

Creating Digital Opportunity in Vancouver: Digital industries in a global perspective

J. Adam Holbrook¹ and Ben Anderson
Centre for Policy Research on Science and Technology,
Simon Fraser University,
Vancouver, BC

Abstract

Clusters of firms based on digital technologies are a recent addition to the entrepreneurial world. But what do we know about these clusters, and more particularly, the innovative communities where they are found? We know from a number of authors, such as Richard Florida, that the creative workers that have propelled this revolution, frequently choose first where they wish to live and then establish their workplaces. Liveability of a city thus becomes a major consideration for these people, the more so since most digital industries are human capital intensive, and can rapidly move from one location to another as circumstances change.

Over the past decades, the City of Vancouver has benefitted from this trend: it has good services, good transportation links to the rest of the continent and the world, and a spectacular environment. It is very much part of the Pacific Rim economy. It scores highly in global surveys of liveability. In earlier studies of the digital cluster in Vancouver, it was found to be a growing and exciting environment.

But the very factors that make Vancouver a desirable place to live and work also contain the seeds of problems for the cluster. As part of the Pacific Rim economy, Vancouver and its suburbs are going through a period of intense adjustment to the global economy. The digital cluster in Vancouver is dependent on highly skilled knowledge workers, yet prices for affordable housing and services within the city are being driven beyond the means of most middle to upper middle class families with children, while salaries have been held back by competition from digital industry clusters elsewhere.

How can the local government(s) make use of the region's assets to retain its existing competitive digital industry firms, and hopefully add to the number of them? We document the views of various sets of respondents, using data from an on-line survey of managers and experts in the digital cluster and interviews with a number of recognized stakeholders. Their responses indicate that if Vancouver is to maintain its reputation for liveability, it will have to make urban policy and program changes soon, or risk losing a substantial portion of this knowledge-based cluster.

¹ Corresponding author: CPROST, Simon Fraser University, 515 West Hastings St., Vancouver, BC V6B 5K3; email jholbroo@sfu.ca. The authors would also like to acknowledge the contributions of Jong-young Lim, Tim Mottishaw, Birgit Schroeder, Stephan Struve and Lilia Valle to the collection and analysis of the data used in this paper

Introduction

Firms based on digital technologies are a recent addition to the entrepreneurial world. Many enterprises in this sector (particularly non-hardware firms, which includes not only software firms but digitally based platforms for non-digital products and services, such as Uber, Amazon and Spotify) do not follow the conventional trajectories of innovative firms, but operate in a “space” that is not at all like that for other sectors. We know that the digital revolution has democratized information; production has been democratized to a great degree but there are still major barriers to any kind of democratized system of reach and access. Virtually every person in the world has some access to the Internet and/or wireless services. This has been enabled by devices and software created by the digital industry. But what do we know about the clusters, or perhaps more accurately the innovative communities that have created this revolution?

The hardware side has appeared to follow the conventional trajectories of other manufacturing clusters – innovative firms are created, grow, and absorb other firms. But software firms appear to follow a different model. Hardware has traditionally relied on a Fordist model of production where capital is primarily tied up in physical resources and the production of a physical commodity, as opposed to the intangibles of software. Software firms have very low barriers to entry, since there is no requirement for substantial investment in the physical means of production. The main input to the software sector is human capital, an intangible, and its main output is intellectual property, another intangible. For example, one of our interviewees actually turned down capital investment and opted for debt because he didn’t need hundreds of thousands of dollars and second, because he didn’t want to be beholden to investors.

This paper will examine some implications, in the context of Vancouver, Canada, of the globalization of the software component of the digital industry (DI) cluster. This research is part of a major multi-partner project sponsored by the Social Science and Humanities Research Council of Canada (SSHRC), “Creating Digital Opportunity: Canada’s IT Industry in Global Perspective” or CDO.

At a recent conference in Saskatoon (April 2016) CDO participants concluded:

- “Software is eating the world” – at least in Canada. This is clear from case study after case study from across Canada – from the digital transformation of agriculture in Saskatchewan to the emergence of ‘software defined networks’ driving the Ottawa cluster to the battle between Uber and City Hall in Toronto.
- for all practical purposes, Canadian competitiveness in digital industries lies in software. Thus we need to examine the factors that support our competitiveness in human capital, IP, and new software applications, not just in the ICT sector of the economy, but across all economic sectors.
- Canada must play closer attention to the issues, meta-framework and strategies for Canadian global competitiveness in a software-driven digital world, given the relative absence of large domestically headquartered digital global players.

Digital industries (DI) are no longer limited to a particular “knowledge industry” but instead are incorporated in and produced by a range (if not all) sectors. CDO has been put in place to analyze the digital ecosystem across the numerous cities covered in the project. This ecosystem varies from city to city. Analysis of the strengths, weaknesses, opportunities and threats embedded in the local innovation ecosystems should inform our understanding and the development of competitiveness strategies.

Software enterprises have significant characteristics that differentiate them from the hardware firms in the digital cluster:

- they are not capital intensive
- their main inputs are human capital
- their major outputs are codified intellectual property.
- But perhaps, most significantly, the firms are highly mobile and can move their operations and staff quickly and globally.

There are, of course, exceptions such as Microsoft and Apple, but even these giants can be thought of as having software divisions and hardware design and manufacturing divisions. They have the ability to move their software operations quickly from one location to another to maximize their returns. The key point is that DI impact the entire conventional economic /productive space.

Virtually every product, process or service today involves the use of digital technologies. But the use of digital technologies in, for example, point of sale equipment, car computers etc. - anything, in the “Internet of Things” - does not really imply that that product or service comes from a DI. We choose to define a computer² as a device that can be programmed, using discrete states (zeros and ones³), to emulate another device – a Turing machine. Thus a DI is an industry that either builds such machines, or prepares the programs for such a machine. But as noted above, this discussion will focus on the software component of DI, where the input is, basically, human capital, and the output, intellectual property.

