Innovation Systems in the Calgary Wireless Cluster: Mapping as an Explanatory Model.
(Draft Copy)

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Abstract

The Calgary wireless study has completed approximately fifty interviews. The scope of the interviews have included representatives from industry (mainly "upstream"), university, government and some business services. The data gathered from these interviews has provided a foundation for understanding the drivers of the wireless cluster in Calgary. In addition, the information collected has enabled the creation of a preliminary mapping series from which several factors of the Calgary regional system of innovation can be identified. These factors include the methods of knowledge transfer and networking, the role of research institutions and their relationship to the industry, generational relationships, and the supplier customer relationships within the cluster. Using the preliminary maps as an explanatory model, this paper discusses the identified factors involved in the innovation process in the Calgary wireless context. Drawing from the existing literature base in innovation studies, the discussion further considers some of the classic factors influencing regional systems of innovation, giving consideration to the specific factors of the Calgary situation. Briefly, the study identifies the Calgary cluster as based on a tightly integrated, highly mobile talent pool inspired by the "entrepreneurial spirit of the West." Wireless is global, however strong regional relationships and the Calgary lifestyle facilitate functioning of the local industry as efficient at adding value.

Introduction

The Calgary wireless study has completed approximately fifty interviews. The scope of the interviews have included representatives from industry (mainly "upstream"), university, government and some business services. The data gathered from these interviews has provided a foundation for understanding the origins, drivers and characteristics of the wireless cluster in Calgary and how they compare to the classic factors of regional innovation systems identified within the existing literature base.

The data collected to this point has enabled the creation of a series of preliminary maps that identify talent, its presence, retention and fostering as the central aspects for knowledge creation and knowledge flow within the cluster. Further, the identification of the talent pool as a tightly integrated, highly mobile body as a key foundation for Calgary aids in extracting other underlying features within the local (Calgary wireless) regional innovation system such as methods of knowledge transfer and networking; the role of research institutions and their relationship to the industry; generational relationships; and supplier-customer relationships within the cluster. Using the preliminary maps as an explanatory model, this paper discusses the identified factors of a regional system of innovation from both a literary and research-based perspective paying particular attention to the role of the talent pool as a defining feature of the Calgary context.

Regional Innovation Systems and Calgary Wireless

A regional system of innovation is characterised by the appreciation that physical proximity among firms in a given region encourages the sharing of tacit knowledge and localized learning in a way that exemplifies the values and cultural norms defined by that region (Wolfe, 2002: slide 7). In addition, it is presumed that this "spatial clustering" provides the opportunity for increased economic activity (Malmberg and Maskell, 2001). Saxenian points out in her analysis of Silicon Valley and Route 128 that differences between regional economies must be understood by viewing firms as an integral part of the institutions and social structures from which they arise (6). Some of the characteristics commonly identified in these 'regional systems' include a skilled talent pool, supporting government and university infrastructure, related and supporting industries, strong local competition (Porter, 1990: 7), strong local networks, availability of venture capital and social capital combined with an entrepreneurial spirit (Feldman, 2002: 2). More recently, the importance of inter-firm networking and knowledge flows (OECD, 1998: 1) and non-market factors such as quality of life, a diverse range of lifestyle amenities, climate and cultural diversity within a given locale have been stressed (Florida, 2001: 2).
A succinct definition of a regional innovation system comes from Nauwelaers and Reid as "The set of economic, political and institutional relationships occurring in a given geographic area which generates a collective learning process leading to

the rapid diffusion of knowledge and best practice" (Wolfe, 2002). Theory thus suggests that individual preferences for space and place ultimately affect the decisions of where talent may choose to locate and subsequently build networks and become involved in the dissemination of knowledge.

