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Conference Paper

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52nd Congress of the European Regional Science Association: "Regions in Motion - Breaking the Path", 21-25 August 2012, Bratislava, Slovakia

Provided in Cooperation with:

European Regional Science Association (ERSA)

Suggested Citation: Bechtloff, Katharina (2012) : The influence of academic institutions on regional clusters using the ICT cluster of Waterloo, Ontario as an example, 52nd Congress of the European Regional Science Association: "Regions in Motion - Breaking the Path", 21-25 August 2012, Bratislava, Slovakia, European Regional Science Association (ERSA), Louvain-la-Neuve

This Version is available at:

<https://hdl.handle.net/10419/120638>

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The influence of academic institutions on regional clusters using the ICT cluster of Waterloo, Ontario as an example

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This is a shortened and translated version of the author's diploma thesis, which was published at the Vienna University of Economics and Business's Institute for the Environment and Regional Development in October 2011.

1. Introduction

The paper aims to examine the role of academic institutions in the development of the ICT (Information and Communication Technologies) cluster of the Waterloo Region in Ontario, Canada. The regional economic impact of clusters as well as academic institutions depends crucially on its ability to innovate. The ICT sector with its analytical knowledge base depends deeply on radical innovations which can be reached through research and development (R&D) with scientific inputs from academic institutions. However, the pure existence of technical universities does not automatically result in the development of an ICT cluster.

In the region of Waterloo three academic institutions - the University of Waterloo, Wilfrid Laurier University and Conestoga College shape and stimulate the regional ICT cluster which now includes up to 700 stakeholders from global market leaders like Research in Motion (RIM) and Google to SMEs¹. The following paper tries to measure their impact through evaluating statistics and scientific research conducted to date as well as qualitative interviews which were conducted in the region of Waterloo in February 2011

2. The influence of academic institutions on regional development

Concerning the role of academic institutions Goldstein/Renault (2005) observed a sustainable influence of universities on regional development. Two well known examples are Stanford University, CA, which is often being seen as the growth engine for Silicon Valley's ICT

¹ Communitech 2010

cluster², and MIT in Cambridge, MA. Additionally there are many other renowned universities, which enhance their region's sustainability³.

Academic institutions, i.e. universities and colleges, educate students and thus provide a qualified labour force as well as produce beneficial scientific research to be used by the firms in the region⁴. These two roles of research and education are influencing each other directly and can be done more productively and cost effectively if they are performed together, even though friction can occur⁵. As members of the academic institutions⁶ students can perform initial research activities in the university's departments and because of the turnover of students universities constantly gain new insights and thus foster innovation⁷. Universities can become the engine of regional growth⁸ and the institution provides the region with knowledge and human capital, which can foster entrepreneurship, innovation and synergy effects⁹.

Policy makers have realised this potential and are founding and funding universities as multiproduct organisations¹⁰ in less research-intensive regions, often with partners from the industry hoping to generate knowledge, innovation, and new technologies¹¹ as well as academic spin-offs¹². However, the pure existence of universities does not automatically create regional effects. Concerning the creation of a cluster, academic institutions can influence the formation by extensively pursuing research activities, but are rarely seen as the only requirement of a cluster. Together with an existing base of industry stakeholders and human capital they can influence and foster shaping the knowledge based cluster in scope, which can be enhanced by the research and development activities of the universities and the industry. Clusters in their growth stage can be impacted the most by support from academic institutions as they provide "well trained specialized human resources with appropriate technical and research skills, but their programmes sometimes lag cluster needs"¹³.

² Lawton Smith 2006

³ Doutriaux 2008

⁴ Mowery/Sampat 2005

⁵ Etzkowitz/Leydesdorff 2000

⁶ Lange 2007

⁷ Etzkowitz/Leydesdorff 2000

⁸ Jonas 2006

⁹ Goldstein et al. 1995

¹⁰ Goldstein/Renault 2005

¹¹ Etzkowitz/Leydesdorff 2000; Kitagawa 2004; Rosenfeld et al. 2005

¹² Mowery/Sampat 2005

¹³ Doutriaux 2008

3. The ICT-cluster of Waterloo

The ICT sector with its analytical knowledge base depends deeply on radical innovations which can be obtained through research and development with scientific inputs from academic institutions¹⁴. Studies have shown that successful innovation can be fostered by intensive cooperation with other companies, research and educational facilities¹⁵. ICT clusters can mainly be found in functional urban regions with an integrated labour market and a high density of corporate headquarters, R&D facilities, research universities, university hospitals, qualified human capital and purchasing power¹⁶.

