Information and knowledge: the diffusion of information and communication technologies

in the Argentine manufacturing sector

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This article seeks to make a contribution to the study of information and knowledge in Latin America, with special attention to the use and diffusion of information and communication technologies (ICT) in Argentine manufacturing. It addresses two main aspects of this subject: the real extent of the use and diffusion of ICT, and its links with the overall performance of enterprises (innovation capacity, organization of work and competitiveness). It studies and summarizes the use and diffusion of those technologies in Argentine industry in order to i) present an empirical map of their use and diffusion in the Argentine manufacturing sector and ii) identify the linkages of such diffusion with the endogenous capabilities of the enterprises. It maintains that the incorporation and use of those technologies cannot be analyzed without taking into consideration the degree of development of endogenous capabilities achieved by the firms in question. On the basis of a survey of 246 Argentine industrial enterprises, it draws some conclusions on the way Argentine enterprises use ICT, not only in order to improve what they are already doing, but also to generate new knowledge.

I
Introduction

This article aims to make a contribution to the debate on information and knowledge in the Latin American economy and society. It focuses on the use and diffusion of information and communication technologies (ICT) in the Argentine manufacturing sector, with special attention to two main aspects of this subject: the real extent of the use and diffusion of ICT, and their links with the overall performance of enterprises (innovation capacity, organization of work and competitiveness).

In view of the great transformations which have taken place in those technologies and the changes that this involves for society, a variety of questions arise which this article will seek to address. Thus, what is the extent of the diffusion of ICT in Argentine manufacturing, especially when considered from a systemic point of view? Is a certain threshold of prior codified and tacit knowledge required in order to gain access to ICT, or is it possible to cut corners? Is the move towards the use of ICT an automatic process, or does it call for specific policies? Moreover, what is the link between the spread of ICT and development of the endogenous capabilities of enterprises? Can there be generalized development of ICT in a society without previous organizational changes and without structures to facilitate learning? Can such technologies spread evenly among the different segments of production and society?

This article will provide elements to help to address these questions from two perspectives. First of all, we will seek to outline a basic descriptive map of the situation by analyzing the results of a survey of 246 Argentine industrial firms, in order to give an idea of the effective diffusion of ICT in the manufacturing sector. This survey also permits some inferences to be drawn on the effective capacity of firms to use ICT in the generation of new knowledge. The central argument in this respect is that the incorporation and effective use of information and communication technologies is a function of other capabilities achieved by the firms, and the use and diffusion of ICT cannot be evaluated in isolation from this evolutionary path. For a start, it is considered that the efficient incorporation and optimal use of information and communication technologies to make possible the generation of new knowledge is only possible in firms that are already developing innovation capabilities and have some degree of competitiveness. This is because of the fundamental difference which exists between information and knowledge, which cannot be overcome through the mere incorporation of ICT out of context. Thus, with the new technologies it is relatively easy to reproduce information, even in large amounts and in the most varied forms (alphanumeric, graphical, audio, visual). It is much more difficult, however, to reproduce knowledge, especially when this is tacit,[1] since in order to turn this into information it is necessary first of all to codify it. As knowledge cannot be codified absolutely and completely, however, its reproduction must also be achieved through experience, teaching and training.

In order to contribute to the debate on these matters, section II below contains a theoretical analysis of the differences between information and knowledge and the linkages between the diffusion of ICT and the development of endogenous capabilities. Section III sets out the analytical dimensions taken into account in order to estimate the degree of information and communication technology use and the development of endogenous capabilities in enterprises. Section IV first of all describes the general characteristics of the panel of firms considered and the degree of diffusion of ICT among them and then goes on to present the results of an analysis of homogeneous clusters designed to identify groups of firms with different degrees of development of the two attributes in question. Finally, section V gives the main conclusions of the study.

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[1] Understood as the stock of learning possessed by individuals which cannot be defined, codified, published or fully expressed and which differs from one person to another, but which could be shared to a substantial extent by colleagues and fellow-workers with a similar background of experience (Dosi, 1998, cited in Cimoli and Correa, 2003).

II

Information and knowledge: linkages between endogenous capabilities and the diffusion of information and communication technologies

In recent years, both the economic literature and the press have made extensive reference to the existence of new paradigms regarding technological and social change, due to the confluence of two great currents: on the one hand, what has become known as the information society, and on the other, the generalized spread of new information and communication technologies. The expressions "knowledge-based society" (Lugones, Bianco and others, 2003), "information society" (Castells, 1998) and "new economy", depending on the different authors, sometimes appear to be similar in meaning, sometimes different, and sometimes complementary.

Lundvall (2003), for example, accepts the idea of a new era as a working hypothesis and shares the basic assumption that the widespread diffusion and use of information and communication technologies represents a fundamental change in the economy and society. He criticizes the concept of the "new economy", however, on the grounds that it takes a simplistic view of the problem, since it ignores the need to make significant changes and institutional reforms that will effectively promote learning processes.

Cimoli and Correa (2003) note that the debate on information and knowledge has been under way for at least three decades but has gained even greater impetus with the arrival of new technologies.[2] There are two well-defined positions in this debate: one is the view that almost all information is knowledge (Cowan, David and Foray, 2000), so that in the final analysis more information necessarily means more knowledge, while the other, much more cautious, position emphasizes the differences that exist between information and knowledge and sees the production of knowledge as a complex process which does not necessarily take place automatically as a result of an increase in information (Johnson, Moher and others, 2002).

It is this latter view that has been gaining ground. It holds that knowledge is fundamentally a cognitive capacity associated with the possibility of interpreting and transforming information. Information, in contrast, is a set of data which are structured and formatted but are inert and inactive until they are interpreted by those who have the necessary capacity to handle them (Lugones, Bianco and others, 2003).

This differentiation –but at the same time interaction– between information and knowledge is not something which is closed in on itself, but must also be incorporated into the learning process as an auxiliary factor. As noted by Rullani (2000), knowledge only maintains its value if it is constantly regenerated and expanded through learning and the various transformations in the cognitive cycle outlined by Nonaka and Takeuchi (1999), in which information and knowledge continually interact. This cycle begins with the socialization of tacit knowledge in specific contexts; its externalization to other contexts after codification; the combination of different levels of codified knowledge in order to increase its complexity, and finally, its internalization (transformation of specific codified knowledge) within the context of the enterprise which is carrying out learning processes in this way.[3] In this sense, information and communication technologies can be functional to the development of learning processes if they reach a certain level of complexity and also if they make it possible to speed up the phases of the above-mentioned cognitive cycle.

