well as the relevant number of formal cooperation agreements with other agents: all this constitutes the critical difference of this network with respect to others previously studied in Argentina. On an average, the percentage of firms in the panel having such type of relationships is higher than the mean of Argentine SEMs, generally characterized by a stark isolation, few formal cooperation agreements, and a very low demand for technical support.

Through cluster analysis, four groups were identified combining high (low) endogenous capabilities and strong (weak) relationships with the core.
An interesting case arises for the two major groups that include cases of weak relationships combined with high (low) capabilities, and therefore do not confirm the theoretical hypotheses of this study. The first group, showing high competitive capabilities and a low dependence on the core includes the largest companies in the panel which showed the best performance during the 90's and have an export rate slightly above the average. These suppliers may have paths of their own for building up capabilities which are autonomous with respect to the network and to their restricted production environment. The second group shows limited capabilities and a low degree of relationship, and is characterized by plant sizes smaller than the panel's average and companies predominantly orientated towards the domestic market. It might be formed by companies that show weaknesses in their evolutive path whose inclusion in the network did not represent for them a supportive factor of development. In other words, the group shows a combination of weak endogenous capabilities and strong limitations in their restricted production environment.

On the contrary, the two other groups –involving a strong relationship with the core plus high (low) capabilities– validate the hypothesis of this work. The first group shows a two-way virtuous relationship where core companies also benefit from the high-level capabilities developed by their suppliers. The model is validated because in this group there is a positive correlation between high-level capabilities and the degree of relationship with the core (restricted production environment). It includes companies with sales, employed personnel, and productivity levels relatively similar to the panel's average, and the highest influence of DFI (direct foreign investment) agents or economic groups. The level of sales-concentration exposure is substantially higher than that of the two previous groups, and their export rates are similar to the average.

The last group illustrates the case of a strong relationship with the core companies and lesser endogenous capabilities. The negative correlation between the variables considered also validates the hypothesis because it illustrates cases of a positive restricted production environment apt to improve the firms' capabilities. This group is entirely formed by SMEs with the highest level of sales dependence on the core, particularly SIDERCA.
This taxonomy should be interpreted within a dynamic framework. On the one hand, the most virtuous category, involving mutually beneficial bilateral relations between suppliers and the core, is a combination of higher levels of endogenous capabilities and a strong style of interaction, which represents the optimal network model. A dynamic environment should leverage the concentration of most key suppliers within this highly virtuous category. However, it must be noted that such an evolution involves a wide range of adjustments in speed and different chances of success.

The category that combines a high level of endogenous capabilities and a weak restricted production environment is formed by companies that, in the best possible conditions, should start moving rightwards in the scheme (by improving their style of relationship with the core) in order to increase synergies and leverage the joint creation of competitive capabilities. In the quadrant that shows a combination of low endogenous capabilities and strong degrees of relationship, companies are able to increase their capabilities based on the support provided by the core and, therefore, they are apt to move towards the optimum proposed quadrant. Finally, the remaining category identifies suppliers with little possibilities of following this path.

Such desirable and feasible shifts depend only in part on the steps eventually taken by the core companies, since they also require a reformulation of public policies focused, among other things, on an evolution from an company-based to a network-based conception of competitiveness.

<table>
<thead>
<tr>
<th>Restricted production environment</th>
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<tbody>
<tr>
<td>Weak</td>
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<tr>
<td>Strong</td>
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<tr>
<td><strong>Endogenous capabilities</strong></td>
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<tr>
<td>Low</td>
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<tr>
<td>Companies for which the network does not represent a supportive factor for development</td>
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<tr>
<td>Companies receiving support from the core to improve their capabilities</td>
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<tr>
<td>High</td>
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<tr>
<td>Companies with a competence-building path that is autonomous with respect to the network</td>
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<td>Both the supplier companies and the core benefit from a virtuous, bi-directional association</td>
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This work analyzes the impact of a project recently implemented through Exiros (a comprehensive supply service company that has implemented an Internet-based e-marketplace) on the competitiveness of this production network. The analysis reveals two types of effects: i) upon Techint Organization’s operating procedures, and ii) upon the generation of competitive advantages across the network.

From the first perspective, after the first ten months of operations, Exiros showed savings for about 8% in purchasing, 30% in the number of man-hours spent in preparing procurement bidding documents, and a remarkable reduction in the core stocks.

From the perspective of competitive advantages across the network, results are multifaceted. Always within a tentative framework, there are a number of specific issues to be considered when faced with the question raised by this supply system against the
possibility of strengthening production networks. In the short term, the increase in the number of bidders lowers supply costs, consequently enhancing the monetary factor of competitiveness. Simultaneously, and in a long-term framework where the number of suppliers may be reduced on a step-by-step basis, the OT network will tend to reconfiguration in global markets in terms of products and inputs.

