July 2011

TECHNOLOGY LED ECONOMIC DEVELOPMENT

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Introduction to Technology Led Economic Development

Technology-led economic development is the practice of using technology to advance an economic development strategy in a region. Technology-led economic development emerged as a prominent strategy during the 1980's when countries around the world began to focus on initiatives to improve their global competitiveness. This focus was in response to shrinking industrial productivity and rising unemployment rates. Investment in technology was seen to be the answer to the issue of productivity and identifying industries that would generate the most economic activity.

To continue the discussion of technology-led economic development and the opportunities for communities and regions, it is important to start by defining what technology is.

What is technology?

> *"The practical application of science to commerce or industry."*
>
> wordnetweb.princeton.edu/perl/webwn

There are many examples of what technology can mean in practical terms to a business:

- Technology can be software or hardware;
- It can be a process or a product that streamlines an operation or a function, generally to increase productivity;
- It can be a new piece of equipment that performs new functions or improves a previously used one;
- It can be a new type of material that is used in production of goods that has superior performance, better quality or improves the longevity of the material or the product it's used in;
- It can be software advances that can speed up an operation and improve productivity.

Technology Businesses

Technology businesses can be varied in size and function. Businesses that are characterized as technology firms will:

- Make technology products (computers)
- Use technology in their production process (advanced electronics)
- Use technology to solve complex problems

Technology businesses are not uniform in process or structure:

- Companies that use high-technology processes may not be creating technology products.
- Companies that are creating technology products may be using technology-intensive manufacturing, but production can be less sophisticated and the labour requirements may be at a low skill level.
- Firms may be have any corporate structure from a sole proprietorship to a branch of a large corporation.
- Due to the various types of businesses that are included in this category, the needs such as workforce, infrastructure, risk levels and capital requirements will vary.
- Firms will be either skill intensive organizations, like software engineering, or routine assembly plants for high-technology products, like semiconductor manufacturing plants.

Skill Intensive Technology Companies have the following characteristics:

- They are knowledge-based businesses which makes them mobile.
- They work on creating technologies or devise ways to effectively implement technology.
- The size of these businesses can range from sole proprietors to large software development companies to departments within large corporations that work on technology solutions for non-technology companies.
- They require a highly skilled workforce and high-speed data networks.
- They generally desire to be located near other similar organizations for contacts, financial backers and clients.
- Their competitiveness is dependent on attracting a creative and highly skilled workforce to stay ahead of the competition by developing an advanced product and or service

High Tech Assembly Companies generally have these similarities:

- They have similar needs to traditional manufacturing in that they seek lower labour costs and utility costs to remain competitive and usually require less-skilled labour.
- Competitiveness is achieved by locating close to markets or sources of their supplies, or near transportation networks to allow them to access markets easily.
- It is not necessary for them to be located near their company headquarters which is why they often relocate portions of their operations, such as the production and assembly units to other countries to cut operational and labour costs.
- Technology allows them to increase productivity, lower costs and improve their responsiveness to customer demand.

The International Economic Development Council (IEDC) has identified the following as the most common ***characteristics of technology firms***:

- Research & Development
  - To produce more innovative products and services, they typically invest significantly in research and development.
- Tendency to Cluster
  - Often cluster around related firms, the source of their technologies, or a dynamic research environment. For example: Silicon Valley.
- Collaboration
  - Tend to collaborate more than other industries; among competitors, suppliers and complementary businesses.
- Global Orientation
  - Have relatively high levels of international investment in production, outsourcing and collaboration. This makes them subject to global cost and price pressures. A community competing to attract a technology business is competing globally, not locally, regionally or nationally.
- Non-Traditional Business Structure
  - Products have a short lifecycle; therefore the companies must have shorter planning cycles than a traditional hierarchical business. They are planning for 12 – 18 months, not 3 – 5 years. The structure must be less formal to allow units of the company to operate autonomously.
- Non-Traditional Workforce
  - Telecommuting as an alternative to on-site work is more acceptable in these companies. Employees do not have to live in the same city as the company. It may also be common to have more contract workers for specific projects or portions of development work. With this structure, there are also companies that have international employees or contractors. Companies are able to attract the expertise they desire, as they do not need to attract them to the location, just the project or job.
  - Works well to attract employees who aspire to lifestyle design who may have the specialized skills that the company desires.
- High Degree of Outsourcing
  - Tend to outsource all activities that are not part of their core business. This can include manufacturing and warehousing.
- Short Company Lifecycles
  - Technology is changing rapidly. There is intense competition and drastic price drops in this sector which can impact a company's survival rate.
  - Serial entrepreneurs in this creative sector do not design companies for lifetime employment; they design companies for specific outcomes and will quickly turnover companies to develop the next inspiration.

