

ICT in Chile at the Beginning of the Fourth Industrial Revolution*

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This paper shows the current status of companies in the information and communication technology (ICT) sector in Santiago, Chile. It presents the results of interviews with 13 ICT companies, reviewing structural elements that determine the development of the sector. For this purpose, a qualitative analysis of that interviewed group is carried out to identify their different linkages and work dynamics. This sector has a great capacity for stimulating innovative development throughout the national economy, a key element in the paradigmatic change that the so-called fourth industrial revolution imposes on us.

Keywords: technical change, software industry and Internet services, government policies, microelectronics, computers and communications equipment

Introduction

The ICT (information and communication technology) sector has two dynamic characteristics: It can generate learning processes and it can distribute technological knowledge to the rest of the economy. Because of these factors, its advancement as a competitive industry constitutes an important opportunity for socio-economic development in Latin American countries (Bastos & Silveira, 2009; CEPAL, 2010; Hernández, Mulder, Fernandez-Stark, Sauvé, López, & Muñoz, 2014).

In the context of what has been called “the Fourth Industrial Revolution” (Schwab, 2016), significant improvements in the digitalization of productive processes, especially the infinite possibilities that arise in decision-making with information generated and processed at different points in the production chain, are becoming more apparent. We expect that in this environment, Chilean ICT companies will make headway in

* This article is part of the Fondecyt research project “How much knowledge does the offshore IT industry and annexed chains (outsourcing, software, communications, retail, finance, and others) transfer to the development of the Santiago Metropolitan Region?”.

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new big data applications, sensor applications, geographic information systems (GIS), and the Internet of things.

Taking advantage of the potentialities of ICT in the context of the Fourth Industrial Revolution demands a change in the neo-liberal paradigm of horizontal politics. The State can stimulate (and not replace) private initiatives, confidence building, and the development of mixed productive conglomerates centered on innovation. These conditions will push the sector to establish a cycle of exigence and technological diffusion between ICTs, not only within highly innovative productive conglomerates from other sectors of the economy, but also within small and micro companies.

This study shows quantitative results through in-depth interviews. Our main intention is to describe the ICT sector and identify how it is making an innovative change between ICT and non-ICT companies. Elucidating these points is fundamental for setting the bases of how to push a country forward into development through the ample diffusion of ICT together with the economy, in the context of a growing digitalization of our economy.

The conviction of structural changes to achieve effective public policy in development has experienced a frustrated existence since 1990. The desire to change public policy (first in cluster from 2000-2009, and, since then, the PROFOS-MIPE associated businesses) did not give the desired results and the right-leaning government of 2010-2014 continued to suppress these weak, though well-intentioned, policies.

Thus, a structural change underlines the importance of the turn in the State's economic position, retaking the historic position of the Development and Reconstruction Corporation (CORFO by its Spanish acronym), creating ample opportunities for innovation with productivity, and creating added-value and incentives in the third generation of production and services to overcome the State's poor incursion in property.

It is fundamental, considering the centrality of ICT companies in the context of the Fourth Industrial Revolution, to have active public policy in the economy if it is to be able to aid new entrepreneurs of base technologies, fueling the potential of technological transfer and innovation. All of the above mentioned require eliminating current bias and neo-liberal orthodox, passing from an arbitrary State to type of linker State.

Antecedents of Chilean ICT Companies

This section will group together the principle results published in the authors' articles (Falabella & Gatica, 2017), so as to give a context for the quantitative analysis.

- The Chilean ICT sector shows good indicators with respects to infrastructure and conditions necessary for its expansion (Cominetti, 2002; Kearney, 2009), as well as in its access and use of ICT goods and services in the economy. At the same time, the existing antecedents show uses with limited impact on development and an increasing complexity of productive activities that imply qualitative jumps in added-value, with relevant differences between big business and for small and medium enterprises (Varela, 2003; EMG Consultores S.A.-MINECON, 2006; Subsecretaria de Economía, 2006; Lever, Myrick, Soto, & Andrés, 2009; Castillo, 2013).
- There is a verified relationship of extended buying and selling with practically all other economic sectors. This shows a highly flexible operation, although usually in small amounts.
- A high level of linking between ICT companies with point and service chains (engineering, finance, tourism, and transportation) has also been observed.
- A low level of linking in ICT sectors that are export intensive in natural resources (NR) (mining, cellulose forestry, fruit-growing, and viticulture) has been detected. This confirms that the revitalizing potential of ICT

is determined by the national and regional economic structures: They are centered in NR and enclave, of low complexity, and, because of that, do not demand new information services.

- An analysis of FONDEF (Funds for Encouraging Scientific and Technological Development, created in 1991 with the aim of contributing to an increase in the national economy’s competitiveness and improving the quality of life of Chileans, promoting the tie between research institutions, businesses, and other entities) that was carried out in the periods 1990-2000 and 2001-2010 detected a high concentration of this type of project in emblematic universities at a national level.