The software industry includes, of course, not just the basic machine codes for a Turing engine, but the “apps”, or “platforms”, which range from operating systems and web-browsers, to custom services (ranging from financial services to dating services). These services, in effect, provide the software (the “app”) that configures the user’s hardware, on demand, to provide the service in question. The line between providing the “app” and providing the actual service is diffuse, but such services are usually thought of as being part of the DI in that they could not be provided without both the hardware and software specific to the task. A somewhat artificial line can also be drawn between “apps”, that the user interacts with directly (such as a dating service) and the software used for machine controllers, where the user of the machine does not normally interact directly with the software to give it specialized instructions (such as an automobile’s engine control computer).

Software industries: the human factor

² This includes basically any device that has an operating system, such as smart phones or laptops.

³ One could include quantum computing with more than two states of information.

As noted above, software clusters⁴ are quite unlike conventional goods and services clusters. They are not capital intensive. In many cases only minimal amounts of working capital are required to start up. The financial barriers to entry are much lower than just about any other kind of enterprise - except possibly personal services, such as hairdressing. Thus they are more open to innovators and entrepreneurs from less developed economies (including less developed regions of developed economies).

The main input is, of course, human capital. From a policy point of view, governments (not just national or provincial, but more importantly municipal) try to establish the conditions that attract, and retain, creative people (Florida, 2002). Some localities provide a “sticky labour market” either because the environment (health, education, recreation, local transport, etc.) is attractive to a “super-creative” person, to use Florida’s term, or to a lesser degree because there are sufficient alternatives where one or more members of the household has secure employment that is not tied to the ebbs and flows of DI contracting. But these environments are not unique: many (including Vancouver) have hinterlands that can be more attractive than the hip/jive/club environment of a large metropolitan city. The attractiveness of a small town/village “where children can walk to school” has a strong drawing power. These same dynamics are allowing digital workers to flee such environments, especially to small towns. Lower costs of living, especially in relation to the costs of Vancouver, and the ability to work remotely are seriously challenging the idea of an attractive locality.

We believe that at least some clusters of software firms exist because of location: creative human capital will trade permanence of employment, and lower remuneration, for employment in an environment with a superior quality of life. These locations are not the preserve of developed nations; indeed many large cities in developed nations do not have substantial software clusters because they are not perceived as having a high quality of life. This suggests there can be, and likely is, global competition for the establishment, of global class software clusters among local and regional governments. These locations seek to deliver a superior quality of life for the human capital required by the global software industry; this is equally an imperative for localities and regions with existing clusters to evolve and to maintain their current positions.

In many economies, particularly in the software side of digital industries employment is contract based; there is now an army of contractors who represent a floating and flexible labour pool. Programmers, animators, and salespeople work on a contract basis with little or no security of tenure, health or pension benefits. Arguably, if they can command premium contract fees, they should be able to make their own social support arrangements, but they cannot get the benefits of pooled contributions for social services such as health insurance – unless these benefits are provided by the state. So why do highly skilled, super-creative, individuals put up with this exploitation? How do the cultural aspects of these industries: hipness, fun, and general social capital play a role here?

All Canadian DI clusters appear to be intrinsically unstable and chaotic. Employment patterns are no longer hierarchical. Everyone is a contractor. Software firms can be set up with little or

⁴ For convenience, we use the term cluster, in spite of the fact that the current literature has moved beyond the original concept developed forty years ago to describe concentrations of manufacturing firms.

no working capital and with few, if any, permanent employees. This makes the establishment of this type of enterprise inherently democratic – entrepreneurs do not need to have access to resources that maybe controlled by established business elites⁵. But it can also mean that these firms can be exploitative – exploiting their skilled labour through short-term contracts rather than through longer term agreements which include social benefits. Entrepreneurs are outsourcing globally, both for reasons of bottom line but also due to their perceptions of the talent pool in the local region.

There appears to be a mixture of cultural and socio/economic factors that determine the development of enterprises in different nations, and it is unreasonable to assume that these factors are any different for software firms. Policy makers should be asking themselves not only as to how to improve the environment in which software firms can start business and enter into the global market, but also how to improve the population’s perception of the processes of enterprise and innovation. The unique factor for software enterprises, is, as noted above, the easy entry into a market, and thus the ease of establishing a software business. By contrast, the ecology of the local DI cluster can be described by the factors that determine how the actors interact with each other such as the pool of trained workers, the proximity of other DI firms and the “buzz” resulting from these interactions.

Cultural factors can be part of the environment, but are also part of the ecosystem. Hutton and Murray (2013) have reported on the juncture – or in their words, disjuncture - between governance and innovation in the City of Vancouver, particularly in the arts and digital media. Their reports on specific cases are specifically applicable to the DI in the city, and are an excellent base from which to work. In these cases both the environment and the ecosystem are factors, and these factors can be directly influenced, for better or worse, by the city administration. At the same time, interviewees are reporting a huge number of potential workers who are trained locally but who are not the workers they are looking for. Why is this? How does this change the impact of these firms locally when local grads have to move elsewhere for work?

Software industries in the City of Vancouver

There are a number of DI clusters in Canada, each of which reflects local conditions that have led to their growth. These include Montreal, Ottawa, Toronto, Waterloo, Calgary and Vancouver⁶. While there are some DI firms that manufacture ICT equipment, most are software firms. Of the DI concentrations in Canada there are perhaps three games/animation/visual effects software (GAV) clusters in Canada (Vancouver, Montreal and Toronto - see Smith and Warfield, 2008 and Britton, *et.al.*, 2009).

⁵ In many cases one member of the family unit is employed by a large, established employer – government, or a large financial firm, thus giving the other spouse the opportunity to take entrepreneurial risks. This is particularly true in large “establishment” cities such as Ottawa, Toronto, and Waterloo.