All of these are factors which can be found in the Waterloo region in Ontario, Canada. The region of Waterloo, which includes the cities of Waterloo, Kitchener and Cambridge as well four townships North Dumfries, Wellesley, Wilmot and Wollwich, is in south-western Ontario, approximately 100 km from Toronto and 140 km away from the border to the United States with an estimated 543,700 inhabitants (2010)¹⁷. Here, three academic institutions - the University of Waterloo, Wilfrid Laurier University and Conestoga College - shape and stimulate the regional ICT cluster, which now includes up to 700 stakeholders from global market leaders like RIM and Google to numerous SMEs¹⁸.

Economically the Waterloo region has a strong background in manufacturing, including Toyota's only Lexus assembly plant outside of Japan in Cambridge, and insurance, with two major insurance companies, accounting for up to 5,000 employees in the region¹⁹. However, during the last decade employment numbers in manufacturing dropped by 22% whereas knowledge based industries like educational services continued to grow²⁰. The region's economic base is mainly comprised of small enterprises with 77% of the companies having less than 10 employees²¹. The biggest employer of the region is the Blackberry manufacturer RIM, which employs 9,000 out of its worldwide 17,000 employees in Waterloo²².

¹⁴ Tödting et al. 2004; Tripl et al. 2007

¹⁵ Powell/Grodal 2005

¹⁶ Karlsson 2008

¹⁷ Region of Waterloo 2011

¹⁸ Communitech 2010

¹⁹ The City of Waterloo 2011; Kitchener 2011

²⁰ Canada's Technology Triangle 2009; Kitchener 2011

²¹ Kitchener 2011

²² Research in Motion 2011

3.1 Background of the ICT cluster

During the Second World War the significance of research and development increased as advanced technologies like radar systems and computer science played an important role for the military. Thus, an R&D friendly environment established which lead to higher spending even after the war ended²³. New academic institutions were founded with the aim to competitively sustain the region²⁴ and to explicitly co-operate with the industry²⁵. These tendencies could also be seen in the region of Waterloo, where a technical academic institution, later named the University of Waterloo, was founded with strong involvement in the industry after the Second World War, and held its first lectures in 1957. It was the aim to not just offer solely academic programmes, but to enhance it by building a co-operative programme, i.e. by combining internships as a component of the student's education²⁶. The foundation of the University of Waterloo can be seen as the first seeds for the ICT cluster in the region and therefore acted as an anchor organization, which enabled the cluster to grow based on the existing manufacturing companies²⁷. By co-operating with the local industry the university was able to acquire funding²⁸ and to foster joint research, which enabled their research activities to be accessible to the community²⁹. The purchase of the first computer in 1960 and the establishment of the Computing Centre by James Graham were important steps in the ICT development of the region. New knowledge was created and transferred into the industry by the first academic ICT spin-off WATCOM in the 1970s. At WATCOM a programming language was developed at the university by Graham and its students was successfully commercialised. The co-operation of the university and WATCOM was used as a role model for many more spin-offs to come³⁰ and as a generous template for the university's intellectual property guidelines, which stated that "ownership of rights in IP created in the course of teaching and research activities belong to the creator(s)"³¹. This policy attracted young, entrepreneurial professors³².

²³ Freedman 1992

²⁴ Goldstein/Renault 2005

²⁵ Lawton Smith 2006

²⁶ University of Waterloo 2009

²⁷ Lucas et al. 2009; Wolfe 2009b

²⁸ Wolfe 2009a

²⁹ Bathelt 1991

³⁰ Wolfe 2009a

³¹ University of Waterloo 2000

³² Bathelt 1991

With the first spin-off company in 1976 the expansion of the cluster started and with American companies like NCR and Raytheon, which operated in the ICT-manufacturing industry, this period of time can be seen as the crucial time for the cluster's formation reaching a critical mass³³. It was influenced strongly by the academic spin-offs of the 1980s and 1990s like Open Text and RIM³⁴, who created a base for the cluster together with new companies moving into the region and newly founded firms. The dynamics of the growth of the cluster in the 1980s and 1990s slowed down in the 2000s because of a lack of funding after the burst of the dot.com bubble³⁵.