In other words, these technologies could only have a significant influence on competitiveness if there is prior or simultaneous technical and organizational change which makes it possible to optimize them and which involves the definition of technological management strategies and policies, the development of models and systems for the organization of

[2] See Cimoli and Dosi (1995), Dosi (1998) and Dosi, Orsenigo and Sylos Labini (2002).

[3] If used systemically, for example, ICT would give rise to stimuli for the codification, externalization and circulation of tacit knowledge, and would function as a vehicle for the circulation and qualitative transformation of the codified knowledge.

work designed to make the generation and circulation of knowledge viable, and an organizational structure which facilitates the communication and learning processes. In this respect, ICT could be said to have a dual impact on the codification of knowledge. While on the one hand these technologies permit greater codification, on the other they require more and more tacit skills in order to make possible its transformation (Lundvall, 2003). Consequently, ICT facilitate access to information, but this is only transformed into skills if there is a certain minimum threshold of knowledge among individuals, enterprises and local agents, and society as a whole. Thus, the potential of these technologies only emerges within the context of systemic processes, which must integrate endogenous skills on various levels. Otherwise, these processes will be severely limited and reduced to the mere circulation of information. This set of elements permits us to put forward the hypothesis that information and communication technologies are a dependent variable of other structural factors, especially the endogenous skills built up in the course of the evolutionary path followed by enterprises.

This interdependence, which is observed in many of the developed countries in a relatively systemic form, would appear to have a more disjointed character in most of the Latin American countries, because of the lower weight of knowledge in the public debate and in the sectors which shape the specialization pattern. A number of studies have indicated that, unlike the situation prevailing in the developed countries,[4] in Latin America, within the framework of a high degree of structural heterogeneity, the prevailing situation is one of: i) low levels of technological skills; ii) a small and shallow presence in production networks; iii) a specialization pattern which is not very complex;[5] iv) limited institutional development, and v) a lack of systemic policies. In this context, Latin American enterprises, and especially the relatively small ones, are marked by their limited innovation capabilities and endogenous skills,[6] their self-centered tendencies, as expressed in their very limited participation in global networks and virtuous territorial systems, and the isolated nature both of the competitive dimensions they sometimes manage to attain and their efforts in terms of training and consultancy. This situation is made still worse by the extreme weakness of the public area[7] and the strong presence of foreign direct investment, whose decision-making and R & D investment processes often take place in the parent firms or simply take no account of local needs.

This structural heterogeneity was further accentuated in the 1990s by the big differences in growth rates and the deterioration of the already regressive income distribution conditions (Cimoli and Correa, 2002; Perez and Stumpo, 2001). As a result, production systems have been generated in Latin America which, because of the very limited presence of the key factor of the new technological model (knowledge), are marked by their low levels of complexity and their high degrees of vulnerability. Because of this set of weaknesses, the market fails to select the most innovative forms of conduct,[8] and this limits the advance of learning processes and the generation of dynamic competitive advantages.

Cimoli and Correa (2003) explain how some of the above-mentioned characteristics condition the spread and systemic use of ICT in the region. In the first place, these technologies are strongly correlated with the level of income, which means that there is an access barrier (Peirano and Bianco, 2002). In the second place, the interpretation and decodification of information demands certain minimum thresholds of codified and tacit knowledge which, as already noted, are rare in the region.

Consequently, placing emphasis on the innovation economy or the knowledge society as yardsticks is subject to a number of limiting factors connected

[4] See Reinert (1996), Lall (2001), and Dosi, Pavitt and Soete (1990).

[5] This presence is marked by scanty backward linkages and the predominance of commodities: goods which make intensive use of natural resources, with little processing or other forms of preparation (Cimoli and Correa, 2002; Perez and Stumpo, 2001). Consequently, during the expansive stage in the 1990s which culminated with the Asian crisis, seven out of every ten workers were engaged in low-productivity activities (Ocampo, 2001).

[6] See Bisang, Lugones and Yoguel (2002); Cimoli and Katz (2002); Milesi (2002); OECD (1995), and Yoguel and Rabetino (2002).

[7] In many cases, economic openness without the creation of the necessary institutions has gradually destroyed the evolutionary path followed by territorial systems which had made some progress in learning processes. In these cases, the conflict between openness and a closed situation results in territorial systems which lose their identity because of excessive openness (Poma, 2000).

[8] In addition to the problems already mentioned, there are also, on the one hand, the prevalence of a linear innovation model which dissociates both science and technology and the generation of knowledge from the production of goods, while on the other hand there is a severe level of disconnection between the demands of enterprises (which are sometimes not explicitly expressed) and the supply of private consultancy and training services, as well as the extreme weakness of the institutions needed in order for the market to function (Yoguel, Neuman and others, 1997).

with the structural conditions of the Latin American economies. In order for it to be possible to generate a virtuous circle between ICT and the advance of knowledge, profound technical and organizational changes are needed in enterprises and institutions. Therefore, this technology cannot be viewed as an autonomous factor which, by its sole presence, guarantees learning processes or the development of skills. This would be similar – in a new form – to the now discredited technological determinism of the 1980s which associated electronic automation with social and productive development.

III

The analytical dimensions considered in this study

As already noted, the incorporation of information and communication technologies in enterprises can usefully be analyzed as a process which is dependent on the prior technological path already followed. Consequently, a necessary condition for these technologies to be functional to the development of competitive advantages by the enterprises is the existence of endogenous capabilities which can boost the processes of generation, circulation and appropriation of information associated with the spread of ICT.[9]

In the approach taken in the present study, the dimension connected with the use of ICT is equated with the set of information and communication tools used by enterprises to circulate information both in the areas of management and administration and in that of production, at the vertical and the horizontal levels. The dimensions connected with endogenous skills, for their part, seek to analyze the generation of knowledge and the possibility of learning in those enterprises. The main hypothesis of this study is that the diffusion of ICT should be linked with the degree of development of endogenous skills. In other words, proper (or inadequate) use of ICT as a means to facilitate the circulation of information depends on the greater (or lesser) degree of development of endogenous capabilities.

The present study, therefore, not only evaluates the degree of diffusion of ICT in the sample enterprises but also takes into account other variables which serve as proxies for the analysis of their technological conduct and endogenous skills.[10] The aim is thus to apply a kind of weighting of the complexity of the ICT incorporated and thereby get away from mere dichotomic counting of the "has/has not" type, as well as establishing a qualitative gradient to see how far an enterprise is moving, firstly, towards the use of informatics in existing processes and, secondly, towards the deliberate use of the largest possible amount of information. The complexity of the ICT incorporated allows some inferences to be made on the dynamics of the learning process taking place in the firms.