Although for most suppliers core companies are not a decisive customer, at the strict supplier level the access to an e-marketplace shows both advantages and disadvantages. Among advantages, the following are outstanding: the possibility of extending the market to other plants of OT and gaining new scales in a particularly recessive cycle; the possibility of increasing their penetration in external markets and ensuring the stability of medium and long-term contracts within an adverse macro-economic scenario. Among disadvantages, the following should be noted: the way in which the e-marketplace works imposes an even higher limitation on already low profitability levels because this mechanism captures market prices which, in the current framework, tend to variable costs. This circumstance, added to the significance of the direct external insertion of suppliers – which also involves reduced margins— and the crisis of the domestic market that reduces their *mark-up*, creates a highly significant limitation for suppliers: it is difficult for them to obtain a convenient degree of profitability to continue their business operations and enhance, therefore, their endogenous capabilities. The recent devaluation of the national currency (peso) partially modifies this scheme because it decreases the share of sales allocated exclusively to cover variable costs.

There is a tendency to focus the entire customer/supplier relationship on the electronic channel. In the case of products beyond simple standardization processes, there is a need to resort to technical communication channels in order to adjust operating details. It may be said that, insofar as the specificity of the transacted good increases, standardization efforts also increase and further strengthen the key role of supplier-accreditation and control mechanisms (especially when they are new).

Therefore, some conflicting interests arise between the behaviour shown by suppliers on the one side and that of buyers on the other. This conflict contrasts with the positive results of the operations performed through Exiros. Certainly, in the short term the network tends to improve the monetary factors of competitiveness on the basis of price reductions, lower stock levels, and the enhancement of supply management, (this being, in turn, the result of a wider range of bidders, a better procurement systematization and product standardization). Simultaneously, as noted above, in the long term the OT network will tend to reconfigure itself towards global markets in terms of products and inputs. In the medium term, the consolidation of these advantages demands actual steps for reducing the potential risks associated with a lower interchange of intangible assets, a degradation of quality, and failures in knowledge dissemination within a framework of a higher network density. However, a higher density of the network does not necessarily imply a higher number of suppliers, neither does it involve a focus on the domestic market: it certainly requires the development of common capabilities that go hand in hand with active policies.

From the perspective of public policies, this work suggests that a shift is needed from a company-based conception of policies –segmented into different thematic areas that are not conceived as a system– to a new systemic conception, and it also contributes some elements in that direction. In this sense, this methodological approach suggests some general outlines for public, private, and mixed policies tending to strengthen learning
processes and the collective generation of capabilities in industries characterized by the existence of production networks of the core-supplier type.

With this goal in mind, a systemic policy from the viewpoint of production networks should include at least the following four considerations:

a. On the one hand, the individual capabilities of network agents should evolve in a coordinated way. Therefore, factors that determine innovative capabilities should be taken into account, as well as social management technologies and training efforts. Likewise, actual support to the companies should be articulated and complementary so as to avoid imbalances in the development of technical and organizational capabilities (quality assurance, cellular organization, training, etc.).

b. Besides, future initiatives should tend to improve the complementarity between the core and its suppliers. Thus, not only virtuous relationships should be fostered but also those with agents that show lesser endogenous capabilities. That is to say, if networks are to be strengthened, specific and highly differentiated policies are required in order to (i) improve the technical skills of suppliers/customers, (ii) increase coordination among development activities, work organization, and training, (iii) improve the core's relationships with both highly competent suppliers/customers that show weak relationships (thus enhancing the network's synergy) and less competent suppliers/customers, envisaging optimality as an ultimate goal for the network.

c. In the third place, since firms that belong to the network also have connections with other organizations, support systems should be devised to strengthen horizontal relationships between suppliers and connections with other interrelated networks that share the same group of providers.

d. Finally, and recognizing their influence on the general dynamics of the network and the interactions between member firms, e-marketplaces should be explicitly considered so as to attenuate the negative impact of such mechanisms on learning and systemic competence-generation processes.

Within the general framework of such interventions, policies should be aimed at promoting more virtuous production networks and increasing the systemic endogenous capabilities of the network's suppliers/customers. In other words, they should be targeted at creating endogenous capabilities that may be transformed through the technical assistance of core firms into dynamic competitive advantages with an impact on the dissemination of information and knowledge among its suppliers.

Advances towards the definition of actual policy instruments, require the recognition that core-supplier interactions have an essentially private nature and that proper policy instruments should tend to encourage a virtuous development of such interactions rather than replace them. In this sense, public supplier-development programs that offer training and consultancy services for small enterprises and exclude the company they supply seem poor and even inadequate: learning and the collective development of enhanced capabilities result precisely from interactions between the core and its suppliers.

Therefore, considering that the core has a key role in defining the strategies and the dynamics of the network as a whole, the first group of general policy instruments should tend to generate conditions and incentives to encourage closer and deeper relationships
(as regards characteristics and scope) with local suppliers. Among them, regulations and standards should be included in order to: a) reinforce (through contracts) purchase-sale transactions; b) make provisions for a high percentage of various national inputs – including those of higher technological sophistication– in the core output, and c) bring them tax benefits if they engage in certain specific supplier-development activities. Additionally, some mechanism should be designed to regulate procurement through e-commerce (e-marketplaces), so that it is focused on raw materials and subassemblies not requiring non-price exchanges.