⁶ Vancouver is a poor place to manufacture things – land and labour are expensive, and it is at the end of supply chains in North America for physical inputs and continental markets.

A recent report for the Vancouver Board of Trade, prepared by the Conference Board of Canada (2016) concludes that there are five globally traded clusters in Vancouver:

- Transportation (including port activities)
- Tourism
- TV and film production (which includes most GAV)
- High-tech industries
- Financial services and insurance, including fintech

In each of these clusters, there is a greater or lesser degree of involvement by the DI. What we do not know about the “digital industry” in Vancouver is much more than we do know. The GAV cluster has been studied extensively (see for example Smith, *et.al*, 2004), but how many other DI firms are there in the Vancouver digital economy, including those in fintech and what are the linkages among them? “Software” can cover everything from social media, apps, education software through to more traditional control programs for mining and manufacturing. In particular many of the firms follow a business – to – business (B to B) business model, a model that does not come readily to the attention of consumers (or, in many cases, policy makers!). They have revenue models that vary from traditional B to B sales to selling advertising. What is the ecology in which these firms operate? Globally there is a whole sub-economy evolving in ways that conventional statistics cannot capture because existing data collection techniques and classification systems cannot resolve the detail of fragmented, yet contiguous organizations.

Given the ubiquity of digital products and processes, it is probable that there is a large hidden group of DI in Vancouver - a sort of "dark matter" universe - that exists alongside the visible industries. We have anecdotal evidence, of non-GAV ranging from specialized logistical software firms (such hotel reservation software) to firms whose products/services are based on digital models to start-ups working on quantum computing (which defy any current economic analysis!). They are rarely captured in surveys, and their contributions to digital innovation are often hidden. They are the “dark matter” in the universe of the Vancouver DI sector. Moreover our experience talking to DI students and other non-business people suggests that there is an underground stream of digital development happening that can’t be considered entrepreneurship – side projects that are labours of love that are hoped to one day be brought to market but are not yet. So, there is a kind of free labour economy out there that is impossible to track and many parts of which will never appear in the formal economy.

We use terms like GAV, but how many firms are there in the spaces and what are the linkages among them? Given that terms such as “software” can cover everything from mining to education, and revenue models from traditional sales to selling advertising, what is the ecology in which these firms operate? There is a whole sub-economy evolving that conventional statistics do not capture because data collection techniques and classification systems cannot resolve the detail. We need an understanding of the whole digital sector in a locality (in this case Vancouver), as the equivalent of knowing the industrial structure of a national economy through its resources, manufacturing and services sectors, yet without an input-output model.

Adapting a model proposed by Cohendet, Grandadam and Simon (2010), we can draw a model, with examples of firms with a presence in Vancouver:

Table 1

	Functionality	GAV firms	Other DI firms (the dark matter)
Upperground	Focus on exploitation	Electronic Arts (EA)	Microsoft, MDA, Hootsuite, D-Wave
Middleground	Focus on integration and diversity building	DHX Bardel	Urthecast, Plenty of Fish, Slack, Tableau
Underground	Focus on exploration	Titmouse	Starling Minds, Life Booster

(adapted from Cohendet, Grandadam and Simon, 2010)

But do they represent isolated examples or are these emerging sectors on their own?

- How do we define these non-GAV industries?
- What fosters the creation of these industries?
- How can Vancouver use its competitive advantages: location, physical environment, quality of life, particularly in terms of its DI innovative links around the Pacific Rim?
- Are its DI competing only with other North American regions, or are we intrinsically part of the global economy?

Not only do we know little about the non-GAV enterprises in Vancouver, we know even less about the linkages among them and with the GAVS sector. Are the skills for GAV transferable to non-GAV firms and vice versa? Do non-GAV firms enjoy the same competitive advantages (and disadvantages) as GAV in Vancouver? Do they draw from the same labour pool, and use the same local infrastructure?

Vancouver as a special case of regional innovation

So why should Vancouver be a centre for software industries at all? A number of factors have been proposed (Wixted and Holbrook, 2011). They include:

- Location: An excellent quality of life, including a safe and stable social environment, a temperate climate, and excellent recreational facilities (as long as the environment is affordable!)
- Educational facilities: World class universities and excellent public primary and secondary schools
- Excellent physical infrastructure (e.g. reliable electrical power and telecommunications)
- Excellent transportation infrastructure
- Financial and legal: a stable financial infrastructure based on English common law

- Proximity to the major consumer of GAV (Hollywood) including being the same time zone as its major clients

Arguably at least some of these factors are the result of its economic and social history. The resultant trajectory has formed its regional (and in this case, its local) innovation system. So what is unusual about its regional innovation system?

Much of the innovation systems and clusters literature emanates from Europe where population centres form densely packed regions with major competing centres on all four points of the compass and in relatively close proximity for many key cities. Thus, a large percentage of cluster studies for example, ignore the spatial distribution of clusters or the interconnections between them (as is argued by, for example, Wixted 2009). However, as the context for most of these studies is the densely populated mega-regions of the Western Europe and the Eastern United States, it would not be too much of a stretch of the imagination to suggest that the two dimensionality of economic space forms the unconscious presuppositions of the research questions. The individuality of place is an interesting question if there are many different localities with a given geographic distance than ‘could have’ (but did not) given rise to high rates of innovation. But such a context as noted above does not fit the geographical context of everywhere. If across large geographical distances there were only a few major centres to start with, then the focus needs to be different.