Thus, in order to analyze the use of ICT and identify the possible circulation of information in the enterprise, indicators were designed to take account of the information and communication equipment and infrastructure (hardware), the computer programmes used (software),[11] and the use and importance of the new communication tools —especially the internet, intranet and e-mail— as means of internal and external contact, including sales and purchasing (e-commerce). For production activities, an appraisal was made of the complexity of the production hardware and software, design software, and software for production planning and control.[12] As well as identifying the existence of these tools, in appraising the complexity of the diffusion of ICT, account is also taken of the proportion of the staff with access to them, the purposes they are used for (in

[9] See, among others, Lundvall (2003) and Cimoli and Correa (2003).

[10] In various studies by the authors (Yoguel, Novick and Marin, 2001; Novick, Yoguel and others, 2002) progress has been made in the construction of a set of indicators to measure these aspects.

[11] As well as the existence of a server and database engine and the existence and conformation of an information processing department in the enterprise.

[12] All this is based on the hypothesis that information and communication technologies are important in all sectors. While it is also considered that the links of ICT with production are specific to each sector and have different weights in the corresponding production functions, however, the level of disaggregation needed to analyze these factors would exceed the capacity of the sample used.

general activities, innovation, quality control, organization of work, training) and the type of linkages they help to develop (trade, institutional, etc.). In particular, account is taken, in the case of the internet, not only of whether it is used or not but also of whether the enterprise has a web page and what it is used for. In the case of the intranet, the platform on which it operates is also considered: internally within the enterprise, or via the internet. Finally, an indicator was prepared for evaluating the importance of e-commerce.

Endogenous capabilities —understood as the potential of the enterprises to turn their generic knowledge into specific knowledge on the basis of existing capabilities and dynamic accumulation of skills, including formal and informal learning processes for both codified and tacit information[13]— are determined on the basis of various elements: firstly, the innovative capacity of the agents, evaluated through an analysis of the formal and informal research and development efforts made;[14] secondly, the efforts made by firms to ensure process and product quality, as measured by compliance with certified standards; and finally, the model used for the organization of work, which influences the possibilities for the circulation of information and the acquisition of tacit knowledge by workers in order to improve their skills and make progress in the two fields in question. The existence of teams and spaces for interaction, rather than the assignment of specific individual job responsibilities, makes it possible to exchange experience and views and increases the possibility of the spread of tacit knowledge among individuals through observation, imitation and experimentation (Novick, Yoguel and others, 2002).[15]

The three elements in question make it possible to appraise the development and use of the skills of the entire labour force engaged in production activities, quality control and technological development. The formal and informal training of workers of different levels, as well as their qualification, are other key elements for the achievement of competitive advantages (Novick, 1999).[16]

IV
Principal results

1. The diffusion of information and communication technologies in the enterprises studied

The panel analyzed included 246 Argentine industrial enterprises located in the metropolitan area, Cordóba and Rafaela, which were interviewed between July and October 2002. The median for the number of employees and sales turnover of these firms in 2001 was 49 persons and 3 million dollars, respectively.[17] The simple average for sales per employee was about 115,300 dollars at 2001 prices, which was similar to the average for Argentine industry, if micro-enterprises are excluded, but the median was only 62,500 dollars. The distribution of firms by types of agents was also similar to the general structure of Argentine industry. Thus, small and medium-sized enterprises predominated (69%), with significantly smaller proportions of very small enterprises (18%) and large enterprises (13%).[18] Of the firms studied, 19% were wholly or partially foreign-owned. In sectoral terms, the production of traditional goods such as footwear,

[13] See Ernst and Lundvall (1997), Lall (1992) and Yoguel and Boscherini (1996).

[14] Appraised on the basis of two indicators which reflect the potential capacity of the firm's human resources to carry out R&D activities, the level of formal organization of those activities (R&D teams), and their importance and scope from the point of view of the results obtained (percentage of R&D products incorporated in the last few years).

[15] The indicator designed for the organization of work seeks to capture these aspects by taking account of two elements, one quantitative and the other qualitative: i) the extent of work in cells or teams, and ii) the degree of autonomy of those cells or teams.

[16] In estimating this element, the following aspects were taken into account: i) the proportion of human resources involved in these activities, and ii) the proportion of technical personnel among the total number of employees.

[17] The simple averages for both variables in 2001 were 140 persons and 18 million dollars; these figures were strongly affected by the extreme values registered by some of the firms studied.

[18] Very small enterprises were considered to be those with a turnover of less than 500,000 dollars at 2001 prices, while small and medium-sized enterprises were those with a turnover of between 500,000 and 20 million dollars and large enterprises were those with sales of over 20 million.

furniture, basic metal products and machinery, etc. predominated (44%), with lesser proportions of goods of greater technological complexity (23%), products for the automotive sector (17%), and commodities (12%). Durable goods accounted for only 4%.

The results of the survey indicate that the diffusion of ICT in the enterprises covered by the sample is considerable in quantitative terms, but is seen to be significantly less important when evaluated from the point of view of the complexity of the software and systems used (tables A.1 to A.6 of the Statistical Appendix). Almost all the firms in the sample made investments in information and communication equipment and systems between 1999 and 2001. The amounts involved in these investments during that period averaged 1.2% of annual sales, 78% of which was spent on equipment and systems for the management area.

As noted above, most of the investments were on management and administration tools,[19] mostly of a low level of complexity, which had only a limited impact on the prevailing forms of management, production and interchange. In spite of this low level of complexity, the growing presence of ICT, mainly in management systems, has faced firms with the need to establish some kind of scheme for the handling of such technologies.

It should be noted that in the course of the 1990s there was a great deal of incorporation of equipment, favoured by the economic opening process and the level of the real exchange rate. This incorporation was not systemic, however. The shares accounted for by web pages and e-mail are even higher than in developed countries, but this highlights the fact that, in isolation, these tools are no measure of competitiveness or endogenous skills.

In keeping with the investments made, most of the firms have a substantial amount of equipment and systems which were incorporated in recent years. Thus, 87% of them have networks, mostly local area networks,[20] while a little over half of them have telephone lines that provide higher speeds and communication capacity (integrated services digital network (ISDN) lines or asymmetrical digital subscriber lines (ADSL)). In the management area, 78% of the firms have servers, although in many cases these do not have a database engine, which reduces their potential. The average age of both the servers and the computers of the firms in the panel is around three years.

