

# “If I had a hammer...”

## The role of infrastructure in creative, innovative clusters and the community in Saskatoon

Peter W.B. Phillips<sup>1</sup>, Graeme Webb<sup>2</sup> and Michael Kunz

<sup>1</sup> Professor and Head, <sup>2</sup> MA Candidate and <sup>3</sup> Summer Research Assistant  
Department of Political Studies, University of Saskatchewan

**Suggested Citation:** P. Phillips, G. Webb and M. Kunz 2009. “If I had a hammer: The role of infrastructure in creative, innovative clusters and the community in Saskatoon.” Presentation to the ISRN Annual Conference, Halifax, April 28, 2009.

### Abstract:

Saskatoon, a major beneficiary of large industrial and scientific infrastructure investment in recent years, is widely recognized as having innovative clusters and a creative community. Using data drawn from five different recent research efforts focused on Saskatoon, this paper tests three hypotheses about the role infrastructure can play. The first hypothesis—that the economic performance of a community depends on networks to generate innovation, and that physical and knowledge infrastructure can foster the knowledge circulation that underlies those networks—sounds intuitively correct but the evidence from the surveys and studies undertaken so far does not provide compelling support. Surveys of both firms and individuals did not reveal that the infrastructure investment was particularly influential. The data does show that firms do seek and receive valuable information from the university and national labs, but this was seemed to be more person-to-person mediated (rather than institutionally managed) and disproportionately relevant in science-based sectors than in other sectors (such as ICT). The second hypothesis—that economic performance in cities depends on talent attraction and that infrastructure enhances the quality of place by attracting and integrating newcomers—is only partly sustained by the Saskatoon example. Research infrastructure (such as at the university and in the CLSI) was positively correlated with talent attraction in one of our studies, but social and community infrastructure was not. Retention, similarly, seems less related to the degree of tolerance and community service and more related to the professional and research buzz generated by multiple employers. The third hypothesis—that infrastructure either facilitates or is the target of new associative forms of governance that mobilizes broad based local support—appears to be sustained in Saskatoon, but it is less clear if or how this relates to civic economic performance. In short, infrastructure be necessary for success but is not sufficient.

**Key words:** innovation systems; clusters; creativity; infrastructure

## 1. Introduction

Infrastructure occupies a privileged place in the hearts, minds and literature of human endeavors. Pete Seeger's famous Hammer Song, written in 1949 in support of the progressive movement, became the folk anthem of the peace movement in the 1960s: "If I had a hammer I'd hammer in the morning/I'd hammer in the evening all over this land..." While never formally adopted by any in the economic development community, one might suggest that it could be the theme song for those interested in local and regional development and growth. Roads, airports, universities, laboratories and all manner of physical investments (what economists call 'gross fixed capital formation') account for more than 20% of Canada's gross domestic product and are widely viewed as a key ways that governments and others can prime development and growth.

More recently, some have argued that infrastructure is a tangible, visible sign of creative and innovative communities and clusters. Some see infrastructure as instrumental in nurturing and supporting creativity and innovation while others see it as an artifact of creative and innovative clusters or communities. There are a wide range of competing theories and explanations, but little evidence of whether infrastructure is a cause of creativity and growth or a result of growth? Is it an input or an output? Can it be used to prime all the good economic things that communities and governments seek? Traditionally, "infrastructure capital" has been physical in nature—it is the transportation system that allows for the movement of goods and it is purposeful development of innovation parks to foster collaboration and creativity. However, "infrastructure capital" is not solely physical (economic) capital. If it were simply physical (economic) capital it would be impossible explain the success of one city-region in enticing new investment while also fostering the growth of existing sectors, while another city-region, with similar physical infrastructure capabilities, is unable to do either. In the absence of social and cultural capital at the city-region level, physical (economic) capital is alone not enough to spur economic development.

Saskatoon offers an excellent case study of the phenomena. In the first instance the province of Saskatchewan has historically and currently has one of the highest percentages of its gdp accounted for by investment. Saskatoon, in particular, is identified by many as a creative city (Canada's Creative capital in 2006) with a strong innovation record (with world firsts in uranium and potash mining, farm machinery fabrication, crop varieties and biotechnology) flowing from a few world-class industrial clusters (especially mining and biotechnology). Moreover, Saskatoon

has been a major beneficiary of investments in hard infrastructure (buildings, labs, big science projects) and soft infrastructure (research networks and projects) funded by federal, provincial and municipal governments and agencies.

This paper has five further sections. Part 2 provides some background on the scale and scope of infrastructure investment in Saskatchewan and Saskatoon. Part 3 offers a brief synopsis of various theories of investment and growth and lays out three hypotheses. Part 4 identifies the sources of data for this analysis. Part 5 examines the data related to the three hypotheses. Part 6 offers some concluding comments.

## **2. Background**

In a way this is an interesting and volatile time to be examining the structures and dynamics in Saskatoon. After the better part of two decades of extreme economic volatility in the core commodity markets relevant to the Saskatoon economy, the city has entered a period of robust yet volatile growth that so far is resisting the global trends. After the last big commodity boom and bust of the 1972-86 period, Saskatoon faced the better part of two decades of relatively stagnant socio-economic development. Per capita incomes lagged national growth and employment and demographic growth was more related to intra-provincial restructuring rather than net provincial economic growth. Now Saskatoon has come into its own. Mario Lefebvre, Director of the Centre for Municipal Studies at the Conference Board of Canada, in February 2009, labelled Saskatoon one of Canada's three 'new economic powerhouses.' He wrote:

“I have been keeping a close eye on the economic situation of Regina, Saskatoon and Winnipeg. And what is about to unfold this year is no luck. These three cities have been posting solid economic performances for years now. .... These three economies have diversified significantly over the past 20 years and while agriculture still matters, it plays much less of a role in the overall economic picture. ... [T]he success of these three cities certainly is not a new story. The Conference Board recognized years ago that something special was taking place in the economy of these three cities. And now, the country as a whole is noticing. In fact, the economic success of these cities has turned them into a magnet for people over the past two years. “

Investment has equalled about 21.4% of Saskatchewan's GDP in the past decade (ranging from 19% and 23% on an annual basis). Government investment represents about 2.3% of GDP and private investment (more than 80% in non-residential construction and machinery and

equipment) has averaged about 19%. Saskatoon's traditional share of provincial investment has always been higher than its proportion of population (currently about 25%) and evidence suggests that share has risen sharply in recent decades. Federal, provincial, municipal and industrial investors have responded to the economic opportunities and demographic pressures in recent years. In the past five years alone, more than \$1 billion of new investment has been directed to the University and related research facilities and major new capital has flowed into oil, heavy oil, potash, uranium, gold and diamonds. Even though world economic growth has stalled and a global recession has begun, commodity prices remain relatively robust and Saskatoon remains buoyant.