The creation of the cluster was based on a synthetic knowledge base³⁶ and was closely connected to the foundation of the technical University of Waterloo, which is today creating the knowledge base of the region together with Wilfrid Laurier University and the Conestoga College Institute of Technology and Advanced Learning. By co-operating with the regional industries, supplying qualified human capital and supporting spin-off activities these institutions are providing important impulses for the cluster and are crucial stakeholders of the region. The current state of the cluster is heavily influenced by its most successful global player RIM, who branded the Waterloo region internationally, and helped attract other global ICT-players like Google. The cluster is not just based on one specific subdivision of the ICT sector, but includes services as well as manufacturing ICT sectors, which enable it to overcome economical challenges like the burst of the dot.com bubble more easily.

3.2 Characteristics of the ICT cluster

The ICT cluster of Waterloo region includes, based on the generous definition of Communtech (2010), more than 700 ICT companies with roughly 30,000 employees. The following section analyses whether statistical proof for the existence of the cluster can be found.

Waterloo's GDP is in the lower third in comparison with other regions of Ontario; however, its growth rates of 40% within the last nine years are outstanding in comparison to cities with similar spatial locations³⁷, which can be seen as the first sign of a competitive advantage. Measuring a value for innovation of a region is difficult, but it is possible to use the number

³³ Bathelt 1991

³⁴ Lucas et al. 2009

³⁵ Wolfe 2009a

³⁶ Wolfe/Nelles 2008

³⁷ Canada's Technology Triangle 2008

of patents of a region as a sign for innovation as Porter (1999) has done. The region of Waterloo's relative number of patents is, with 362 patents per million inhabitants in 2005 and 631 in 2006, higher than Ontario's (129 and 181) or Canada's (117 and 148)³⁸. The high number of patents in 2006 is connected to the success of RIM, which applied to register 458 patents between 2007 and 2008, which is more than any other Canadian company³⁹. The deducible high rate of innovation is another indication for competitiveness of the region. Although Waterloo's public R&D expenditures are generally in line with Ontario's and Canada's spending (1% in comparison to 0.9% of GDP for 2005), the private expenditure is significantly higher (1.7% in comparison to 1.1% of GDP for 2005) than the nationwide average⁴⁰. The significantly higher private R&D expenditure might be explained by a survey of Communitech (2005), where technology companies stated that they are spending 24% of their revenue for R&D activities and 59% of them expected these numbers to grow further.

The significant amount of R&D activities is the driver for the high demand for skilled labour in the region. Even though the population of Waterloo region has a lower average educational background than of Ontario, the number of people with degrees, especially Ph.Ds, in an ICT related field is outstanding (61,800 people or 34% of the people with a degree), which shows again the importance of the industry. Currently 90,867 or 16,7% of the population are students enrolled at one of the three academic institutions⁴¹.

3.3 The companies and actors of the ICT cluster

The region of Waterloo is often complemented by the city of Guelph and was named Canada's Technology Triangle⁴² containing up to 700 technology companies⁴³ and according to current newspaper articles even up to 800 companies⁴⁴. These numbers include probably around 200 early stage companies, which are still in a planning stage⁴⁵. Currently 563⁴⁶ technology companies are being listed in the Technology Directory⁴⁷, which includes

³⁸ Canada's Technology Triangle 2008 based on United States Patent and Trademark Office and Statistics Canada 2007

³⁹ Canadian Intellectual Property Office 2008

⁴⁰ Canada's Technology Triangle (2008) based on Statistics Canada, Science, Innovation and Electronic Division and CANSIM

⁴¹ University of Waterloo 2011b; Wilfrid Laurier University 2001a-b, Kitchener 2011; Conestoga College 2011

⁴² Communitech 2010; Wolfe 2009a

⁴³ Communitech 2010

⁴⁴ Humphreys 2011

⁴⁵ Communitech 2010

⁴⁶ 563 companies are named in the Technology Directory of Communitech (2010) without double counting

⁴⁷ Communitech 2010

advanced manufacturing, aerospace, biotechnology, environmental, hardware, internet, IT Services, telecommunication, wireless and mobile services as well as digital media, software and ICT, with the latter three sectors accounting for 51% of the technology companies of the region including global players like Open Text and international presence of NCR and Google.

