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Competences as drivers and enablers of globalization of innovation: Swedish ICT industry and emerging economies

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ABSTRACT

The objective of this paper is to discuss the relationship between competences and the global innovation networks in the Swedish ICT industry using both survey data and information from a case company- TELEQUIP. The paper portrays the interplay between the availability of competences in the home country as well as in the host country, with the specific strategy of the firm for engaging in global innovation networks.
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Keywords: competence, globalization, global innovation networks, Sweden.

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1. Introduction

The objective of this paper is to discuss the relationship between competences and the global innovation networks in the Swedish ICT industry using both survey data and information from a case company- TELEQUIP[1]. The paper portrays the interplay between the availability of competences in the home country as well as in the host country, with the specific strategy of the firm for engaging in global innovation networks.

The paper starts by discussing the interplay between competences and globalization of innovation, distinguishing between region and firm-level competences. Global Innovation Networks (GINs) are defined in this paper as "a globally organized network of interconnected and integrated functions and operations by firms and non-firm organizations engaged in the development or diffusion of innovations" (Chaminade 2009). Firms can globalize their innovation activities by engaging in the global exploitation of innovations (exports), global sourcing of technology, global research collaboration and offshoring of innovation (Archibugi and Michie 1995;

[1] The real name of the company is not disclosed, due to confidentiality agreements.

Audretsch and Feldman 1996). This paper is concerned with the last two forms of GINs.

Competences may influence global innovation networks in at least two ways: as drivers of globalizations and as enablers of globalization. Scholars in international business and innovation studies (Arora, Gambardella et al. 2001; Arora and Gambardella 2004; Arora and Gambardella 2005) argue that firms pursuing an asset seeking strategy (Howells 1990) may be attracted to a certain region to tap into the specific competences available there (Narula and Zanfei 2004). Therefore competences may play a role as a driver for the establishment of global innovation networks, notably, for global research collaboration and offshoring for innovation, as the evidence of knowledge hubs like Bangalore shows (Arora, Arunachalam et al. 2001; Saxenian 2001; Parthasarathy and Aoyama 2006; Chaminade and Vang 2008). On the other hand, firm-level competences may also be enablers for the establishment of innovation networks (Nooteboom 2000; Nooteboom 2004; Nooteboom, Van Haverbeke et al. 2007) and international networks. Competences define the absorptive capacity of a firm (Cohen and Levinthal 1990) which in turn, influences the ability of an organization to benefit from engaging in collaboration with other organizations. It also affects the ability of the firm to operate in international environments. Thus competences are also an enabler for the engagement in GINs.

Through regression analysis using survey data and in-depth interviews with TELEQUIP in different world locations (Sweden, South Africa and China), the paper explores the interplay between globalization of innovation and competence building, from two perspectives:

a) Which competences globally dispersed companies need and how are they managed? – competences as an enabler
b) To what extent the access to competences may be the driver for the location of R&D labs abroad? – competences as a driver

The paper is structured as follows. First, it introduces the conceptual framework exploring the relationship between firm and regional competences and globalization. Next section present the method used for this paper. Section 4 is centred on the

empirical evidence of relationship between globalization of innovation and competences in the ICT industry in Sweden in general and in multinational firm in particular. Last section of the paper concludes with some reflections on the role of competences in GINs, based on the Swedish experience.

2. Conceptual framework

2.1. Global innovation networks

It is widely accepted that innovation is the result of the interaction and exchange of knowledge between different individuals and organizations (Freeman 1987; Lundvall 1988; Lundvall 1992). Scholars in the innovation literature have contributed to our understanding of networks of innovators (De Bresson and Amesse 1991; Freeman 1991; Powell and Grodal 2004) particularly with regards to the structure of the network (Burt 1992; Dickens 2007), the governance of the networks (Humphrey and Schmitz 2002; Nooteboom 2003; Coe, Dicken et al. 2004; Gereffi 2005) and its impact on knowledge distribution among the actors of the network (Giuliani and Bell 2005; Giuliani 2007) but substantially less on its geographical spread.