Comparison of ICT Networks Through FONDEF Projects

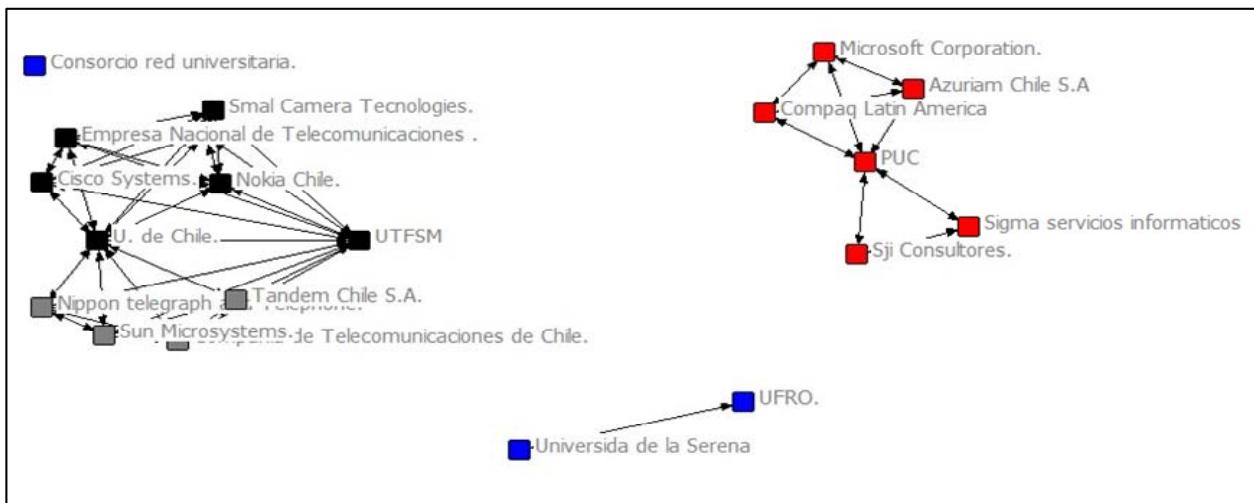


Figure 1. Technology web 1990-2000. Source: Research performed by the authors (Falabella & Gatica, 2017).

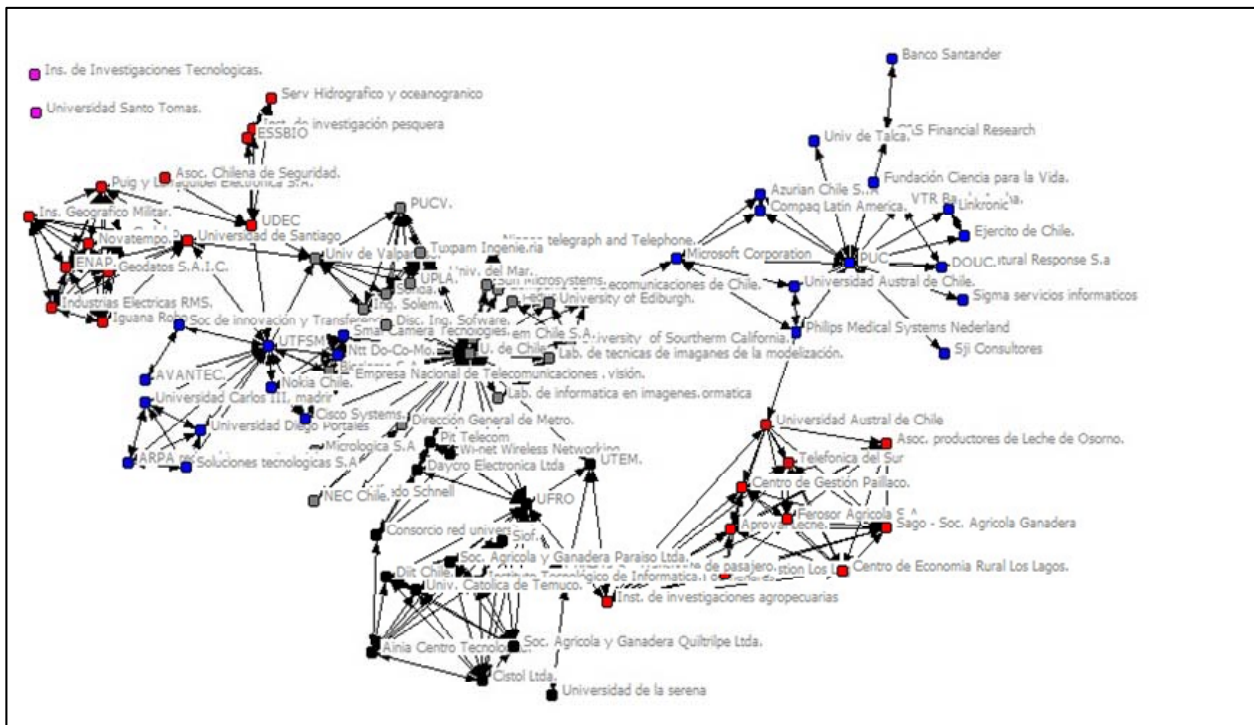


Figure 2. Technology web 2001-2010. Source: Research performed by the authors (Falabella & Gatica, 2017).

- From 1990 until 2000, an “embryonic” phase of development was observed; between 2001 and 2010, a “recent consolidation” phase was seen, which implicated a certain amount of maturity in the technological and investigatory field. It also shows certain networks articulated around emblematic universities, primarily in the Metropolitan Region.

- We have a software and information services development industry that has provided a high quantity of activity in the national economy and possesses technology networks that are beginning to become more complex (see the previously presented graphics). We are not able to observe a sector “captured” by any specific sector, although it is possible to generate learning curves in key activities which become evident by the presence of subgroups in the global technological network and that would respond to “vertical activities” that would focus on generating solutions for specific sectors.

- The references show that the production of the ICT activity in its wider sense (considering telecommunication and Internet services, technical assistance, professional ICT consultants, ICT trade, integration and development and programming of software), is dominated by large Internet and communications companies, with other value-added services being limited, and a lesser presence in activities dedicated to lending technological services of high complexity or software development (the majority being small and medium-sized companies) (EMG Consultores S.A.-MINECON, 2006; Fernandez-Stark, Bamber, & Gereffi, 2010). The articulation of the national market is predominately low percentages of exportations (Varela, 2003; EMG-MINECON, 2006; Acha & Bravo, 2009).