The city of Waterloo hosts 205 technology companies, i.e. 39% of the ICT cluster's firms are situated in the city. While the city of Cambridge only hosts 12% of the companies, it includes 28% of the advanced manufacturing companies, which shows its strong manufacturing base as it also hosts Toyota's automobile plant. 51% of the companies of the whole cluster have up to 5 employees and only 7% have more than 100. An additionally 320 firms support the cluster, by offering services to the ICT companies like advisory, financing and insurance as well as R&D and academic institutions⁴⁸.

The cluster is being supported by local civic associations like Communitech with almost every regional technology company as a member and Canada's Technology Triangle, which are "key contributor(s) to the process of cluster development. (...) Civic capital acknowledges the critical role of local leaders in intensifying and formalizing collaborative networks within and between communities"⁴⁹. These associations are trying to increase the institutional thickness⁵⁰ for the local and regional ICT industry and are interacting and in competition with each other, which supports the growth of local governance⁵¹.

3.4 Success factors

While in the 1970s and 1980s the cluster was especially characterised by customer access and transport routes⁵², today the cluster does not present itself as the classical cluster described by Porter (1990). Competition between the companies, a major factor in Porter's diamond, is rarely seen and supply chains and key markets are global. Only the labour market is mostly regionally based and being influenced by the three academic institutions. Here the University of Waterloo is seen as the "premier educational and research institution in the cluster"⁵³. The

⁴⁸ Communitech 2010

⁴⁹ Lucas et al. 2009

⁵⁰ Ash/Thrift 1994

⁵¹ Wolfe/Nelles 2008

⁵² Bathelt 1991

⁵³ Wolfe 2009a

universities are seen as “magnets for new ideas/ventures”⁵⁴ and formal and informal ties are beneficial for both partners. The academic institutions influence the cluster by acting as incubators for spin-offs, which are integrating into the cluster. Bathelt et al. (2010) observed 18 spin-off companies of the University of Waterloo and found out that while in the beginning they show strong ties to the university, they quickly weaken due to their customer needs and adjust their focus from academic research to incremental innovations.

Marshall (1922) saw one of the advantages of a cluster in a skilled local labour market and the Waterloo region and especially the city of Waterloo is offering a large quantity of highly qualified advanced labour force since at least the 1980s⁵⁵. Due to the universities and the high number of ICT companies the region provides a wide range of labour capital. Small companies benefit by having access to employees who have gained experience working for global ICT players like Descartes Systems through their co-operative studies before graduation.

The key elements of success in the cluster are embedded with the University of Waterloo acting as the anchor organisation for human capital and knowledge transfer and as a research partner. The ongoing growth of entrepreneurial companies and SMEs provide the base of the cluster, which combine with global players like RIM and provide a fertile environment to attract new businesses from outside the region.

3.4 Weaknesses

The dynamic of the growth of the cluster with lots of newly founded companies and direct investments of the 1980s and 1990s lost its intensity 2000. It is important to notice that the dynamic of the cluster never occurred due to explicit policy means (Bathelt 1991) and unlike other Canadian ICT clusters no National Research Council (2011) has been created to actively support the cluster initiative. By now the city and the province as well as the academic institutions themselves have programmes supporting local entrepreneurs and are also aimed at attracting new companies from outside the region. However, by attracting new global players like Google to the region it is questionable whether the supply for qualified labour force can meet the new demand. All these are weaknesses Wolfe (2009a) identified and were already spotted by Bathelt (1991) as potential supply shortage of human capital. Still, after Bathelt’s observation in 1991 the cluster still prospered in the 1990s.

⁵⁴ Colapinto 2007

⁵⁵ Bathelt 1991; Wolfe 2009a

A new negative development is the potential weakness of Research in Motion, Waterloo's biggest employer, which had to lay off more than 200 employees for the first time in the summer of 2011, as its ability to create innovative products decreased in comparison to its major competitor Apple⁵⁶. It is yet to be shown whether RIM can stay a strong competitor and if the loss of jobs at RIM can be absorbed by other regional ICT players.