With respect to suppliers, when properly encouraged within a framework of incentives following the above-mentioned guidelines, the private action of the core might be further complemented by support public policies apt to speed up competence-generation processes, i.e., upgrading. Although isolated actions might be undertaken at the individual firm level, the policy should be carried out within the framework of the whole network. In this sense, traditional standardized and horizontal instruments do not seem suitable enough: actual requirements in each case demand more complex and flexible tools. The experience of programs such as SEPCYT's Technological Consultancy Service (Programa de Consejerías tecnológicas de la SEPCYT), aimed at financing technological management counselors, might be helpful to rethink policies orientated towards production networks. Since suppliers start from highly uneven degrees of development in technological and organizational capabilities and since different technical languages coexist within the same production network (communicating its members among themselves and also with the "outside" world), the existence of counsellors that play the role of "translators" might be helpful to increase aggregate capabilities and competitive advantages. Such agents should (i) act as full-fledged "translators"82 and also (ii) facilitate the introduction of external codified knowledge into the network. In order to maximize the impact of such instruments, they might adopt a mixed form including the public sector through specific technical contributions and the network core itself.

This set of policy instruments might be more momentous if accompanied by actual measures tending to explicitly evidence to the core and its suppliers that the network-system actually exists so that they may consider themselves as pertaining to an integrated system (Bianchi and Miller, 2000) and become thus fully aware that their individual competitiveness and performance are closely associated with the overall competitiveness and performance of the network as a whole.

Finally, on account of the conditions of this network, several questions remain unanswered: i) To what extent is it possible to change SIDERCA and SIDERAR's relationships with their suppliers so that virtuous traits increase and newly-generated capabilities may be transformed through the action of the core into dynamic competitive advantages?; (ii) To what extent the systemic capabilities created by suppliers may proceed in their creative process if faced with drastic changes in procurement policies?; iii) Which are the best policies towards suppliers so as to improve their current interrelationships without coming into conflict with procurement through e-commerce as it is being implemented in this transitional period?; (iv) Is there any other area where non-price relationships with suppliers may be re-created so that their capabilities and knowledge are disseminated and not wasted?

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82 In Giuliani, 2002, a similar notion (the "gatekeeper") is suggested, aimed at increasing the ability of a firm cluster to absorb external knowledge.
The present work emphasizes the idea that specific methodologies are needed to better grasp how agents codify tacit knowledge, an elusive reality whose measurement has been attempted herein through the notion of degree of relationship. This suggests that studies centered on few companies should be encouraged in order to hold throughout long periods in-depth meetings suitable to capture the intensity of a phenomenon so relevant for the constitution of a network. Another question of bearing to our arguments here is whether the companies that are best-related with the core and other agents are actually less limited in their production environment.
Appendices