There is little reference in the work on innovation systems to states where populations are either linear or broken up. We could use words such as; periphery, gateways and others but each of these has complications. “Periphery” or semi periphery (Wallerstein 1976, Boreham et al. 1989) are used in reference to places that are distant from international economic centres but this can emphasise distance from the centre while not illuminating the urban structure dimensions. It also de-emphasises the network bridging role that such places can play. “Gateways” is also somewhat problematic as it is traditionally emphasises transport, particularly multi-modal (sea, rail, truck) trans-shipment rather than innovation (Rodrigue *et.al.* 2009). In some cases “entrepôt” (Phillips 2002) is useful where foreign investment drives local activity, particularly for foreign sales, but again as we shall see, foreign investment is not a major driver of the cluster, except for the branch plant operations of multinationals.

The problem with the language of ‘innovation systems’ is that we want to think of them as a unified structures. The results of the Innovation Systems Research Network (ISRN) over the years has been used to describe the innovation activities in various cities in western Canada. Saskatoon is an entrepôt for biotechnology (Phillips 2002), Calgary as a technology services hub for the oil and gas production assemblage (Langford et.al. forthcoming) and Vancouver as a location for highly creative human capital intensive activities from movies to fuel cells (Diaz, Wixted and Holbrook, forthcoming). However, we can go further and describe the degree to which cities are linked to a broader suite of regional economic activities. Saskatoon is internationally connected in but a few resource-based industries, Calgary is highly integrated with its regional production system based on the petroleum industry, but Vancouver is increasingly operating as a separate Pacific Rim economic region.

As Wixted and Holbrook (2011) have argued, based on research originally documented by the ISRN (Holbrook and Wolfe 2000, 2005) that, at least in the case of Canada, in order to

understand the national innovation system (NIS), one must first understand the regional innovation system (RIS). Is the Canadian NIS the sum of a number of RIS, based either on economic regions or provincial boundaries?⁷ In the Canadian context this sum is distorted by the wide variation in sizes of the regional systems – national level data (and the ensuing analyses) of the Canadian system of innovation are heavily biased by the economic activities occurring in the two major industrialized provinces, Ontario and Quebec. In most developed nations, innovation, science and technology policies are formulated by the central government, yet most innovation takes place locally. Thus nation-wide innovation policies may not affect each region equally, and could conceivably be counterproductive.

The ISRN project made it clear that, in Canada, there are viable regional/local clusters, usually based on one or two “anchor” industries. Specific clusters are often intermediaries, acting as agents between a major industry and a number of cluster specific manufacturers and service providers. Thus, for the DI in Ottawa and Waterloo, the IT firms were/are based on Nortel and Blackberry, and in Calgary, the DI firms are all closely attached to, and dependent on, the oil and gas sector. The major firms define the type of DI work that goes on. In Vancouver the “anchor” industry is GAV, in which, although EA is a big player, is not the only player. Vancouver DI tend to follow the model of the GAV, and thus, has, typically, small firms, chaotic, contract-oriented etc.

A region cannot automatically assume that it has a niche; the entrepreneurs within that sector must work to establish its niche, and fight to retain it. Given the ubiquity of the Internet, most digital industries automatically acquire a global presence, and a global competitive position as soon they are established. Most digital industries cannot operate on a regional or national basis – either they have a global competitive advantage (or a niche), or they will fail against other enterprises. The software cluster in Vancouver is not unique. It has, as we will see, certain competitive advantages, but many other regions have their own strengths.

The CDO study in Vancouver

The CDO study in Vancouver is part of a series of similar studies underway in Canada, covering most of the DI hubs mentioned above. Some studies are focussing on the manufacturing aspects of DI, others on knowledge transfer, while still others are looking at the software/intellectual property aspects DI. Each of these studies is being informed by a standard interview guide (Appendix “A”) which outlines the common areas of interest. Each study will consist of a number of interviews with individuals in the DI under examination. The final, joint, outcome will pull all of these studies together.

Given the focus in Vancouver on software, and the role of the “ecology” in determining the competitiveness of the region, the first step was to examine, the background against which these interviews will take place.

⁷ Or, for that matter, international. Seattle is close physically to Vancouver but there is relatively little interaction between the two. Initially the two cities were resource exports – mainly lumber – competitors, and then diverged when Seattle became a major military and aerospace hub during WW2. Today differences in immigration policies tend to harden the boundary.

Fortunately there exists a quantitative survey protocol that enables this task to be completed quickly and cheaply. The Global Entrepreneurship Monitor (GEM); see <gemconsortium.org>) an annual global study of national attitudes and conditions affecting entrepreneurship, and thus innovation, has two standard survey instruments, the Adult Population Survey (APS) and the National Experts Survey (NES).

The NES is an on-line survey of a panel of 36 (or more) experts selected by the national GEM team. It seeks their views, differentiated by expertise and field of work, on a number of economic factor conditions. Canada is part of GEM and an annual NES is carried out, reaching experts across the country. Similar surveys are done in a number of provinces. But it is also possible to use the NES to examine a very specific location/cluster/set of experts.

The great benefit is that many of the NES questions map more or less exactly on to the CDO interview guide. The concordance can be found in Appendix “B”. The concordance highlights the importance of a number of GEM NES survey areas:

- R&D knowledge transfer
- education and training
- market access
- commercial infrastructure
- financing
- government policies and programs

Thus a special version of the NES (called the “provincial experts survey” or PES) was run for the DI in Vancouver in 2015 and 2016 to map out the DI ecology in the city. The BC survey was directed specifically to experts in the DI field (including a few academics and government officials). The data from the two years were aggregated to get a panel of approximately 70 experts. The NES data for Canada were similarly aggregated.⁸

The NES questions are answered on a nine point Likert scale, with 1 being “strongly disagree” and 9 being “strongly agree”. We reviewed them, and compared them to the Canadian national survey in two ways:

- Modal analyses of blocks of similar questions in the NES (for example there are eight questions relating to financial conditions in BC/Canada).
- Normalized frequency counts of the Likert scores for both Vancouver (BC⁹) and Canada for the specific CDO – related questions.