**Table 1: Major capital investments related to research or industrial development in Saskatoon, 1900-2009**

Period	University	Government	Industry developed with government support
Before 1940	<ul style="list-style-type: none"> <li>• Ag College 1908</li> <li>• Engineering 1912</li> </ul>	<ul style="list-style-type: none"> <li>• 1927: airport opened</li> </ul>	<ul style="list-style-type: none"> <li>• 1939: first short-line farm machinery manufacturing in Saskatoon</li> <li>• 1940: Intercontinental Packers</li> </ul>
1940-70	<ul style="list-style-type: none"> <li>• 1955: University Hospital</li> <li>• 1965: Vet College</li> </ul>	<ul style="list-style-type: none"> <li>• 1947: Sask Research Council</li> <li>• 1948: NRC regional lab</li> <li>• 1959: Ag Canada Dominion Research Lab</li> </ul>	<ul style="list-style-type: none"> <li>• 1944: CCF investment policy</li> <li>• 1950: first uranium mined</li> <li>• 1962 (potash first developed; no Crown investment)</li> </ul>
1970-90	<ul style="list-style-type: none"> <li>• 1972 SED Systems</li> <li>• 1975: VIDO</li> <li>• 1980: Engineering Building</li> </ul>	<ul style="list-style-type: none"> <li>• 1972: new airport</li> <li>• 1980: Innovation Place</li> <li>• 1983: NRC PBI</li> <li>• 1989: AgWestBio</li> </ul>	<ul style="list-style-type: none"> <li>• 1975: potash nationalized; PCS created</li> <li>• 1977: POS Pilot Plant</li> <li>• 1988: Cameco created and gradually privatized</li> <li>• 1989: PCS privatized</li> </ul>
1990-2009	<ul style="list-style-type: none"> <li>• 2011: Health Sciences Complex</li> </ul>	<ul style="list-style-type: none"> <li>• 1992: SREDA formed</li> <li>• 1998: AAFC national research labs and genebank</li> <li>• 1999: Airport Authority</li> <li>• 2004: NRC Incubator</li> <li>• 2004: CLSI</li> <li>• 2008: New Persephone Theatre</li> <li>• 2010: InterVac</li> <li>• 2012: New Art Gallery</li> </ul>	

Source: Various.

Government has been a major investor in the development of Saskatoon infrastructure. The University of Saskatchewan, the single largest employer in town, is the destination of much

of the investment, either directly into university colleges or buildings or in Innovation Place, the research park that occupies university land just north of the main campus. In between the two districts, many of the major government and university infrastructure investments have been sited, including the Western College of Veterinary Science, AAFC, the POS Pilot Plant, the Vaccine and Infectious Diseases Organization (VIDO), International Vaccine Centre (InterVac) and the Canadian Light Source (CLSI). Beyond the campus district, there is no single location with significant industrial or economic infrastructure. The mining industry is scattered about downtown, the west side and the airport area, but there is no identifiable linking infrastructure (except perhaps the airport, but the site benefits are likely minimal as no point in the city is more than 25 minutes driving from the terminal).

Since its inception in 1997, the Canadian Foundation of Innovation (CFI) has been a major investor in Saskatoon. The two single largest contemporary investments in economic development in Saskatoon are the CLSI and InterVac. Approved with six beamlines at an initial capital cost of \$173-million, the synchrotron is one of the largest science projects in Canadian history and was the product of an unprecedented collaboration of federal, provincial and municipal governments and agencies, universities from across the country and industry. Since its opening in 2005, eight additional beamlines have been funded and developed, each at an additional cost of at least \$10 million. In 2008, VIDO at the University of Saskatchewan was commissioned to build a InterVac, a \$140 million vaccine research and development facility, which will be the largest Containment Level 3 facility in Western Canada developing vaccines for humans and animals against emerging or persistent diseases. The two projects together account for more than \$400 million of investment in recent years. The tag line for the CLSI—‘field of beams’—evokes the hopes of Ray Kinsella in the 1989 hit movie *Field of Dreams* that ‘if we build it, they will come.’ The notion that infrastructure imbues some irresistible draw for science and investment is not unique to the CLS—the supply push notion of investment as a primer for development permeates the literature and myths of economic development.

Soft infrastructure has similarly been developed or supported by government action, often with little thought given to how it might generate sustainable economic development. One long-term and significant source of targeted funding that nurtures research networks has been through the commodity check-offs. Producers pay small levies on crops and livestock produced and sold in the province and use that to leverage university and industrial research and development.

While the individual levies are small, the aggregate funds available in Saskatchewan for research exceeded more than \$100 million over the past 20 years. Much of that has been coordinated and used by groups such as the Crop Development Centre, POS Pilot Plant and various federal labs, all located at the University. Meanwhile governments have put more money into soft infrastructure. The province has contributed by developing groups such as AgWestBio, a non-profit Saskatchewan corporation funded by government but with an independent Board of Directors, that is mandated to “initiate, promote and support the growth of Saskatchewan’s agricultural biotechnology industries” which “promotes and supports the commercialization of related food and non-food technologies.” The City, meanwhile, created the Saskatoon and Region Economic Development Authority (SREDA), one of the first independent economic development agencies to be started in Canada, to coordinate and lead economic and community development. Nationally, funding agencies put money in networked science and research, including through the Networks of Centres of Excellence, Genome Canada and various new tri-council-funded networking initiatives, all which Saskatoon has worked to use to generate new activity in the city.

