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GEOGRAPHY | RESEARCH ARTICLE

Knowledge and innovation in the Lebanese software industry

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Abstract: The software industry is strongly influenced by knowledge and innovation. The ability to develop new solutions and services is considered essential to firm survival and growth. The innovation process, being long and costly, relies heavily on interorganizational relations and the interaction between different types of actors (e.g., intermediary support organizations, universities, R&D centers) that can advance knowledge transfer and innovation. Consequently, innovation is seen as an open and interactive process. Many researches related to economic geography have demonstrated that the different types of proximity can be an important tool to facilitate interactions and knowledge exchange. The Information and communication technology (ICT) sector is recognized as a key driving force for Lebanon's economy. It is a fast growing sector with an estimated market size of USD 436.2 million in 2016. Furthermore, Lebanon is emerging as a leading exporter of software development and services in the region. The methodology of this paper is mainly based on a literature review and interviews based on semi-structured interviews, which were conducted face to face, or by phone. The first objective of this paper is to analyze the characteristics and dynamics of innovation within the Lebanese software industry. The second objective is to provide a framework to analyze how the different types of proximity affect the innovation and the interactions inter-actors within this industry. The paper demonstrates that innovation in the Lebanese software sector is often driven by the demand and the client's needs and request. In addition, we noticed that in Lebanon, the local R&D structures or the universities do not support this sector. Furthermore, the support offered by the Lebanese

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PUBLIC INTEREST STATEMENT

The ICT sector is a key driving force for Lebanon's economy. It is a fast growing sector with an estimated market size of USD 436.2 million in 2016. Lebanon is emerging as a leading exporter of software development and services in the Middle East. The ability to develop new solutions and services in this sector is considered essential to firm survival and growth. The innovation process, being long and costly, relies heavily on interorganizational relations and the interaction between different types of actors (organizations, universities, R&D centers) that can advance knowledge transfer and innovation. The main objective of this research is to understand and analyze the dynamics of innovation in the software industry in Lebanon.

government is still weak and this is mainly related to the complexity of the political and social system in Lebanon.

Subjects: Human Geography; Economic Geography; Urban Geography

Keywords: proximity; innovation; knowledge sharing; software sector; Lebanon

1. Introduction

The ICT sector is recognized as a key driving force for Lebanon's economy. It is a fast growing sector with an estimated market size of USD 436.2 million in 2016. In 2013, the ICT sector contributed to 3% of Lebanon's GDP. Furthermore, Lebanon is emerging as a leading exporter of software development and services in the region (Investment Development Authority of Lebanon [IDAL], 2017). Comparatively to other Lebanese sectors, the software sector is distinguished by its dynamism, innovation, and its good capacity of identifying future technologies (Hadhri, Arvanitis, & M'Henni, 2016). The results of the Lebanese Innovation Survey concerning ICTs indicate a very dynamic portion of the entrepreneurial activities, with a strong export orientation, including Gulf countries, and a rather young personnel (Hadhri et al., 2016). Chidiac (2017) indicates that the performance of the Lebanese ICT Small and medium-sized enterprises (SMEs) depends largely on its leader. The leader positions himself as "Pivot" or as "Gravity Center" of his company. Reactive, he focuses on the internal rather than the external. So, he invests more in his employees and in his customers, so in the internal sphere of the company rather in the external one. For Bejjani (2012), this performance can be explicated by a well-educated and multilingual workforce; a reputation for individualism and sense of opportunity coupled with a strong family and social support system. Ahmed and Julian (2012), however, not only acknowledge that the Lebanese strong family and social support structures have allowed entrepreneurship through opening up informal funds but also signal that family business structures can discourage risk taking, restrain risk-taking and business creativity and innovations.

Nevertheless, there is not enough academic work on this industry in Lebanon. Some research analyzed rather of the general state of R&D of innovation in Lebanon. In term of research and innovation, Lebanon has a small but diverse and fragmented S&T community embedded in 41 universities and higher education institutions and 5 rather small public research centers (Gaillard, 2010). In their typology of the research and the innovation system in the Arab World, Hanafi and Arvanitis (2016) classified the Lebanese as a small, dynamic, and integrated research system with proportionally high numbers of researchers and scientific production. Although its scores in overall innovation are low, Lebanon is classified above the average Arab country. Lebanon tends to have niches of research and innovative activities like the clinical medicine and engineering-related areas (Gaillard, 2010). The engineering-related areas (algorithmic electronic engineering, computer sciences, telecommunications, etc.) are the second most important field of research (Hanafi & Arvanitis, 2016). Gaillard (2010) points some issues of the Lebanese innovation system such as the modest contribution of the national research institutes and their limited research potential. He also points the paucity of reliable statistical information on STI activities and the lack of a central institutional mechanism to collect such information. Hanafi (2011) noticed that there are also an increasing number of small private research institutes, often NGOs, which carry out studies, mainly socioeconomic studies and policy-oriented analysis, opinion polls, market studies, and studies for international organizations. Aridi (2015) highlighted also Lebanon's weak academia-industry connection and that Lebanese universities are not well integrated into the innovation ecosystem.

However, the characteristics of the software industry have not been fully explored and we do not know much about its competitive advantages and its innovation challenges. In addition, in general, despite the importance of the software and the ICT sectors in the Middle East region, we noticed a limited number of researches on the state of innovation in those sectors.

The first objective of this paper is to analyze the characteristics and dynamics of innovation within the Lebanese software industry. The second objective is to provide a framework to analyze the innovation system and the interactions inter-actors within this industry. Our analysis is based on a combination of the researches on the innovation drivers in the software industry and the geography of innovation approaches.