- Finally, there is a high concentration of national activity in Santiago. On this, the work of Acha and Bravo (2009, p. 111) asserted that “the software industry is located almost entirely in Santiago, 92%, and 8% in the Fifth Region, and it serves, almost exclusively, the Metropolitan Region”. This centralism is also detected by the study of Fernandez-Stark et al. (2010). Santiago contains multiple urban centers, a critical mass of potential innovators, a large availability of a highly qualified (MBA, PhD) workforce, and professionals who speak English well, which allows them to do better in business.

In conclusion, we have an industry with a high diffusionary capacity concentrated in the national capital (Santiago), which has not been able to generate a great amount of linkage with exporting activity. Its technology networks are becoming more complex and are acquiring more specialization in certain sectoral fields. In this context, it is necessary to review the depth of some types of businesses like small and potentially innovative businesses.

This work examines the need for a more profound knowledge of this type of company to detect new products and processes. The new digital economy demands a reformulation of our traditional frames of analysis. We must necessarily review more “micro-analytics”, generating, in the long term, new frames of analysis.

Methodology

The results of the in-depth interviews with 13 ICT companies (mainly small but highly specialized companies with a great potential for innovation) are given here. The following axes of analysis have been developed:

- (1) Structural information where the average age, percentage of external capital, subcontracting activities, presence of R&D forces, and principal products have been allocated;

- (2) Information about the productive linkages. This implicates identifying the weight of the principle buyers. The data are contrasted with the Product Input Matrix (PIM) for this sector that was recently studied in

an article published by the current authors (Falabella & Gatica, 2017). The PIM was reviewed on a national level in 2008, elaborated by the Central Bank, and the “Information Services” product was chosen, which includes software development. With respect to the classification, “Information Services” is the finest level of separation that the PIM makes available;

(3) Text analysis using a tool known as QDA (Qualitative Data Analysis) Miner Lite¹ (open use software) to analyze the transversality of the in-depth interviews. This works with transcriptions of the surveys directly from the software. Three points are developed: The principle products in the interior of the analyzed group are identified, the highest frequency clients are determined, and the the most relevant structural topics are presented. The text analysis is generated through a coding system generated by the researcher in each in-depth interview. The identification of each code is made by the body of each text;

(4) The quantitative analysis of the interviews allows us to establish a profile of distinct key aspects in the dynamics and the relationships that the ICT companies are involved in, as well as the perceptions that the informants have over certain processes and interactions that they deem relevant;

(5) A survey of the principle features with respect to the qualities and not of a numeric distribution of the companies in them. This said, the distinct profile of the companies interviewed, with respect to their pertinence to the diverse Knowledge Process Outsourcing (KPO), Business Process Outsourcing (BPO), and Information Technology Outsourcing (ITO) segments (Fernandez-Stark et al., 2010) allows for the outlined attributes to consider an interesting variety of ICT company in terms of type.

(a) The information is grouped according to the linking variables and innovation knowledge;

(b) They first indicate the aspects that are common to all the companies to then indicate some specificities by type.

In the end, a mix of methodologies is proposed which brings together quantitative and qualitative approximations to address this problem. Clearly, this approach to this type of innovative sector requires working with the products and the definitions with a higher level of detail, as the sectoral classifications are so wide. This work finds itself in an intermediate situation, using old technology to deal with new categories.

Description of the Objective of the Study

On average, the companies interviewed are 21 years old. It should be noted that they were installed in the first “embryonic stage” of the industrial development, between 1990 and 2010. This draws another conclusion: An average life of 21 years, where the shortest lifespan is 13 years, shows a low turnover in the business market. The companies have withstood the test of time.

Of the 13 companies, only five were created in the consolidation stage of the technological network (38%), showing that the evolution of technological development initiatives, confirmed by the previous study, was slower than the creation of the companies. For this reason, the networks of R&D presented previously were reactive to the empresarial development.

Only 28% of the companies have foreign capital. A large portion of the companies use national capital which relates to their small size.

With respect to the principal position of the companies in the chain: A minority deal with web design. The vast majority of the companies take on a role of producer and, at the same time, intermediary (22%).

¹ QDA Miner Lite. Software para el análisis textual. Programa Libre. <https://provalisresearch.com/products/qualitative-data-analysis-software/freeware/>.

Notwithstanding, there are companies that specialize in the role of producer and intermediary, separately. Also, there are some companies dedicated to system integration.

In terms of size, the majority of the companies interviewed are small. On average, they have 31.1 workers and sell an annual median of 25,000 UF (MM\$660 or one million dollars). From this we can deduce the nature of these technological companies. They are small organizations with a lot of know-how and a low intensity in physical capital. This correlates to three results:

(1) There are no unions in the companies interviewed. This can be explained by a form of individual negotiation, characteristic of high technology sectors;

(2) They have a very low rate of workers with graduate degrees. Of the interviewed bloque, approximately 1% have a graduate degree; this figure is low considering that a national project is the generation of an offshore ICT platform on a global scale, which requires highly qualified staff (MBA, PhD) who have English speaking skills, something that appears relatively frequently in Santiago. It is important to note that this diagnostic took place before the explosion of tools used in the Fourth Industrial Revolution like big data tools, Internet and BI (business intelligence); probably a better standards for ranking are required;

(3) The average age of the workers is 35 years old. It is a young workforce with professional training. The data show that the average worker of the analyzed companies has 10 years of professional experience.

It is interesting to note that 46% of the companies report having a research and development department. This rate is higher than the national average (for more information on this, see the 9th Survey on Innovation from April 2016 which suggests that the ratio of innovation, understood as the percentage of companies that carry out some kind of innovation over the total number of companies, was 16.6% for the years 2013-2014), which shows that the sector is thriving from the point of view of innovation. The latter could be explained by the nature of the sector in which software production principally implies adaptation processes.