1. Indicator listing
   (SDC=M SIDERCA, SDR=SIDERAR)

Y1  NUMERO, survey number
Y2  VTAS2000, total sales 2000
Y3  ICI, unweighted innovative capabilities
Y4  DECONOMICA, economic dynamics between 1995 and 2000
Y5  QRD, qualified people in R&D
Y6  GERD, stable group for R&D
Y7  LAB, R&D lab
Y8  DNP, weight of new products
Y9  ALCANCE, number of activities in which developments are made
Y10 ISO9000, quality certification
Y11 SECUENCIA, quality control mechanisms
Y12 TGS, unweighted average index of social management technologies
Y13 EPC, training structure
Y14 TC, workers involved in training
Y15 CELULA, percentage of people working in cells
Y16 RELEVANCIA, cell autonomy and relevance
Y17 SUPERVISOR, role of the supervisor
Y18 CSAL, salary bonuses
Y19 %VENT95, sales to Techint in 1995
Y20 %VENTT2000, idem 2000
Y21 PSCC, SIDERCA’s role in training
Y22 PSDR, SIDERAR’s role in training
Y23 SIDERCC, dummy variable: whether the company sells to SIDERCA
Y24 SIDERAR, dummy variable: whether the company sells to
Y25 SDCPROC, assistance to improve SIDERCA’s technical processes (takes into account Y26 through Y31)
Y26 MPROCSDC, SIDERCA’s production processes
Y27 CISDC, use of SIDERCA’s installed capacity
Y28 EFISDC, less nonacceptances and reworking
Y29 USOSDC, use of raw and other materials
Y30 LOSDC, lay out
Y31 LOGSDC, logistics
Y32 SDCCOMP, SIDERCA’s assistance to improve competitiveness (takes into account Y33 through Y36)
Y33 RH1SDC, internal interaction in teams
Y34 RH2SDC, interaction between teams
Y35 RH3SDC, staff training
Y36 RH4SDC, others (SIDERCA, Human resources)
Y37 SDCRRHH, SIDERCA’s assistance to improve human resource management (takes into account Y33 through Y36)
Y38 COMP1SDC, chances of doing business with other companies
Y39 COMP2SDC, ability to act as supplier of other big companies
Y40 COMP3SDC, control over their own suppliers
Y41 COMP4SDC, access to international information
Y42 INSFSDC, use of SIDERCA’s infrastructure
Y43 RECONOCIMIENTO, recognition of contributions to Techint
Y44 SDRPROC, SIDERAR's assistance to improve technical processes (takes into account Y45 through Y50)
Y45 MPROCSDR, SIDERAR's production processes
Y46 CISDR, use of SIDERAR's installed capacity
Y47 EFISDR, less nonacceptances and reworking
Y48 USOSDR, use or raw and other materials
Y49 LOSDR, lay out
Y50 LOGSDR, logistics
Y51 SDRRRHH, SIDERAR's assistance to improve human resources (takes into account Y52 through Y55)
Y52 RH1SDR, internal interaction in teams
Y53 RH2SDR, better interaction between teams
Y54 RH3SDR, staff training
Y55 RH4SDR, others (SIDERAR, human resources)
Y56 SDRCOMP, SIDERAR's assistance to improve technical processes (takes into account Y57 through Y60)
Y57 COMP1SDR, chances of doing business with other companies
Y58 COMP2SDR, ability to act as supplier of other big companies
Y59 COMP3SDR, control over their own suppliers
Y60 COMP4SDR, access to international information
Y61 INFSDR, use of SIDERAR's infrastructure
Y62 ACUERDOS, formal agreements with other firms
Y63 VINC INF, informal relationships with other firms
Y64 VAR TECH, percentage change in Techint's share in sales between 1995 and 2000
Y65 OCUP, number of people employed 2000
Y66 OCUPR&D, number of people dedicated to R&D with respect to total employment in 2000
Y67 LABR&D, formal R&D lab
Y68 %ASISTSDC, percentage of 15 SIDERCA's technical assistance alternatives
Y69 %ASISTSDR, percentage of 15 SIDERAR's technical assistance alternatives
Y70 ASISTSDC, SIDERCA's technical assistance
Y71 ASISTSDR, SIDERAR's technical assistance
Y72 ASISCAPSDC, SIDERCA's assistance in training
Y73 ASISCAPSDR, SIDERAR's assistance in training
Y74 VINCSDC, relationship with SIDERCA core
Y75 VINCSDR, relationship with SIDERAR core
Y76 TAMA, size typology
Y77 %SDC, ratio: sales to SIDERCA over sales to SIDERCA+SIDERAR
Y78 VTAS95, total sales in 1995
Y79 OCUP95, number of employed people 1995
Y80 weighted ICI, weighted innovative capabilities index
Y81 INFLTECH, Techint's influence
Y82 ANTIG, foundation year
Y83 VINCSDCP, weighted relationship with SIDERCA
Y84 VINCSDRP, weighted relationship with SIDERAR
Y85 QREUSDC, number of meetings with SIDERCA
Y86 CREUSDC, sophistication of meetings with SIDERCA
Y87 QVISSDC, number of visits from SIDERCA's representatives
Y88 CVISSDC, sophistication of SIDERCA's visits
Y89 QINFSDC, amount of information provided by SIDERCA
Y90 CINFSDC, sophistication of the information provided by SIDERCA
2. Definition of the indicators

This section describes how indicators are estimated. It refers to indicators of innovative capabilities, work organization, and training efforts involved in the development of endogenous capabilities and also to the indicator of degrees of relationship which reflects interconnections between the firms and the core and other agents outside the network. Structural indicators are also defined as well as some which are not associated with the four areas mentioned above. There are three different types of indicators: i) continuous (C), ii) discrete (O), and iii) nominal (N). In the case of continuous and ordinal indicators, higher values correspond to better characteristics of the firm. Below, each indicator is defined and its character (C, O, or N) is indicated between brackets.

Development of endogenous capabilities

2.1 Innovative capabilities

Y66 (C) ratio of workers dedicated to R&D over total number of workers: The direct proportion between the two aggregates is estimated.

Y5 (C) ratio of workers with a relatively high qualification (engineers and technicians): The quotient between this aggregate and the total number of people employed in R&D is computed. The indicator is equal to 1 if this percentage is greater than 30%; it is equal to 0.5 if the percentage lies between 20 and 30%; it is equal to 0.25 when the percentage is greater than 0 and less than 20%; and it is equal to zero otherwise.

(a3) ratio of highly skilled workers dedicated to R&D (“innovative skilled workers”) over total number of employees. The indicator is equal to 1 if this percentage is greater than 4%, it is equal to 0.5 when this percentage is greater than 2% and less than 4%, and equal to 0 in the remaining cases.

Y7/Y67 (O) specific R&D infrastructure (R&D labs) for creating and/or adapting new developments. The indicator is equal to 1 if there is a formal infrastructure and equal to 0 otherwise.

Y8 (C) Development of new products: The indicator is the quotient between the weight of new products introduced since 1995 and the total turnover in 1999.
Y9 (C). **Relevance and sophistication of development activities**: The indicator is defined by the total number of achievements in development activities over the total number of possible cases (product development and improvement, development of new processes, process improvements, new forms of distribution and marketing and internal JIT).