With an understanding of what technology is and which businesses can be identified as technology companies, regions need to identify their reasons for wanting to develop a technology-led strategy.

There are two basic purposes for a technology-led economic development strategy in a region as identified by Fred Steinmann of the Nevada Small Business Development Center:

1. Technology Commercialization – to place new products, services or methods of production in the marketplace through existing companies and firms or through new companies and firms birthed around the development of a particular new technology.
2. Technology Development – to place new or existing "off-the-shelf" technologies into existing businesses in order to enhance the competitiveness of a business or enabling the non-technology-oriented business to develop new or enhance existing product lines, services, or manufacturing processes.

Technology-led economic development is not a new concept, but as advancements occur world-wide and the economy fluctuates, regions must continually evolve their strategies to be effective in their pursuit of economic growth and prosperity.

Changes in Economic Dynamics

The Institute for the Future (IFTF) conducted an extensive forecasting exercise in 2009 to look at the future of technology led economic development. They looked at the history of economic development strategies and some key changes that regions need to be aware of in setting targets for future growth.

The strategy for turning science and technology into local economic growth over the past 50 years has been through the development and support of research parks and incubators. These parks were generally built on low-cost land to create a low-cost place for technology-driven companies to access research universities. (IFTF, 2009)

By the 1980's economic development strategies were known as "smoke-stack chasing." The essence of that strategy was to grow local economies by trying to lure existing companies from one city or region to another. The danger of this strategy was that companies that had the mobility to pick up and move to another location if they were lured with the right incentives could easily move again when the incentives ran out or if another jurisdiction offered a better deal. Regions were in a game of expensive and constant competition with each other to attract business that was providing no new investment into the economy as a whole but simply moving from place to place.

Eventually the 1990's and 2000's saw economic development strategies evolve into recognizing the value of investing in the growth of local companies that would be more likely to be retained in the region. Regions wanted to create attractive environments that would retain talent and economic activity. Large investment in real estate and infrastructure for research parks and incubators was part of the technology-led economic development strategies during this time. The Silicon Valley model was designed to create a rich regional mix of mobile labour, entrepreneurs and clusters of firms. In the hope of leveraging the research and talent of universities, almost all incubators are positioned in close proximity to research universities. (IFTF, 2009)

> "The next generation of technology-based economic development strategies will need to address a dramatically different world from the one in which research parks and incubators were born and thrived." (IFTF, 2009)

The forecasting research by the Institute For The Future identified the following trends that they believe will challenge the existing models for technology-based economic development:

- **The Biological World**.
    - If the 20th century was defined by physics, the 21st century will be defined by biology. Biomedical clusters will grow according to a very different set of rules than IT industries did.
- **Global, Networked Science.**
    - Science is becoming globalized, which means that local clusters cannot exist in isolation. To succeed they need to be connected to other innovation hubs.
- **The New Scientist.**
    - The lone genius is rapidly becoming a thing of the past, as young scientists pioneer massively collaborative work styles. Science 2.0 will shake the institutional foundations of science, from journals to patents to university departments.
- **Big Science, Lightweight Innovation.**
    - As the federal government pours money into basic research, companies are stripping their R&D organizations to the bone, in favor of lightweight and open innovation strategies. The inevitable disconnect means a need for new systems that can take raw breakthroughs and prepare them for commercialization.
- **New Public Agenda.**
    - Turning federal dollars into jobs fast is the order of the day. But it's not clear if research parks and incubators can deliver at the pace demanded.
- **The Persistence of Place.**
    - While science is taking full advantage of the web, place is more important than ever for the creative collaborative work that can't be virtualized. The way young innovators use space will be more dynamic, ad hoc and flexible.

- **Universities Transformed.**
    - Today's leading research universities treat intellectual property like corporations of yesterday, while the most innovative companies are opening up and becoming more like yesterday's universities. As universities shift roles from ivory tower to economic engine, fundamental flaws in technology transfer mechanisms will become all too clear.

Global trends are not issues that local economic development agencies can change or control, but being aware of global dynamics can help regions determine how they can position themselves to build on opportunities that do exist.

The opportunities in question are in the growth of regional knowledge ecosystems (RKE). RKE is a regional approach to technology-led economic development that is very much within the scope of an economic development organization to lead and promote. The basics of an RKE strategy from an economic developers point of view is to facilitate networking and collaboration of the many partners required for a successful technology-based economy. Some of those partners will be research parks, large research-driven companies, start-ups, universities, investors and professionals.