With regard to the use of software, the demand of most of the firms is quite unsophisticated, consisting mainly of standardized office automation systems (78%). Only a relatively small proportion of the firms (about 22%) use more complex programmes, such as systems for working in groups (circulation of knowledge) and for providing support for decision-making at the middle and managerial levels.

In the are of production, in contrast, the presence of informatics equipment and the use of special software is considerably smaller than in the management area. The most common equipment, found in 23% of the firms, is for programmable logical control; it is followed by computerized numerical control, robots, numerical control, automated assembly and fitting systems, and flexible production cells. In most cases, this equipment operates in isolation, without being integrated through software with other areas of the firm. Only in design is there extensive diffusion of systems (such as computer-aided design, computer-aided engineering, etc., which are present in 50% of the firms); the level of diffusion of systems is lower in planning and control activities (planning of requirements of materials, planning of manufacturing resources, and computer-aided process planning), and is almost completely absent in the production phase: only 4% of the firms use some system of computer-aided manufacturing.[21]

In contrast, the new communication tools are widely disseminated, although in many cases their "real" use and even the objectives which led to their incorporation limit their potential impact. 54% of the firms interviewed have a web site, although in most cases its purpose is not very complex (providing institutional information, publicizing products, and simply being present on the web). Similarly, 96% of the firms have an institutional e-mail account, while in 37% of the total number of firms, over 75% of the employees in the management and administration areas have personal e-mail accounts. A considerable number of firms (57%) also have intranets, although in two-thirds of them these are merely internal networks that do no operate via the internet, thus limiting their possibilities

[19] This is in keeping with the findings of the survey on the technological conduct of Argentine industrial firms (Bisang, Lugones and others, 2003), which identified, within innovation activities, a marked tendency for efforts to be directed towards the management area rather than marketing and production.

[20] 75% of the firms have local area networks (LANs), while only 15% of the enterprises have wide area networks (WANs).

[21] Although it should be noted that in many cases the equipment already has built-in software.

in terms of access and connectivity for suppliers and clients.

In this context, the weight of such tools in the field of links with suppliers and clients is considerable, although very uneven. The most frequently used medium is e-mail, but the telephone and personal visits still occupy important places, thus showing that personal contacts and face to face dealings cannot be replaced easily or completely by the new technologies. The intranet and internet are of less importance in this field; their level of use is similar to that of traditional mail, which has now lost much of its former importance. Something similar may be observed in the relations of firms with institutions such as technology centres, trade associations, technological liaison units, consultants and universities.

Lastly, e-commerce is fairly widespread among the firms in the panel: 5% of them make electronic purchases and sales, 10% only make purchases in this way, and another 14% only make e-sales. Thus, almost 30% of the firms in the panel make some kind of electronic purchases or sales. Of the 70% which do not engage in e-commerce, 42% are unfamiliar with the possibilities, functioning and regulations regarding e-commerce. In line with this, most of the firms (54%) would be unwilling to use this tool in the future, while 16% would only be willing to purchase in this way, another 10% only to make e-sales, and the remaining 20% would be willing to make both purchases and sales.

Within the analytical framework followed by this study, the empirical evidence collected makes it possible to outline a preliminary set of aspects which, in general terms, are seen as characterizing the process of incorporation of information and communication technologies undertaken by the firms in the panel: i) the degree of incorporation of these technologies may be deemed considerable from the quantitative point of view; ii) the presence of ICTs is considerably greater in management than in production; iii) there is a predominance of ICT tools of a low level of complexity, aimed at objectives with limited potential impact, so that the weight of the process is much less in qualitative terms than quantitatively; and iv) because of this, the process of diffusion of ICT analyzed here is closer to the mere management and circulation of information than to a process which will enable firms to strengthen the generation and circulation of the knowledge needed to improve their capabilities.

These general characteristics are observed, however, against the background of a high level of heterogeneity, which must be taken into account in order to enhance the debate and make it possible to include in it all the nuances that this new phenomenon undoubtedly displays. Consequently, in the next section but one an analysis will be made of homogeneous clusters of firms, in order to identify and summarize the main types of conduct adopted by the firms in the panel with regard to two dimensions – the use and diffusion of ICT, and the development of endogenous capabilities – and then identify the linkages between them.

2. Analysis of homogeneous clusters of firms

Using a multi-dimensional exploratory analysis technique —multiple correspondence factor analysis (MCA)— homogeneous clusters of firms were made on the basis of the simultaneous consideration of various characteristics associated with the diffusion of ICT on the one hand and the development of endogenous capabilities on the other. MCA makes it possible to analyze all the associations which exist between the different forms of the variables making up the data matrix and to obtain a set of classes made up of individuals having high intra-group homogeneity and high extra-group heterogeneity. This method operates through reduction of the number of dimensions studied for the phenomenon in question, thus forming factor axes whose determination makes it possible to concentrate the analysis on those variables and forms which do most to explain the problem addressed, thereby giving a more manageable picture of it (Roitter, 1991; Crivisqui, 1993).

Using MCA, an analysis was made of homogeneous groups, which made it possible to construct different groups made up of the individuals closest to each other on the basis of the Euclidian distances calculated for the coordinates of the individuals on all the factor axes.[22]

Through two different statistical exercises, and using the methodology described above, it was possible to identify a gradient of situations for each of the analytical dimensions considered in this study. Thus,

[22] In order to interpret the results correctly, it must be borne in mind that while the forms of the variables associated with a given group indicate that individuals with that characteristic are represented in the group to a (significantly) greater degree than in the sample as a whole, this does not necessarily mean that all the firms in that group display that characteristic.

homogeneous groups were identified which differ from others according to the degree of diffusion of ICT in them (in terms of both presence and complexity) and also according to the degree of development of endogenous capabilities, so as to subsequently establish the linkages between the two dimensions.

The analysis was carried out on the basis of the indicators already described, which make possible the simultaneous estimation of both quantitative and qualitative aspects. In both cases, the indicators reflect not only the presence of a given attribute, but also its degree of complexity and its possible contribution to the generation of knowledge. Finally, both planes were combined in order to evaluate the hypothesis of this study.