(a) **Level of quality assurance processes**: This aggregate indicator is a weighted average of the following factors:

Y11 (O). QA follow-up (weight 0.30). It is equal to 1 when follow-up worksheets are used at checkpoints and estimates are made of 75% of all possible statistical parameters (frequency distribution, histograms, cause-effect diagrams, variable control graphs, attribute statistical controls). It is equal to 0.50 if less than 75% of the parameters are estimated, and equal to 0 if no follow-up worksheets are carried out.

Y10: (O) Quality certification. It is equal to 1 if the firm is ISO9000 certified and is equal 0 otherwise.

Y3: (C). Unweighted innovative capabilities. It is a simple average of Y66, Y5, Y8, Y9, Y10 and Y11

Y80 (C). Weighted innovative capabilities

Y98 (C). ICTs general indicator; it is the simple average of Y99 through Y102

Y99 (O). It is equal to 1 if the firm uses e-mail with its customers and providers; equal to 0 if not, and equal to 0.5 in intermediate cases

Y100 (O). Use of ICTs in management and production. It is equal to 1 if ICTs are used, equal to 0 if they are not used and equal to 0.5 in intermediate cases

Y101 (O). It is equal to 1 if the firm has a regularly updated webpage; equal to 0 if no webpage exists and equal to 0.5 if there is a webpage but it is not updated

Y102 (O). It is equal to 1 if e-commerce is used and equal to 0 otherwise

**2.2 Work organization**

It is a simple average of three factors.

Y15 (C). **Percentage of workers organized in cells**. The simple ratio is estimated.

Y16: (O) **Relevance of cells**. This indicator is equal to 1 when cell-workers participate totally or partially in determining production rhythms, establishing and controlling quality standards, programming or reprogramming machinery, designing, improving or developing processes or products. The indicator is equal to 0.6 if they participate in at least 80% of such activities, and equal to 0.3 if they participate in 60% (or less) of such activities.

Y17 (O). **Role of the supervisor**. This indicator is equal to 1 if the supervisor performs technical activities; it is equal to 0 if he/she is only involved in control tasks, and equal to 0.5 in intermediate cases.
Y18 (O). **Salary bonuses.** This indicator is equal to 1 if salary bonuses are higher than 30% of the salary; it is equal to 0 if they are less than 10%, and it is equal to 0.75 and 0.25 in intermediate cases.

Y12 (C). **Weighted average of Y15, Y16, Y17 and Y18**

**Cell autonomy.** This indicator is equal to 1 when a supervisor and a facilitator are included in the team; it is equal to 0.5 if only one of them exists, and equal to 0 when none of this functions is included in the cell.

### 2.3 Training efforts

**Type of qualification.** This indicator is equal to 1 if the percentage of professionals and technicians in the firm is greater than 15%; it is equal to 0.5 when this percentage is greater than 5% and less than 15%, and it is equal to 0 in the remaining cases.

**Percentage of training expenses with respect to total sales.** This indicator is equal to 1 if this percentage is greater than the average; it is equal to 0.5 when this percentage does not differ from the average by more than 10%, and is equal to 0 in the remaining cases.

**Participation of less skilled human resources in training.** This indicator is equal to 1 if this percentage is greater than 60%, and is equal to 0 in the remaining cases.

Y13 (O). **Existence of a distinct training structure within the area of human resources.** This indicator is equal to 1 when a separate area exists and otherwise is equal to 0.

Y14 (C) **Percentage of trained workers.**

Y85: **Frequency of technical meetings with SIDERCA.** This indicator is equal to 1 when meetings are sporadic, it is equal to 2 when quarterly to monthly meetings are held, and equal to 3 when weekly or daily meetings are held.

Y86: **Sophistication of technical meetings with SIDERCA.** This indicator is equal to 1 when meetings deal on general subjects and it is equal to 2 when technical topics are dealt with.

Y87: **Frequency of visits to the plant by SIDERCA's personnel.** This indicator is equal to 1 when such visits are sporadic; it is equal to 2 in the case of quarterly to monthly visits, and equal to 3 when weekly or daily visits are made.

Y88. **Sophistication of visits from SIDERCA's personnel.** This indicator is equal to 1 when they deal on general subjects and it is equal to 2 when more technical topics are dealt with.

Y89. **Frequency of exchanges with SIDERCA as regards technical information and communication.** This indicator is equal to 1 when technical information/communication is sporadic, it is equal to 2 in the case of quarterly updates, and equal to 3 when weekly or daily updates are made.
Y90. Sophistication of exchanges with SIDERCA as regards technical information and communications. This indicator is equal to 1 when mere information is involved; and it is equal to 2 when actual communication takes place.

Y91. Frequency of technical meetings with SIDERAR. This indicator is equal to 1 when meetings are sporadic, it is equal to 2 when quarterly to monthly meetings are held, and equal to 3 when weekly or daily meetings are held.

Y92. Sophistication of technical meetings with SIDERAR. This indicator is equal to 1 when meetings deal on general subjects and it is equal to 2 when technical topics are dealt with.