Modal analyses

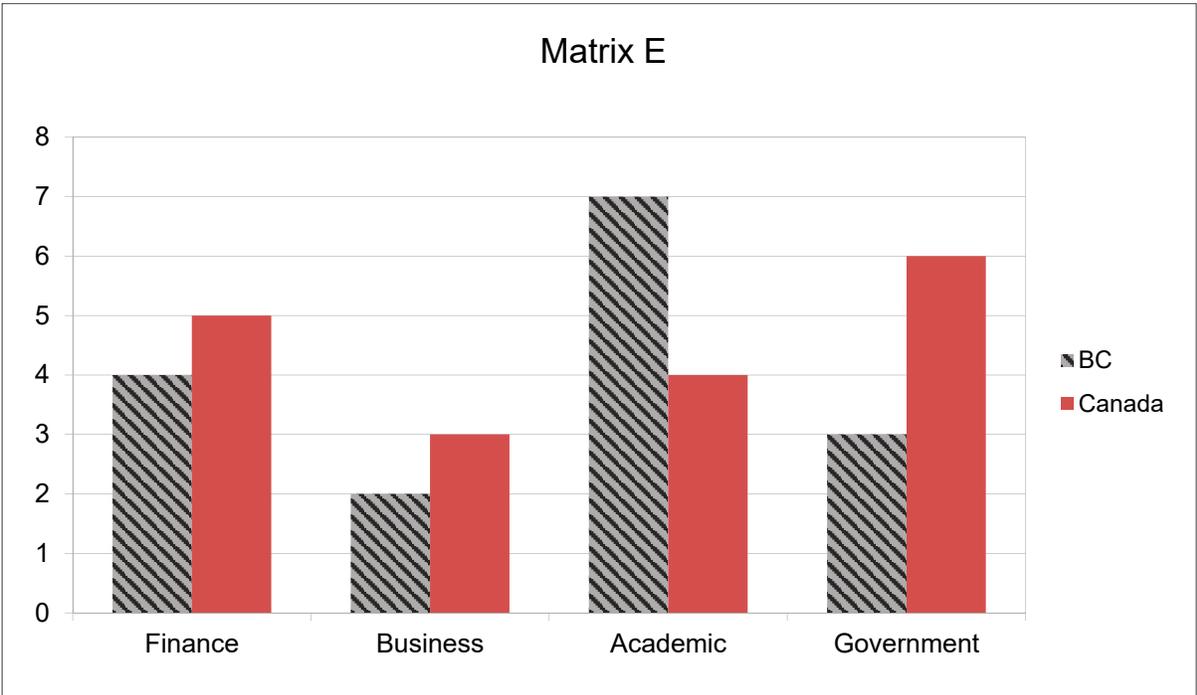
⁸ Conditions in Vancouver have not changed much between 2015 and 2016, therefore PES aggregation is reasonable. Similarly for Canada, except for Alberta, but since the Canadian NES only has about 14% of its responses from Alberta, we believe the merged data to be good. On average there were about 70 responses for each question in the aggregated data base – they varied slightly from question to question.

⁹ Vancouver is shown as BC on the charts simply to save space.

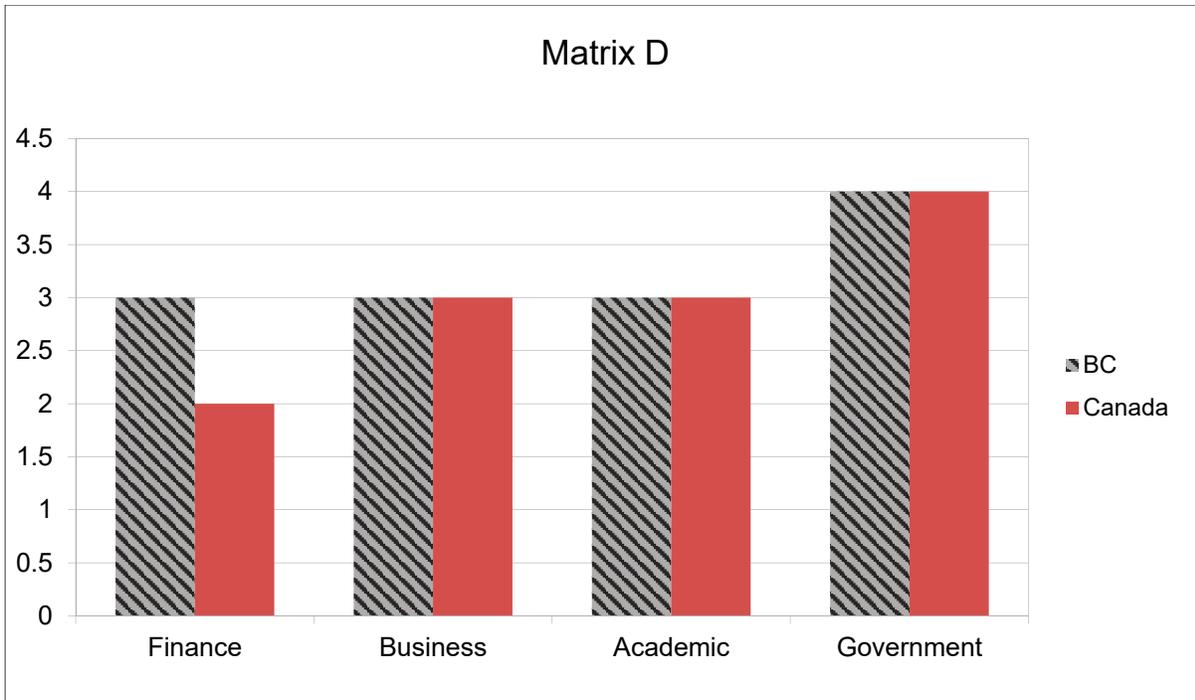
The most rigorous way to analyse blocks of similar statements based on Likert measures is through taking the mode of all of the responses. Understandably, the results often reflect the interests of the respondents. Since, for both the NES and the BC PES we know which sector each respondent belongs to, we took the mode of all responses in a given subject area by sector of origin of the respondent. Originally we thought it would be possible to distinguish between GAV and non-GAV firms. This is not the case: it is clear that a separation between the two, whether by NAICS or expert opinion is at best judgemental.. Thus we used the GEM/World Economic Forum classification to separate the respondents.