On the other hand, the geography of innovation networks has been the focus of economic geographers for almost two decades (Cooke 1992; Asheim and Isaksen 1997; Mothe and Paquet 1998). Traditionally, economic geographers have argued that due to its tacit nature, knowledge is sticky and tends to be embedded in certain regions or territories. Local or regional networks of innovators are then considered to be crucial for innovation and competitiveness and most of the contributions were rather endogenous – i.e. looking at regional networks and ignoring networks at other geographical levels. The seminal work by Bathelt, Maskell and Malmberg on global pipelines- open a new venue of research on the interplay between local/global. Bathelt et al. (2003) argued that the most competitive clusters were those that showed a high degree of local interactions but also strong linkages with international sources of knowledge. Almost all the scholarly work that has followed on local/global knowledge interactions (Moodysson 2008; Moodysson, Coenen et al. 2008; Martin and Moodysson 2011) has been mainly treating the international level as a black box ignoring whether those international linkages were with countries in close proximity

or whether they were globally spread and constituted truly global innovation networks.

As indicated in the introduction, global innovation networks are defined in this paper as a "globally organized network of interconnected and integrated functions and operations by firms and non-firm organizations engaged in the development or diffusion of innovations" (Chaminade 2009). This definition highlights the main characteristics of a GIN: its global dispersion, its focus on innovation (and not production) and the combination of both internal and external networks. Following Archibugi and Michie (1995), it is possible to distinguish different modes of global innovation networks: the global exploitation of innovations, global sourcing of technology, global research collaboration and global generation of innovation. Firms may globally exploit their innovations simply by selling their products abroad; they may innovate by acquiring technology from abroad or by engaging in research collaboration with firm and non-firm organizations located in a different country and, finally, they may also develop innovation through offshoring R&D labs abroad (global generation of innovation). This paper is concerned with the last two forms of GINs. The interplay between these two forms of GINs and competences will be discussed next.

2.2. Competences as an enabler for globalizing innovation activities[2]

The resource based view of the firm (Teece 1980; Wernefelt 1984) has long argued that the strategy that firms may pursue is contingent to the competences and the capabilities that the firms have (Wernefelt 1984; Grant 1991; Barney 1996; Eisenhardt and Martin 2000; Barney, Wright et al. 2001). In a similar vein, the international business literature claim that the success of the internationalization process is also dependent on some firm´s competences like the previous experience of the firm in international markets as well as the capability of the firm to organize internally the connections between the headquarters and the subsidiaries(Dunning and Narula 1995; Dunning, Narula et al. 1997). Finally, innovation scholars have long maintained that the capability to innovate and engage in interactive learning with

[2] This section is based on Plechero and Chaminade, 2010.

other organizations and individuals in highly contingent to the technological competences that the firm has (Cohen and Levinthal 1990; Lall 1992; Bell and Pavitt 1995{COHEN, 1990 #1948).

The different modes of globalization of innovation may be affected by a variety of competences and capabilities like the qualification of the human resources, the previous international experience (Sousa, Martínez- López et al. 2008) or the educational background, international experience or commitment of the managers of the company (Sousa et al, 2008). In line with previous studies (Plechero and Chaminade, 2010) in this paper we will focus on those more related to the globalization of innovation: the qualification of the human resources, the firms level of technological competences and the firms organizational competences.

Qualified human capital is considered to be central for building the absorptive capacity of the firm (Cohen and Levinthal, 1990) and thus is determinant of the ability of the firm to locate, acquire and use information and knowledge from other organizations, such as other firms, users or knowledge providers (i.e. research institutions. Human capital is considered to be crucial for engaging in interactive learning which, in turn, is conducive to innovation. We might therefore expect that the qualification of the human capital is an important enabler for global research collaboration and for global generation of innovation.

R&D or, more explicitly, intramural investments in R&D are expected to serve not only the generation of innovation but also to facilitate the acquisition of knowledge from external sources (Cohen and Levinthal, 1989). The more the firm knows, the more it is able to learn and therefore, the more that it will benefit from the interaction with other sources of knowledge. R&D may therefore to be considered directly related to the ability of the firm to benefit from global research collaboration.

The development of new forms of organization and coordination to manage disperse knowledge is typical from asset seeking strategies (Dunning and Lundan, 2009). Both the coordination of R&D and innovation activities globally as well as the engagement in research networks requires the introduction of organizational innovations at the

firm level (Dunning and Narula 1995; Knight and Cavusgil 2004; Sabiola and Zanfei 2009{Sabiola, 2009 #5864). The coordination of R&D activities between R&D subsidiaries and the headquarters is organizationally very complex, as it involves the integration of both internal and external networks and requires advanced managerial and organizational competences. Firms with higher organizational competences are expected to be related to strategies of global research collaboration and global generation.