A high percentage of subcontracting is observed, reaching 30.8% in the interviewed companies. This indicator shows a horizontal subcontracting which allows the companies to achieve the benefits of higher specialization and flexibility. The main motives for subcontracting are: developing specialized hardware, externalization in the programming, complementing technologies, and collaboration to offer integral services.

Just as it was shown in the Product Input analysis, this sector forms an important part of the economy. Its relative index of concentration is 0.1, close to the global economy's of 0.07. The sector presents a great diffusion capacity as it provides to 102 sectors, representing 92% of the total economy. By looking at the principal products, we can prove that they offer technological solutions that respond to many sectors in a transversal way. Solutions specific to the mining sector (the main national economic sector) were only offered by two companies at time of the interview.

Principal Results

Review of Sectoral Linkages From the Group of Companies Interviewed

An interesting viewpoint comes from contrasting the current sectoral linkages from the bloque of the analyzed companies with the distribution of their contribution to the national GDP and the sectoral participation via the PIM. For the effects of the analysis, two indicators have been calculated:

- One indicator of relative specialization shows which sectors of the group of ICT companies analyzed have a higher participation than that of a similar sector in the general economy. If the indicator is higher than one for the ICT sector analyzed ($n = 13$), it can be concluded that it has more relative importance in the analyzed group

than in the national economy; for the effects of analysis, this indicator resembles the localization quotient where $CL > 1$ represents a relative specialization in a territory or region.

- The other indicator is of the profitability of the linkage. This compares the participation of the sectors over the group of studied companies ($n = 13$), with the distribution of sales by sector of the ICTs using the data from the PIM. An indicator above one shows a profitable sector, where a low quantity of sales has a high quantity of financial resources exchanged.

Table 1

Regarding the Sectoral Linkages of ICTS

Branch of economic activity	A) % share in GDP (source: Central Bank)	B) % distribution of sales of computer services (Source: Matrix Input Product)	C) N° companies that provide sectors (survey of ICT companies $n = 13$)	D) % of sectoral distribution	Relative specialization (D/A)	Profitability of the sector link (B/D)
Farming, silviculture and fishing	3.5	0.3	3	9.4	2.7	0.032
Mining	14.8	3.6	2	6.3	0.4	0.576
Manufacturing industry	11.6	18.3	9	28.1	2.4	0.651
Electricity, gas and water	3.0	2.0	0	0.0	0.0	
Building	7.9	0.7	0	0.0	0.0	
Commerce, restaurant and hotels	10.6	15.3	5	15.6	1.5	0.979
Transport and communication	6.6	13.3	7	21.9	3.3	0.608
Financial and business services	19.8	39.3	3	9.4	0.5	4.192
Personal services and housing	17.4	2.8	2	6.3	0.4	0.448
Public administration	4.8	4.4	1	3.1	0.7	1.408
Total	100.0	100.0	32	100.0	1.0	1.000

Note. The number of sectors is greater than the number of companies. A company can have presence in several sectors. Source: Self made.

The first conclusion that can be drawn is that the most important sector, for this group of companies, is the manufacturing industry, accounting for 28.1% of the clients. Notwithstanding, when we analyze the profitability of these linkages, we find that it moves at a low range—0.651. We have a great number of transactions (28%) that only explain 18.3% of the transactions according to the PIM.

The second most connected sector is transportation and communication, representing 21.9% of the ties in the analyzed companies. Cellular phone applications are highlighted in this point. Their relative profitability is still low (0.608). This means to say that it weighs more in its linkage than in its participation in transactions.

The third sector—business, restaurants, and hotels—is very attractive. It explains 15.6% of the linkages and produces 15.3% of the transactions. In this group, we have the retail industry, which is experiencing a strong expansion into other Latin American countries.

Weighing in at 9.4% of the sectoral linkages, we have the agriculture, forestry, and fishing sector, along with the finance sector. These sectors, though, have big differences in profitability. In the first case, the profitability is very low. In the case of the finance sector, its profitability is the highest in the analyzed bloque. This link has 9.4% of the linkages and can account for 39.3% of the transactions in the PIM.

A separate mention should be made of the mining sector, which represents 14.8% of the GDP but only produces 3.6% of the transacted amounts and 6.3% of the linkages at the level of the company group. Mining has not been able to tie itself with the ICT sectors.

In the bloc of the analyzed companies, practically no work is observed for the construction or gas, water, and electricity production sectors. This result is convergent with the low weight of transactions of the PIM.

Finally, if we analyze the relative specialization indicator, where the distribution of sectors according to linkage is compared to the general distribution of the GDP, it shows that the ICT sector studied has specializations in agriculture and livestock, forestry, fishing, the manufacturing industry, commercial activity, and transportation-communication.

These conclusions are still too wide to identify the potentialities of the ICT sector in the context of a digitalized economy. It is necessary to open the analysis due to the transverse nature of the IT sector. Because of how sectoral statistics are formed, the ICT development inside of each sector may remain invisible to traditional statistics.

Products, Clients, and Key Topics

Through text analysis tools (QDA Miner Lite), we can get a transverse glimpse from the in-depth interviews, complementing the quantitative analysis as shown in the following points. First, the principal products inside of the conglomerate of interviewed companies will be identified. We will work with the names of the specific products, those that are grouped using the common concepts. In the second analysis, the main clients in the group of companies will be presented. It should be noted that these analyses consider the frequency of appearance of each concept in the different cases (companies).

With respect to product distribution in the bloc of analyzed companies. The majority of companies declare themselves as dedicated to the adaptation of imported software. It is worth saying that they dedicate themselves to import programs that can and must be adjusted to their local realities. This definition is fundamental to understanding the role that these companies play: More than generating radical innovation or incorporating new products or services, they assume the role of adapting innovations.