The wireless industry is global however as a regional system of innovation Calgary exhibits many of the classic features identified in innovation studies. The underlying science and basic technology for the industry is imported from a knowledge base that is at least national or international. Calgary enjoys a connection to long-range research institutions such as TRLabs and The University of Calgary, which participate in supra-regional relationships. The Alberta Informatics Circle of Research Excellence (iCORE), and Calgary Technologies Inc. work as recruiters of research talent for the region as well as promoters for imported and home grown support activities respectively. These government and semi-public research institutions value scientific research and the transfer of that knowledge into industry for growth. Recent recognition of a "critical mass" in Calgary from interviewees suggests that the city has a core of supporting industries such as intellectual property lawyers, sophisticated accounting services, and other business services that maintain and grow the industry. Calgary however it is not characterized as having a network of venture capital[1].

Strong local networks are in place however the informal nature of these networks makes it difficult to track knowledge flow and social capital is built through trust among friends or their "friendly network." A good portion of the key individuals involved in the growth of the cluster have similar backgrounds and training. One interviewee claimed that he knows and maintains his network from his days at "NovAtel University"[2]. On several occasions Calgary has been touted as having a very strong entrepreneurial spirit or "spirit of the West" however the lack of availability of seed money and venture capital needed to nourish that spirit or growth is seen as a significant barrier to the cluster's maturity.

The knowledge and therefore the talent in the Calgary wireless industry is imported from a no less than global base and important players function as "system integrators" who add value and then market products world-wide. Calgary imports basic science and technology, adds value through the "system integrators" and sells in a world-wide market. This pattern thus speaks to the lack of emphasis on local customers and local competition. Deitz and Garcia note a pattern consistent with the Calgary "system integrators" in networked or localized clusters where the development agenda is to "…add value to the hubs by

[1] Comments and quotations are included throughout the paper from interviews that were conducted as part of the core research for the Calgary portion of the Innovation Systems Research Network's initiative. These interviews are subject to the confidentiality agreements as per the University of Calgary ethics committee and therefore the names of interviewees cannot be disclosed in conjunction with their comments.

[2] For a detailed history on the role of NovAtel in the Calgary wireless cluster see Langford et al. *The Origins of the Calgary Wireless Cluster* (April 2002). Prepared for the ISRN Annual National Network meeting in Quebec City, May 9 –10, 2002.

providing a strong package of amenities, goods, or services" which are then prepared for export to a global market (Blakely, 2001).

Talent as a Leading Factor to Innovation

By far the most significant characteristic identified by members of the Calgary wireless community as a factor for economic growth and development is the skilled pool of talent. This finding is consistent with recent research by Glaeser (2000) who points out that access to a skilled labour market is a primary factor in holding together a "regional agglomeration" (Florida, 2001: 5). The labour force is the central node that grounds the wireless cluster in Calgary and from it stems a regional system of innovation. The Calgary wireless cluster has been labelled by one participant as a "pond of talent" in which the cluster has been able to grow and spawn new business. It is in the "pond" where knowledge is exchanged and created and the formal and informal mechanisms of knowledge flow can take shape to include other drivers for growth such as deal making and deal flow, government-industry-university collaboration, formal research and mentorship and the development of strategic business and personal relationships.

Richard Florida suggests that factors involved in attracting and maintaining a regional talent base depends on a certain acceptance of diversity within a region in addition to a thick job market and a high quality of life (Ibid.). An interviewee pointed out that people do not move to a region for "A" particular job but for the availability of "jobs" in their field. When firms were asked why they chose to locate in Calgary and what advantages Calgary held in terms of running a business, the first response was that Calgary has a highly skilled talent pool and a high quality of life. The other emphasized advantages to doing business in Calgary are the proximity to the Rocky Mountains, the ability to get in and out the city with ease, and the low costs of doing business.

Malmberg and Maskell point out that often clusters localize as a result of a historical development (2001: 4). This is certainly the case for Calgary where the wireless cluster developed out of the mature oil and gas industry. Strong firms backed by the government played an active role in recruiting talent early on and key events such as the NovAtel divestiture in the early 1990's led to the dispersion of that talent throughout the city and was ultimately a key factor in spinning out new business ventures[3]. One company explained that after subcontracting a firm to do a study on what it would take to relocate a branch firm into the city, the response was that it would be an easy task to relocate people into Calgary however trying to recruit away from the city is where the difficulty would lie.