Some of these charts are shown below:

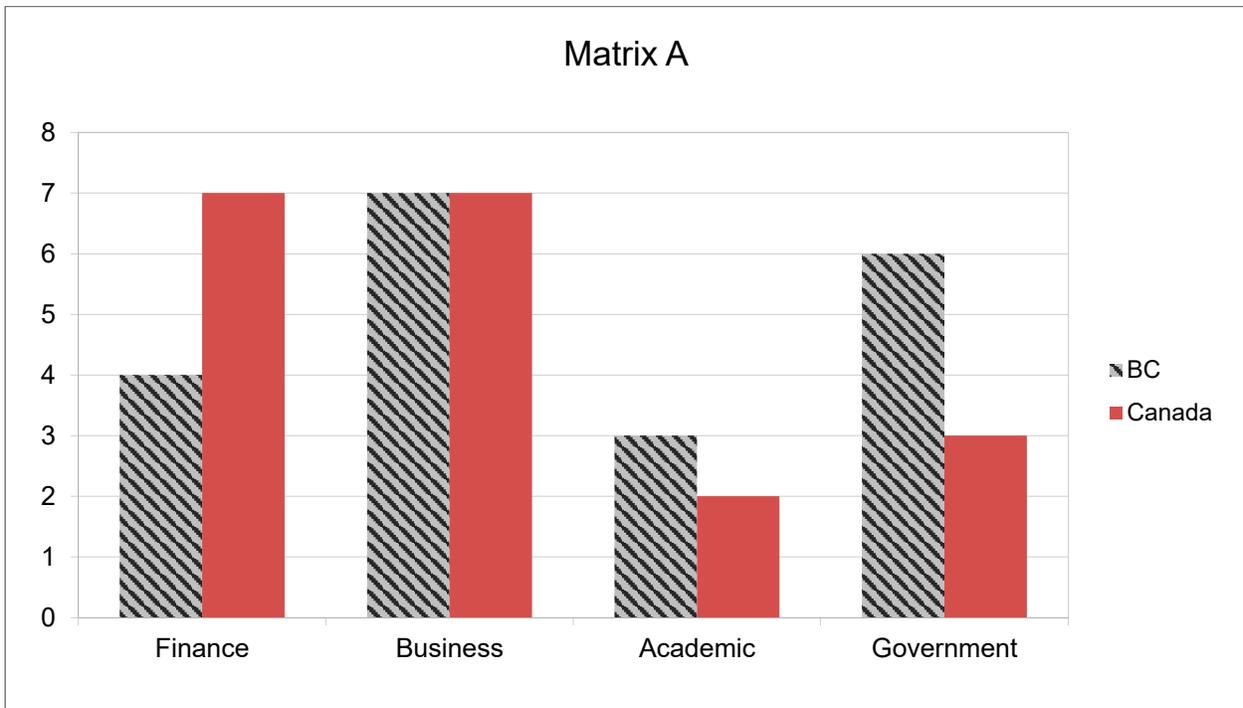
Excellence of R&D transfer, modal analysis (E series)



Excellence of education and training, modal analysis, (D series)



Ease of financing, modal analysis (A series)



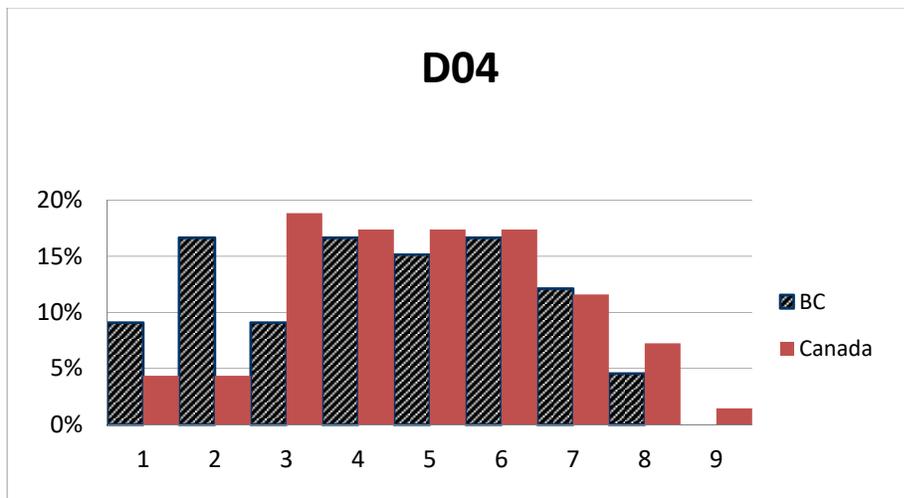
Thus the modal analyses suggest that:

- There are mainly consistent opinions on the excellence of training (in DI)but there is a wide variation on the excellence of technology transfer from universities
- Most BC sectors report that the financing opportunities are fine (except, interestingly the finance sector itself)