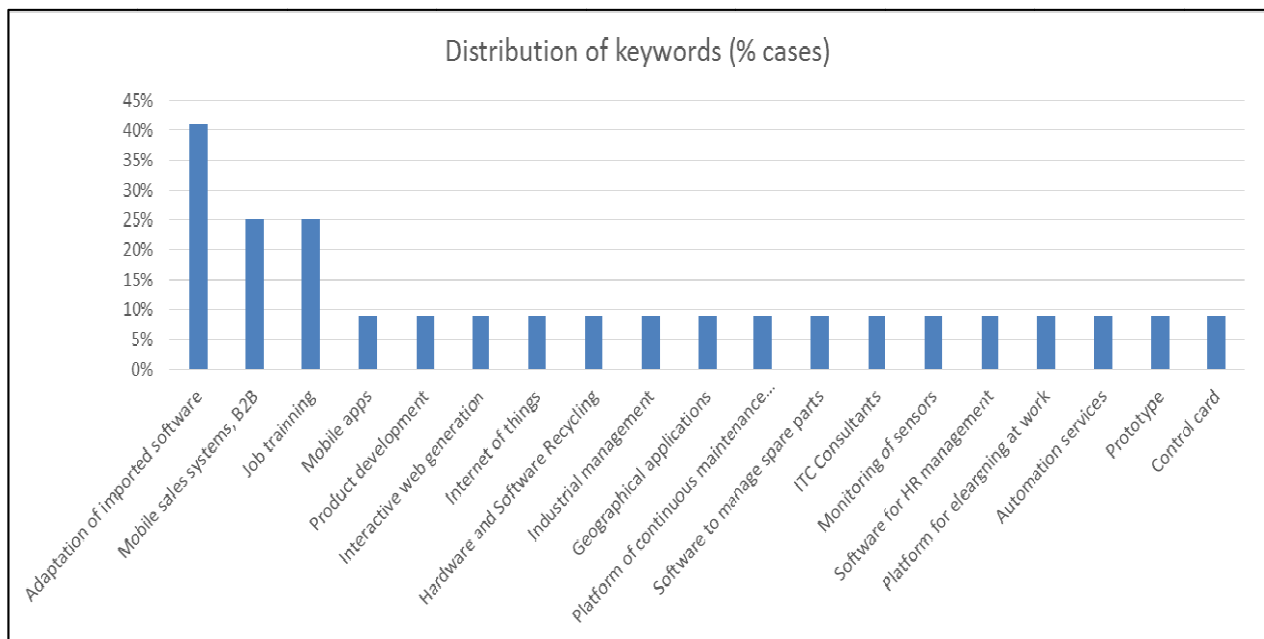


Figure 3. Distribution of keywords. Source: Analysis of the interviews using QDA Miner Lite software.

In a second dimension, we have the developments oriented at sales and at-work trainings. The latter is relevant because it ties the sale of software (generally imported) with training and after-sale consulting for the companies' clients.

In general, some products belonging to the so-called 4.0 industries (see Schwab, 2016) are important. These include applications tied to the emerging digitalization, e.g., Internet, automatic services, GIS applications, among others.

With respect to the principal clients. Within the interviewed group, there is a higher frequency of companies that consider themselves to have a transverse supply. It is worth noting that they serve many economic sectors at a time, resulting in a structural characteristic of this sector (this having already been proven in the product-input analysis).

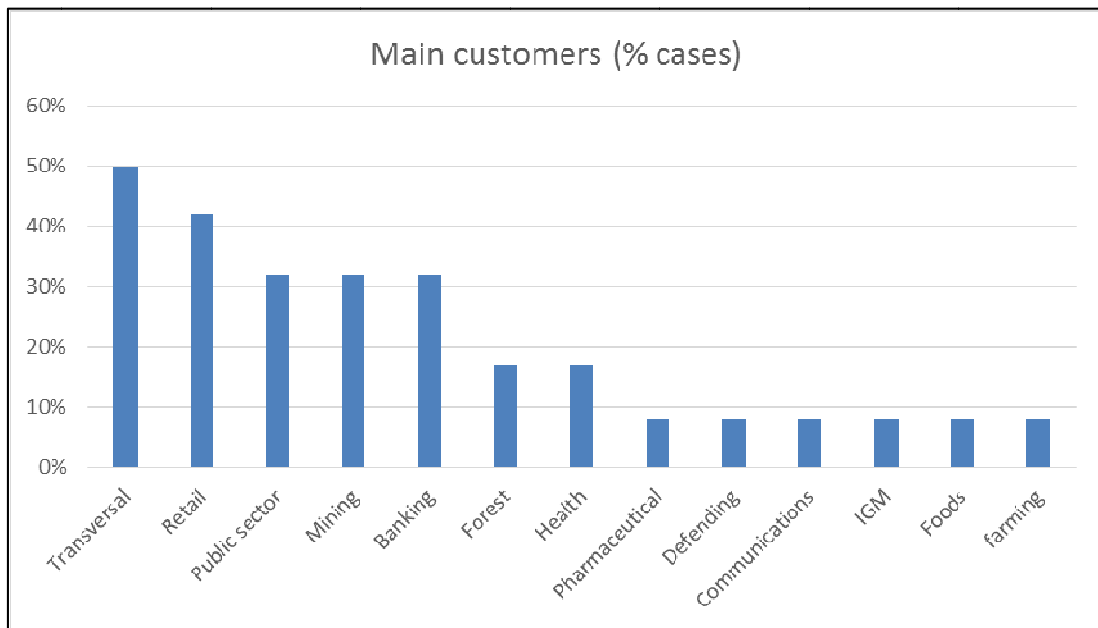


Figure 4. Main customers. Source: Own elaboration from the interviews using the QDA Miner Lite software.