We may therefore expect that firms internal competences –such as the educational level, the R&D investment or the organizational innovations- may act as enablers for the engagement in GINs, particularly for the global research collaboration as well as the global generation of innovations.

2.3. Competences as a driver for the globalization of innovation activities: offshoring and global research collaboration

One of the traditional arguments in international business literature explaining the internationalization of production and innovation activities has been the exploitation of existing advantages. The OLI framework developed by (Dunning 1993; Dunning 2001) in the early nineties argued that multinational companies expanded their activities abroad to exploit their competitive advantage in terms of ownership, location and internalization. Dunning (1993) refers to four different strategies for internationalization: market seeking, resource seeking, efficiency seeking and asset seeking, being the first three more related to asset exploiting strategies (Knight and Cavusgil 2004).

The distinction between asset exploiting and asset seeking strategies is particularly relevant for the globalization of innovation activities in general, and for the global generation and global research collaboration in particular and has important implications for the role of competences as a driver for the engagement in global innovation networks. While it is true that some companies may locate R&D labs abroad to adapt existing products to the specific market needs (asset exploiting), there is growing evidence of the increasing importance of asset seeking strategies in the localization of R&D abroad (Howells 1990; Zander 1999; Zanfei 2000). Firms are

attracted to certain regions or engage in research networks to tap into specific competences and knowledge available in that particular region or network.

Traditionally technological competences have been concentrated in a handful of developed countries and regions (Li, Poppo et al. 2010). But the technology clubs of the world are slowly changing (Castellacci and Archibugi 2008). In 2006 the UNCTAD published a report on Research and Development (R&D) Foreign Direct Investment which pointed, almost for the first time, to the changing role of developing countries in the global flows of innovation-related investments (Unctad 2006). It showed how R&D investments to and from developing countries had increased dramatically in a few years. Innovation had become truly global, involving organizations and regions outside the high-income countries.

One of the most often cited arguments explaining this global shift is the accumulation of competences in certain regions around the world, like Bangalore in India (Arora, Arunachalam et al. 2001; Saxenian 2001; Arora 2006; Partharasarathy and Aoyama 2006) or Beijing in China (Altenburg, Schmitz et al. 2008). Thus some regions in developing countries have become knowledge hubs in global value chains (Castellacci and Archibugi 2008) , particularly in ICT industries (Chaminade and Vang 2008).

We may therefore expect that the knowledge or competences available in a certain host region is an important driver at least for the offshoring of innovation activities (global generation of innovation) .

3. Method

This paper combines the analysis of survey based data with a case study to illustrate with more detail the complex relationship between competences and global innovation networks from a managerial perspective.

3.1. Survey

The survey captures information about the different dimensions of the globalization of innovation for each firm, such as global technological collaboration (R&D strategy,

sources of technology, establishment of networks for sourcing/developing technologies or innovations), and global generation of technology (offshoring). The survey also captures information about structural characteristics of the firm, such as size, industry, specific activities, and the main functions performed by the firm. Finally, it also captures information on competences at firm level such as qualification of the human resources, investments in R&D, organizational management techniques, etc.

The dataset used for the survey contains all the Swedish companies that according to Statistic Sweden operate in ICT in the following NACE 2 codes: (26.30 Manufacture of communication equipment; 62.01 Computer programming activities; 62.02 Computer consultancy activities; 62.03 Computer facilities management activities; 62.09 Other information technology and computer service activities). The size of companies in the database is small, medium- size and large organizations. We excluded in the survey the firms with less than 5 employees.

The survey was web-based are directed to the entire ICT population. Firms were contacted by email and asked to conduct the survey online. The final number of companies contacted by mail were 1662. The final number of responses (complete questionnaires) was 194. The response rate was therefore 11,7 %. The distribution of responses by firm size and subindustry is representative of that of the total population of the industry (using statistics from statistics Sweden). Of the total sample, we have selected the companies that have engaged in global research collaboration or global generation of innovation.

We estimate the relationship between competences and globalization of innovation using a regression model. We use two models to capture the two forms of global innovation networks considered in this paper, one for global research collaboration and one for global generation of innovation.