Rural communities are not out of the loop just because they do not have a university or research park in their municipality. When looking at the Province of Saskatchewan, most support programs, venture capital funds, angel investment networks, commercialization assistance, and educational programs are designed for the province as a whole. For most of the major industries located in Saskatchewan, their region is the whole province. All communities within the province have access to existing support systems. In addition to program based support, regional knowledge ecosystems are designed to involve multiple collaborations of groups of people in various locations. The importance of the system is the interconnectedness which can be facilitated by economic development agencies with an interest in technology-based economic development strategies.

According to the research of The Institute For The Future (IFTF, 2009), the key networks involved in a regional knowledge ecosystem are:

- Research partnerships between universities and companies
- Social networks of entrepreneurs, professionals and amateurs
- Investor cliques and clubs
- Virtual networks and their members both inside and outside the region.

Regional Knowledge Ecosystems focus on development of innovations and determining which innovations should be commercialized and graduate into private industry, regardless of the sector or industry. The former concept of cluster theory was built around that of specific companies and a single industry. (IFTF, 2009)

Technology led economic development forces communities to be more aware of the global economy. Models for technology led economic development must focus on the assets of an entire region in order to effectively compete. International outsourcing for various components of technology businesses has become so commonplace, that communities cannot effectively compete in this market without understanding the importance of using the strengths and assets of their larger region. In models of technology-led economic development the term "region" can be everything from a census area to a provincial scale and sometimes even a national scope. The principles of the model do not change, no matter what the scale of the geographic region.

Technology companies will continue to focus on attracting the right talent in order to produce the necessary innovations required to stay ahead of their competition. This may mean outsourcing portions of a project to someone located in another country. If a company finds a software developer in another country that can write the code that they require, they may subcontract them to produce that portion of the project. Knowledge workers are also very mobile and are more willing to re-locate to the job that is most interesting to them or to the location that offers the lifestyle they desire. This emphasises the necessity of focusing strategies on a regional basis and identifying assets of the larger region to attract the right people and the right commercial opportunities.

Manufacturing companies are also competing globally to offer their goods at the best price. If labour rates are more cost effective in another country, it is common for companies to have branches of their company in whatever country offers them the best opportunity to increase their profits. Headquarters of the companies do not have to be located in the same region as the plants producing the goods that they sell. Regions that have traditionally been dependent on manufacturing industries are at higher risk to lose out to foreign countries that are able to produce the same products for much less cost. (Bendis, 2008) These are the regions that must make concentrated efforts to evaluate how they are going to compete in a very mobile, global economy. Regions that have established deliberate technology-led economic development strategies to address these concerns have the greatest chance of overcoming the barriers and identifying how their region can compete.

Identifying local assets and resources are critical for a region when it wants to attract globally anchored technology businesses. Knowledge workers (managerial, professional and technical positions) have become a dominant occupational category and competition to attract the most talented workers in these fields is intense as they can work anywhere in the world. The countries and companies that successfully attract them have a distinct advantage in driving economic growth in the technology and innovation sectors. (Bendis, 2008)

Regions that are focusing on technology-led economic development to drive economic growth must themselves be driven to find the best ways to accelerate innovation. The topics covered in the rest of this paper focus on what is required to create an environment that will foster innovation, the best ways to commercialize innovation in order to derive economic impact from innovations, and the financing required to commercialize those innovations.

Strategic Alliances and Technology Clusters

Technology Clusters and Business Networks are two of the strategies that can be explored by regions seeking a technology led economic development plan.

> *"A technology cluster is a significant concentration of innovative companies around a nucleus of R&D facilities in a single locale – the ideal environment for innovation to flourish."*
>
> -National Research Council

Technology clusters are generally built on a regional basis. An individual municipality often does not have the size necessary to create a viable cluster. Technology clusters will be drawn to areas that have specialized support services that can assist with advancing technology based businesses. These businesses require technicians and consultants that are specialized in providing support to technology industries. They also look for financial institutions and venture capitalists that understand the unique financing needs of technology firms. Major research universities are also an asset to a technology cluster.

Business networks comprised of firms with mutual interest in working together within a technology cluster can be successful at generating additional growth in a region. Economic developers can initiate the process of bringing these companies together, but the companies must lead the networks.

In technology-led economic development, partnerships and strategic alliances between all the key players including researchers, universities, private industry, entrepreneurs and investors are critical to moving any strategy forward.

Every region can make improvements to their economy by making use of technology, innovation and entrepreneurship strategies regardless of the industry base that they have. All regions do not have the capacity to become another Silicon Valley by developing an information technology industry. Many regions that have been working on technology led strategies have also started to develop technology clusters. These clusters can vary greatly in size and scope.