Secondly, we have the sales of informatic products in the retail sector (large commercial chains). This last sector has reached an important development at a national level. In the case of Chile, there is a clear process of internationalization of national retail to the rest of Latin American countries (e.g., Peru, Colombia, and Argentina).

At a third level of importance, we have the demand of products on the part of the public sector (dependent upon the state) and the mining of copper. Again, we prove that the mining sector (which is defined as a nationally important conglomerate) presents an interesting potential growth in the development of specialized software to cover currently existing gaps. In this same range, we have the bank which also represents an interesting potential for development.

With respect to the key topics. In this point, we will present the structural ideas that can characterize this group of companies using the results of the text analysis. Finally, in this section we will present a cloud of points that have the particularity of showing the quick manner of the principal characteristics of the sector through the most frequent concepts.

First, we observe a bloc of small- and medium-sized companies. In general, they tend to value a workforce with experience over workers with a graduate degree in the area. A relationship between the national and international ICTs is observed (the former is convergent with the evidence of horizontal subcontracting). The majority present an articulation with different actors in institutions—the public development sector and universities. Forty-two percent of the companies analyzed participate in some sort of organizational labor-union.

We found that 24% of the companies qualify as family-owned businesses. Of lesser importance, we have a stable workforce and low employee turnover (both at 17%). The scarcity of English speakers draws attention.

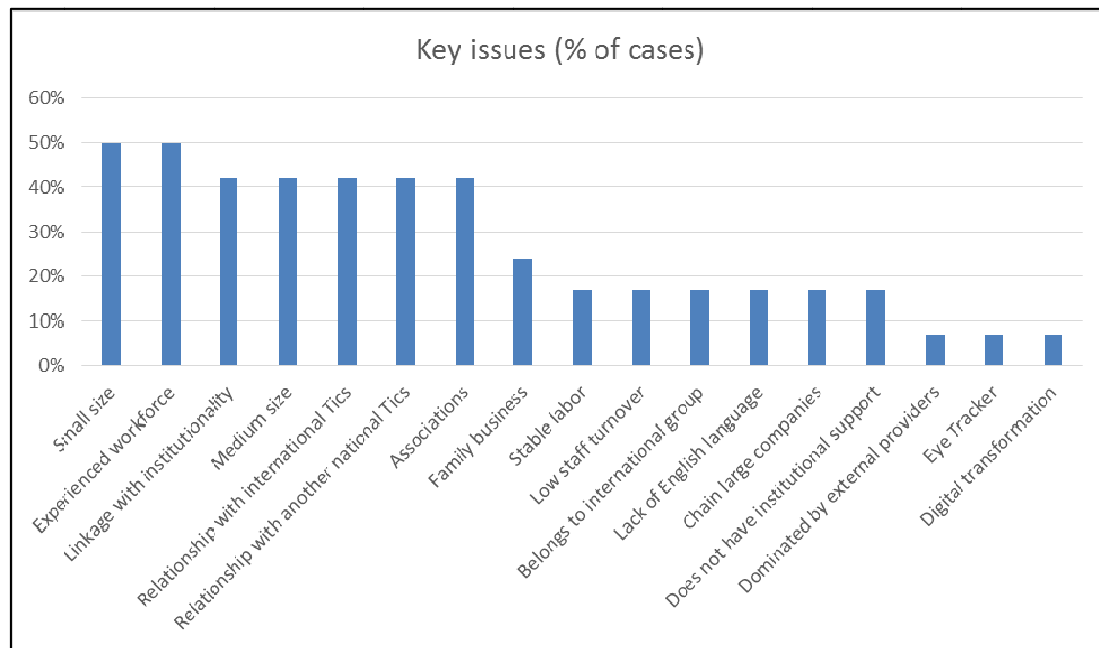


Figure 5. Key issue. Source: Own elaboration from surveys using QDA Miner Lite software.

Qualitative Analysis

With respect to the distinct linkages of the companies with the national and international markets in what they reference as their suppliers (backward) and their buyers (forward), different modalities can be detected. Before seeing the details, we will indicate the general points of the linkages in this sector of analysis:

- The forward linkage is transverse to distinct sectors. The most common is to specialize in a function or service that adapts to multiple necessities, more than a strictly sectoral focus.
- The links with large companies are highlighted, but there are articulations with firms of all different sizes.
- Sales relationships exist with the state for some of the companies. The perception varies—for some, it is just one more commercial niche, while others find it tedious and slow to sell to the state.
- There are different ways of linking IT providers and clients. There are long-term contracts between the provider and some big companies, especially when there is maintenance and constant monitoring involved, but it is not the most common. Another form is a regular relationship through renewable contracts for specific time periods or related jobs. There are also one-off contracts for distinct actions (related or not) that require a buying company, and, with a good experience, can repeat. Finally, there are one-off contracts for specific jobs that do not necessarily imply continuity.

With Respect to Intermediaries

In the case of companies with intermediaries (importers and/or marketers) of technology produced by big foreign companies (infrastructure, goods, and/or software), the following is found:

- The modalities of intermediation are: (a) affiliates from a foreign company; (b) be an authorized franchise owner to sell a determined brand in the country; and (c) be brand marketers for foreign brands but without the formal ties as in (a) or (b).
- The backward linkage is principally international and corresponds to the tie with a big company that provides the infrastructure, goods, and/or software that is adapted and marketed locally (or marketed directly without adaptation).
- The forward linkage implies, in general, an adaptation and/or adjustment of the imported technology according to the necessities of the buying entity (development in adaptive engineering).