3.5 The regional economical influence of the academic institutions

Conestoga College as well as the University of Waterloo commissioned studies about their regional impact in the beginning of the 2000s. The college found out that its graduates spend 1.4 Billion CAD in the local economy⁵⁷. The University of Waterloo and its graduates are estimated to be accountable for 1.1 Billion CAD in the regional economy and 1.6 Billion CAD in the province of Ontario in 1999⁵⁸.

Figure 1: Economical impact of the University of Waterloo on the region in 1999 (in CAD)

Source: Price WaterhouseCoopers (2001)

Value Added Impacts (1999 \$000)	Total	Multipliers
<i>Operating Organization</i>	\$265,159	0.84
<i>Knowledge Generation:</i>		
Alumni	\$58,577	0.84
Spin-offs Operating Expenditures	\$618,412	1.02
Spin-offs Capital Expenditures	\$48,209	0.53
<i>Attracting Students:</i>		
From Rest of Ontario	\$58,895	0.89
From Outside Ontario	\$30,004	0.89
<i>Attracting Visitors</i>	\$21,316	0.66
<i>Public Institution</i>	Not quantified	
Total Value Added	\$1,100,572	0.96

The regional economical impact of the university is accounted by the expenditures of the university itself, the knowledge creation of its alumni and spin-off companies as well as the students and visitors, who bring money into the region by staying at the university. All these expenditures are increased by direct and indirect multiplier effects.

⁵⁶ Humphreys 2011

⁵⁷ Conestoga College 2011

⁵⁸ PriceWaterhouse Coopers 2001

The universities and the college also influence the region via spin-off companies. At least 242 start-up companies by graduates of Conestoga College could be identified⁵⁹. Statistics Canada noticed in a 1999 report about intellectual property commercialization that the University of Waterloo has help establish more than 100 spin-off companies and thus 22% of all spin-off companies in Canada which were based on technology transfer, more than any other Canadian university. PriceWaterhouseCoopers (2001) counted in its report even more than 250 companies which were founded in direct connection with the University of Waterloo. The University of Waterloo is also directly or indirectly responsible for more than 23,000 jobs⁶⁰.

The University of Waterloo, Conestoga College and Wilfrid Laurier University are influencing the region both directly and indirectly through knowledge distribution via technology transfer and spin-off companies, through partnerships and by third-party-funds research as well as by knowledge generation through human capital. While Conestoga College is especially educating the local population, only 19% of the Wilfrid Laurier University (2008) students and just 13% of the students of the University of Waterloo (2011a) are local. These universities pull students to the area, which are now spending their available income in the region.

4. The influence of academic institutions on the ICT-cluster of Waterloo - an empirical analysis

4.1 Qualitative Approach

Based on the analysis of literature and statistics and economical databases the underlying question could only partially be answered. Due to its high flexibility and the possibility to get a deeper insight into the research field⁶¹ a qualitative approach has been chosen to explore the research question. In February 2011 interviews with seven stakeholders of the cluster have been conducted in Waterloo, Canada. They were based on a partially standardised interview outline, which fostered the flexibility and included the possibility to include non anticipated comments⁶².

⁵⁹ Conestoga College 2003

⁶⁰ PriceWaterhouseCoopers 2001

⁶¹ Froschauer/Lueger 2003

⁶² Diekmann 2009; Atteslander 2008

The interviewees were contacted after conducting an extensive internet research using the Technology Directory from Communitech (2010). The interviews took place either at the work place of the interviewees, their canteen or a nearby coffee shop in order to get open answers in a friendly atmosphere. Also, to foster the openness of the conversations, all the names of the stakeholders as well as their companies have been de-personalised. Thus, in the following analysis I1 – I7 and C1 – C7 are being used.

4.2 Results of the interviews

Stakeholders of the ICT sector are acting within a global market: their supply chain as well as their distribution market is a global one (I3). As an example the revenue of Waterloo's biggest ICT stakeholder, Research in Motion (RIM), generates only 7.1% in Canada and 39.3% in the US⁶³.

The ICT cluster of Waterloo is not just known for its global players like RIM, with its thousands of employees and 26 locations in the region, or Open Text, but also by its small and medium sized enterprises (SMEs) (I1). "Waterloo is recognised today as the high-tech capital [in Canada]" (I4). Even though this is a very optimistic view on the cluster (I6), I4 fostered that view by the number on US companies like Google who invest in the region and thus generate a broader base of the cluster. Thus the cluster is generally being seen as one of the top clusters of the region. Even if RIM, which is the most successful member of the cluster since the 2000s, would not be in the region anymore, Waterloo would still have an ICT cluster (I3).