### **3. Theory**

The theory that justifies such an interest in infrastructure is all over the place. Economists, sociologists, political scientists, management theorists and geographers all consider infrastructure as a key part of an economy and society.

Economists posit that hard infrastructure (what they call GFCF) and soft infrastructure (sometime called human capital) are at the core of the conception of the economy. Basic theory parses the world into land, labour and capital, and then attempts to explain how we make choices about their allocation, use and valuation, based on marginal valuation and exchange. Traditional growth theory posits that investment is critical to growth (the Arrow-Debreau-Solow-Swan model). With any given ratio of labour to capital, adding more capital (in the form of buildings, machinery and equipment) would raise the marginal productivity of labour, which would raise wages and ultimately draw in more labour. Ultimately, more capital would create more jobs and raise both incomes and the quality of life. But, in this conceptualization, diminishing returns eventually will set in as capital no longer adds much to our labour productivity, because the technologies are assumed to be exogenously derived and generally stagnant. In the context of

this theoretical configuration, there is a valid theoretical reason for governments to invest in capital when there is surplus labour or low wages. While parts of the world face these circumstances, most advanced industrial economies do not really face those circumstances in any meaningful way any more.

New growth theory has re-endogenized technological change. Just as land, labour and capital can be drawn into the market through price signals in the Arrow-Debreau-Solow-Swan growth model, the Romer-Lucas endogenous growth model assumes that people will similarly be willing to engage in efforts to change the production processes and recipes that define our technological capacity. Thus, in addition to saving to fund capital investment and future consumption, now we assume people will also invest in the search for new ways of doing things. The theory provides a robust explanation of how decisions to invest and innovate are linked to both capital investment and human capital (which is posited but not well articulated). The limitation is that the theory does not identify the necessary or sufficient conditions for individuals to engage in this endogenous activity of investment in invention and innovation. So, while investment in physical and human capital is desirable, it is unclear how, when and where governments should engage.

A number of contextual theories of growth have stepped into the breach. Marshall (1890), while predating much of the theory, provides a clear explanation for why one might want to invest in infrastructure around districts, milieu, poles or regions where there is an agglomeration of workers and firms engaged in competitive and collaborative activities. A century later, Porter's diamond theory of competitiveness (1990) simply updates Marshall's concept to the 20<sup>th</sup> century vernacular. Thus, the rule of thumb might be to invest in physical and human capital in areas that specialize. What is not clear is how to identify areas of nascent specialization and what types of investment might yield the highest economic and social benefits.

Soft infrastructure has been addressed by Bourdieu (2006, 110), among others, who defined social capital as:

...the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition—or in other words, to membership in a group—which provides each of its members with the backing of the collectively-owned capital, a 'credential' which entitles them to credit, in a various sense of the word.

In other words, social capital was capital that was accrued from relationships between two or more individuals, in the form of a “capital of obligations”, which could be spent by an individual or the group as a whole to achieve a desired end.<sup>1</sup>

The ISRN has posited three potential hypotheses that provide causal explanations for how investment generates economic outcomes.

First, the literature on regional and national innovation systems argues that innovation depends upon interactive, social learning between economic agents and that this is socially organized in spatially proximate regions (Morgan 1997; Asheim and Gertler 2005). The development of local ‘untraded interdependencies’ (Storper 1997) is at least partly related to infrastructure for knowledge generation and circulation, such as universities, networking milieu and research networks (Scott 2004).

Second, people flows bring large numbers of immigrants predominantly to major urban areas, which thereby generate economies of scale and scope. Preliminary studies suggest that regions are most successful in developing if can attract highly educated ‘talent’, which requires a tolerant and welcoming attitude to social diversity (Florida 2002; Gertler et al. 2002; Saxenian 2002). Specialized research infrastructure and knowledge institutions—such as universities and research laboratories—are an important part of this dynamic.

Third, innovation often involves more than technology and economic activities. Increasingly, the literature asserts that the economic success of cities (and other areas) is linked to their success in encouraging and promoting new forms of democratic and civic engagement (Putnam 1993; Gertler and Wolfe 2004; Phillips 2007).

#### **4. The data**

Saskatoon has been the focus of a number of research investigations that provide material for this paper.

In 1997-99, the canola cluster in Saskatoon and globally was investigated, leading to a major book on the global oilseeds complex centred in Saskatoon (Phillips and Khachatourians 1999). More than 30 semi-structured personal interviews of supply chain and cluster actors were undertaken in 1997 and 1998. The role of infrastructure was examined in the context of this cluster.

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<sup>1</sup> The Forms of Capital. Pg. 114.



In 1999, Dobni and Phillips developed a Science Map of the key public, private and collective investments and commercial developments in Saskatoon. Building on the model of Denny Doyle's Techmap of Ottawa's ICT sector, this map broadened out the investigation to all science based research and industrialization over the city's history. The key investment milestones were identified in the map, as well as the succeeding permutations and combinations of public and private assets as they matured and were repurposed.

In 2002-3, the Saskatoon team of the Innovation Systems Research Network, a SSHRC funded Major Collaborative Research Initiative, undertook 75 in-person, structured surveys of actors within the biotechnology cluster, examining issues related to the structure and function of the industrial complex. The role of strategic investments was investigated in that context.

In 2007-8, the Saskatoon ISRN research team, part of the renewed SSHRC MCRI project, administered three surveys related to the creative community in Saskatoon. In May-August in both 2007 and 2008, teams of undergraduate students from the Department of Political Studies at the University of Saskatchewan undertook a total of 75 structured interviews using the ISRN instruments. These actors were chosen by the researchers based on the need for a wide variety of perspectives and from suggestions put forth from the interviewees (i.e. a 'snowball method' was used to create a list of possible interview targets). The interviews were conducted in person and ranged from approximately twenty minutes to two hours.