The paper is divided in eight sections. In Section 2, we present a literature review of the relation between innovation and geography. In Section 3, we describe the historical development of the ICT sector in Lebanon. In the fourth section, we present the methodology of the paper, which is mainly based on a literature review and interviews based on semi-structured interviews. In Section 5, we present the different dynamics of innovation in the software sector. In the next section, we analyze the nature of relations university/industry. In Section 7, we evaluate how the different types of proximity affect the innovation and the interactions inter-actors within this industry. In Section 8, we highlighted the weak support offered by the Lebanese government to the software industry, which is mainly related to the complexity of the political and social system in Lebanon. Finally, in the conclusion, we present some recommendations.

2. Innovation and geography

Research on innovation spans a number of disciplines with several theoretical perspectives. Each of these disciplines offers us a different definition of innovation. In this paper, we have chosen to adopt the OECD definition in the Oslo manual (2005, p. 46): “An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.”

Innovation processes differ greatly from sector to sector in terms of development, rate of technological change, and access to knowledge. Some sectors are characterized by rapid change and radical innovations, others by smaller, incremental changes (Malerba, 2005). The software industry is one of the sectors strongly influenced by knowledge and innovation. The ability to develop new solutions and services is considered essential to firm survival and growth. Consequently, this industry requires a high level of technological competence, in turn requiring ongoing innovation. This challenge calls for the continuous mobilization of human resources and R&D investments. However, R&D activity is just one element—albeit an important one—in the process of software innovation (Lippoldt and Strykowski, 2009). Specifically in the case of SMEs, with small capacity of R&D and specialist skill shortages, attention has been directed toward the role of absorptive capacity: the ability of a firm to identify, assimilate, and exploit external knowledge (Rose, Jones, & Furneaux, 2016). Innovation researchers emphasize the importance of cooperation between different actors (intermediate organizations, universities, R&D centers, etc.) and network in progressing knowledge development, knowledge transfer, and innovation (Franke & Von Hippel, 2003). These interactions could be facilitated by proximity.

Some researches suggest that despite the globalization of knowledge flows (Amin & Cohendet, 2005; Malecki, 2010; Tödtling, Grillitsch, & Höglinger, 2012), there is still some role for geographical proximity in the knowledge transfer and innovation process (Fritsch, 2001; Tödtling, Lehner, & Tripl, 2006). This is due to the distinction between tacit and codified knowledge (Polanyi, 1966). Knowledge can be articulated explicitly (codified) or manifested implicitly (tacit) (Lam, 2002). Codified knowledge can be transformed into text and symbols and can be transferred without direct physical contact. Subsequently, the geographical proximity is not important. For tacit knowledge, the transfer requires a face-to-face collaboration. Accordingly, geographical proximity is important. However, some other authors highlighted that cohabiting in the same territory is not a sufficient condition for actors to have relations with each other (Markusen, 1996). Some actors develop relations without cohabiting in the same territory (Torre & Caron, 2005).

This finding raises the fact that geographical proximity has to be seen in the context of other forms of proximity: cognitive, social, institutional, and organizational proximity (Boschma, 2005). The cognitive proximity means that people share the same knowledge base (Boschma, 2005). The social proximity is associated with personal relationships between actors (Uzzi, 1996). Institutional proximity implies that actors share the same representations, rules of conduct, and values (Ben Hassen, Klein, & Tremblay, 2012). The relational or organizational proximity implies that firms and organizations, in their collective dimension, may share the same patterns of production and innovation (Boschma, 2005). There is now more and more agreement on the fact that geographical proximity can have an influence on a sector or a firm's capacity to innovate if it also translates into relational or organizational proximity. Entrepreneurs consider the social, cognitive, and communicational aspects of proximity to be vital in explaining their knowledge absorptive capacity. Knowledge dissemination is more likely to occur between actors who have similar cultural and organizational backgrounds (Boschma & Frenken, 2011). Multidimensional proximity clarifies how networks emerge, collaborate, and innovate (Ben Letaifa & Rabeau, 2013). To take into consideration the interaction during specific events, Torre (2008) also introduced the notion of temporary geographical proximity. The temporary geographical proximity enables actors to interact temporarily with one another. It can happen in different places: trade shows, conferences, and exhibitions (Torre, 2011, 2014).

Furthermore, some other researches highlighted that the environmental factors are important to the software innovation process. The nature of the intellectual property regime, technical standards, legal and regulatory requirements, and other environmental factors influence the ability of software firms to optimize their processes in favor of innovation (Lippioldt & Stryszowski, 2009). Rose et al. (2016) have also identified some elements of infrastructure (such as broadband availability and speed, microprocessor power, customer experience, and user computer literacy), as having important moderating influences on software innovation. Infrastructure determines the fundamental, unavoidable technological and social conditions in which innovative efforts are situated. Consequently, governments can play an important role to support the growth of the software industry. In fact, many of the new software exporting nations such as Ireland or India succeeded because their government took active steps to encourage the high-tech sector in general or the software industry in particular (Carmel, 2003; Crone, 2002). Even in the USA, Langlois and Mowery (1996) showed that the development of the US computer software industry has been powerfully influenced by federal government policy through the defense-related federal spending in R&D, training, and technology development.