By differentiating according to the degree of diffusion of ICT, three groups were obtained with the following characteristics:

i) *High level of diffusion of ICT*. This group accounts for 28% of the firms in the panel. They are marked by a strong presence and high degree of integration of most of the information and communication tools considered. There is a predominance of firms with complex management software, and also a considerable proportion of firms with complex programmes in the production area. The information tools are incorporated on a systemic basis, aimed at integration among the different areas of the firm. These firms make extensive use of the internet, intranet and e-mail.

ii) *Limited level of diffusion of ICT.* This group, made up of 36% of the firms, has characteristics which are almost the opposite of those of the previous group. In terms of the various planes considered, these firms have the lowest relative level of complexity. They make little use of the intranet, e-mail, e-commerce and the internet.[23] Most of these firms do not have a server, and their computers are not networked. In management, the use of basic-level computer programmes predominates, while in production little use is made of the new tools based on ICT.

iii) *Medium level of diffusion of ICT.* This group accounts for the remaining 36% of the firms, which do not display such homogeneous characteristics as in the previous two groups. In some respects they are closer to group i), while in others they are more similar to group ii). Among their main characteristics is the absence of production software and hardware in most of the firms, the predominance of basic-level management software, the presence of servers and networks in most of the firms, a very high level of utilization of e-mail, but an almost complete absence of intranets.

When the firms in the panel were differentiated according to the degree of development of endogenous capabilities, a similar statistical exercise likewise gave three groups:

i) *High level of development of endogenous capabilities.* This group accounts for 38% of the firms in the panel, which are marked by the predominance of highly-skilled human resources. The most notable endogenous capabilities were: the considerable presence of quality control systems throughout the production process, as reflected in process and product standardization; the importance of cells in the organization of work (high level of autonomy),[24] and the medium or high level of the efforts made in the field of training. Furthermore, an considerable proportion of the firms carry out research and development activities in the hands of formal and/or informal teams made up of staff members working full or part time in this area. Finally, in 55% of the firms "new" products account for a substantial proportion of their sales.

ii) *Low level of development of endogenous capabilities*. This group accounts for 42% of the firms in the panel, with a low average level of human resources skills. The predominant characteristic of this group is the absence of quality control systems and of research and development teams. With regard to human resources management, the organization of work is through the individual assignment of job responsibilities, and training activities are scarce or non-existent. There is also little incorporation of new products.

iii) *Intermediate level of development of endogenous capabilities*. This group consists of 20% of the firms —and like the previous group iii) established according to the degree of diffusion of ICT —is less homogeneous than the previous

[23] 93% of the firms in this group do not have an intranet, or if they do, it is used by less than 25% of their employees. In a similar proportion of firms, less than 25% of the employees use the internet. In 80% of cases, e-mail is used by less than half the staff.

[24] In 76% of the cases the workers participate, at least sometimes, in the programming or reprogramming of the equipment they use.

two groups. Quality control is practiced in 40% of the firms, while in those of them which carry out research and development activities, the staff working in this area only do so part-time, in spite of the importance of new products in the firms' turnover. With regard to human resources management, work in cells is a feature of this group, but the cells have little autonomy and the learning processes are therefore limited. Indeed, in half of the firms there is no training of human resources. The high level of qualifications of the staff in a considerable number of these firms marks a strong difference, however, from the group with a low level of endogenous capabilities.

3. Joint analysis

Using the two sets of homogeneous groups of firms constructed as described above, a joint analysis was made which makes it possible to identify several different types of situations (table 1).[25]

On the one hand, there is a strong relation between the endogenous capabilities developed by firms and the degree of diffusion reached by information and communication technologies, in keeping with the central hypothesis of this study.[26] As may be observed, in the group with a low level of diffusion of ICT, firms with low levels of capabilities are over-represented, while those with high levels of capabilities are under-represented. In contrast, in the group with a high level of diffusion of ICT, firms with low levels of endogenous capabilities are under-represented, while those with high levels are over-represented. Finally, only 24% of the firms with a medium level of diffusion of ICT belong to the group with an intermediate level of endogenous capabilities. In this set of firms, which represents about half of the panel, the hypothesis that there is a systemic association between endogenous capabilities and the level of diffusion of ICT is confirmed.[27]

TABLE 1

Argentina: Distribution of groups of firms by degree of diffusion of information and communication technologies (ICT) and by level of development of endogenous capabilities

A. Diffusion groups, as a percentage of total number of firms

Level of diffusion of ICT	Level of development of endogenous capabilities[a]			Total
	Low	Medium	High	
Low	59[b]	18	23[b]	100
Medium	42	24	34	100
High	21[b]	17	62[b]	100
Total	42	20	38	100

B. Percentages of total number of firms in the panel

Level of diffusion of ICT	Level of development of endogenous capabilities[a]			Total
	Low	Medium	High	
Low	21	7	8	36
Medium	15	8	13	36
High	6	5	17	28
Total	42	20	38	100

Source: Prepared by the authors on the basis of the survey on the use and diffusion of information and communication technologies in Argentine manufacturing carried out by the Institute of Industry/Institute for the Greater Buenos Aires Conurbation (IDEI/ICO), Universidad de General Sarmiento.

[a] Chi squared test significant at the 1% level.

[b] Z test significant at the 1% level (see footnote 25).

[25] When examining the relation between two qualitative variables we considered on the one hand the chi-squared test in order to contrast the significance of the association between them, and on the other hand a Z test for the differences of proportions between each pair of forms. This latter test contrasts the contribution of each pair of categories to the chi-squared. A significant relation may be said to exist (over- or under-representation) when the corresponding test has a 10% significance level.

[26] The value of 25 obtained for Pearson's chi squared permits us to reject the hypothesis that there is no association between variables with a 1% significance level.

[27] In order to contrast the hypothesis that the diffusion of ICT depends on the level of endogenous capabilities reached, a linear regression analysis was also made between the two variables, including the size of the firms as an additional independent variable. In order to estimate the model with the data for the 246 firms studied, a numerical index was used which was constructed on the basis of the sum of the values assumed for each of the categories associated with ICT, on the one hand, and with endogenous capabilities on the other. The sales of the firms in 2001 were used as a proxy variable for their size. As may be seen from table A.6 of the statistical appendix, there would appear to be a positive relation between the level of endogenous capabilities and ICT, and also between the size of the firms and the level of diffusion of information and communication technologies. Similar results were obtained using an ordered Probit model, taking the level of diffusion of ICT as a dependent variable. The foregoing analysis does not make it possible to see what is behind the estimated coefficients, however: that is to say, the variance between cases. It was therefore decided to opt for examining the information by means of a non-parametric analysis.