During the interviews only I7 pointed out that originally up to 90% of his companies value added chain was generated within a 100 mile radius. This allowed close cooperation as well as a feedback-loop between the suppliers and the company. Due to internal changes and an internal financial sourcing competition these parts of the company's operations have since been outsourced to India, which highly affected the local suppliers. The reasons for the agglomeration of the cluster thus cannot be simply explained as a network of suppliers and consumers as Marshall (1922) described it, but with a common need of resources like human capital and especially the academic institutions of the region.

Interviewee 4 tried to explain the impact of academic institutions on regional development: "In fact (..) universities become the magnet for industry (..). They can also fuel the growth

⁶³ Research in Motion 2011

(..). It's not just Waterloo, if you see the growth of Silicon Valley, a lot of research done at Berkley and Stanford. In, the access of talented manpower (..) [and] the initiative taken from professors, innovative culture of Waterloo professors and local (..) industry, so that created a lot of synergies" (I4).

Asked about why his company, a global leader in its ICT services and products, decided to build an R&D centre in the Waterloo region in the 70s, when his company decided to buy some land in the middle of agricultural farmland, interviewee 7 said: "So they picked Waterloo because of the university [of Waterloo]. (..) Close to Toronto, close to the US, but predominantly because it was the technology area building up". A similar view of the role of the university in the decision making process of his company is shared by interviewee 3: "I think, in fact it's because of the University of Waterloo that there is a cluster in this area and not some town somewhere else in Ontario". These motives also seemed to play an important role on RIM's decision to incorporate the company here: "Lazaridis [former Co-CEO of RIM] often tells people that he, built his factory right next to the mine referring to the nearby University of Waterloo, Wilfrid Laurier University and the Conestoga College"⁶⁴.

The academic institutions help to create an inflow of people who are keen to learn and who can create together an innovative knowledge base of the cluster (I3, I5). The improved academic programme of Conestoga College, which cooperates closely with the industry, is helping to enhance the regional level of education. Also, companies seem to accept these improvements by recruiting both co-op students and graduates from the college (I1, I3, I5). Still, the University of Waterloo as one of the top ICT universities of Canada is playing the most significant role of the three academic institutions as a source for human capital, knowledge and international reputation. Wilfrid Laurier University, due to its social and economical focus, plays a minor role in educating technicians. However, it educates the people who support the ICT cluster in areas like marketing and management as well as technicians who can do a second degree here (I1, I3, I5).

Analysing the three academic institutions shows that due to their different offerings can almost be seen to be working collaboratively between themselves as they seem to all be able to contribute differently to the region. In a couple of academic programmes more than one academic institution is offering a similar programme, which is widely seen as allowing

⁶⁴ Sweeny 2009: S.35

students and later on companies to have a broader variety to choose from. Here a positive rivalry which was described by Porter can be found. However, the biggest rivalry can be found with other national and even international universities.

4.2.1 Knowledge Transfers

Academic institutions can influence the region they are in via knowledge transfers, which can be broken up into basis, technology and research as well as human resources transfers.

Basis knowledge transfer is being characterised by informal contacts between companies and universities, which are being fostered by alumni activities as well as the spatial proximity of the University of Waterloo and Wilfrid Laurier University with companies like RIM or Agfa and Sybase, which are located in the University of Waterloo Research and Technology Park (I3, I6, I7). Even without any closer cooperation with the universities basis knowledge transfer offers the stakeholders to stay in contact and to continuously be updated on the deeds of each other, which can enable more advanced knowledge transfer in the future (I6).

Transfer of human resources was pointed out as one of the strong connections between the academic institutions and the cluster. Both graduates as well as co-op students are being used as qualified work force by the industry.

Co-operative (co-op) programmes, where students have to do mandatory internships throughout their studies, are offered by all three academic institutions with the University of Waterloo being the biggest academic co-op provider⁶⁵ and are seen as an easy means of interaction and of networking between universities and industry (I3). Besides the exchange of knowledge and contacts, it is also a “try before you buy” programme (I3) for the companies, who can test their future employees and hire the co-op students they like after graduating (I1).