3. The ICT sector and its actors in Lebanon

Lebanon is a small country in the Middle East. Classified as a middle-income country with a small-sized economy, GDP of 47.1 billion USD in 2015 (Harake, Matta, & Hasna, 2016). The Lebanese economy is mainly driven by services such as banking and tourism representing 75.8% of GDP and industry represents 19.7% of GDP. The Lebanese ICT sector is a fast growing sector with an estimated size of USD 530 million in 2017 (IDAL, 2017). Its impact on the GDP is estimated at USD 6 Billion by 2017 (Ministry of Telecommunications of Lebanon (MTL), 2013).

The Lebanese software industry emerged in the 1970s. The sector started with some local companies catering to large organizations. Since hardware was expensive and limited to some sectors, demand stemmed from large institutions in the public sector and the banking industry, as well as education and health care. The companies provided software services and solutions mainly in finance, banking, accounting, and logistics. Some of the early firms as Isticharat¹ are still among the leading players today (World Intellectual property organization [WIPO], 2015).

In the mid-1980s, with the emergence of Personal Computers, the Lebanese software sector followed a considerable boost. This brought computing within reach for a wider pool of clients. The technology developments triggered an important wave of new software business start-ups that

catered to medium-sized companies from all sectors, like retail and hospitality. Simultaneously, the larger corporations invested in upgrading their IT systems to the latest technologies and drove demand up even further (WIPO, 2015). Since the second half of the 1990s, the sector was marked by two trends. The first is the internet, which spurred a new generation of digital services companies. The second trend is related to the rise of the telecom-related software like the Value Added Services for mobile operators.

Meanwhile, after emerging from the Lebanese civil war, considerable efforts were spent to redress the Lebanese economy. The 1990s were focused on strengthening the enabling environment to allow private enterprises to succeed. The government took initiatives such as the enactment of new laws (e.g., the National Investment Law), improvements in administrative setups (e.g., the establishment of the Investment Development Authority of Lebanon), the reactivation of the Beirut Stock Exchange in 1996, and the launch of economic zones (Ministry of Economy and Trade of Lebanon, 2014).

The early 2000s witnessed the second wave of efforts focused on sectorial initiatives with long-term subsidized loans focusing on selected industries. The main actors during this period were Banque du Liban (BDL) with significant support of foreign development agencies. In 2000, Kafalat, Lebanon's credit guarantee scheme, was jointly established (Ministry of Economy and Trade of Lebanon, 2014).

Finally, since 2009, with the rapid growth of smartphone penetration, the software industry has shifted to mobile applications (WIPO, 2015). Simultaneously, the sector was marked by "entrepreneurship buzz" (Stel, 2013). In fact, Lebanon has over the past few years made significant gains in the area of innovation and the entrepreneurial ecosystem due to the vitality of the private sector and the implication of the government. The support infrastructure for entrepreneurs has expanded with a system of incubators, financial support, Venture capital (VC)s, and a range of private sector and civil society projects, programs, and organizations: UK Lebanon Tech Hub, AltCity Bootcamp, Speed@BDD, etc. For example, the National ICT Strategy Coordination Unit has been established on 1 July 2010 at the Prime Minister's Office with the long-term objective of making Lebanon the region's main Hub for e-services, creativity and innovation in Telecom and Internet Services. But the main event that marked the sector recently is the Circular 331, issued by the Central Bank of Lebanon (Choucair & Flynn, 2017). Furthermore, Lebanese universities have recently launched several entrepreneurial and SME programs: AUB's Center for Innovation Management and Entrepreneurship, LAU's Institute of Family & Entrepreneurial Business, BAU's Center for Entrepreneurship, etc. (Ministry of Economy and Trade of Lebanon, 2014).

Today, the sector consists of more than 800 IT companies and comprises all activities related to software development, hardware, and IT services (IDAL, 2017). Increasingly, the sector is shifting away from retail activities toward content generation and innovation. Software development and application production have gained momentum in the past few years (BankMed, 2014a). The IT sector (excluding distribution and sales activities) employs more than 5,000 highly skilled individuals. Today, the Lebanese Software Services industry includes around 211 companies, mostly SMEs, engaged in the creation and development of software products, services, and applications.

4. Methodology

The methodology of this paper is mainly based on a literature review and interviews based on semi-structured interviews, which were conducted face to face, or by phone. The research began with a preliminary stage in which we reviewed the literature on the Lebanese software sector, mainly with written documents, websites, newspapers, etc. This step helped us to determine the most important stakeholders and the characteristics of the software sector in Lebanon: relationships between stakeholders, role of the government, etc.

The second step was a qualitative investigation based on two semi-structured questionnaires that included two rounds of interviews and was conducted during the months of July and August

2016. The first series of interviews were held with nine experts and representatives from organizations in the Lebanese ICT sector. They represent the different institutions involved in the ICT sector in Lebanon such as Kafalat, SPEED, Berytech, Lebanon for Entrepreneurs, etc. The average length of the interviews was 45 min. The questionnaire (**Questionnaire 1**²) was divided into five parts:

- (1) General information about the organization: programs and services, role in the development of the industry, etc.
- (2) Dynamics of the local network: the network of partners, role in the network, the key leaders of the network, the level and type of relationships and interactions, barriers, challenges, limits, results, etc.
- (3) The relationship with governmental actors: the nature of relationships, the degree of government involvement in the development of the sector, etc.
- (4) Challenges of the software sector in Lebanon: strengths, weaknesses, opportunities, threats, etc.
- (5) Dynamics of the entrepreneurship ecosystem: challenges, actors, evolution, etc.