Dependent variables

Global research collaboration: In the survey the firms were asked who did they actively collaborate with for the development of their most important innovation in the last 3 years. The firms were also asked to indicate the geographical location of the

partner (the region, the country and globally). The options available included clients, suppliers, competitors, consultancy companies and universities. We created a dummy variable that takes the value 1 when the firm has answered positively to collaboration with any source at global level, and 0 otherwise

Global generation of innovation: In the survey the firms were asked if they had offshored R&D activities. The firm could only answer yes/no. Therefore, the global generation of innovation is a variable that takes the value 1 when the firm has offshored R&D and 0 otherwise.

Independent variables

Human capital: We use two variables to capture the qualification of the human capital in the firm. In the survey we asked the firms to indicate the estimated proportion of the employees by level of education. The three options were technical education/training, university degree and postgraduate degree. We created two dummy variables "employees with university degree" and "employees with postgraduate degree" that takes value 1 if the firm responded affirmatively to each of the categories respectively.

R&D activities: We use three variables to capture the R&D activities of the firm. The first one is a dummy "R&D activities" that takes the value 1 if the firm had answered Yes to the question "do you have any significant R&D activity?". The second one is a numerical variable with the number of full time equivalents employed in R&D. The third one captures if the firm had engaged in intramural R&D and is derived from the question "Did your company engage in any of the following innovation activities in 2008"- being the options intramural R&D, extramural R&D, design, training and acquisition of machinery and equipment.

Other organizational competences: The variable "service innovation*"* captures if the firm has introduced any service innovation in the last three years; the variable "Support innovation" takes the value 1 if the firm has answered positively to the question "has the firm introduced new of significantly improved supporting activities for your processes (e.g. purchasing, accounting, maintenance systems, etc) in the past three years (2006-2008)"? or to the question "has the firm introduced new or

significantly improved logistics, distribution or delivery methods for your inputs, goods and services in the past three years?" independently on the degree of novelty of that innovation. The variable "Advanced production systems" is a numerical variable that captures the number of systems of production organization that the firm employs. The available options were quality control systems, just in time production, continuous improvement, quality circles, internal manual and others. Finally we also asked the firms to estimate the percentage due to products "manufactured by your unit according to design specifications provided by external buyers" (Original Equipment Manufacturing-*OEM*), "developed and designed by your unit according to performance requirements of buyers" (Original Design Manufacturing-*ODM*) and "developed and designed by your unit and sold under your own brand" (Original Brand Manufacturing-*OBM*).

Regional competences: If the firm had answered yes to the question on whether it had offshore production or innovation, they were asked to indicate "what were the important regional factors in the decision to offshore production and innovation into a host region". The different options available captured market, costs and knowledge drivers separately for production and innovation. For the variable "Host region competences" we use only the ones regarding the offshoring of innovation activities. The variable takes the value 1 if the firm has marked the "availability of specialized knowledge in the host region", the "availability of qualified human capital at a lower cost than in your own country" or "access to knowledge infrastructure and services in the host region (R&D infrastructure, technical support services, etc)" as important factors explaining the decision to offshore innovation. To capture the level of competences in the home region, we created the variable "Home region Tier"[3]. We have categorized regions where the firms are located in Tier 1, Tier 2 and Tier 3, based on the industry dynamism. Tier 1 regions are the most dynamic and firms located there can have higher level of technological capabilities, also networks among agents and knowledge flows are more mature than in Tier 2 or Tier 3. Tier 2 regions present a medium level of interaction among the members of the network, and firms located in Tier 2 have a medium level of technological capabilities. Tier 3 regions are the least dynamic and interactions among the members of the network are weak.

[3] For a more detailed description of how this variable is constructed, please refer to Chaminade and Plechero (2011)

Region Tier is an original categorical variable that represents the dynamics and importance of the ICT industry in different regions in Sweden. We assigned the Tier level based on information about employment, economic dynamism, and industrial activities for each sector in each particular country. In Sweden, Tier 1 is the region around Stockholm (including Kista), Tier 2 is Göteborg and Skåne and Tier 3 is the rest.