Finally, in 2008 a social network analysis was done on social entrepreneurs in Saskatoon. Over the course of its 2007 Theme III interviews (Inclusive Communities and Civic Engagement) the Saskatoon ISRN team was able to identify four main structures in Saskatoon that were of particular importance: the university, government, business and civil society.<sup>2</sup> Within these four structures, particular individuals and organizations were identified as playing key roles. Taken together, a list of key actors in the Saskatoon city-region was compiled. A refined copy of the list of important actors in Saskatoon was narrowed down to 253 individuals (73 from business, 63 from the university, 59 from government, and 58 from community based organizations). It was these individuals, and the networks of which they were a part, that formed the source population from which to study the level of infrastructure social capital in the Saskatoon city-region. Thirty individuals, from the refined list of 253, took part in this research. These thirty individuals were from all four major structures in the Saskatoon city-region (5 in

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<sup>2</sup> Theme III, ISRN (2007)

government, 9 at the university, 7 in industry, 9 in civil society and 2 others)<sup>3</sup>. Their entrepreneurial orientation and social networks were elicited in a survey and analysed by Webb (forthcoming 2009).

## 5. Analysis

The data from Saskatoon was used to test the three hypotheses about the role of infrastructure in influencing economic performance in the city.

### 5.1 Infrastructure and innovation networks

The first hypothesis is that the economic performance of a community depends on networks to generate innovation, and that physical and knowledge infrastructure can foster the knowledge circulation that underlies those networks.

The survey of firms (theme 1, ISRN II) identified that most of those surveyed credit their competitive advantage to superior innovation. Of the 24 participating firms, 12 firms expressed a belief that they had superior research and development or had created innovative products. Another four firms indicated that their international connections or their network of alliances and partnerships were the basis for their success. There was a strong connection between the sector of the firm and their responses. Eight of 10 firms involved in biotechnology or agricultural research believed that the quality of their research and development was a competitive advantage for their firm.

To some extent, every firm asked “*Has your firm collaborated with other players leading to innovation?*” answered positively. For some, particularly those providing services like contract research, this collaboration simply consists of feedback from their customers influencing their business practices. For others, their collaboration included large-scale projects executed with other firms and organizations. Firms spontaneously mentioned collaborations with a number of major infrastructure investments, such as the University of Saskatchewan (5), the Saskatchewan Research Council (2), Plant Biotechnology Institute (2), POS Pilot Plant, Agriculture and Agri-Food Canada, the local office of the Industrial Research Assistance Program, the Innovation Place Bioresource Centre and VIDO. When asked to describe the

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<sup>3</sup> Two participants held positions in more than one sector. As a result, while there are only 30 participants, there are 32 sectoral tallies.

motivation underlying their collaboration, the most common answer was the need for efficiency and to cut costs; other answers revolved around gaining access to knowledge, innovation, and expertise in order to stay at the cutting edge of advancements in science and technology. Smaller firms, such as the start-ups in biotechnology and the junior exploration mining companies, often cited the limited capacity of their firms and the necessity of collaboration for specific services, equipment and infrastructure.

This community-wide result correlates with the results of earlier work on the canola sector (Phillips and Khachatourians 1999) and the ISRN I survey that concentrated on the dynamics within the biotechnology cluster.

A survey of canola firms in Canada and globally undertaken in early 1998 asked companies about the factors influencing their decisions to locate their research efforts. Half of all the respondents, representing the majority of private companies responding, acknowledged the importance of proximity to either collaborators or competitors. About 40% recognised the importance of being close to their collaborators, particularly the NRC and AAFC in Canada and key research universities.

**Table 2: How important are the following to your decisions to both undertake research and to locate the research in labs in Saskatoon or elsewhere?**

	N = 28	%
Proximity to competitors or collaborators	14	50%
- competitors	8	29%
- collaborators	11	39%
Access to labs, greenhouses and test fields	4	14%
Access to local pool of skilled labour	7	25%
Key scientists either in your company or partner organisations	5	18%
Access to large and accepting market for seeds being produced	6	21%
Role of government agencies (federal, provincial, regional, SREDA) related to hospitality, red tape (or lack of)	5	18%
Source: Phillips and Khachatourians 1999.		

The ISRN I survey revealed similar results. When key business, community and government leaders were asked about which institutions were most influential in the development of the local cluster, they identified many of the same groups. In the 75 surveys, 64 individuals and 157 institutions were mentioned as providing the leadership or glue that led to the development of the cluster. The most significant agents of creativity and innovation in the

cluster were the university, AgWestBio, NRC/PBI and AAFC and a number of key individuals in the university administration, AAFC, NRC/PBI and the industry.

**Table 3: Key business, community or government leaders who played an important role in the development of the cluster**

Sector and institution	Individuals mentioned		Citations	
	#	% total	#	% total
<b>Industrial lobby groups</b>	<b>9</b>	<b>14.1%</b>	<b>51</b>	<b>32.5%</b>
AgWest Biotech	2	3.1%	31	19.8%
Private firms	6	9.4%	19	12.1%
Chamber of Commerce	1	1.6%	1	0.6%
<b>University</b>	<b>16</b>	<b>25.0%</b>	<b>27</b>	<b>17.2%</b>
Administration	9	14.1%	16	10.2%
Faculty	5	7.8%	8	5.1%
CLSI	2	3.1%	3	1.9%
<b>Federal Government</b>	<b>18</b>	<b>28.1%</b>	<b>42</b>	<b>26.8%</b>
Politicians	2	3.1%	2	1.3%
Bureaucrats	3	4.7%	3	1.9%
AAFC	5	7.8%	11	7.0%
NRC-PBI	5	7.8%	22	14.0%
NRC-IRAP	3	4.7%	4	2.7%
<b>Provincial Government</b>	<b>12</b>	<b>18.8%</b>	<b>17</b>	<b>10.8%</b>
Politicians	5	7.8%	8	5.1%
Bureaucrats	5	7.8%	5	3.2%
Innovation Place	2	3.1%	4	2.6%
<b>City</b>	<b>2</b>	<b>3.1%</b>	<b>13</b>	<b>8.3%</b>
<b>Other (Nes)</b>	<b>7</b>	<b>10.9%</b>	<b>7</b>	<b>4.5%</b>
<b>Total</b>	<b>64</b>	<b>100%</b>	<b>157</b>	<b>100%</b>

Source: Phillips et al 2004; tabulation of responses to ISRN Survey Section F: Q3 from entire sample.