There are two interesting hybrid cases where this hypothesis is not fulfilled: in 28% of the firms the level of endogenous capabilities reached was higher than the level of diffusion of ICT, and in the remaining 26% the opposite situation was observed (section B of table 1).[28]

By combining the levels reached in terms of endogenous capabilities and diffusion of ICT, four groups may be identified:[29] i) high levels of endogenous capabilities and high levels of diffusion of ICT; ii) low levels of endogenous capabilities and low levels of diffusion of ICT; iii) levels of endogenous capabilities higher than those of diffusion of ICT; and iv) lower levels of endogenous capabilities than of diffusion of ICT.

i) High levels of endogenous capabilities and high levels levels of diffusion of ICT (17% of the panel)

The firms in this group display most of the attributes of "virtuous" groups: high levels of both endogenous capabilities and diffusion of ICT. In this sense, they differ from the intermediate cases —iii) and iv)— in terms of attributes linked with information and communication technologies and also with endogenous capabilities. With regard to the technologies used, these firms are markedly different from the rest because of their greater use of complex software in the management area (support for decision-making at the middle and higher management levels) and in that of production, as well as in the importance they attach to the training of their staff in informatics (table A.7 of the statistical appendix). If we also take account of the high level of endogenous capabilities reached by these firms, it could be argued that the diffusion of ICT can be a positive contribution in some phases of the metabolism of knowledge. These phases include both the conversion of tacit knowledge into information and the combination of information from various sources into new tacit and codified knowledge. In other words, the high levels of endogenous capabilities of this group reflect the development of learning processes involving both codified and tacit knowledge of some degree of complexity. Likewise, in view of the importance assumed by information and communication technologies, these would permit connections both between different areas within the same firm and between different groups of firms and could therefore act as a vehicle for the circulation of codified knowledge and for promoting the codification of tacit knowledge generated in the various working environments.

This group displays a high relative presence of firms which have some proportion of foreign capital in their ownership and are medium-sized or large in terms of both sales and number of employees. It also displays a marked degree of sectoral specialization, since 65% of the firms are concentrated in five sectors (chemical products, motor vehicle parts, rubber and plastic products, electrical machinery and equipment, and medical and measuring instruments).

Most of the firms in this group have a considerable degree of openness to the exterior, as reflected in a high export coefficient and the magnitude of their imports of inputs (table A.7 of the statistical appendix). Finally, as regards their market dynamism, the considerable weight of the firms whose sales increased during the 1990s should be noted.

ii) Low levels of endogenous capabilities and low levels of diffusion of ICT (21% of the panel)

The firms in this group display the predominant features of the groups with low levels of endogenous capabilities and low levels of diffusion of ICT. This means that neither the information they receive and process nor the development of learning processes appear to be of much significance. As regards the degree of diffusion of ICT, they are characterized by the presence of basic-level software in the management and administrative areas and the absence of complex software in the area of production. As for the levels of endogenous capabilities reached, most of these firms do not have certified quality control systems or research and development teams. They also make little effort to train their staff and their employees generally have low levels of skills.

In this case, the low levels of endogenous capabilities give grounds for assuming that there are only feeble learning processes and, in view of the low levels of diffusion of ICT, only very limited codification of the tacit knowledge which may exist.

In this group, domestic-capital firms predominate which are small in terms of both sales and numbers of

[28] If only these two cases are taken into account in the estimation of the regression model referred to in the previous footnote, the endogenous capabilities variable ceases to be significant for explaining the behaviour of the diffusion of ICT. Consequently, in these groups qualitative analysis becomes even more important.

[29] In this analysis, no account is taken of the 8% of firms with medium levels of diffusion of ICT and medium levels of endogenous capabilities.

employees. These firms are agents with a very low export coefficient, and they purchase few imported inputs. Almost two-thirds of the firms in this group had a negative sales performance in the 1990s, and this was reflected even more starkly in their employment figures. They display less specialization, and most of them carry out activities which are generally less complex than those of the previous group (rubber and plastic products, motor vehicle parts, metal products, foodstuffs and furniture).

iii) Levels of endogenous capabilities higher than those of diffusion of ICT (28% of the panel)

Most of the firms in this group are in a stage of their technological trajectory in which, although they have medium or high levels of endogenous capabilities, they have not yet reached a high level of diffusion of ICT.

Although this group does not differ much from the most virtuous one in terms of its levels of endogenous capabilities, some of its attributes cause it to be located in a lower category. Among these are the lesser importance assigned to quality control systems and the lower relative weight of training.

In view of the definition of this group, it would seem of interest to explore the various attributes connected with the diffusion of ICT which caused this group to occupy a lower level than the most virtuous group. Firstly, it is important to note that the lower degree of development in this respect is not located in any area in particular (management, production or communication), but corresponds to a generalized lag in the adoption of this type of technology.

With regard to the management area, this group differs from group i) in the low level of complexity of the software and equipment used,[30] the more limited use of its servers, and the lesser importance attached to training in the field of informatics.

The same is true in the production area, where there is not only limited use of this type of tools but also a low level of complexity and lack of integration with the rest of the firm. Thus, the number of persons in different areas who interact with each other is significantly less than in group i). Likewise, the degree of synergy and proper utilization of the learning process are also more limited.

Finally, if we look at the characteristics regarding the use of ICT as a tool for communication, it is noteworthy that these firms assign little importance to the use of the internet, intranet and e-mail (table A.7 of the statistical appendix).

In terms of the size of the enterprises, small firms predominate,[31] while as regards sectoral specialization the most important branches were motor vehicle parts, metal products, machinery and equipment, rubber, and chemical products, which accounted for 67% of the production of the firms in the group.

In this case, the relatively high degree of development of endogenous capabilities is reflected in quite a high degree of generation and circulation of codified and tacit knowledge. The shortcomings observed in terms of the diffusion of ICT do not permit the enhanced circulation of this knowledge, however.

iv) Lower levels of endogenous capabilities than of diffusion of information and communication technologies (26% of the panel)

This group of firms is located at a low level, because the position they occupy in terms of the level of development of endogenous capabilities is relatively lower than the degree of diffusion of information and communication technologies in them. As noted at the beginning, the fact of having made progress in the incorporation of these new technologies, even in the absence of a prior competitive base, should at all events enable these firms to occupy a higher level than those registering both a low level of endogenous capabilities and limited diffusion of ICT. The firms in this group have better performance in the domestic and foreign markets and a higher level of diffusion of ICT than all the other groups except i). This is reflected in general in a greater presence of servers with database engines; interconnected networks; training in informatics; substantial use of the internet, e-mail and the intranet; complex management software; design software in the production area which is integrated with the rest of the firm, and, to a lesser extent, integrated planning and control software. It should be noted, however, that in these latter aspects, which are considered to be of key importance for defining the level of complexity attained in the diffusion of ICT, there is a significant distance between these firms and those in group i).

In terms of endogenous capabilities, as may be

[30] There is total predominance of basic-level office software in this group, which brings it down to a level similar to that of the least virtuous group in the panel.