Additionally we include a variable capturing the type of firm (standalone, subsidiary and headquarter) and another one for the size of the firm. Below is the description of the variables:

Table 1. Descriptive statistics

Variable	Type	Number Observ.	Mean	Std. Dev.	Min	Max
Collaboration global	Dummy 1=yes	105	0.462	0.500	0	1
Generation global	Dummy 1=yes	31	0.159	0.367	0	1
Standalone	Dummy 1=yes	169	0.871	0.336	0	1
Subsidiary	Dummy 1=yes	20	0.103	0.305	0	1
Headquarter	Dummy 1=yes	5	0.026	0.159	0	1
Size	Categorical 1=less than 10 2=10 to 49 3=50 to 249 4=250 to 999 5=more than 1000	63 96 25 7 2	1.907	0.830	1	5
R&D activities	Dummy 1=yes	89	0.468	0.500	0	1
No. Employees performing R&D	Numerical	89	5.513	7.749	0	33
Intramural R&D (local, regional, global)	Dummy 1=yes	60	0.308	0.463	0	1
Employees university degree	Dummy 1=yes	181	0.928	0.259	0	1
Employees postgraduate degree	Dummy 1=yes	91	0.467	0.500	0	1
Service innovation	Categorical 1=firm level 2=country level 3=world level	93 28 17	1.026	0.888	0	3
Support innovation	Categorical 1=firm level 2=country level 3=world level	73 15 5	0.605	0.741	0	3
Production advance systems	Numerical	146	1.872	1.569	0	5
OEM	Dummy 1=yes if OEM>50	24	0.123	0.329	0	1
ODM	Dummy 1=yes if ODM>50	33	0.169	0.376	0	1
OBM	Dummy 1=yes if OBM>50	72	0.369	0.484	0	1

Host region competences	Dummy 1=yes	6	0.031	0.173	0	1
Region TIER	Categorical 1=Tier1 2=Tier2 3=Tier3	 75 33 87	2.062	0.912	1	3

3.2. Case

To illustrate the complex relationship between competences, global innovation networks and its managerial implications we use a case study in the ICT industry. The firm selection is based on three criteria namely the firm's global presence (particularly presence in China, India, Brazil and South Africa), production and innovation capabilities, innovation leadership and headquartered in Sweden. Due to the request of anonymity of the firm, we use TELEQUIP instead of the real name of the company.

TELEQUIP is a world-leader provider of telecommunications equipment and services. TELEQUIP's main business is the provision of network equipment and services for telecommunication. The R&D sites (20-25) are in proximity with the main manufacturing units, which indicates a high degree of overlap between the global production network and the global innovation network of TELEQUIP. In terms of locations, TELEQUIP has important R&D facilities in countries like Germany, Canada, USA (Silicon Valley), Ireland, Hungary and China. Currently the three largest TELEQUIP's R&D facilities in the world for the radio division are the one in Sweden, the one in the Silicon Valley (USA) and the one in China. The research conducted in TELEQUIP R&D centers worldwide can be both for the development of a completely new product or service for the whole corporation as well as for the adaptation of an existing product to a local market[4].

Interviews were conducted in 2010 and 2011 with several CEOs of the company in the Headquarters as well as in the subsidiaries in South Africa and China: the Vice-

[4] An example of the development of a local solution for local needs could be the development of radio equipment in rural areas in India that would be conducted completely by TELEQUIP India. Another example of a development in which the subsidiaries will be involved could be a technology developed in US that needs to be adapted to the standards and requirement of the market in which TELEQUIP is commercializing that technology.

president and head of R&D at Headquaters, the Chief director of TELEQUIP China, the CEO for Commercial management of TELEQUIP Sub-saharan Africa, the Strategy and Marketing director of TELEQUIP Sub-saharan Africa and the CEO of Innovation and partnering of TELEQUIP Sub-saharan Africa. We used the information collected in the different sites to check the validity of the statements (for example, between the headquaters and the subsidiaries). Interviews were semi-structured and lasted 2 to 3 hours. All interviews were recorded and transcribed. A document summarizing the most important issues raised in the interview was also produced within 24 hours after the interview. Additional information was collected from the annual reports, website and other public information of the firm.

4. Globalization of innovation and competences in the Swedish ICT industry

4.1. Results of the survey

The results of the regression equation given in Table 2 show that both firm-level competences as well as regional competences matter for firms engagement in globalization of innovation, but they relate differently for global research collaboration than for global generation of innovation.