Y93. Frequency of visits to the plant by SIDERAR's personnel. This indicator is equal to 1 when such visits are sporadic; it is equal to 2 in the case of quarterly to monthly visits, and equal to 3 when weekly or daily visits are made.

Y94. Sophistication of visits from SIDERAR's personnel. This indicator is equal to 1 when they deal on general subjects and it is equal to 2 when more technical topics are dealt with.

Y95. Frequency of exchanges with SIDERAR as regards technical information and communication. This indicator is equal to 1 when technical information/communication is sporadic, it is equal to 2 in the case of quarterly updates, and equal to 3 when weekly or daily updates are made.

Y96. Sophistication of exchanges with SIDERAR as regards technical information and communications. This indicator is equal to 1 when mere information is involved; and it is equal to 2 when actual communication takes place.

2.4 Dissemination of knowledge and know-how among other agents outside the network and the core

2.4.1. Agents outside the network

Y62 (O). Formal agreements. This indicator is equal to 0 if the firm has not signed formal cooperation agreements. Its value is 0.5 when the firm has formal cooperation agreements covering at least one of the possible areas (merchandising, input procurement, technology procurement, training, and exports). It is equal to 0.75 when agreements covering two areas exist and equal to 1 when the agreements cover at least three areas.

Y63) Informal connections with other agents. The number of different issues or topics included in possible exchanges with other agents is considered, as well as the frequency of such interactions. Among possible issues, a group of topics of greater relative complexity is selected among those having a relative weight of 1 when the alternatives of the firms were considered (the possibility of carrying out joint business, possible partnerships, shared training programs, shared product and process developments, problems associated with quality management). A weight of 0.5 is assigned to informal talks about business carried out within the framework of Mercosur. A weight of 0.25 is assigned to informal talks about merchandising strategies for the domestic market, and topics related to the sector's chamber. Finally, a weight of 0 is assigned to the remaining alternatives (the country's overall conditions, financing, labour problems and others).
aggregate obtained for each firm is divided into the maximum possible amount (7.5) for the sake of parameterization. The result thus obtained is then multiplied by the periodicity of connections: the factor is equal to 1 when daily or weekly contacts occur; it is equal to 0.5 when monthly contacts occur, and equal to 0.25 if contacts are merely sporadic.

Institutions outside the network. The values of this indicator lie in the interval \([0,1]\); it is equal to 1 when the firm resorts to other institutions that: i) perform tests, ii) provide analysis and methodology, iii) research technological and market information and also process and examine it, iv) provide training seminars and courses, v) carry out research and development projects. The remaining values are defined as the ratio between effective contacts and the total of possible contacts.

2.4.2 Inside the network

This indicator involves 6 different factors

\(Y_{21}/Y_{22} \) Participation of the core in training activities. This indicator lies in the interval \([0,1]\). Its maximum value corresponds to a firm that has actual influence on decisions about training, thematic areas involved, methodologies selected, target audience, trainers' selection, assessment and other related issues. Its value decreases with the decreasing number of assistance areas.

\(Y_{26}/Y_{27}/Y_{28}/Y_{29}/Y_{30}/Y_{31}/Y_{33}/Y_{34}/Y_{35}/Y_{36}/Y_{38}/Y_{39}/Y_{40}/Y_{41}/Y_{45}/Y_{46}/Y_{47}/Y_{48}/Y_{49}/Y_{50}/Y_{52}/Y_{53}/Y_{54}/Y_{55}/Y_{57}/Y_{58}/Y_{59}/Y_{60} \) All these indicators are equal to 0 when the firms involved consider they receive no technical assistance in that specific area. It is equal to 1 if they receive technical assistance but rank it as poorly significant, and it is equal to 2 if they rank the assistance as moderately or very significant.

\(Y_{42}/Y_{61} \) Use of the core's infrastructure and laboratories. This indicator is equal to 1 if the supplier uses the core laboratories and it is equal to 0 otherwise.

\(Y_{25} \) Simple average of \(Y_{26}\) through \(Y_{31}\)

\(Y_{32} \) Simple average of \(Y_{33}\) through \(Y_{36}\)

\(Y_{37} \) Simple average of \(Y_{38}\) through \(Y_{41}\)

\(Y_{44} \) Simple average of \(Y_{45}\) through \(Y_{50}\)

\(Y_{51} \) Simple average of \(Y_{52}\) through \(Y_{55}\)

\(Y_{56} \) Simple average of \(Y_{57}\) through \(Y_{60}\)

\(Y_{44} \) Simple average of \(Y_{45}\) through \(Y_{50}\)

\(Y_{68} \) Simple average of \(y_{26}\) through \(Y_{41}\)

\(Y_{69} \) Simple average of \(y_{45}\) through \(Y_{60}\)
Y74 (C). Simple average of Y68, Y21 and Y70

Y75 (C). Simple average of Y69, Y22 and Y71

Y83. Weighted average of Y68 (0.60), Y21 (0.20) and Y70 (0.20)

Y84. Weighted average of Y69 (0.60), Y22 (0.20) and Y71 (0.20)

Technology transfer. This indicator is equal to 0 if there is no transfer from the core; it is equal to 0.5 when there is transfer from the core, and equal to 1 when there is transference from the core and/or other technology providers, etc.