- Cluster development was articulated and promoted by Harvard Business School Professor Michael Porter in 1990. The concept of cluster development is that all the assets, value chains and required skills must be contained within a proximate geographical location. Promoting and improving the competitiveness of a specific sector was the goal of economic development in this model.
- In our global economy where outsourcing to specialists or locating certain corporate divisions to lower cost regions , the cluster model is not the complete solution. Companies more commonly look like a network of smaller enterprises or divisions. Cluster development work must identify more specific functions of companies that would have an advantage to locating in proximity to one another and identify how their proximity to one another can drive innovation in a region. (Bendis, 2008)
- ***Self-contained regional clusters*** can be used to contain research, services, development, trials/testing, and manufacturing for a specific industry. In order to have successful innovation-

led strategies, it is important to have ***Specialized, networked regions*** where assets and players in knowledge industries, scientific advancement and technological innovation are connected. These players are researchers, institutes, companies, investors, business leadership and government officials. The connectivity of the players will speed up commercialization and global competitiveness of a region.

- The emphasis on knowledge and creativity in the new economy is dependent on localized or regionally based innovation. Regional clusters that share a common base of knowledge can be a supportive environment to encourage innovation. Silicon Valley has survived through many waves of innovation and that ability has made it a model for many other regions seeking optimal strategies for technology-based economies. (Lucas, Sands, Wolfe, 2009)

Examples of Canadian Regional Technology Clusters

A study of the Canadian technology sector by the University of Toronto reveals that the sector in Canada has a substantial export orientation consisting overwhelmingly of small companies. In 2005, there were 32,000 technology companies in the sector, 80% of which employed only one to nine employees. (Lucas, Sands, Wolfe, 2009)

The formation and growth of clusters is determined by a number of factors. The economic fundamentals for an industry or technology must be present first, and secondly there must be an entrepreneurial spark to get it going. There is usually a combination of endowment factors and trigger events that stimulate the start of the process. One of the key elements in successful clusters has been the low opportunity cost of gaining access to skilled human capital, and attracting managerial talent and entrepreneurs into the cluster. Multiple studies of successful clusters conclude that entrepreneurs are the key agents that build upon the existing base of institutional assets and provide the stimulation for the formation of a cluster. (Lucas, Sands, Wolfe, 2009)

The University of Toronto found a common link among the clusters in its study; early commercial success came from exploiting the local knowledge base to commercialize new products and services.

"The early success of cluster firms depended on their ability to exploit both local and global knowledge sources to develop, market and sell innovations to external customers. The lead anchor firms were able to draw upon existing capital, skilled local labour markets and exploit their existing or new linkages with customers to commercialize their products.

Some chose to spin-off new firms to develop products or actively promote the growth of new firms through an "affiliates" program, because the new technologies lay outside their core capabilities. The initial success of an anchor firm or startup often provided a demonstration effect for other potential entrepreneurs in the cluster to emulate their success. The growth of both the lead anchor firms and the gradual birth of additional new firms influenced the organizational structure of the clusters."

-Lucas, Sands, Wolfe, 2009

University of Toronto

Eight technology clusters in Canada were studied by the University of Toronto:

ICT in Toronto

- The cluster had early successes in the 1970's due to a combination of factors. The city was an attractive location for the Canadian operations of large US multinational corporations. In addition, the federal government put support into academic research at the University of Toronto via the Defence Department. This allowed the University to pursue and develop academic expertise in computer technology.

Telecommunications and photonics in Ottawa

- Northern Electric established a research facility in the region in the late 1950's.
- Concentration of federal government laboratories in the region created a steady stream of industrial engineers, researchers and managers.
- Many of the leading entrepreneurs in the cluster began their careers as researchers at these research labs .
- A large number of highly skilled IT scientists and engineers were attracted to the area in the 1970's to work at some of the companies that had formed. When those firms closed there were a significant number of skilled workers in the region that went on to work for/or create new start-up companies, some of which are now the leading companies in the cluster.

ICT in Waterloo

- There was no anchor firm present during the formation of the cluster, but the university which was focused on engineering, math and computer science, played an instrumental role. The community created a supportive environment that linked firms to each other and to public institutions such as the university. The community had a strong existing industrial base in advanced manufacturing.
- The first ICT firms were created in the 1970's with a focus on developing software and hardware to support networking and communications applications. Two of the early firms in the region were spin-offs from the university in 1974. Later successes included Open Text and Research in Motion.