It is important to point out the talent pool, as a mobilizing force for innovation, is organic. It is indeed human and is therefore social and behaves under socio-

[3] Ibid.

cultural norms and values. The Calgary wireless talent pool, while highly skilled, does not comprise a large majority of the metropolitan population. As a result the talent pool is a tightly integrated group that tends to live and work in the same areas of the city and therefore many relationships within the cluster tend toward the informal. It is important to emphasize here that the Calgary wireless cluster thrives through these informal relationships. While formal venues and forums exist in high technology areas for the exchange of information, it is the informal networks that are most highly exploited in knowledge transfer (see Figure 1.1 for more detail). In Florida's terms then, the Calgary wireless pole retains its ability to innovate as a direct result of the ease with which individual people interact. He argues that the factors of space and closeness give rise to tacit knowledge flows and learning which are the foundations of innovation (Wolfe, 2000: 5).

Looking at the talent pool as the primary factor for innovation in the Calgary wireless cluster, the aim of the paper is to show how the talent pool works as a mobile force to encourage innovation through the exploitation of informal networks. This is discussed with the use of a series of figures that attempt to map informal knowledge flows.

Mapping Series: An Explanatory Model

The mapping series attempts to illustrate the genealogical and strategic relationships that exist in the Calgary wireless cluster. The mapping series is a representation of some of the key firms and players included in the research only and is not considered to be a comprehensive examination of the cluster but a general representation of relationships that exist and patterns of informal knowledge flow, transfer and creation.
The "X" axis of each map represents the industry segments that classify a firm. The "Y" axis represents a timeline of indicating when a firm established in Calgary.[4]

Figure 1.0

The first of a series of maps attempts to give a visual representation of the historical genealogical relationships of the companies interviewed within the Calgary wireless cluster. Firms recognised as preliminary and core drivers at the early stage of the cluster development are indicated as G1 (first generation). Firms that arise out of the G1 core, either by direct spin off, transfers of key employees or knowledge, or by the creation of strategic relationships are denoted as G2 and so on so that the pattern is recognized from the first to the start of the fifth generation firms.

[4] Much of the information in the accompanying maps was synthesized from interviews with representatives of firms who advised the authors on certain genealogical relationships. Information was also gleaned from various web sites and annual reports of the participants and none of the relationships in the maps depend on any single source.

Of the thirty-two total company interviews conducted, eleven firms or 34% comprise the G1 core of the cluster, nine firms or 28% comprise the second generation of firms, six firms or 19% comprise the third generation, five firms or 16% comprise the fourth generation and one firm or 3% accounts for the fifth. Notably, only three of the G1 firms have direct genealogical relationships to the key founding events for wireless in Calgary, namely the joint venture between Nova Corporation and Alberta Government Telephones (now Telus) to form NovAtel and its subsequent divestiture. The significance lies in the fact that those three companies were major key players in the Calgary market at that time and therefore actively recruited and employed a majority of the skilled labour force. After the NovAtel divestiture, much of the talent remained in the city and went on to work for other major firms such as Nortel, NovAtel Inc., Harris, Novatel Wireless and others. The other remaining eight G1 firms in the region were in Calgary for reasons unrelated to NovAtel and some firms held strong roots in Calgary as early as 1967 and continue to conduct business in the region. Other G1 firms joined the cluster much later most reporting that the decision to settle had to do with the availability of talent and quality of life within the region.

Figure 1.0 indicates the core G1 firms and the generations of firms that were established by direct spin off from that core group only. It is noted that genealogical roots extend to some of the G4 firms however it is not simply through related historical roots that these firms are associated. The transfer of key personnel and tacit knowledge flows create a much more tightly integrated network as can be seen in Figure 1.1.