In the case of global research collaborations, organizational competences – in this case captured by the availability of advanced production systems- matter most. As expected, the number of employees in R&D as well as the engagement in intra-mural R&D activities is positively correlated to the engagement of the firm with global research collaboration, as it is directly related to its absorptive capacity. In terms of human capital in general, only the existence of qualified human capital at postgraduate level is significant, which may be related to the importance of R&D employees. Interestingly enough, size doesn't seem to matter for the propensity of Swedish ICT firms to engage in global research collaboration. This result seem to be in line with data from the Swedish innovation survey which also shows a very high proportion of small (and medium size firms) that report to collaborate for innovation with distant partners such as Indian or Chinese. The competences available at the regional level in Sweden (captured by the variable Region Tier) is not significantly related to global research collaboration. The international orientation of the Swedish business sector (Marklund 2004) is also reflected in their propensity to engage in

global research collaboration, independently of the firm size or the location of the unit in Sweden.

Table 2. Competences as drivers and enablers of GINs

	Global research collaboration	Global Generation
Firm level competences		
Human Capital		
Employees university degree	0.094 (0.159)	-0.089 (0.091)
Employees posgraduate degree	0.123* (0.078)	0.080* (0.045)
R&D activities		
R&D activities	-0.139 (0.124)	0.026 (0.073)
R&D employees	0.017** (0.008)	-0.005 (0.005)
Intramural R&D	0.190** (0.096)	0.443*** (0.055)
Other organizational competences		
Service innovation		0.027 (0.026)
Support innovation		0.014 (0.031)
Advanced production systems	0.058** (0.027)	0.019 (0.016)
OEM	-0.001 (0.130)	-0.002 (0.075)
ODM	0.058 (0.109)	0.173** (0.063)
OBM	0.088 (0.087)	-0.010 (0.050)
Regional competences		
Host region competences		0.446*** (0.116)
Region TIER	-0.012 (0.044)	0.055** (0.025)
Other firm characteristics		
Standalone	0.144 (0.128)	
Subsidiary		-0.026 (0.074)
mnc	-0.159 (0.276)	0.108 (0.151)
Size	0.007 (0.056)	0.035 (0.032)
R-squared	0.176	0.499

Note: ***, **, * indicate significance at the 1%, 5% and 10% level respectively. Standard errors in parenthesis.

Both firm level competences and regional competences are related to the propensity of Swedish ICT firms to engage in global generation of innovation (or offshoring of innovation activities). At firm level, the qualification of human capital, the engagement in R&D activities and the existence of other organizational competences are positively related to offshoring of innovation, although with different degree. Conducting intramural R&D activities is highly significant for offshoring of innovation, as it may be expected. So it is if the firm is producing and designing products according to the performance requirements of buyers (ODM) but not if the firm is an OBM or OEM. The qualification of the human capital is also significant, but to a lesser extent. As in the case of global research collaboration, the size of firm is not significant. The results also confirm that competences are a very important driver for the global generation of innovation. The availability of knowledge in the host region and the Region Tier are highly correlated to this form of GIN thus pointing out to the importance of asset seeking strategies in the process of globalization of innovation of Swedish ICT firms. What the survey does not tell us is how competences are related to the specific form of innovation activities that are offshored or how competences are managed within a specific multinational company. A case study can provide some insights into these issues.

4.2. Competences and globalization of innovation to emerging economies: the case of TELEQUIP

The case of TELEQUIP is interesting to illustrate how different competences accumulated in specific regions in emerging economies are shaping the decision of a multinational company to locate innovation activities worldwide.

In the past 10 years the number of European sites of TELEQUIP has declined to gain more efficiency. According to one of the interviewee: “small sites with 100-200 people are not attractive places for people as they do not grow”. While the number of sites in Europe has decreased, the presence in USA remained unchanged while new R&D sites within the emerging economies, like India and China were opened.

In general, the R&D activities and the most specialized competences (in the internal network) remain concentrated in the sites located in Europe and USA but, according to the Vice-president R&D China has upgraded rapidly as an important R&D site inside TELEQUIP. The reason for this move towards large Asian economies is related to being in proximity to the local market and adaptation of the products to the local demands and standards but access to competences and more explicitly, access to "domain competences" is regarded as the second main driver for the location of R&D activities abroad.