Other types of companies correspond to national firms that develop services based on ICT (like e-learning, web design, among others), but where there is no actual generation of technology or programming. Here we can see that there are national backward linkages with ICT companies that provide ICT support and programming where they develop their services. These national ICT providers may be intermediaries or developers depending on cost criteria.

With Respect to the Developer Companies

These companies articulate in the national market based on the development and programming of software oriented toward the buyers, transforming and improving the processes of production, internal management (operation, supervision, human resources, schedules), sales, among others.

- The origin of these companies tends to be a particular, unedited product for a specific need and that is then transformed according to the new requirements of the clients, sectorally transversed. This principal product is in permanent transformation based on the new requirements.
- Based on the detected necessities of particular companies and/or the State, on the market in general and by the accumulated knowledge, the adjustments to the main tool are carried out, developing new applications, and, in one case, new companies emerge to provide annexed or complementary services.
- There are experiences in foreign forward linkages. In the cases where it is mentioned, the developing company sells to big companies that operate in Chile (on a national basis) and, some time later with a good experience, the possibility to sell services to foreign affiliates arises (typically within Latin America). Without being an extended or consolidated experience, it is an interesting mechanism as it allows the ICT companies to experience and insert themselves in external markets. There is a learning in the national market through the demands that large companies impose that later permit for an international exit.
- In its tie to the big companies, no mention was made of the imposing practices from the big companies on these software developing PYMES. These latter companies explain it as the others having gained prestige based on good work and for the specific services that they offer.

- The informants of the distinct ICT companies report that the buying firms that are connected with them and based on internalizing the goods, services, software, or IT infrastructure transform distinct aspects of their functioning. The specific field that it transforms is diverse and depends on what the IT company offers, may it be automatization of operation, of supervision and control or distinct questions related to human resource management, production, distribution, and marketing. In synthesis, through these interviewed companies, the

principal ICT impact on the innovation of national companies refers in the first place to productive processes and distribution, and then to marketing.

- The principal mechanisms through which knowledge is transferred from the IT company to the buying company are distinct training modalities for the daily management and supervision of good workings of the goods and services. It depends on the type of contractual relationship that exists, whether it be just one specific training, a series of training, or a more long-lasting tie. The limit of transferred knowledge is the management and normal monitoring of the good or service, but no detailed questions about the internal function that could put the business of the ICT provider at risk (lack of confidence). To address this point, the technology developing companies need to be particularly cautious.

- All the types of ICT companies have a critical vision of the capacity of the rest of the national economy to impulse national technological development and innovation. It is interesting that this perception is transverse and does not depend on whether the companies are developers or intermediaries. The evaluation that they have made touches the following aspects and fits precisely in what is generally thought by the big companies of the principal export chains in the country: (a) The national businessman is conservative and does not want to run risks with products newly developed by national companies, and, along with that, prefers well-known foreign brands over local, emerging companies; (b) there is an excessive search for utilities and quick returns; and (c) based on these points and the incentives that generate a national market, the ICT companies tend to be importers, marketers, and intermediaries more than developers.

With Respect to Institutional Ties

Given the information received by the informants, it can be inferred that a certain capacity by the state to push innovation in the ICT sector exists via “digital government” policies.

Based on the ICT capacity and buying abilities of the State, the ICT economy mobilizes. Innovation will depend on if State action not only invigorates the ICT market, but also, based on the good and services required, challenges the productive processes of the sector. Equally, its impact will vary if it articulates with developers and intermediary companies. The interviews show some of the ties between the companies and the State, which are not always identical. There are companies that are not tied to the State and do not view it as important, others that are not connected but see it as a future possibility, and a third group that is joined but does it through litigations.

Also related to the public environment, there is a critique of the State that indicates there are no clear or long-term policies to incentivize the small and medium-sized companies in general and technology in particular and facilitate their entrance into the foreign market which would impulse innovation and development in the economy. It is contradictory that some of the informants express ties with CORFO and Pro-Chile and are conscience of some, if not all, of the instruments of these services. However, the evaluation that is done over the impact of policies and the evidence to support it is sometimes more positive, while other times more negative, often with much ambiguity.

- They are critical of the country’s primary exporter orientation and of the state policies (or lack thereof) that encourage higher added-value activities.

- At the level of public opinion, it is clear what profound ICT development and its potential for economic development means. In this way, the ICTs often limit the their presence and coverage of networks, but not the complex use of it. An informant added that in connection to this, on certain occasions there is a frivolous view

of innovation that highlights an element that draws a lot of attention from the press, but is not focused on concrete and advanced solutions for effective necessities.

In the case of the intermediary companies (importers and/or marketers) of technology produced by large foreign countries (infrastructure, good, and/or software), the following is detected:

- The component of innovation developed by the actual ICT company corresponds fundamentally to the adjustment and adaptation of the imported technology and its insertion in the local market. According to the information given, most often there are specific requirements that exist which imply a diagnostic of problems and necessities on the part of the national technicians and professionals, who then create an appropriate adaptation according to the requirements of the clients.

- The imported technology and foreign availability does not always coincide with the needs of the local economy. In this sense, some companies that are seen as “introducers” of technology are often non-existent in the country, but have already been tried outside of the country. The client introduces these companies by adapting to them. In this case, it is the rest of the economy that is left behind in a specific technology, more than the economy being a dynamic force that pushes forward with technological development.

- Brand representatives receive training in the necessary knowledge for managing and adapting the regular use technology and new products of interest to be introduced in the national market. Those who are not brand representatives receive training depending upon the sale (in a one-off contractual tie).