The second series of interviews were held with 12 software companies. The average length of the interviews was 1 h 6 min. The 12 companies were randomly selected according to a representative survey design in terms of the size of the company (Table 1). We should notice here that, historically, Lebanon lacked a formal unified definition of small and medium enterprises. Public and private sector entities developed definitions that suited their requirements³ (Ministry of Economy and Trade of Lebanon, 2014). Based on the number of employees, we used here the definition of the Ministry of Economy and Trade of Lebanon (2014): micro: 0–10 employees, small: 11–50, medium: 51–100, and large: more than 100 employees. Our sample is representative of the size distribution of the companies in the Lebanese software sector where SMEs represent 90% of registered firms (IDAL, 2017).

The small size of our sample is explained by the difficulty of getting appointments with Lebanese companies. Several companies have refused to participate in our research, citing their refusal to disclose information they consider confidential. To compensate for this gap, we focus on the quality of the information and the nature of the questions.

The questionnaire (**Questionnaire 2**) for companies was divided into seven parts:

- (1) The company: history, evolution, activities, etc.
- (2) Production: product development, strategic positioning, markets, etc.
- (3) Innovation: nature, objectives, factors that influence innovation, networks, obstacles, sources of knowledge and trade partners, etc.
- (4) Dynamics of the local network: the network of partners, role in the network, the key leaders of the network, the level and type of relationships and interactions, relations between the two associations, barriers, challenges, limits, results, etc.

Table 1. Distribution of the interviewed firms

Size (number of employees)	Number
Micro: 0–10	4
Small: 11–50	4
Medium: 51–100	1
Large: <100	3
Total	12

- (5) The relationship with governmental actors: the nature of relationships, the degree of government involvement in the development of the sector, etc.
- (6) Challenges of the software sector in Lebanon: strengths, weaknesses, opportunities, threats, etc.
- (7) Dynamics of entrepreneurship ecosystem: challenges, actors, evolution, etc.

Our analysis began with the processing of the data. To facilitate the processing of information collected, we transcribed the interviews. We prefer to have a full transcript of everything that was said to keep the logical arguments of each interviewee. Subsequently, we conducted a content analysis of interviews, and finally, we classified the information and elements of the interviews, using an analytical framework that incorporated the main research themes. We processed the verbatim with NVivo 10, a qualitative research analysis program. NVivo helped us to codify the data based on an analysis grid covering a set of themes related to our topic. This allowed us to classify statements made by each respondent based on the topic discussed (Table 2).

5. The dynamics of innovation in the software sector in Lebanon

Innovation in the software sector in Lebanon is determined by some characteristics. First, innovation in this industry is often driven by the demand and the client’s needs and request. The clients play an important participatory role in driving innovation.

The whole sector [Software] is driven by clients’ requirements. We always try to join the needs expressed by our clients. When we brainstorm, what we will try to adopt is innovation that can bring business and life solutions. In addition, to bring business you should be able to bring a certain need and a certain pain. (Company medium size. Questionnaire 2. Interview, 2016)

We should notice here that this is a general characteristic for the software industry (Lippioldt & Stryzowski, 2009). In fact, customer relationship management is critical and essential for SMEs in the sector (Chidiac, 2017). This relationship is aimed at achieving full customer satisfaction and creating trust. During our interviews, we noticed that most managers know their clients very well. Consequently, the most frequent type of innovation is the incremental one. Most of the Lebanese software companies combine existing knowledge, often generated elsewhere, and adapt it to a problem often identified by their clients.

The number of patent, publications and R&D is generally low in Lebanon whether in the ICT sector or even in other sectors. At the company level, innovation is not bad. There are good

Table 2. The analysis grid

Themes	Subthemes
Linkages between actors	Nature of the relation
	Local network
	International network
Governance	Leadership
	Role of associations
	Role of public actors
	Role of firms
Innovation	Leadership
	Resources
	Relations industry/universities
Entrepreneurship ecosystem	Resources
	Efficiency

new ideas, but it is not yet the Silicon Valley. However, generally, there is no R&D in the ICT companies in Lebanon. Innovation is more about “business solutions”. We are not good to invent something visionary. (Company small size N°1. Questionnaire 2. Interview, 2016)

Second, products and business solutions are, incidentally, the most common type of innovation because they are related to the client request. Organizational innovations are rare in the Lebanese Software industry, this is related to the managerial culture in Lebanon where entrepreneurs rely on family members to establish and develop their companies (Fahed-Sreih, Pistrui, Huang, & Welsch, 2010, p. 35). As demonstrated by Ahmed and Julian (2012, p. 27), “Lebanon is a country where management styles are still traditional. Thus, trying to apply modern management practices can be rather difficult.” Lebanese entrepreneurs have shown relatively limited enthusiasm for transition from the model of owner-manager to long-term sustainable organizations with professional management (Ministry of Economy and Trade of Lebanon, 2014).

Third, most of the software companies rely on their internal efforts to innovate with weak or inexistent links with the public R&D structures or with the universities. Furthermore, most of the companies adopted the “open innovation model.” Companies rely on many sources of innovation: the web, technology magazine, in-house technical specialists, visits to foreign markets and industrial exhibitions, their connections with foreign firms, etc. To the question: “Do you call or contact the universities during your innovation process?”, a manager answered:

In general, our source of information is the Internet, our suppliers, our customers, etc. In general, it’s an internal work. We do not have relations with the universities. We don’t have this culture in Lebanon. All companies in the ICT sector in Lebanon have this problem at the level of the company-industry relationship. There have been some attempts at joint enterprise-industry projects but nothing concretized at the moment. (Company small size N°1. Questionnaire 2. Interview, 2016)

Consequently, the innovation capacity of the firms depends on their internal capacity to generate new ideas and at the same time, their “absorptive capacity” to absorb the global knowledge flows. Therefore, there are different sources of knowledge for the Lebanese software companies (Table 3).