This showed up in the context of labour mobility and networking. Of 390 canola industry employees surveyed in 1998, a full 39% of them had linkages to the university, and 7% had prior employment experience with AAFC and NRC. Questions for individuals challenged the importance of some of these flows. Phillips and Webb (2008) examine questions about whether the local economy supports mobility of knowledge between jobs and sectors. The survey asked respondents whether Saskatoon's economy enables mobility between sectors. On a 10 point scale (1=none; 10=high), 58 responses responded with an average of 6.5 (standard deviation 1.6) that the economy facilitates mobility. When asked whether the respondent uses knowledge gained in other sectors in their current work (0=never; 10=frequently), 62 responded with an average 6.6 average (2.2 standard deviation). There was no significant correlation between the responses and the talent index.

**Table 4: Labour market mobility in the Saskatoon agri-food research community**

	Current	Past employment experience			
	<i>Employer of respondent</i>	<i>University</i>	<i>Other Companies</i>	<i>AAFC</i>	<i>NRC</i>
Companies	189	45	81	13	8
AAFC	162	42	50	--	4
NRC	39	19	9	3	--
Total	390	151	140	16	12
% total		39%	36%	4%	3%

Source: Phillips and Khachatourians 1999.

Firms were also asked “*When your firm or business unit has a problem with product design, production, market development, that it cannot solve on its own, where do you go for solutions?*” Nine firms, largely from the biotech sector, reported that they would look for help from academics. For many, these connections were informal and were often described as simply picking up a phone and calling an acquaintance at the University of Saskatchewan (or elsewhere) that was thought to be able to lend assistance. Two firms interviewed have dedicated science boards to advise on their activities. Firms in the mining or software sectors, in contrast, said they would be more likely to turn to consultants, parent or sister companies or other companies in their field (in one case, a biotechnology firm posted their problems to a website and offered rewards for possible solutions).

Lastly, respondents were asked a series of questions about their specific location in the city of Saskatoon and how it affects their firm. Firms were located throughout Saskatoon including the North and South Industrial Areas, along Airport Drive, on campus, downtown and in Innovation Place. Of these locations, only those located in Innovation Place reported that the specific address helped to facilitate creativity and innovation. Innovation Place was praised for its beautiful buildings and grounds, its range of amenities, and the vibrant nature of its research community. It was the only location in Saskatoon that was said to have ‘buzz’ (for research based firms); most respondents reported that Saskatoon simply was not large enough to have areas inside of it with buzz distinguishable from the city as a whole.

In Saskatoon, it appears that a large proportion of collaboration and cooperation between firms and other organizations in the local economy occurs informally through personal contacts. These collaborations most often occur on the level of brief consultations. A common scenario is that when a problem occurs, an individual in a firm would simply pick up the phone and talk to a knowledgeable friend or acquaintance at the University of Saskatchewan or another firm in order

to gain knowledge to help fix the problem. While formal connections are still very important, especially connections with public research organizations and universities, the perception from the interviews is that informal connections between individuals is a more important conduit of information in the average firm's day to day operations.

However, this rich environment of information exchange does not seem to facilitate information transfers between different sectors. The proposition that firms might benefit from the existence of other sectors in Saskatoon was usually dismissed out of hand, especially when the question was framed in terms of learning and sharing knowledge across sectors. When pressed, some firms talked about access to support services as a benefit to their firm while some of the larger employers said they needed workers from other sectors, especially considering the recent economic boom. However, the overall impression from the interviews is that the presence of other sectors in the local economy in terms of learning, overall benefit or hiring was not an important consideration for a large majority of respondents.

Looked at from the perspective of social capital investments, the evidence is weaker. Further research into the level of openness in the Saskatoon city-region was conducted as a part of the 2008 study on community leaders (Webb forthcoming). Thirty participants were asked: "How open are the social networks in Saskatoon to new people and new ideas?" Using a scale of one to ten, where one is a low level openness and ten is high level openness, the respondents had an average response of 6.32 (with a range of 8, the minimum response being 2 and the maximum response being 10) with a standard deviation of 1.85. The respondents indicated that while there were "growing pockets of very open, innovative and welcoming networks" there was some resistance that newcomers (both immigrants and in-migrants) experienced upon entering the city.<sup>4</sup> Earlier work tested to see if the city's social fabric helped with this. During Theme III (Inclusive Communities and Civic Engagement) ISRN interviews conducted in 2007 the participants were asked: "Do interactions [between various networks, associations and government actors] tend to be collaborative or competitive?" Of the 27 interviewees, 19 answered the question (on a one to ten scale, one being highly competitive and ten being highly collaborative) with an average response was 6.95 (with a range of 7, from a minimum response of 2 and a maximum response being 9, and a standard deviation of 2.20). In short, social capital

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investments appear to be somewhat biased to supporting collaboration and weakly support innovation.

## **5.2 Infrastructure and quality of place**

The second hypothesis is that economic performance in cities is highly dependent on talent attraction, and that infrastructure could enhance the quality of place by attracting and integrating newcomers.