[31] In 2001 these firms had a sales turnover of up to US$ 3 million

seen in table A.7 of the statistical appendix, this group occupies a position which is higher than that of group ii) but below that of groups i) and iii).

In view of the low level of these capabilities, there is little generation of codified and tacit knowledge. In this respect, although the greater importance attached to ICT should make possible a higher degree of connection between the different areas and better circulation of knowledge, there are limitations due to the shortcomings in question.

Among the structural features which distinguish this group from the weakest one is the greater relative size of the firms, among which medium-sized and large enterprises predominate. Furthermore, this is the group with the greatest sectoral diversification, the five main activities being chemical products, electrical machinery and equipment, machinery and equipment, motor vehicle parts and printing and publishing. Although, in view of the predominant sectors and sizes of enterprises, the level of endogenous capabilities reached could be expected to be higher than that actually registered, this might be explained by questions of structural heterogeneity.

V
Conclusions

In this article we have analyzed the use and diffusion of ICT in Argentine industry with two main objectives: to provide an empirical map of the use and diffusion of these technologies in manufacturing, and to identify the linkages between this diffusion and the development of endogenous capabilities in the enterprises in question.

The study shows that ICT is widely disseminated in industrial activity and that most of the firms have made significant investments in those technologies, especially in certain periods – such as the period of convertibility – when the cost of computers and software was relatively low compared with other goods. Both the level of diffusion of ICT and the use made of these technologies show weaknesses, however, which may be summarized as follows: generally speaking, the diffusion of these technologies is greater in the administrative area than in that of production, and in both areas there are many cases of the use of relatively unsophisticated tools for tasks of a low level of complexity.

The evidence assembled shows that, in the firms included in the panel, this process is uneven and incomplete and that most of them are far from having applied informatics in the major part of their processes and integrated the sources of information of their different areas (production, marketing, purchasing, etc.). The level of progress in the outside linkages of these firms is at an even more incipient level. Thus, for example, although most of the firms have web pages, few of them make sales electronically or contact their suppliers by this means. The study found almost no indications of more complex actions such as the establishment of networks among small and medium-sized enterprises for the exchange of information or local or sectoral cooperation. Nor is there any evidence that the incorporation of ICT has led to appreciable changes in the forms of organization of production (within the plant, or between different plants where a given enterprise carries out different processes).[32]

Within these global characteristics, however, there is a high degree of heterogeneity, which it was possible to examine more systematically on the basis of an analysis of groups which are more homogeneous in terms of the degree diffusion of ICT. Similar heterogeneity was observed in respect of the uneven development of endogenous capabilities.

When the classification of firms as a function of their endogenous capabilities is compared with their classification by degree of diffusion of ICT, a high degree of coincidence between the two groups is observed. Thus, a little less than 50% of the firms are located at the extremes of the two classifications (high levels of endogenous capabilities and high levels of diffusion of ICT and low levels of capabilities and diffusion). The gulf between these extreme groups is very

[32] This evidence collected in the case of Argentina is also partly applicable to other Latin American countries. It also shows the need for caution when interpreting ICT indicators based solely on the development of web pages, e-mail, intranet and extranet, when these are not supplemented with information on the application of ICT to the production process and relations with clients and suppliers.

significant in both of the indicators in question. Thus, 60% of the firms in the first group train their staff in informatics, while only 6% of the second group do so, and the percentages are similar for the use of complex computer programmes (65% against 4%). These differences highlight the big disparities between the extreme cases in the survey.

We thus see that in the set of firms studied, there is a very marked direct relation between endogenous capabilities and the degree of diffusion of ICT. At the same time, however, the same data reveal that the incorporation of these technologies and their applications in the manufacturing firms analyzed are not only a consequence of the endogenous capabilities attained, although those capabilities are a powerful predictor of the degree of diffusion of ICT, for the size of the firms is also an important variable, showing the indivisibilities that exist in the acquisition of computer equipment and programmes.

Obviously, the most interesting cases are those corresponding to the two intermediate groups, where the working hypothesis is not fulfilled: high (low) levels of endogenous capabilities and low (high) levels of diffusion of ICT. The two intermediate groups very clearly show something which has already been noted in the specialized literature, namely, the varied ways in which these technologies are incorporated in firms and the different rates at which firms introduce informatics tools. The existence of these two groups in the sample suggests that the incorporation of ICT may lag behind the path already travelled by the firm, or it may run ahead of their capacity to make full use and take full advantage of the new technologies. Imbalances may thus be observed within the firms which can act as a burden or a new motor of progress in their forward path. It may well be imagined that firms whose progress in terms of endogenous capabilities outstrips their level of incorporation of ICT could strengthen their endogenous capabilities by a more systemic incorporation of information and communication technologies.

In short, the process of incorporation of ICT is unbalanced and unequal in many senses: within the firms themselves (for example, between the areas of production and management), between different firms, and between sectors of activity. The diffusion process has advanced along the lines of least resistance, being connected with structural factors such as the size of the firms and the capabilities they have acquired in the course of time. The data obtained gives grounds for inferring that, in most cases, the most interesting potentialities of ICT (such as the possibility of promoting internal learning processes) are still only being exploited in a very incipient manner.

In line with this set of arguments, it seems appropriate to contrast the foregoing conclusions with the recommendations of some international experts who specialize in the digitalization of the operations of manufacturing and services enterprises.

After having had some rather unrealistic views on the immediate potential of ICT, many of these experts are now a good deal more cautious in their recommendations. They now say that the incorporation of information and communication technologies in firms should be subject to a joint analysis which also involves the trading strategies of the firms. The degree of digitalization of a firm cannot be considered in isolation, but must also take into account its business strategy (Slywotzky and Morrison, 2000).

Much of the literature on real cases of the diffusion of ICT offers elements of interest for the matters addressed in the present study. It has been stated that the incorporation of ICT is a process which runs into various types of resistance within firms and in their links with suppliers and clients. This resistance is due to difficulties of communication between the experts in these fields and the persons responsible for running the various areas of a firm; fear of change and of the unknown; and difficulties in choosing technologies. Moreover, there is the difficulty of finding digital solutions to improve production processes, which are less generic in nature than those developed for the administrative and management areas. In order to incorporate information and communication technologies it is necessary to have a horizon and time sequence that depends on the evolutionary path of each individual firm (Slywotzky and Morrison, 2000; Windrum and de Berranger, 2002).