6. The collaboration university/industry

As mentioned above, little coordination exists between the sector and the universities or the scientific research centers. This situation can be explained by two main reasons. On one hand, the industry claims that universities do not apply their theoretical work practically. Educational levels in Lebanon are high and competitive with international standards (BankMed, 2014b). However, many companies highlight the mismatch between current skills in the market and the

Table 3. Sources of knowledge for the Lebanese software companies

Level	Characteristics	Explanation
Internal	Strong	Based on the good quality of human capital provided by the universities because of the solid educational system in Lebanon. Today, Lebanon ranks 19th worldwide for the quality of its higher educational system, while it occupies the 6th place for math and sciences education (BankMed 2014b)
Local	Weak	The collaboration industry/university is weak
		The collaboration between companies is weak
National	Weak	The collaboration industry/university is weak
		The collaboration between companies is weak
Regional	Strong	Based on the relation with customers mostly located in the GCC region
International	Strong	Based on different knowledge sources: web, magazine, etc.

skills companies ask for. One of the companies' manager informed us "We have people who are very well trained, who are very good, but who are not necessarily completely adapted to the market. The education system is very theoretical" (Company large size. Questionnaire N 2. Interview, 2016). For example, in the engineering or science fields curriculums, little place is dedicated to educate students about management of SMEs or feasibility analysis for projects (Oukil, 2011). There is also a lack of entrepreneurial curriculum that promotes innovation and creativity.

The education system is very well developed in Lebanon. However, there are areas where you feel employees are more friendly corporate than others. In the field of engineering for example, the curricula are not up to date. Therefore, the basics of engineering are there, people understand and know, but they need much more adaptation than a French student for example. In France, there is a culture to remain up-to-date, to expose oneself to the new technologies at the level of programming language for example. Therefore, in Lebanon there is a bit of delay in this sense. **(Company micro size N°1. Questionnaire 2. Interview, 2016)**

There is no structured cooperation between universities and the non-academic world (European Commission, 2012). During the interviews, some managers mentioned that universities in Lebanon are not used to collaborate with companies:

I believe that it is because the lack of a cooperation and development mentality in the universities. The universities here are not prepared to work with the industry; they do not have a record of success stories in that type of collaboration. It is a completely new field. We are trying to break that ice actually and work with some universities. (Company micro size N° 4. Questionnaire 2. Interview, 2016)

The collaboration with universities is still at its first stage and mostly concerns human resources, recruitments, internship, etc. Historically, the first mission of the Lebanese universities is education: prepare talents for the companies and ensure that the human capital is well prepared for the job market. However, R&D was always neglected as mentioned by a manager of one of the organizations: "Academia is a bit slow, in catching up. Universities here are always geared in the direction of preparing talent for the region" (Organization 7. Questionnaire 2. Interview, 2016).

As for all the MENA countries, entrepreneurship and innovation education in Lebanon are at an early stage, and relevant course offerings are very recent and limited to a very few universities (Oukil, 2011). Traditionally, Lebanese students have been educated in social norms to enable them to enter the labor market as employees but not as entrepreneurs or innovators (Saleh, 2014). However, this situation is changing, several Lebanese universities have recently launched entrepreneurial and SME programs (Ministry of Economy and Trade of Lebanon, 2014).

One of the main obstacles of collaboration between the industry and universities in Lebanon is the legal aspect of the R&D. There are a number of laws on Intellectual property rights (IPR) in Lebanon.⁴ However, the IPR system in Lebanon remains largely unused by entrepreneurs and academics, due in part to the costs and complexity of the patenting processes. Consequently, the companies often use alternative tools to protect their innovations, including "...secrecy, exploitation of lead-time advantages, moving rapidly up the learning curve, use of complementary sales and service capabilities, technical complexity, keeping their humans resources, as well as ongoing innovation relationships based on trust and use of trademarks to differentiate their products from those of imitators" (Economic and Social Commission for Western Asia (ESCWA), 2016).

Here, we must mention that software piracy is extremely common in Lebanon and is in complete violation of IPR (ESCWA, 2016). According to the Business Software Alliance (BSA) (2016), the software piracy rate in Lebanon was in 2015 at 70%, placing the country at the 37th highest piracy level among 111 countries worldwide. The piracy phenomenon in Lebanon extends to reach all forms of media (entertainment and music), software (business software, games, and unlicensed

computer programs), and technology (mobile downloads, internet-based piracy) (Economic and Social Commission for Western Asia (ESCWA), 2016; International Intellectual Property Alliance (IIPA), 2013).

On the other hand, universities are countering that there is a lack of interest on the behalf of local companies in developing indigenous knowledge production. In Lebanon, innovation is usually described as being ad hoc and personal rather than structural and collective. Usually, entrepreneurs concentrate their efforts on the internal sphere of the company: its employees and in its customers, rather than in the external sphere (Chidiac, 2017). Consequently, the innovation process within the software sector is mostly related to the manager especially in the case of SMEs. As noticed by Chidiac (2017), the general performance of SME in the Lebanese software is linked to the manager personality and connections. The manager place himself as “Pivot” or “Center of Gravity” within his company.