One of the big challenges is to have the graduates stay in the region after their studies and to not lose them to cities like Toronto (I2, I6), especially as some of them live in a “bubble” at the campus without really connecting to the region (I3). The co-op programmes offer a means to involve the students in regional companies where they might stay after their graduation. However, this is balanced with another aim of the programme to experience internships outside of the region and explains why companies like Microsoft, which takes more co-op students from the University of Waterloo than any other university, and IBM in Markham,

⁶⁵ University of Waterloo 2011c

which is close to Toronto, used to be the biggest co-op provider in the 1980s⁶⁶, are also important partners of the programme (I2, I6). Today, Research in Motion, the biggest regional employer, takes more co-op students than any other company (I3). With all of these companies interested in co-op students, a competition for the best co-op students can be observed. If a company is new to the market, it is more difficult to get good candidates and sometimes regional companies are even forced to use co-op students from universities outside of the region (I7).

These kinds of transfers often encourage companies and academic institution to also make use of technology and research transfers (I4). The open intellectual property policy of the University of Waterloo, which is due to its technical programme the first location for ICT-cooperation, facilitates technology and research cooperation, which usually is used for long-term advanced research ideas (I3, I7). Short-term research activities are usually just undertaken within companies in order to be able to avoid any time lags (I4). Also, companies are usually more interested in the developmental side while universities focus on research (I7). Still, research cooperation is beneficial for both sides: companies can use the knowledge of professors and their students at a fairly reasonable price without having to hire researchers themselves; and if they do like a student they can use this as a trial period and offer them a contract afterwards (I4). Smaller companies can profit from the accessibility of research funds and thus use multiplier effects when working together with the university researcher (I4). The universities can profit from generating extra revenue as well as getting a closer look into the needs of the industry and new trends, which is especially important in the ICT field (I4).

4.2.2 Innovation

ICT companies have to be innovative and adaptable to radical innovations, which are crucial because of the short lifespan of the ICT products. By receiving an influx of people due to the academic institutions new ideas are brought into the region which helps foster innovation as well (I3). The academic institution can have direct innovative effects on companies by research and human capital transfer. However, Bramwell/Wolfe (2008) already asserted, the universities have little direct impact on the innovation activities of the companies, but firms often declare that they do have a lot of impact. In the interviews conducted the interviewees

⁶⁶ Bathelt 1991

often mentioned the innovation supporting role of the academic institutions without naming concrete examples.

4.2.3 Networking function

No clear statement can be made concerning the networking function of the academic institutions. It seems as if the academic institutions and here especially the University of Waterloo is actively involved in the development of informal networks, however, most of the networking is done by civic capital organisations like Communitech (I1, I2, I3, I7). Colapinto (2007) came to a similar conclusion seeing start-up companies looking for networking and support more with Communitech and Canada's Technology Triangle than with the universities. Lucas et al. (2009) asserts that networking is being performed by informal and interpersonal contacts.

4.2.4 Human Capital

The region sees an inflow of people because of the strong performance of cluster companies like RIM and thus supposedly good labour market conditions as well as the academic institutions, who can create a good foundation for the labour market together with the industry. They enable companies to get access to more potential employees who are already in the region (I3). Because of the highly specialised ICT companies they do not just need an inflow of people, but of educated and qualified people which the universities can provide (I3, I5).

The academic institutions and especially Conestoga College have been trying to enhance their programme over the last couple of years in order to better meet market needs. By offering new, especially technical bachelor programmes the college is actively working on enhancing the human capital of the region as a higher number of students are now able to get into a technical degree programme. They as well as the other two universities have special "first generation" initiatives, which are aiming at students from families without an academic background (I5).

4.2.5 Knowledge Spill-over

No concrete answers have been found concerning the knowledge spill-over. Informal contacts between universities and companies are frequent (especially I1 and I6), however no explicit spillovers could be asserted.