ISRN II, Theme 1 surveys revealed that many firms credit their capacity to innovate and their connections and alliances to having the right people on board. Most of the explanations were unrelated to infrastructure investment. A few firms reported their capacity was at least partly due to their interactions and cross-learning with other institutions, but those were viewed as minor contributors. Firms were also asked what characteristics of Saskatoon enhance and what characteristics of Saskatoon undermine their firm's ability to attract and retain highly educated and creative workers. While general community quality of life and community structure was the prime reason offered, a number of respondents reported that Saskatoon's science and business community made it an exciting place to work and offered alternative employment opportunities. This was not, however a universal view. There was a marked difference between sectors. Respondents from different sectors did not agree on how characteristics of Saskatoon affect the attraction and retention of highly educated and creative workers. While most respondents agreed that Saskatoon has a high quality of life, the importance placed on quality of life considerations in general seemed to vary by sector. From their spontaneous elaborations on their responses, it is clear that many biotechnology firms believed that career opportunities were more important than quality of place concerns. Workers attracted to Saskatoon biotechnology firms come because it is an important center for biotechnology and is a natural place for an aspirant biotechnologist to go. Social and cultural characteristics of Saskatoon, while of interest to possible employees, are not generally seen as being essential. In contrast, software firms tended to emphasize the importance of social and cultural factors in the attraction and retention of highly educated workers. Global competition for workers was seen as being so intense that qualities of place were essential to the firm's success because mobile creative and highly educated workers simply would not come to their firm if the city was less appealing.

From the responses it seems that there were two factors which determined whether quality of place attributes were seen to be important: the world-wide demand for highly educated and creative workers in that sector and the prominence of Saskatoon in the relevant sector. The first is obvious; when there is a high demand for workers they will have more choice and more factors will play a part in their decisions. The second is more interesting. For sectors like biotechnology and mining, Saskatoon is a well-known business centre with a world-wide reputation. In these areas, firms tended to suggest that potential employees made their decision based on the specifics of the firm and the job opening and that characteristics of the broader Saskatoon community were secondary or unimportant to their selection. In contrast, software firms – a sector in which Saskatoon is at best a bit player—tended to emphasize the importance of characteristics of the Saskatoon city-region in the attraction of workers. This is partly because there are few other employment opportunities if their job does not work out. In sectors where Saskatoon is known in the industry, going to Saskatoon is seen as a natural career progression. It may also be that, since workers in mining and biotechnology are more likely to have visited Saskatoon or, at least, know something about the region, respondents downplay the importance of quality of place considerations because they do not have to ‘sell Saskatoon’ to the same degree as employers in other sectors where Saskatoon is less well known.

The results of earlier work on the canola cluster and on creatives support this view.

**Table 5: Job attributes and community features that affect highly mobile employees, 1998**

1 = most important; 5 = least important	Ph.D. (n=25)					Masters (n=45)				
	1	2	3	4	5	1	2	3	4	5
Proximity to other companies/agencies hiring	22			1	2	39	2	1	2	1
Type of work in the job	17	2				13	12	1	1	1
Salary and benefits		9	4	2	1	5	9	11	2	
Future career prospects within the company		6	5	5	1	4	3	8	5	1
University links (adjunct appointment; collaborations)	1		2	4				1	2	2
Workplace setting (e.g. research park)			2		1			1	2	2
Personal income tax levels			2		1			1	2	3
Commuting distance to work			1		7		1			4
Cost of living (excl. housing)			3	1				4	2	
Cost of housing			1	2				3	3	
Sales tax levels								1		
Proximity to friends and family			1	1		6	1	3	3	3
Community facilities (e.g. cultural, sports)	1	1	1	2				1	2	
Survey questions: If you have moved from elsewhere, have considered employment opportunities										



elsewhere or are actively considering a move elsewhere, what factors are most influential to your decision? Rank top five (1 = most important)

Source: Phillips and Khachatourians 1999.

A survey of workers in the canola sector in 1998 showed that “thickness” of the labour market was the key consideration mentioned by respondents (table 5). All mobile employees—i.e. employees with graduate degrees—that responded to the questionnaire ranked proximity to other companies or agencies that could hire them as one of their top five considerations and 87% of the respondents put it as the most important consideration. The second most important feature was the type of work in the job, another feature of a thick labour market. Salary and benefits came third, followed closely by career prospects. Almost all the other factors, either related to the job or related to the community, were ranked well below these four factors. Somewhat surprising to some may be that few of the respondents were concerned about taxes, cost of living, or community amenities. The key message appears to be that if the labour market and the job are attractive, all other factors are secondary.

A survey of creatives, undertaken in 2007, tested which characteristics of living and working in Saskatoon make it an attractive place. Respondents were offered 20 specific community features and asked to rank them on a five point scale, from very negative to very positive. They were also asked to rank the top three positive features and the top three negative features. Table 6 shows the results. While all but the tax regime generated average positive responses, only four responses were statistically positive: commute time (a function of community size and transportation infrastructure); community environment; suitability for raising children; and work environment. Four variables (commute time, suitability for raising children, work environment, and proximity to family) garnered the most net votes.

			Positive votes			Negative votes			Net votes
	Avg	SD	1	2	3	1	2	3	
Commute time	1.33*	0.99	9	15	11	1	1	1	32
Community environment	0.94*	0.85	4	4	4	1	1	3	7
Suitability for raising children	0.93*	0.89	8	9	5	0	1	2	19
Work environment in firm	0.91*	0.88	4	6	6	0	1	1	14
Proximity to family	0.84	1.25	13	7	6	5	6	1	14
Proximity to friends	0.80	1.05	3	5	9	2	4	4	7
Recreational/cultural amenities	0.76	0.89	1	6	2	1	6	1	1
Ability of partner to find work	0.65	0.91	7	2	1	3	3	2	2
Quality of schools	0.63	0.78	2	3	3	1	0	2	5

Job opportunities/advancement	0.61	1.05	6	5	10	3	4	8	6
Community safety	0.58	1.07	5	5	5	4	3	7	1
Social and ethnic diversity	0.57	0.83	0	2	5	0	5	2	0
Cutting edge work in the field	0.46	1.08	9	3	2	5	2	2	5
Affordable living	0.44	1.30	10	4	4	15	5	4	-6
Openness to creativity	0.41	0.90	1	1	3	2	2	3	-2
Natural environment/climate	0.32	1.17	2	4	2	13	6	6	-17
Restaurants/nightlife	0.31	0.88	1	2	2	2	4	4	-5
Tolerance	0.30	0.91	0	1	2	6	4	7	-14
Salary	0.15	1.02	1	2	2	5	10	8	-18
Local and provincial tax regimes	-0.17	0.96	1	0	2	13	11	6	-27
Source: Phillips and Webb, 2008.									