7. Innovation and proximity

The importance and the perception of proximity depend on many factors; we observed different types of proximity: proximity companies/universities, proximity between companies, and proximity with customers.

7.1. Geographic proximity companies/universities

The most important type of geographic proximity for the firms is the proximity with the universities and the labor pool. However, most of the firms do not have direct link with the universities. The relations with universities concern mostly the recruitment of human resources. As demonstrated above, the collaboration university/industry is weak in the innovation field but there is some collaboration for human resources. Indeed, the main strength of the sector remains the strong human capital provided by the universities. In fact, skilled human capital remains the most crucial factor for software innovation. The availability of trained and creative workers is a key element in the software innovation process; human capital is a crucial input. Depending on the nature of the innovation, the physical capital requirements can be relatively modest (Lippioldt & Strykowski, 2009). In fact, a greater proportion of highly qualified workers in the firm would positively affect the firm’s innovation performance.

Lebanon’s ICT labor force is endowed with competitive technical skills when compared to the region. The new labor market entrants are mostly high skilled, multilingual, and cost-competitive. This is mainly due to the country’s advanced educational system. Historically, Lebanon has been home to prestigious higher education institutions.⁵ Today, Lebanon ranks 19th worldwide for the quality of its higher educational system, while it occupies the 6th place for math and sciences education (BankMed, 2014b). Despite the high qualifications of Lebanon’s ICT labor force, the salary scale in this sector is considered competitive (BankMed, 2014b).⁶

Most of the Lebanese SMEs are based on exporting skills. We create a company in Lebanon, we hire people, we send them to France, or the Gulf to do projects, in the end we play on the differentiations of taxation, and especially salaries. Human resources here are competent and much cheaper than in the rest of the region. (Company small size N°4. Questionnaire 2. Interview, 2016)

However, the situation of the human capital in the software sector is paradoxical. On one hand, many fresh-graduated go into the labor market yearly and face difficulties in finding appropriate jobs related to their field of study (Saleh, 2014). While unemployment points to 14% in 2014 according to the ILO, the youth unemployment rate stands at 20% compared to the world average of 13% (Startup Ecosystem Think Tank (SETT), 2015). Consequently, many graduate and well-qualified young people choose to seek opportunities elsewhere (UK Lebanon Tech Hub, 2016). On the other hand, for some companies, it is hard to find good employees and some managers mention a competition between the big IT companies and the small ones.

Our huge problem in Lebanon is recruiting. It is to find enough people, without having to constantly fight with our competitors. You have graduate engineers from the top Lebanese universities, who train good engineers. Right away they are hired by people who are going to pay twenty to thirty percent more than the market or even a lot more, because they want to make sure to have the best people. They want to lock those skills. They are the big software companies. (Company large size. Questionnaire N°2. Interview, 2016)

7.2. Geographic proximity between companies

For the geographic proximity between the software companies, we noticed two main tendencies. First, some companies are aware of the importance of collaboration with others companies in Lebanon. Some persons mention the importance of geographic proximity with other software companies to collaborate and exchange resources.

Not to solve the problem, but it is to see if he knows someone who can help me solve it. For example: "I am looking for a java architect, to recruit him". There are companies with which I work and we exchange resources. "I have many projects; can you send me two resources for two months?" Another type of cooperation between companies is that we go together in projects. So it's more a business cooperation. (Company small size N°1. Questionnaire 2. Interview, 2016)

Some entrepreneurs rather see local players as their competitors and have little confidence or interest in their local networks. The perception of the local environment and the proximity depend on many complex factors. First, it depends on the personality of the entrepreneur, if he is a collaborative type of person or not. It also depends on his cultural and social background. Second, it depends on the type of his products and services. Usually, the companies specialized in "common" products or services: social media, creation of website, etc., have little confidence or interest in their local network. They see local players as their competitors. This factor can be related to the market. When the company is more concentrated on the local Lebanese market, the competition is high and the market size is limited. Consequently, his tendency to collaborate is limited. On the other hand, when the company specializes on "specific" products or services and works in a specific niche, he is more confident and encouraged to collaborate more, especially when his market is more international.

Another factor was mentioned during the interviews, which is the specialization aspect. A company will in fact be more inclined to agree to collaborate with another company specialized in different subfield because the risk of stealing technology is reduced and especially when their products or service are complementary. However, for the companies working in the same subfield, collaboration is risky because the partner can always steal the company's technologies and secrets, particularly knowing that the legal and the institutional framework are weak in Lebanon as mentioned above.

The majority of the Lebanese [software] companies today have a certain specialization. So if you have 30 software companies, you can find 3 or 4 in each area that are against collaboration. So if we take 4 of 30, 26 with which we can collaborate and 4 with which we can't collaborate. (Company small size N° 2. Questionnaire 2. Interview, 2016)

Nevertheless, some persons mentioned that the collaboration in the software sector is hard because the Lebanese culture is characterized by individualism and personal initiative (Chakour, 2001).

The Lebanese are quite individualistic as entrepreneurs. They work alone. We do not have a culture of cooperation, but we are gradually seeing more and more development in this aspect with time. (Organization 5. Questionnaire 2. Interview, 2016).

7.3. The geographic proximity with the customers

The growth of the Lebanese software sector is highly limited by the size of the market and the best way to grow in volume is by addressing other markets (Fayad, 2014). Consequently, the

importance of geographic proximity with the customers depends on the market. For the local clients, the geographic proximity is important.