4.2.6 Spin-off companies and entrepreneurship

The academic institutions helped the cluster to grow both in depth and in range. Especially spin-off companies, with a focus on ICT spin-off companies of the University of Waterloo, are influencing the life of the cluster. The region and the academic institutions are supposed to be “entrepreneur minded” (I3, similarly I6) and this image seems to have an effect on the attracted students and researchers. Interviewee 6 cites a study conducted by PriceWaterhouseCoopers (2001), which states that 22% of all start-up companies with academic ties in Canada were found in the Waterloo region. An example for a spin-off company is Dalsa, which was found 1980 by University of Waterloo professor Chamberlain and sold in February 2011 which the interviewee estimated sold for 340 Million CAD:

Since the 1999 dot.com crisis a decrease in the number of newly formed ICT companies and especially hardware ICT companies has been noticed, which are caused by financial insecurities and a general downturn in the economy (I4). I4 is actively involved in spin-off companies, which are trying to commercialise patents, which were generated together with the university, but faces difficulties in getting enough venture capital in order to undertake further costly development activities (similarly I6).

The University of Waterloo decided in 2001 to create a technology hub with an accelerator centre, which was later named the University of Waterloo David Johnston Research and Technology Park, in the vicinity of the campus. Start-up companies which are past the idea finding process can apply for the accelerator centre, where an expert committee rules on their application. The accepted start-up companies are usually “very ICT focused because that complements the university” (I6), and even though it is not a requirement to be a spin-off of the University of Waterloo around 80% of the 26 companies are affiliated with the university. Besides acting as an incubator, the Research and Technology Park wants to fulfil another aim: to attach the companies emotionally to the region and make them grow and stay here (I6). Also the park offers a lot of co-op possibilities for the students and employment opportunities for graduates with companies like Sybase and Open Text having offices on site. Thus, even companies which are not at the park, see it as a great attraction for businesses even though it is in a high price segment (I7). It seems as if the positive image of the university helped the research park to establish a good reputation 10 years after its foundation.

Due to the success of the Research and Technology Park another hub has been setup in the city of Kitchener, which specialises in digital media and is supporting both entrepreneurial as well as already established companies in that segment. While conducting the interviews in February 2011 Google was just about to move from the Research and Technology Park to the Kitchener hub, as it was expanding and needed more space. This can be seen as a vote of confidence for the Kitchener location as up until then most of the successful projects have been undertaken in the city of Waterloo (I6).

4.2.7 Image effects

During the interviews it became clear that for the interviewees co-operation with an academic institution, even just a transfer of human capital generates positive image and prestige effects. Especially the University of Waterloo has built up a reputation which companies try to transfer to themselves. These effects also cause addresses in Waterloo to be more valuable than those in Kitchener and Cambridge, simply for the fact that Waterloo is included in the name of the university. Interviewee 7 explained that companies without any ties to the university can still profit from a Waterloo address just because of its name. This can also be an explanation why most of the ICT cluster companies on a percentage base are in the city of Waterloo. Thus the university is at least partly responsible for an agglomeration of the cluster in the city, which again causes more companies to come and settle in Waterloo.

4.3 Limitations of the study

It is to be noticed that due to the short number of interviews it is difficult for this study to draw a picture of the whole ICT cluster. However, using the existing studies they can offer further insights in the life of the cluster and the impact of its academic institutions and can be used for further empirical studies.

5. Conclusion

The underlying research question of this paper was the role of the academic institutions in the development of the ICT cluster of Waterloo. The paper demonstrates that strong ties between the mainly technical oriented University of Waterloo and the industry date back into the founding days of the university and they significantly supported the agglomeration of ICT related companies in the region. Since the very beginning of the evolution of the cluster the University of Waterloo played a leading role thanks to its openness to patent disclosure, spin-off collaborations, partnerships with ICT stakeholders and the attraction and education of

students with the inclusion of companies. Today, together with Wilfrid Laurier University and Conestoga College the academic institutions are influencing the cluster by exchanging knowledge and transfer of human capital and act as incubators for new companies.

This empirical study can be used as a basis for further investigations. In particular, the question of knowledge spillovers from academic institutions and the ICT players are so far answered insufficiently. Also, both in literature and in the interviews, the interviewees mention the impact in innovation activities by the universities without giving concrete examples. To clarify this question an extensive empirical investigation would be desirable.

The paper suggests that the ICT cluster would not exist without the academic institutions which act as engines of growth for the cluster. The cluster could presumably handle losses of its biggest employer Research in Motion, but it could not exist without its academic institutions. The University of Waterloo, the Wilfrid Laurier University and the Conestoga College, which increase its impact by enhancing its academic programme, are building a unique knowledge base and thus a comparative advantage which shapes the cluster of Waterloo region.

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