Figure 1.1

Figure 1.1 elaborates on Figure 1.0 showing the impact of informal knowledge flows and the transfer of talent on the formation of new firms. Dashed lines are used to indicate the transfer of knowledge or key personnel. It is noted that twelve additional firms, or 37.5% of the total companies interviewed, find linkages on the map as a direct result of the transfer of key personnel or tacit knowledge that is carried with people as they move from firm to firm. Many interviewees explained that the staff in Calgary for wireless is shared among the firms. Key players in the GPS sector have been known to transfer groups of personnel. Similarly large actors that outsource much of their manufacturing have been known to exchange personnel regularly so as to enhance the capabilities of the staff and improve their understanding for products and process on multiple levels of integration while potentially developing new innovative ideas. These transfers may appear to have a formal structure because of the ease and efficiency with which personnel transfers occur. However the transfer of key people and the tacit knowledge that they carry with them occurs with ease as a result of the open communication among firms through friendly networks at the senior management level. In addition, many participants work on a contract-by-contract basis and thereby come into contact with many different people and firms within the cluster thereby expanding their own personal and business networks. The nature of the

Calgary cluster is a small community where everybody knows what everybody else is doing therefore recommendations regarding new opportunities can be made to staff members and friends in the network without jeopardizing proprietary information or compromising position or status. Furthermore, the boundaries in the customer, supplier and competitive relationships in the cluster are overlapping such that some of the firms have difficulty identifying who their competitors are. One interviewee noted that there is a strong overlap between the classes of strategic partners and potential competitors. Another interviewee indicated that, “it is very difficult to say who our competitors are. Our competitors can also be our clients.” Yet another interviewee indicated that the Calgary cluster is based on “coopetition.” All suggesting that co-operation and knowledge transfer often occurs among competitors.

Other examples at the level of the individual exist as well. From the inception of the research to present (June 2001 – May 2002), informal knowledge flows have traced one talented individual through four companies in the cluster. It would be safe to say that the individual has a very extensive network and maintains friendly relationships with many key employees in the cluster.

Saxenian recognizes this phenomenon in the Silicon Valley region noting that once informal communication practises become institutionalised, collective learning can occur in a more integrated and formalized manner (1994, 133).

Figure 1.2

The formality of the Calgary cluster becomes visible in the mapping series when strategic relationships are examined. Informal relationships become institutionalised in the cluster through the creation of strategic partnerships between firms and formal personal business relationships. Figure 1.2 examines strategic relationships developed between some of the participating organisations in the cluster as well as indicates some instances where the same key individuals sit on Boards of Directors for multiple firms. These relationships build on the informal networks already discussed.

It is significant that many of the overlapping Boards of Director and strategic relationships involve individuals from G1 and G2 firms to younger G3, G4 and G5 firms. This may indicate a pattern of mentorship within the cluster where more senior and experienced individuals are giving advice to younger emerging firms although this has not been confirmed to date from the interviews.

Many participants have noted that there exists in Calgary civic associations and networking bodies that deal with ICT in general such as Calgary Technologies Inc. (CTI), and the Calgary Council for Advanced Technologies (CCAT), however the Calgary wireless cluster lacks a formal body or forum for discussion and knowledge dissemination. Looking at Figure 1.2 it is learned that in a majority of the cases the historical roots of the companies or individuals from the companies involved in “institutionalised behaviour” trace back to the NovAtel divestiture. This suggests that industry collaboration still occurs between individuals that

presumably worked with one another at an earlier date. Therefore the persistence of the informal networks in the Calgary wireless cluster indicates that industry collaboration and deal flow occur at the same informal social level as personal communications in Figure 1.1. The processes of business formality become the work behind the scenes while informal networks take precedence. An interesting observation noted during interview sessions was that most senior executives could site their colleagues' telephone numbers by memory, which brings into question the relevance of formal networking body in a small integrated group.
The area of activity between 1992 and 2001 indicates a tightly knit network of senior management who actively participate within the cluster such that involvement of individuals and tacit knowledge flows occur from G2 companies down through to the G5 firm.

Figure 1.3

The participation in industry by the research institutions and government infrastructure is difficult to ignore. Figure 1.3 introduces how local and regional institutions play a role in knowledge creation and transfer. The knowledge flowing back and forth between industry and research institutions adds a remarkable level of integration to the cluster map. The map depicts that in almost every firm interviewed the university has played some role in the exchange and/or creation of knowledge. The research institutions serve the obvious needs of the industry by educating and training a skilled supply of workers. In fact, every participant in the thirty-two interviews reported that the talent pool is a key resource from which they draw upon as a source of innovative ideas. The faculty, staff and students from these institutions also serve as liaisons to industry through avenues for knowledge exchange and learning such as collaborative research programs, participation in research consortia, co-ops and internships and the development of new programs to meet the needs of industry.