Referring to national companies that develop services based on IT (like e-learning, web design, etc.), but are not creating technology or programming on their own, it is shown that:

- Its own added-value is in the ICT-based design (e-learning, web design), but not in the ICT element itself.
- They indicate that for this there must be a close collaboration with a buying company and based on their requirements the complexities of design vary and extend the services offered in general. In relation to the companies that are national technology developers, we have the following:

- There is a software tool vital to personal development that has positioned them in the market, with a transverse use, which has adapted itself to the necessities of distinct economic sectors and clients. Nevertheless, they are specific application focal points in which the market values the given service and specialization.

- The development of this key service has been through distinct mechanisms: (a) solicited by a contracting company, (b) a necessity identified in the market, or (c) based on knowledge from working in other companies and then getting into a PYME.

- Based on this principal service and positioning in the market, one acquires experience and knowledge that allows innovative jumps in their own initial tool, as well as inventing new services and programs to offer to their own clients and others.

- The big companies with which they are connected give a push in the innovative process. In these cases, with constant problems or challenges, and, as was indicated, when this tie is virtuous, it can lead to jumps into the international market.

The situation of institutionality in which the interviewed ICT companies are involved takes of different forms, which—at least at first glance—are not due to the criteria of the technology developers, intermediaries, or applicators that we saw previously, but rather to the trajectory and value of the leading line of companies in this field.

In reference to institutional labor-unions from the interviews, the principal associations of the sector can be identified as ChileTec (ex GECHS), ACTI y AIE. Nevertheless, the degree and form of involvement is variable.

With respect to the articulation of the state development agencies, there are also diverse modalities of involvement that are synthesized below:

- Companies that are not already involved in any service and do not see it as useful, or in the case that they do find it relevant, indicate that the time and administrative logistics make the objectives of the proposed market difficult.
- Among the companies that do have a connection with the state, CORFO and ProChile stand out.
- The tie with CORFO is through distinct ICT development projects, where some companies have a regular relationship through a certain continuity of projects, while others have participated specifically in one experience, but it has not been replicated.
- The companies that export, or propose to do so, have created a relationship with ProChile, mainly at foreign trade fairs or joint meetings.
- The perceptions that the informants who have connected with state services have, share a relatively critical vision of the time and bureaucratic requirements, but, at the same time, recognize the importance of linking together with the State, even if the concrete linking experiences have not been particularly successful.

In what corresponds to the relationships with universities and technological centers, we detect various expressions on the part of the interviewed companies:

- Mostly there are no relationships with universities and technological centers. A critique has been made that the time to develop innovation in these instances is very slow with respect to what the market requires. It is also said there are not always products or solutions coming from these places that respond to the concrete and applied necessities that the companies have. They recognize, though, that it would be an important fluid link to have with universities and technological centers as interests and logics can be imbricated.
- Another smaller group of companies does recognize that they form relationships and form parts (or have formed parts) of activities with universities and technological centers. Nevertheless, there are no references to experiences that have resulted in innovations in products or concrete services. Rather, they report participation in meetings, seminars, and talks. But in the interviewed companies, joint technological projects have not emerged.

Conclusions

We should specify that we are not referring to the ICT sector in general, but rather to a fraction (minority) of PYMES specialized in activities of high know-how, which corresponds to the 13 companies interviewed in-depth.

It is interesting that the spaces of horizontal subcontracting are generated among the companies of a similar listing. Nevertheless, we see that there is not a sufficient enough connection between the sector of the ICTs and the national chain of exporters. A national plan is lacking that would allow for the generation of production conglomerates around the mining and forestry industries (the “national champions”). In this way, the ICT sector would allow for the generation of innovative trajectories with “demanding clients”, to pertain to a global chain, to then share this learning through new products and routines to the rest of the national productive fabric.

The Chilean ICT sector is strongly concentrated in Santiago (the national capital), the place with the highest concentration of Masters and Doctorate holders and the most globalized nucleus in the country. This allows for better focusing on a public initiative that takes advantage of the possible externalities that can be

generated by the geographic closeness. This special proximity, added to the specialization generated in the financial linking and in retail (the latter expanding to other Latin American countries), allows us to observe an interesting sectoral development to trigger development, better orienting public policies.

From the qualitative analysis, we distinguish the necessity to identify the variability in the “forward” and “backward” linkages at the interior of each sector. This is one of the variables to consider when creating public policy, being a good objective of the work of the segment of ICT companies that develop systems. Clearly, the possibilities for development of these firms are conditioned by the demand of products that have the highest added-value. Notwithstanding, we have a type of businessman that is “adverse to risk” and that is mainly looking for profitability in the short term.

The qualitative study also shows a group of companies that are dedicated to the distribution of imported software. This implicates efforts at adaptation of foreign programs to respond to the companies’ requirements. It is important to remember that there was not a protagonistic role for state companies, through public procurement, to stimulate innovation.

Finally, we show the need to develop social capital in the 13 companies interviewed, a fundamental element in allowing innovation in the sector. We have a group of companies that are not associated to any form of labor-union. The articulation with the state is circumscribed to CORFO, some ICT development projects that continue over time with ProChile, and in participation in international trade fairs. In the group of companies interviewed (13), there were no ties with universities or technological center observed.

There is definitely an important space for public policies that strengthen the levels of meso-economics, integrated by productive public-private network partnerships. They are fundamental for the incubation of innovation and development in the ICT cluster that generates positive externalities to the rest of the national economy.

Before a policy of productive development/services, mainly from CORFO, it is necessary to have strong structural changes to the ownership of economic groups (to mostly mixed ownership) and foreign capital (to mostly state ownership) and a new constitution that makes these proposed developmental changes possible. It would need to be accompanied by the constitution of key actors in development (salaried workers, MIPE) and by integrated knowledge, which are also keys for the development of Chile.

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