2.5 Remaining indicators

Y1 (N). Survey number

Y2 (C). Sales in 2000

Y19 (C). Ratio: sales to Techint over total sales in 1995

Y20 (C). Ratio Sales to Techint over total sales in 2000

Y23 (O). This indicator is equal to 1 if the firm sells to SIDERCA and equal to 0 if it does not sell to SIDERCA

Y24 (O). This indicator is equal to 1 if the firm sells to SIDERAR and equal to 0 if it does not sell to SIDERAR

Y64, (C) Y20-Y19

Y65 (C). Number of employed people, 2000

Y76 (N). FDI and other related criteria. The indicator is equal to 3 in the case of FDI; it is equal to 2 if the company belongs to a Group, and it is equal to 1 for SEMs.

Y77 (C). Ratio: SIDERCA's sales over total OT sales: derived from data provided by surveyed people

Y78 (C). Total sales amount in 1995

Y79 (C). Number of employees in 1995

Y81 (O). This indicator is equal to 1 when the weight of sales to Techint is scarce, It is equal to 2 if sales to Techint are moderately important, and equal to 3 when sales to Techint are high.
Y82, (O). Foundation year: This indicator is equal to 1 if the company was created before 1970; it is equal to 2 if it was created before 1980; equal to 3 if its creation date is previous to 1990, and it is equal to 4 if the company was founded in the 90s.

3. Fieldwork description

The fieldwork was carried out between June 1st 2001 and September 20th 2001. The initial information was a database including 218 firms provided by SIDERCA and SIDERAR. The firms were contacted so as to confirm whether they actually had the characteristics needed to be included in this research:

- whether they were suppliers of SIDERCA and/or SIDERAR.
- whether they actually produced some product and/or service, i.e., whether they were not mere importers or distributors
- whether some of their offices or plants were easily accessible for fieldworkers (i.e., located in Buenos Aires province).

160 firms were selected in this first stage. It was impossible to contact four of the firms because of erroneous data recorded in the database and because they were not included in telephone directories, industry guides, etc. The remaining 54 firms did not satisfy at least one of the above-mentioned characteristics.

The second stage started by faxing or e-mailing an introductory note explaining the purpose of the contacts, the final goals of the study, and who were responsible for research teams. The message also announced later contacts by telephone in order to make arrangements for a personal interview. Besides, the general outline of the questionnaire was advanced.

The third stage included the first phone call to identify a contact. The number of firms in the sample was reduced to 115 since 45 of the companies refused to take part in the survey. They offered different excuses, such as lack of time, lack of personnel to answer the questionnaires, or lack of interest in participating in activities involving no profit, be it pecuniary or in the form of training activities.

Interviews were carried out by a group of 10 pollsters already experienced in surveys and knowledgeable in production-network matters. Two preliminary training meetings were held while the first stage of the research was ongoing. Such preliminaries were aimed at acquainting the team with the questions involved, explaining the general and specific purposes of the research, and indicating how the answers would be used later for constructing indicators and testing the general hypotheses.

From the 115 contacted firms that accepted the interviews, 52 successful interviews were held. Three (3) companies were contacted and even visited by fieldworkers but, due to various circumstances, they either put off the interview or received questionnaire forms promising they were going to fill in the answers and actually did not, without even returning the unfilled forms. When the fieldwork was in its final stage, negotiations were being carried out to include 60 additional firms in the survey. However, the corresponding interviews did not take place because available dates in businessmen agendas exceeded the deadline established for fieldwork. The 52 interview that were finally performed had an average length of one hour and a half. 34% were carried out in the northern Greater Buenos Aires; 26% in the capital city (Buenos Aires city), 21% in the western Greater...
Buenos Aires, and the remaining 19% in the southern Greater Buenos Aires. Interviews involved management-levels: managers, directors, and executives. Only three interviews involved presidents of vice presidents of the companies in question and two were made with partners.

4. List of products manufactured by the surveyed companies

First line products and/or services

Repair of scales; adhesive and sealants; rail wheels; anti-freeze agents; cylinders; diamond tools; lubricating oils; cast iron; anticorrosion oils; maintenance; car parts; pressure measurement; gauging and certifications; limestone and dolomite; valves; reducing and other gears; boards and panels; sensors; lime; engineering and construction works; housings and cabinets; SAM servers; special spare parts; graphite electrodes; pallets; oil industry services; timber boards; bricks; wiring terminals; cables; refractory (non-formed materials); basic resin sandpaper; industrial paints; paints for buildings; metal tooling services; spare parts tooling; bumper chromium-plating; brushes; treatment of pathogenic materials; general services; specialty manufacturing; instrumentation; digital recorders; measuring devices; etc.