There appears to be three different relationships to the university among industry groups in the Calgary wireless cluster. The first group includes the smaller spin off's from the G1 to G4 core and utilize the university faculty, researchers and students quite readily and interact with them on a fairly regular basis. The second group includes small and medium sized businesses that might be classified as system integrators. This group tends to approve of the research facilities, programs and graduates in the region however they may not interact on an intimate level. The major players that service the upstream (manufacturers) and the downstream (end users) activities in the cluster comprise the third group. This group tends to play an active working role with the research institutions utilising internship and co-operative programs in addition to working together by way of tacit knowledge exchange and sponsorship.

The Calgary research institutions and public infrastructure bodies may be viewed as playing a reactionary role in meeting the needs of the wireless industry.

During the period from 1983 to 1992 there were only a few, however significant, players in the wireless market. From 1992 to present however the market has spawned many new businesses. It wasn't until 1990 however that Calgary was formally recognized at the national level as a major wireless player and TRLabs set up a Calgary laboratory to facilitate a wireless communications research program (TRLabs Annual Report 2000). In addition, it wasn't until 1996, out of direct discussions with major industrial players, that the local university responded to industry needs by making an effort to double ICT enrolments and physical infrastructure to accommodate new students was completed in Autumn 2002. Other specialized institutions such as the Southern Alberta Institute of Technology (SAIT) that supply many firms in the region with specialized graduates, have only just begun discussions on creating a focused program for wireless technology and communications.
The initial lack of professional services capable of supporting a wireless industry that characterized the region early on may be one of the reasons for the reactionary position.

A metaphor that speaks to the path dependent nature of the Calgary wireless context is captured in a photo that depicts highly tread footpaths created in the snow within the fields surrounding the University of Calgary campus and the University Research Park (see Figure 2.0). These "footpaths" represent the nuclear body of knowledge and the pattern of tacit knowledge flow in a given regional system of innovation. Figure 1.3 is a similar representation however it also depicts the transfer of such knowledge between industrial players.

Conclusions

Of the interviews completed for the Calgary portion of the ISRN initiative on clusters, thirty-two of those represent feedback from industry. From these interviews the Calgary wireless cluster has been identified as a regional system of innovation that conforms to some of the classic factors comprising such systems. The talent pool and the informal methods of knowledge flow and communication were identified as crucial elements in the Calgary wireless regional innovation system. A detailed profile on the talent pool as a mobilizing force for knowledge creation, flow and dissemination was constructed through a series of maps. The maps are a visual representation of how informal communication linkages penetrate different structures in the cluster. Figure 1.0 illustrates the effect of genealogical ties and a strong labour force redistributing itself within a region and the subsequent business formations that grew out of those events. Building on genealogy, Figure 1.1 adds a visual representation for informal communication and knowledge flows within a cohesive group. Figure 1.2 adds a formal dimension to the business processes of a growing cluster showing how personal networks and informal business communication may lead to formal business partnerships, strategic relationships and mentoring. The last of the maps, Figure 1.3 adds a significant dimension to the series. The role of the research institutions has come to play a critical role in the Calgary wireless cluster. Tacit knowledge flows between institutions, industry and government in

the region defined by socio-clutural norms and values give rise to the creation of innovative ideas. More importantly, the firms and institutions that work collaboratively recruit ideas and talent from a world-wide knowledge base. In accepting diversity within a regional system new ways of thinking are introduced and the production of new ideas are stimulated among the players.

The last figure (Figure 2.0) introduced is not included as part of the series but as a metaphor for the series itself illustrating the talent pool within a region as a tightly integrated mobile force for knowledge production and stimulation that draws from global resources.

The Calgary wireless agglomeration is driven by the talent pool and reinforced by the high quality of life in the region.

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