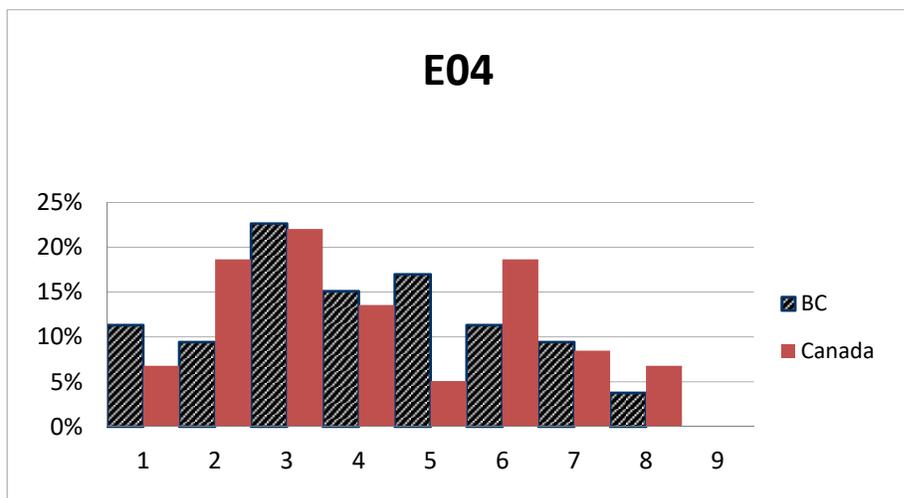
Frequency Analyses

A selection of the graphs of the normalized frequency counts are shown below. A complete list of the questions is in Appendix B. The vertical axis is expressed as a percentage of the total valid responses to the question:

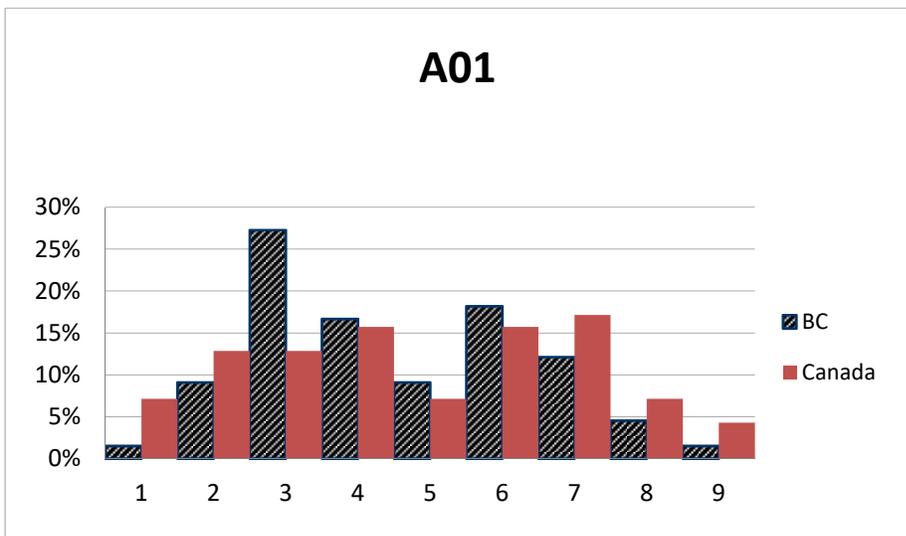
The vocational, professional, and continuing education systems provide good and adequate preparation for starting up and growing new firms (D04)



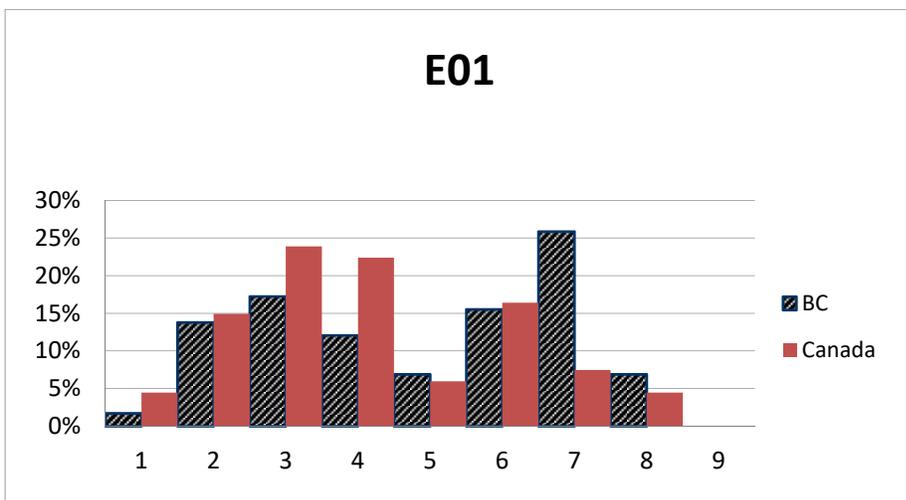
There are adequate government subsidies for new and growing firms to acquire new technology (E04)



Equity funding is available for new and growing firms (A01)



New technology, science, and other knowledge are efficiently transferred from universities and public research centers to new and growing firms. (E01)



The frequency response analyses for specific questions are also revealing. From the sample of questions shown above we can see:

- Most respondents are comfortable with the excellence of the educational and training system(s)
- There is less satisfaction with the availability of subsidies (!)
- The response to the availability of is mixed, possibly reflecting (in the case of BC) the lack of a local stock exchange
- The bipolar response to the question about the excellence of technology transfer from universities to industry likely reflects the wide difference between the attitudes of different categories of respondents (as shown in the modal analysis “E”)

Analysis and Conclusions

While the CDO interview program in Vancouver has started, it is not nearly complete. But it has already started to show results that are important for understanding the cluster and for making policies to help retain and grow the cluster. Respondents have, in general, confirmed many of the results of the GEM survey thus validating the description of the ecology that the GEM survey presents.¹⁰ The GEM results point out there are a number of clear places where governments and the private sector are doing well, and others where there is clear room for improvement.