In the last decade or so, TELEQUIP has followed a clear strategy of reducing the number of R&D sites worldwide while increasing the size of the remaining sites (less sites bur larger ones). This has occurred in parallel with the increasing technological complexity of ICT products and services, which demands a larger variety of skills (from software developers, to radio experts, computer engineers, etc). Different subsidiaries play a very different role in the global innovation strategy of the company depending on their competence level. Each of the largest R&D sites of TELEQUIP sites has specialized in a particular knowledge domain. For example, the site in the Silicon Valley (USA) has the R&D site for radio products, as the site in China and India is strong in IT which is related to TELEQUIP Internet Protocol (IP) business.

China

Accessing domain competences is one of the main drivers for TELEQUIP to locate one of the largest corporate R&D sites in China, but is not the only one. When asked if they would change their strategy if they could find the required number of skilled people with the desired qualifications in Sweden, our interviewee responded that they would not change their strategy, as the main driver for locating the R&D lab in China continues to be the access to one of their largest markets and the development of products and services for that market. So, it is a combination of large market opportunities together with the availability of highly qualified personnel at a lower cost what makes China (and more precisely Beijing) one of the most important locations of R&D sites in TELEQUIP.

The location in particular regions also facilitates close interactions with universities and research centers. The interviewee with the Operation Development Director of

TELEQUIP in China regards the large pool of skilled people coming from various Chinese universities as a main reason for locating the R&D sites in this country and in particular regions. For example, the Nanjing centre has been started due to presence of regional actors, being universities and colleges, as well as TELEQUIP's biggest manufacturing unit. In his view there are not many differences between the Chinese market and markets in rest of the world which makes it easier for the subsidiary to provide solutions for the entire company. In his words: "Our market strategy is to provide global solutions, and solve problems in terms of network smooth and call quality, whether what we face is high-end markets or low-end markets".

The division of labor in terms of innovation between the HQ and the subsidiary is better explained by the CEO of TELEQUIP in Sweden. He indicates that "For the activities related to Radio based stations the most important innovations are the ones that are developed in Sweden, Canada and China but Sweden does mainly core innovation while in China the activities are mainly related to the implementation of idea. The Chinese subsidiary can be relevant, for example, for incremental innovation (e.g. reducing cost and adapting the product to the specific profile of Chinese operators). But some of those innovations also have a global effect. An example of incremental innovation with a 'global' effect is the production of a play station adapted to the local context; this idea is starting now to be spread worldwide". This possibility of the subsidiaries to develop solutions potentially useful for the entire corporation puts an additional emphasis on the competences in the subsidiaries. There are not merely adapting the products to the local market, but developing products or services (sometimes brand new) that are potentially useful for the entire corporation.

India

TELEQUIP has a subsidiary in Bangalore. According to the vice-president R&D the Indian subsidiary can be regarded as strong within the IT area but the Chinese have a broader range of domain competences in many different areas and thus conduct research for different business in TELEQUIP. So R&D in India is narrower than in China not because the Indian market demands fewer or less sophisticated products, but because they don't have all the requisite competences. Especially since TELEQUIP -as a group- benefits from what goes on in its Chinese operation in that it generates knowledge and equipment for global markets, competences rather than

market proximity seem to matter more. So, it is the breadth and depth of skills available in China what makes the Chinese site a more interesting location for R&D for TELEQUIP than India.

South Africa

The subsidiary of TELEQUIP in South Africa aims at adapting TELEQUIP products for the African market. The subsidiary does not have its own R&D department. The interviews done by one of our partners in South Africa may provide some insights[5] of why this is so. A CEO of TELEQUIP Sub-saharan Africa explains that the reasons behind a lack of R&D site in SA are related to size of market (smaller than that of China and India for example) and the lack of skilled labor or specific expertise in certain competences. He emphasizes the lack of engineers as a main hindrance for TELEQUIP in SA. The Commercial Management of TELEQUIP in Subsaharan Africa also talks about reasons for choosing India and China as the R&D sites and he mainly refers to the issue of a large pool of skilled labour at a reasonable price. In his words: "R&D price is still quite high and to do it we have to look at the centres that provide engineering expertise and efficiency. And also at a very low cost. And India and China provide those fundamentals". Further on he refers to the fact that in the case of China the products can also be supplied at a global level, thus confirming what the interviewee in the headquarter said.