While table 6 is illuminating, it does not directly address the relationship between those characteristics and one's talent or creativity. Table 7 presents the results of a correlation analysis between the talent index and the individual responses to the attractiveness of the 20 identified characteristics. Only six of the 20 were statistically correlated. Salary, cutting edge work and affordable living were all positively correlated to the talent index (at the 95 or 99% confidence level) while restaurants/night life and proximity to family and friends were negatively correlated with talent. The positive measures are all individually related and would normally be viewed as part of one's personal cost benefit calculations. The correlations would tend to suggest that the work in Saskatoon is a positive driver, and that it is perceived to be appropriately compensated (perhaps both in normative or purchasing power terms). In contrast, Saskatoon is somewhat less attractive from the perspective of talented individuals because of its limited nightlife and dislocation from friends and family.

<b>Table 7: Correlation between talent index and community characteristics, 2007</b>		
	Correlation coefficient	Statistical significance
Salary	0.245	99
Cutting edge work in the field	0.234	95
Affordable living	0.219	95
Restaurants/nightlife	-0.335	99
Proximity to family	-0.347	99
Proximity to friends	-0.383	99
Source: Phillips and Webb 2008.		

One way to test these results is to examine the questions about whether the local economy supports mobility of knowledge between jobs and sectors. The survey asked respondents whether Saskatoon's economy enables mobility between sectors. On a 10 point scale (1=none; 10=high), 58 responses responded with an average of 6.5 (standard deviation 1.6) that

the economy facilitates mobility. When asked whether the respondent uses knowledge gained in other sectors in their current work (0=never; 10=frequently), 62 responded with an average 6.6 average (2.2 standard deviation). There was no significant correlation between the responses and the talent index.

Finally, the survey asked what “particular aspects of Saskatoon ... facilitate creativity in the city.” In all, 80 responded saying there were specific aspects of the city that affected creativity. Of those who indicated specific institutions or features, 26 respondents reported that specific industry or infrastructure facilitated creativity while 31 reported that cultural aspects of the city supported creativity. Those citing institutions focused on the relatively large part the scientific community plays in the city, mentioning the important role of infrastructure at the University (including the CLSI and the federal labs), the biotechnology firms and the nature of a competitive yet cooperative community. Those citing the community and cultural aspects of the city cited the city amenities (cost, variety), the rural/agrarian/small town virtues (e.g., friendliness, acceptance, volunteerism), and the access to affordable and engaging cultural events and facilities. Statistical tests were done to determine whether there was any relationship between the citations and the talent index. The correlation coefficient between the talent index and industry/institutions was .298 (statistically significant at the 99% level), indicating that those who have higher talent measures see value generated by those institutional/industrial features that are unique to Saskatoon. There is no statistical correlation between the talent index and community/culture features or the negative responses. This does not necessarily mean that cultural and community attributes are not a contributory factor, simply that they are not differentially recognized by those who form the ‘talent’ pool we surveyed.

<b>Table 8: Industrial/institutional and community/cultural attributes that support creativity</b>		
	# cites	Specific attributes cited
Industry and Institutions	26	<ul style="list-style-type: none"> <li>• Inclusiveness; large scientific community; competition and cooperation</li> <li>• Biotech industry</li> <li>• Research infrastructure (university, CLSI, federal labs); large research community relative to small city</li> </ul>
Community, Culture and cultural amenities	31	<ul style="list-style-type: none"> <li>• Size; amenities; lifestyle; pace; cost; sense of community</li> <li>• Cultural events; affordable and accessible activities</li> <li>• Rural/agrarian/small town virtues (friendly, accepting, volunteerism)</li> </ul>
Yes, NES	5	
None	20	Negative features included isolation, conservatism

Source: Phillips and Webb 2008.

### **5.3 Infrastructure and new forms of associative governance**

The third hypothesis is that infrastructure either facilitates or is the target of new associative forms of governance that mobilize broad based local support.

There are numerous variables and indicators that have been used to measure the degrees of social inclusion and civic engagement. The ISRN II research project has focussed primarily on the level and types of collaboration that occur between community-based organizations, industry associations, and the three levels of government. It is the collaboration amongst these diverse actors at the city-region level that constitutes a form of collaborative governance.

There is significant evidence in Saskatchewan the opportunity for attracting and the resulting need to manage and use new infrastructure is a spur to new modes of associative governance. In the most strict, historical sense, one might argue Saskatchewan (rather than Saskatoon particularly) has been a source of many of the innovations in associative governance. Co-operatives occupied an early and dominant position in agriculture (Saskatchewan Wheat Pool, Dairy Producers Co-operative), finance and insurance (Credit Union Central, Co-operative Trust Company of Canada, and Co-operators Life Insurance) and retail trade (Federated Co-operatives) which jointly developed, owned and controlled the majority of the marketing and supply system in the dominant agri-food system (including grain elevators, stockyards and poultry operations, farm newspapers and farm supply), a plurality of the finance, insurance and retail activity in the province and many of the processing plants (such as the cooperative oil refinery). Equally important from a provincial and national perspective, Saskatchewan was one of the early and most frequent users of Crown ownership and control of utility infrastructure (power, telephones, natural gas, intercity buses, auto insurance and water) and industrial development (through the innovation of a Crown management board to act as a custodian and manager of public assets). At one point or another, the province has been the sole operator, monopoly owner or a major shareholder in almost all of the major economic sectors in the province (including wood processing, pulp and paper manufacturing, potash, uranium, oil, gas and farm land ownership).