Second line products and/or services

Production of scales; lubricating agents; mixers and parts; pumping; measuring instruments; oil companies; bars; paramax; inserts; die-making; iron and steel industry; temperature measurement; fittings; lime; safety-relief valves; driving elements (rings and pinions); digital and translation instruments; controllers, slaked lime; gate manufacturing; automation; tenwen; ground graphite; boxes and crates; car parts; hydraulic fluids; waste recovery; granulating; repair painting; slings; ceramic fibers; agriculture and cattle breeding; alumina activated alumina; pre-tooling; oil services; mechanical seals; tests/metering; manufacturing for third parties; electrical grids and wiring; gauging services.

Third line products and services

Brakes and parts; solvents; general control or testing equipment; extrusion products; lubricants; paper mills; other instruments; sale of devices and appliances; precipitated calcium carbonate; cooling towers; measuring electronics; sensors; calcite; materials; air conditioning; services; packaging; agroindustry; heavy metal tooling; industrial products; accessories and fittings; refractory shapes; common alumina; automotive industry; ceramics; services; networking; nep instruments.

5. Development areas

5.1 Improvements in management, planning, and organization structure

Initiatives in management are evident in formal and informal areas and sometimes have a noticeable impact on production. From the specific perspective of management and/or strategic planning, actions could be detected in business planning, scheduling processes, transactions, and process streamlining. In turn, such changes had consequences on production, such as generating new product lines, implementing quality improvements and certifications; continuous improvement, downsizing; production increases; higher competitiveness; product and process improvements; higher market share; changes in storing patterns and raw materials flow; removal of low-demand products, and better positioning of the enterprise at the national and international level.

Besides, organizational improvements also influenced basically administrative issues and organizational aspects of production. Improvements such as restructuring at management levels; automonitoring; more customer-friendly relationships; distribution of responsibilities according to
tasks; creation of new departments; more frequent contact with people; team organization; staff cutbacks; salaries and costs; computerized organization. Lastly, the impact of production activity became evident in continuous improvements, a greater productivity, higher production, improvement in operational sequences; changes in lay out, greater efficiency; improvements in sales services and better relationships with customers, etc.

5.2 Towards professional profiles and/or managerial development

The most obvious sign of such activities were mostly permanent training courses and a continuous effort towards organizing and structuring administrative procedures, etc. Economic and production consequences were detected at the enterprise-level, such as a greater market share, higher customer confidence and greater scope-effectiveness among current customers and prospects, better merchandising, higher competitiveness; and a better positioning of the enterprise at the national and international level.

5.3 Reengineering of administrative processes

These activities were evident in the tuning-up of administrative controls; software purchases; continuous improvement; cost-reduction in products; continuous improvements in the administrative system; permanent reviews; greater scope-effectiveness among current customers and prospects; process redistribution; higher competitiveness; a higher efficiency and better management; network implementation; computerized streamlining; less overlapping tasks.

5.4 Product development and improvement

The most visible manifestations of product development were reflected in sales increases and a greater scope-effectiveness among current customers and prospects, the development of R&D activities, the development of new parts and products; improvements in quality control systems, improvements in mechanic capabilities, adaptation to customers' requirements, less products repaired, development of new product technologies, development of procedure manuals, standard certifications, more durability, creation of new commercial departments, savings in production times, continuous improvement; changes in product technology; improvements in production processes; low nonacceptance levels; manufacture streamlining; greater competitiveness, favourable comments from customers.

From the viewpoint of the improvement and development of new processes, actual efforts were evident in the possibilities of developing tailor-made procedures, improving R&D activities, introducing new machinery —especially numerical control devices—, reducing costs, responding more accurately to customer requirements, purchasing machinery, reducing nonacceptances, implementing new devices, assembling systems, implementing new production systems, increasing sales and having a higher market penetration, developing new products, achieving a higher level of customer satisfaction, improving production processes and associated costs, improving services.

5.5 Production process optimization

New process developments were also evident in the development of tailor-made procedures for the customer, the introduction of new equipment, R&D activities, improvements in production and productivity, improvements in human resource qualification-levels, cost optimization, application of new technologies, reduction of non-acceptances and costs, decreased downtimes, higher efficiency, continuous improvement, increases in productivity, and improved assembly automation. Besides, new tools were developed to improve production processes, and new production lines were established so as to improve technology, etc.

5.6 Product adaptation
In this area, the most noticeable evidences of change could be found in R&D activities, higher sales (2), layout-driven part development, better response to customers’ requirements (2), improvements in existing products; lesser needs to repair products, an evident need for technology developments (3), better product performance, and possibilities of organizing systems.

5.7 New distribution and marketing styles

Changes in marketing were evidenced in exports, in the statement of business plans, in outsourcing, in the development of sales agents, in an effective use of the webpage, in lesser costs, in remarkable image changes and novelties in brochures derived from widespread ITCs (CD, Web). Other such changes may also be cited involving logistics, higher sales levels, a higher use of the Internet and e-mail, a conscientious screening of candidates to sales representatives, improvements in the domestic distribution network, the creation of new commercial departments, increases in sales, improvements in containers, labelling and packaging, developments of new business units, increased competitiveness, and higher customer recognition.
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