In this region, people like the face-to-face relationship; they like to see each other. And I think the issue of trust plays an important role in seeing who we are dealing with. Seeing the person can determine the way one feels about him or her on a personal and business level. Trust is the cement of business, there is no business without trust. So geographic proximity is important for our customers to build trust, to establish a link that modern means of communication cannot replace. (Company micro size N°1. Questionnaire 2. Interview, 2016)

As a general observation, respondents carry positive attitudes in the importance of collaboration, but they may not have intention to put it into practice because the lack of time, resources, etc.

In Lebanon, ICT is a small community, everyone knows each other, we are a small group of people, we do not have time to organize because we have too many things to do. There are some who want to organize things, but they have not been given the means to do so. It is happening but little by little. (Company micro size N°1. Questionnaire 2. Interview, 2016)

8. Government and the software industry in Lebanon

The majority of the persons interviewed highlighted the absence of a clearly stated and government endorsed national strategy for innovation and the technological sectors in Lebanon. They also emphasized that a major weakness was related to a lack of continuity as a result of frequent changes of leadership.

The Lebanese economy is often described as open and liberal with minimal state intervention (Marseglia, 2004). This was always considered as an advantage since the private sector has to survive and prosper despite the lack of assistance from the public sector (Sayigh, 1962). As indicated by Chakour (2001), Lebanese people do not rely on the government to provide for their well-being. The Lebanese government actions are weak for the following two main reasons.

First, during the last 40 years, Lebanon faced many internal and external shocks that weakened the government and launched the country into a path of political and economic uncertainty (Raphaelli, 2009). Lebanon is considered a fragile country that has faced several brutal violent conflicts: civil war, Syrian military and intelligence presence, and the July 2006 conflict with Israel. Second, the Lebanese society is organized along sectarian lines of 18 recognized religious communities that each have their political leaders and parties and social institutions (schools, clinics, and charity organizations). Accordingly, citizens have historically depended on sectarian leaders for protection and provision more than on the government (Welsh & Raven, 2006, p. 30).

Disabled by those issues, the Lebanese state has a relatively weak capacity. The public actions in favor of research and innovation have been very timidly developed (Hadhri et al., 2016; Hanafi & Arvanitis, 2016). There is no ministry in charge of national S&T policy making in Lebanon or a clear national strategy for technology (ESCOWA, 2016). The Lebanese ICT policy was limited in terms of government usage and priority. According to the World Economic Forum (2016), Lebanon is ranked 135 out of 142 countries, in terms of government prioritization of ICT. In the same report, Lebanon was ranked 141 out of 142 in importance of ICT to government vision and government procurement of advanced technologies. Our interviews showed that the Lebanese do not think that the government considers the support of new and growing firms as a high priority. Furthermore, Chakour (2001) highlighted that Lebanese perceive the government officials in Lebanon as incompetent and ineffective in supporting new and growing firms.

In fact, there are problems more important in Lebanon than the ICT sector. Our governments were never up to the task of solving the country's problems. We have a very weak public sector. There are just scattered efforts here and there of a few individuals within governments. In fact, there is no vision in Lebanon, how to manage the country, not just for

the ICT sector. We are in a system that does not work at all. It is clear. What we always do is wait for a few people here and there, windows of opportunity, to be able to pass something. So you just have to have that window of opportunity. (Company small size N°1. Questionnaire 2. Interview, 2016)

For the software industry, however, the situation is changing. Recent policies seem to indicate a new direction with stronger focus on ICT by the Lebanese administration. Business community in Lebanon is “registering an increased weight on ICTs in government vision and efforts to improve the regulatory environment” (World Economic Forum, 2016). “Starting from a low level, government indicators are also moving in the right direction: in particular, the regulatory environment is improving in terms of judicial independence, the efficiency of the legal system, and the effectiveness of law-making bodies. Substantial improvements are registered for the impact of ICTs on business models, organizational models, basic services, and government efficiency. Building also on a solid basis in terms of education, skills, and knowledge-intensive jobs, Lebanon has many of the factors in place to continue on this positive trajectory ”(World Economic Forum, 2016).

One of the main governmental decisions was the Circular 331 issued by BDL on 22 August 2013. Its goal was to engage Lebanon in the knowledge economy. The circular also intended to slow and eventually reverse Lebanon’s famous brain drain and stimulate entrepreneurship. Circular 331 encourages investment in local start-ups, incubators, and accelerators by offering 7-year interest-free government loans to private banks, which can be invested in treasury bonds with an interest rate of 7% (UK Tech Hub, 2016b).

Circular 331 has significantly reduced the funding barrier that Lebanese entrepreneurs faced in the past. Before Circular 331, Lebanese start-ups could access guaranteed loans, commonly through Kafalat. But Circular 331 may have resolved access to finance, but other problems (high-speed Internet, bankruptcy laws, piracy, inefficient institutions, etc.) hinder the software sector’s development (Choucair & Flynn, 2017).

In fact, one of the most important challenges for the software sector in Lebanon is the internet. All, the companies that we met insist on the fact that “The Internet in Lebanon is really bad.” According to Worldwide Internet Speed tests, it has currently ranked 172 out of 198 countries with an average speed of 3.52 Mbps. Other tests show that it is as low as 1.6 Mbps and the global average is 22.3 Mbps.⁷

9. Conclusion: The entrepreneurship ecosystem boost innovation and relational proximity

The first objective of this paper was to analyze the characteristics and dynamics of innovation within the Lebanese software industry. We determined that the innovation in the software industry has two types of characteristics. On one hand, innovation is often driven by the demand and the client’s needs and request. On the other hand, in contrary to many previous researches that showed the importance of external R&D and universities for the innovation in this sector, we noticed that in Lebanon the local R&D structures or the universities do not support this sector. Another important result is the government role in the sector. Despite some recent projects and interventions, the support offered by the Lebanese government is still weak and this is mainly related to the complexity of the political and social system in Lebanon.