Saskatchewan, more than many jurisdictions, has found its model of governance under stress. While cooperatives and Crown corporations are fundamentally associative models of governance, they were found to be less effective as capital and labour became mobile in the last

few decades. Many of the co-operatives have been bought out by for-profit companies (e.g. Dairy) or have converted themselves to joint-stock enterprises (e.g. Sask. Wheat Pool) while many of the provincial industrial Crown corporations have been privatized (e.g. Potash Corporation of Saskatchewan, Cameco, Sask Forest Products and Sask Oil).

In their place, a number of 'partnership' models have emerged. Government stepped back somewhat from direct ownership and control and instead made greater efforts to build the climate for development and to support local and industrial initiative. As early as the 1970s the province encouraged the short-line farm-machinery manufacturers to collaborate to development their industry, providing support for the development of PIMA, the industry association and the Prairie Agricultural Machinery Institute in Humboldt. In the late 1980s the province provided the leadership and seed money to develop AgWestBiotech (now AgWestBio) which has become the flagship industrial organization in Saskatoon engaged in nurturing the life-sciences industry (Phillips et al 2008). AWB, using largely government funds but directed by an arms-length private sector board, has been instrumental in providing leadership for attracting new firms to the industrial cluster, for operating a private equity pool (Procyshyn 2004) and for coordinating ad-hoc teams to bid on new projects or infrastructure. AWB provided the leadership, for example, for the bid to host a National Agricultural Genomics Centre in Saskatoon; while the bid failed, the initiative pressed Ottawa into creating Genome Canada and the affiliated Genome Prairie operation in Saskatoon, which now provide strategic leadership for developing and managing world-scale genomics research projects to be centred on Saskatoon. Meanwhile, the municipality responded to this new imperative for associative governance and converted its business development office into the industry-financed and led Saskatoon and Region Economic Development Authority (SREDA). A small group of entrepreneurs, academics and civic leaders have used these platforms to leverage new resources into Saskatoon. The individual and collective leadership of AWB, Genome Prairie and SREDA have been instrumental in developing proposals, lining up partners and pitching for federal support for a number of major investments in the city, including the CLSI and InterVac.

This unconventional mix of actors has led to some interesting and innovative partnerships. The CLSI exemplified this. In 1994, a committee sponsored by the Natural Sciences and Engineering Research Council (NSERC) recommended that Canada develop a dedicated national source for synchrotron light research. Two years later, an international peer

review panel evaluated proposals from Ontario and Saskatchewan and unanimously recommended that the CLS be built in Saskatoon. The driving force for this initiative being located in Saskatoon was a few intrapreneurs in the federal and provincial ministries and at the university, aided and supported by the leaders and partners in AWB and SREDA. As the project gained momentum, it became a community quest. The municipal government made an almost unheard of investment in a national science project, contributing \$2.4 million (or approximately \$10 per capita) to the capital project. The MPs and Senators from all parties coalesced to lobby for the project in Ottawa. The University took the lead with developing the technical aspects of the project, assigning the VP Research to lead the initiative. When the project got to the decision stage, it became clear that the federal government did not have an appropriate funding mechanism for this scale of project—the Canadian Foundation of Innovation was partly a response to the need presented by the CLSI. As the project progressed, new models of management and engagement were tested. The doors were opened to let the local people see the project; there are one or two multi-day open houses and a steady stream of organized tours annually—an estimated 35,000 people have toured the facility, or about 10% of the regional population. The project leaders also worked with community ambassadors, including taxi drivers, to educate them on the nature of the project and its impact on the city and economy. More recently, the CLSI has appointed international-award-winning science fiction author Robert J. Sawyer to be writer-in-residence at the synchrotron from June 1 to July 31, 2009. Sawyer will use the residency to explore the creative processes at the root of science and art, and increase public discussion of science in Canada.

This example has spawned a number of similar ventures (albeit at a smaller scale) in innovative associative governance in pursuit of economic and social goals in the city. Leaders and partners in the synchrotron team, for instance, have fanned out and helped with recent community efforts to build indoor soccer stadiums, a new performing arts centre and a new art gallery.

## **6. Conclusions**

Investment in infrastructure is undoubtedly an important and vital part of any industrial economy. The theory and evidence, however, does not provide any definitive direction to its role and impact on innovation.

The first hypothesis—that the economic performance of a community depends on networks to generate innovation, and that physical and knowledge infrastructure can foster the knowledge circulation that underlies those networks—sounds intuitively correct but the evidence from the surveys and studies undertaken so far does not provide compelling support. Undoubtedly investment is a necessary tool, but the surveys of both firms and individuals did not reveal that the infrastructure investment was particularly influential. The data does show that firms do seek and receive valuable information from the university and national labs, but this was seemed to be more person-to-person mediated (rather than institutionally managed) and disproportionately relevant in science-based sectors than in other sectors (such as ICT).

The second hypothesis—that economic performance in cities depends on talent attraction and that infrastructure enhances the quality of place by attracting and integrating newcomers—is only partly sustained by the Saskatoon example. Research infrastructure (such as at the university and in the CLSI) was positively correlated with talent attraction in one of our studies, but social and community infrastructure was not. Retention, similarly, seems less related to the degree of tolerance and community service and more related to the professional and research buzz generated by multiple employers.

The third hypothesis—that infrastructure either facilitates or is the target of new associative forms of governance that mobilizes broad based local support—appears to be sustained in Saskatoon, but it is less clear if or how this relates to civic economic performance. The absence of a refutable hypothesis or a strong counterfactual limits the value of this observation. While this may be necessary for creativity and innovation, it probably is not sufficient—Saskatoon’s relatively weak economic performance between 1944 and 1980 coincided with significant development of associative governance.

Ultimately, the question was whether the ‘hammer’ is a necessary or sufficient tool for realizing social and economic innovation. The theory and Saskatoon case offer at least a *prima facie* case that investments can be influential, but there is no convincing argument that infrastructure investment by itself is sufficient for generating innovation networks that can absorb and mobilize talented individuals, either in commercial or associative governance systems.

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