The results from our interviews suggest that, in Vancouver, DI, of all types, have:

- the advantage of a good supply of local talent, either developed locally or migrated into Vancouver. Indeed, there is a clear tendency to migrate to Vancouver and then develop some sort of DI enterprise. The labour market is “sticky” and the quality of life is a major factor.
- the structure of the sector is volatile, almost chaotic - DI vary rapidly with time. This is where the “middleground” comes in to play – it appears to be a required feature of the ecology of the cluster. The constant churn of projects, labour and firms throw up world class outputs, which are constantly being regenerated. Even large firms such as Motorola and Nokia who were major players in Vancouver only five years ago, today have virtually disappeared. Yet Microsoft, Amazon and Sony are making major investments in the city.
- the talent pool has overlapping skills: practitioners move easily from one component of the sector to another just as they migrate from one firm to another
- there is a strong attraction to “plays” across the Pacific, notably China. Our interviews also show there is a surprising strength of linkages to the Chinese market, where many smaller firms in Vancouver are providing software and software services, usually in Chinese for clients in China.

¹⁰ Similar results were presented in a comparative study/scorecard comparing Vancouver to other similar cities by the Conference Board of Canada for the Vancouver Board of Trade. See VBOT, 2016.

- there is strong pressure from US DI firms to hire away the best talent. A specific point of friction to the DI industry in Vancouver brought out by many interviewees is the strong competition for human capital from other, particularly foreign, software clusters, such as those in the US. This competition is fuelled by lower salaries in Vancouver (although partially made up for by lower cost publically funded education and health care), and more particularly by housing costs. Because of the cost of housing in central Vancouver, driven by foreign purchasers, entry-level and junior DI workers have to live at some distance from the city, thus throwing them into what is a difficult transportation system¹¹.
- Finally the divide between GAV and non-GAV is not clear. Statistical codes, such as NAICS, have, of necessity, divisions that while they may cover the greater part of the economy, may have arbitrary divisions between different DI.

There are several multinational firms in Vancouver, taking advantage of the good supply of human capital, and the relative openness of the labour market. The CEOs of these firms are lobbying, publically, the provincial government arguing that more skilled human capital is the best investment that the public sector can make (Vancouver Sun, 2016) This leads to the suspicion that multinationals are engaged in “farming” IP in Vancouver. Indeed the usual exit strategy for a DI entrepreneur is to try to negotiate a buy-out with a larger (usually foreign) firm.

But Metro Vancouver has local competition as well. There are a number of smaller cities or rural areas, well within long-distance commuting to Vancouver which have good transportation and communication facilities that can provide a more desirable environment within the BC health/education and legal framework (for example: Victoria, Kamloops and Kelowna, all of which have good air service, good post-secondary education and much cheaper housing). Smaller towns and municipalities outside Vancouver, according to several interviewees, and based on personal observation, are within easy travelling times of Vancouver are becoming increasingly attractive to workers in the DI cluster. One interviewee has noted that those DI freelancers who are more adventurous, are settling in the frontier areas of BC, which, to many others, might be less attractive.

The Trans-Pacific Partnership (TPP)

A key influence in the globalized DI in Vancouver, western North America and the Pacific Rim will be the Trans-Pacific Partnership (TPP), an all-encompassing free trade agreement. In the final text there are sections that refer directly to:

- intellectual property
- information technologies
- service industries

¹¹ Vancouver is on a peninsula, with a relatively few number of bridges accessing the core, leading to major levels of congestion for both public transportation and private vehicles, and very high prices for land, whether for residential or industrial use.. While the public sector system is good, it has not kept pace with demand; the city has, in addition, adopted policies that attempt to discourage the use of personal vehicles.

Canada, and particularly Vancouver, will have to compete in this Pacific Rim environment. The results of this agreement may not be apparent for many years, but provide both a threat and a stimulus to the DI in Vancouver to adapt to remain, and hopefully become even more competitive.

As the CDO conference in Saskatoon noted, there is growing recognition on the part of governments at all levels – municipal, provincial, regional development agencies and federal – of the critical importance of digital technologies for the future of the economy, but they are not yet seized with a sufficient sense of urgency about how to deal with them. Government mandates, methodologies, resources, capabilities, risks/pitfalls and toolkits for policymaking, regulation, investments and planning need to be thoroughly assessed with respect to the social, economic and environmental uses of digital data/information. Canadian DI cannot survive without "Global Growth Plans" that must include non-traditional external funding, external markets and external collaboration at all levels that add value (the US and EU have no incentive to help Canada in a meaningful way)

Conclusions

Location may give some regions a head start, but this advantage is likely only temporary and can be overcome by perceptive and directed policies in other regions. Equally locational advantage can be negated by the failure of policymakers to meet changing circumstances such as housing markets. There have recently been a spate of articles in the business media about Vancouver, (for example from Bloomberg (2016) and the Economist, (2016)) "Sustainability" is often cited as a suite of policies that can attract and retain human capital. But there are important differences: hopefully most sustainable projects are progressive and improve the quality of life in a given location; unfortunately some are regressive, such as the destruction of working class neighbourhoods to enable the construction of high-end residences.

In early August, 2016 the BC government enacted a special land transfer tax for purchases of properties in Metro Vancouver by non-residents (of Canada) of 15%. This tax was designed to reduce the speculative fever surrounding the "flipping" of properties, particularly by Asian investors¹². The tax does appear to have cooled the market, at least temporarily. But while the tax is directed at very expensive properties, it also makes it difficult for individuals moving to Vancouver to work in the DI from abroad to purchase a home. Whether this will affect the DI cluster remains to be seen.

Urban planning is not an exact science, but it too has a direct impact on the development of software clusters. The key lesson for policy makers is to learn from past successes and errors, and to transplant the successes into their policy environment. Canada does not have an inherent competitive advantage across the entire spectrum of DI. But it is clear that Canada does have a number of niches where it has a global competitive advantage in these industries. The overarching policy question is how to exploit these advantages.

¹² It should be noted that real estate speculation in Vancouver is nothing new. Even before the railway was completed in 1886, speculators bought up building sites they believed would be near the new railway terminus. The CPR simply moved the terminus to an area where they (and their cronies) already owned most of the land!

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