The second objective is to provide a framework to analyze how the different types of proximity affect the innovation and the interactions of inter-actors within this industry. The role and the perception of proximity seem to change. The more the sector becomes structured and organized, the more the proximity is seen as an important tool to improve the competitiveness of the sector. We concluded that the recent “entrepreneurial boom” (Stel, 2013) can play an important role in boosting these changes. With the development of the entrepreneurship ecosystem⁸ in Lebanon, many organizations and associations were created to support the software companies which engage in a broad range of activities, from training to organization, financing, etc. The majority

of the companies insisted on the “buzz” effect of Circular 331 on the software sector: “In fact, ten years ago, there was nothing at all. In 2000 there was not much. I believe that when the Bank of Lebanon, the BDL launched Circular 331, in 2013, and that is where there’s really something that has begun to be built” (Company large size. Questionnaire N°2. Interview, 2016). As demonstrate by Mulas, Qian, and Henry (2017), fast-forward to 2016 and Beirut is a different city for start-ups. The support infrastructure for entrepreneurs has expanded with several acceleration programs such as the UK Lebanon Tech Hub, AltCity Bootcamp, Speed@BDD, Smart ESA, and more in the pipeline. Beirut Digital District has become the hub of the ecosystem, and BDL’s Circular 331 and other donor-backed funding support programs such as World Bank-Kafalat and USAID-IM Capital have resulted in multiple VC and matching funds for Lebanese entrepreneurs.

But the most important contribution of those organizations is building collaboration, trust, and consequently relational proximity between companies as confirmed by the manager of one of the organizations: “we see more and more, young entrepreneurs are much more open to collaboration, support,... And organizations like Berytech, like UK Lebanon Tech Hub help to do that.”

In fact, the different workshops, events, etc. organized by those organizations create a “temporary proximity” which helps companies to meet, know each other, connect, and eventually collaborate. Also, these organizations play an important role in developing the knowledge base of companies and accelerating the flows of information and knowledge between them.

It’s constantly improving. I can see it in our cohorts. First cohort, no collaboration whatsoever. We tried so hard to put them together, to talk to, you know, that the community-approach to doing things works. It was very difficult, they’re very distrustful. I could see the difference between when we first started, only in a year, the first batch and the second batch is insane. Now, we don’t even need to tell our companies to talk to each-other. You know, I recently had two companies here who were fighting. A week later, I came, and I saw them sitting together and talking. It’s so different from before, that’s the thing. (Organization 7. Questionnaire 2. Interview, 2016)

Finally, the different issues of the Lebanese software industry could be solved by a clear and precise policy by focusing on these points: encourage industry/university cooperation, improve the education in the ICT, and create more support for the existing companies.

Our research has contributed to a limited work on the Lebanese software industry, but of course, continued research will be interesting to follow the development of this young industry. Future researches could focus on the relation between the entrepreneurship ecosystem and innovation.

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Notes

1. Founded in 1977, Istisharat is the oldest software development company in Lebanon dealing with the banking, insurance, and manufacturing sectors. Istisharat gained very successfully the foreign markets by exporting its products to Europe, the Gulf, and the USA.

2. Our questionnaires are based on our previous researches, which were part of the ISRN project:

<http://sites.utoronto.ca/isrn/>; with some modifications.

3. For example, the Banque Du Liban defines SMEs as enterprises with less than LBP 15 billion in annual turnover, while Kafalat defines SMEs as having less than 40 employees (Ministry of Economy and Trade of Lebanon, 2014).

4. Examples: Law No. 240/2000 of 2000 on “Patents” (it covers enforcement of IP and related laws, industrial property, IP regulatory body, inventions, plant variety protection, transfer of technology and trade secrets, etc.)

- Law No. 75/1999, Articles 89, 91, and 92 on “Protection of Literary and Artistic Property”. It covers the copyright law

- Law No. 69/20 of 23 May 1969 on “Rights of Creators of Musical Works”

- Circular No. A/1/4 of 25 May 2006 on “Protection of Computer Programs and Fight against Piracy”
 - Circular No. A/1/5 of 25 May 2006 on “Protection of Literary, Artistic, and Scientific Works” (Economic and Social Commission for Western Asia (ESCWA), 2016)
5. Lebanon’s higher education is the oldest in the region and dates back to 1866, when the American University of Beirut (AUB) was found under the name of the Syrian Evangelical College, followed by the University of Saint Joseph (USJ) in 1875, then by the Lebanese American University (LAU) in 1947, as a Beirut College for Women. The Lebanese University (LU) which is the only public university in the country was found in 1951. Before the civil war, Lebanon had one of the best university systems in the Middle East and was a magnet for foreign students. Today, Lebanon encompasses 42 higher education institutions (BankMed, 2014a).
 6. For instance, the average monthly wage of a software engineer in Lebanon is USD 1,700, which is 60% lower than in UAE, 235% less than in Australia, and 341% lower than in the United States (BankMed, 2014b).
 7. <https://en.annahar.com/article/499996-building-Lebanons-innovation-roadmap> (15 May 2017).
 8. For more details about the concept of entrepreneurship ecosystem, see Stam (2015), Spigel (2017), and Malecki (2018).
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