The role of the South African subsidiary in the global strategy of TELEQUIP is related to the adaptation of the products to the African market. For doing so, knowledge of the local languages is essential. As one of the interviewees in South Africa indicates "*as more and more people get into the mobile arena with handsets and so on, the local languages become more important*". Therefore in order to penetrate the whole Africa it is a necessity to have skilled people from African regions. He indicates that even though the headquaters have the knowledge on networks they need to have a better understanding of the local consumers.

[5] Interviews were conducted by Tashmia Ismail and Helena Barnard, Gordon Institute of Busines Studies (GIBS), Pretoria University, South Africa. The authors of this paper had access to the transcription of the interviews.

The interviews held in Sweden, China and South Africa point out to a kind of division of labor of offshoring sites in TELEQUIP according to competences. It also shows the interplay between firm level competences and regional competences as enablers and drivers of innovation.

Table 3. Competences and the role of different sites in the global innovation strategy of TELEQUIP

Sites	Competences	Role
Sweden (Headquarter)	Advanced R&D competences in a variety of domains	Core innovation
China (Beijing)	Broad domain competences in radio communication	Provide solutions for the entire company (e.g. play station) Implementation of core innovations developed at the headquarter
India (Bangalore)	Strong competences in internet protocol business (specific competences in certain domain)	Provide solutions for the entire company but only in the specific domain of IP
South Africa (Gauteng)	Local languages	Simple adaptation of services to local market

Core R&D seems to be conducted barely in three sites worldwide in Sweden, USA and China. These centers provide complex R&D solutions for the different business and for the entire corporation which requires a combination of a wide arrange of skills. A second tier of centers are those that provide very specific competences in certain domain, like for example the R&D center in Bangalore which provides very deep expertise in software. They are also global, in the sense that they provide solutions also to the entire company, but only on specific domains. A final tier of centers are those that conduct mainly development for the local markets. Finally, there are locations in which there are not yet any R&D center, but only production and sales, with small adaptations to local markets.

5. Conclusions

The ICT industry is probably one of the most globalized ones. It is also one in which emerging economies have started to play a very prominent role. While the accumulation of competences in some regions in emerging economies may explain the location choice (competences as a driver) it is very limited to explain how can companies globalize their innovation activities in the first place, that is, which firm-level competences are necessary to engage in global research collaboration or global generations of innovation through offshoring.

By distinguishing between competences as an enabler and competences as a driver this paper contributes to our understanding of the role of firm and regional competences in the globalization of innovation.

For Swedish ICT firms, the level of competences in the region where the firm is located (home region) and the level of the competences in the host region are related to the propensity of the firm to engage in generation of innovation. The level of competences at firm level is related to both global research collaboration and global generation of innovation. The involvement of the firm in R&D activities is correlated both with global research collaboration and with global generation of innovation, as it increases not only the innovative capability of the firm but also the capacity to tap into and absorb knowledge from external sources (Cohen and Levinthal, 1990). Global research collaboration is also related to organizational competences particularly the level of flexibility and quality of the processes within the firm. Engaging external sources in the innovation process is necessary but also costly. Having advanced production systems in place may help to standardize some of the processes thus reducing the transaction costs involved in open innovation. Thus firm-level competences are an important *enabler* for the globalization of innovation, while home regional competences are only for the global generation of innovation.

The results of the survey also confirm that competences accumulated in the host region are an important *driver* for the globalization of innovation and in particular for the global generation of innovation. Furthermore, as the case illustrates, the type of innovation activity that is being offshored and the role that the subsidiary plays in the global innovation strategy of the company is highly dependent on the breath and

depth of the competences available in the host region. While some subsidiaries may be able to play a double role adapting existing products to the local market and developing new solutions for the global markets, others may only play a limited role.

The case of TELEQUIP also points out that there is not one single reason why a company decides to locate an R&D lab in a certain country or region. It is a combination of factors that include firm strategy, environmental conditions and the characteristics of the potential locations in terms of markets and skill supply. In terms of the strategy, TELEQUIP's selection of the sites seems to respond to a double strategy: some of the sites have been selected because they have excel in very specific competences (like Bangalore in India or Ireland) while some others are a combination of the willingness to position themselves in a larger market (also in India) while accessing a broader base of domain competences (Beijing).

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