In conclusion, the data and views presented here serve to identify a set of questions that may usefully be taken into account in policy design. Firstly, the systemic incorporation of information and communication technologies cannot be seen as a process that is independent of the development of the endogenous capabilities of the firms involved. Secondly, it must be borne in mind that the Argentine manufacturing sector, like that of many other countries of the region, is made up of very diverse organizations which have very dissimilar possibilities of incorporating such technologies in their internal processes and their links with suppliers and clients. In this respect, the identification of four groups in the joint analysis (based on the two

analyses of homogeneous groups) clearly shows that there is a limited number of stages or types of diffusion of ICT that can be envisaged for incorporating these technologies into Argentine industry. Thirdly, policies for promoting the incorporation of information and communication technologies in firms should recognize from the beginning that such incorporation is more than just a new element to be put on the firms' balance sheets. It does not seem reasonable, therefore, to propose isolated policies which do not take account of the fact that the diffusion of these technologies and their effective use is a complex and relatively slow process.

(Original: Spanish)

Statistical appendix

Nature and distribution of informatics equipment

TABLE A.1

Argentina: General infrastructure and equipment for information and communication technologies in the management area

Infrastructure and equipment	Percentage of firms
Networks	87
Local	75
Wide area	15
Integrated services digital network/ asymmetrical digital subscriber line	56
Servers	78
Servers with a database engine	41
Networked printers	79
Shared scanners	31
Shared plotters	13
Shared hard disks	68

TABLE A.2

Software used by firms

Type of software	Percentage of firms
Management	
Off-the-shelf	77
Complex (CASE tools, CUBO software, Datawarehouse)	13
Production	
Manufacturing	4
Planning and control	30
Design	50

TABLE A.3

Informatics equipment in the production area

Equipment	Percentage of firms
Programmable logical control	23
Computerized numerical control	11
Robots	8
Numerical control	6
Assembly and fitting system	4
Flexible manufacturing cells	2

TABLE A.4

New communication tools used by firms

Tool	Percentage of firms
Web page	54
Internet access	96
75% of staff with internet access	18
e-mail	96
75% of staff with personal e-mail accounts	37
Intranet	57
75% of staff with access to intranet	28

TABLE A.5

Form of links with other firms and institutions

IForm of link	Percentage of firms		
	Total	With other firms	With institutions
e-mail	95	93	80
Telephone	90	87	74
Visits	46	38	36
Internet	24	22	16
Intranet	13	12	3
Mail	17	14	10

TABLE A.6

Results of regression analysis[a,b]

	Regression analysis Total sample of firms	Regression analysis Intermediate groups
A	11.4 (11.9) [c]	18 (15.1) [c]
B	0.53 (7.1) [c]	$8.3*10^{-3}$ (0.09)
C	$9.7*10^{-3}$ (3.6) [c]	$2.6*10^{-2}$ (3.4) [c]
R^2 (adjusted)	0.23	0.06
F	35.0 [c]	5.8 [c]

[a] Model: Index of homogeneous dissemination groups = A + B (index of endogenous capabilities) + C (sales, in millions of dollars).
[b] Figures in parentheses correspond to t statistic.
[c] t is significant at the 5% level.

Source for all tables in this appendix: Prepared by the authors on the basis of the survey on the use and diffusion of information and communication technologies in Argentine manufacturing carried out by the Institute of Industry/Institute for the Greater Buenos Aires Conurbation (IDEI/ICO), Universidad de General Sarmiento.

TABLE A.7

Percentage of firms belonging to each of the four groups, by attributes

Attribute	High levels of endogenous capabilities and of diffusion of ICT (group i)	Higher levels of endogenous capabilities than of diffusion of ICT (group iii)	Lower levels of endogenous capabilities than of diffusion of ICT (group iv)	Low levels of endogenous capabilities and of diffusion of ICT (group ii)
1. Structural characteristics				
Sales under 0.5 million	0[a]	15	10	41[a]
Sales between 0.5 and 3 million	12[a]	48[a]	37	26
Sales between 3 and 8 million	29[b]	17	13	20
Sales between 8 and 20 million	33[a]	9[b]	23	11
Sales over 20 million	26[a]	11	18	2[a]
Fewer than 20 employees	0[a]	27	27	39[b]
21 to 50 employees	21	39[b]	18	29
51 to 100 employees	28[b]	19	11	14
Over 100 employees	51[a]	15[a]	44[a]	18[b]
Foreign direct investment	40[a]	18	22	6[a]
Export	80[b]	70	75	45[a]
Merger or purchase	42[a]	21	23	22
Do not import inputs	17[b]	40	26	47[b]
Increased sales in the 1990s	56	40	66[b]	39
Motor industry	18	24[b]	6[a]	14
2. Endogenous capabilities				
Fully implemented quality control system	91[a]	55	31[b]	10[a]
Existence of a research and development team with full-time personnel	44[a]	36[b]	16	6[a]
New products account for over 30% of sales since 1995	50	56	41	34
Operatives programme machines used in their cells, at least sometimes	81[a]	55	34[b]	33[b]
Medium or high levels of training efforts (over 40% of staff involved)	69[a]	55	31	16[a]
High proportion of technical personnel	67[a]	54[a]	20[a]	18[a]
3. Diffusion of ICT				
Server and database engine	67[a]	30[b]	55	24[a]
Backup and UPS[c] systems	93[a]	49	70	49
Have interconnected network, at least internally	33[a]	10	27	6[a]
Complex management software	65[a]	3[a]	31	4[a]
Only basic-level office software	33[a]	92[a]	58	92[b]
Complements or contracts in informatics	35[b]	70[b]	42	71
Training in informatics	60[a]	14[a]	34	6[a]
Integrated planning and control software	77[a]	9[a]	17	10[a]
Complex hardware and software in the production area	47[a]	18	20	14
Does not have design software	28[a]	55	48	77[a]
Design software integrated in production	42[a]	5[a]	20	6[b]
Low level of importance of internet	12[a]	49	13[a]	84[a]
High level of importance of internet	30	25	31	0[a]
Low level of importance of intranet	35[a]	78	67	96[a]
High level of importance of intranet	35[a]	8	13	0[a]
Medium level of importance of e-mail	2[a]	39	2[a]	75[a]
High level of importance of e-mail	98[a]	58	98[a]	22[a]

Source: Prepared by the authors on the basis of the survey on the use and diffusion of information and communication technologies in Argentine manufacturing carried out by the Institute of Industry/Institute for the Greater Buenos Aires Conurbation (IDEI/ICO), Universidad de General Sarmiento.

[a] Z test significant at the 5% level.

[b] Z test significant at the 10% level.

[c] Stabilizer designed to protect delicate equipment from surges or interruptions in the electricity supply.

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