ICT in New Brunswick

- In the mid-1980's the cluster took shape due to the policies of the provincial government. They identified ICT as a sector with potential to create economic growth. NBTel, the provincial telecom provider served as the lead anchor firm which invested in digital infrastructure and innovative technologies.
- Commitment to product innovation in the region was severely reduced when NBTel merged with three other provincial telephone companies in Atlantic Canada.

ICT in Cape Breton

- No anchor firm is present and there has been little evidence of growth in this cluster.

Photonics in Quebec City

- In 1960 the Defence Research and Development Canada Laboratories discovered the CO_2 laser which led to a build up of expertise in photonics.
- Two additional research institutes were created based on industry-university-government partnerships in the mid – and late 1980's. This transition to industrial application assisted in the creation of many other leading firms in the cluster.

Wireless in Calgary

- A perceived demand was identified for improved communications technology to facilitate exploration and drilling for petroleum and natural gas in the province's diverse geography.
- North America's first wireless telephone network was established in response to this need. It was created jointly between Alberta Government Telephones and Nova Corporation in 1982.
- Many people working at start-up companies that followed traced their roots back to that first network called NovAtel.

Wireless in Vancouver

- The cluster traces its roots back to three firms that emerged in the late 1960's and mid 1970's. The companies were innovators in mobile data technologies.
- A critical mass of expertise in the wireless field was established in the region and most of the companies now located in the cluster are spin-off companies from those initial three initial innovators.

In all the cases that were studied by the University of Toronto (Lucas, Sands, Wolfe, 2009), the primary condition for the formation of clusters was a strong research base either in lead anchor firms or in public sector institutions. Lead anchor firms created a demonstration effect and new start-ups emerged to exploit the technological niche which sparked further entrepreneurial activity. As more firms emerged, they complemented and supported the work of other firms already present in the cluster.

Anchor organizations in all of these successful clusters provided in-house capital, market linkages, stable employment to attract talent, training and experience to employees who often went on to create additional companies in the region and sometimes investment in new start-ups in the region.

Lucas, Sands and Wolfe noted that consistently in these clusters, the centrality of skilled labour was the single most important local asset to attract and retain firms. Highly educated, potentially mobile workers are naturally drawn to an environment where there are multiple employment opportunities due to a dense network of local firms. In traditional literature on clusters, conclusions reference a thick labour market being the result of proximity to a post-secondary institution. In the Canadian research conducted by the University of Toronto, "magnet organizations" such as lead anchor firms or private research institutions provided a much more critical role in developing skilled labour. Multiple employment opportunities were a strong draw for creative talent. Large companies provided experience and valuable education that equipped workers to easily move to other companies or to branch out into entrepreneurial ventures of their own.

Regions that have an abundance of labour that are highly skilled and specialized will attract technology firms. In areas with multiple companies in the technology sector, there is an excellent opportunity for inter-firm mobility. The flow of knowledge between firms within a cluster creates a positive dynamic in a region.

Cluster theory established by Michael Porter, defines a cluster as being "geographically proximate". The importance of being located nearby is for internal networking, linkages and formal and informal interactions. The results of the Canadian ICT cluster study revealed that in each cluster, global linkages are as important if not more important that local ones. The question is then raised as to whether the local knowledge base is the most important knowledge base to the companies in this sector. Innovation is led by both local and global knowledge in successful tech firms and clusters must be effective at building a variety of methods for acquiring knowledge from around the globe.

Lucas, Sands and Wolfe discovered in their research that inter-firm collaboration in the form of local customer or supplier relationships is relatively low in most cases. "For the majority of firms, the focus of

their economic activity – key customers sources of supply, competitors, important strategic partnerships and the resulting knowledge flows – occurs at the global level." Companies may use local suppliers for certain inputs, but most are using a variety of sources from across the globe. Technology firms have demonstrated that they have strong linkages to a variety of specialized clusters around the world. These firms tap into the specialized networks worldwide by interacting with their local research institutions to find these bodies of knowledge. It is rare for firms located in technology clusters to be entirely self-contained.

Financing was identified as a significant issue in Canadian technology companies. Most of the clusters indicated that early stage funding, venture capital and angel investors could be found, but firms struggled to find financing for growth strategies. Canadian firms that have experienced success and growth have become targets for foreign takeovers. Canadian companies have found themselves vulnerable to these takeovers because there was not enough depth and investment experience in the Canadian capital market to provide the backing for large, successful domestic high technology companies. (Lucas, Sands, Wolfe)

Cluster strategies must be based on locational assets and an investment in harnessing and mobilizing these assets. Research, industry and government all have an important role to play in the success of clusters.

The National Research Council has recognized and invested in 11 technology clusters across Canada:

Vancouver – Clean Energy with fuel cells

- Accounts for 70% of the jobs in this field in Canada

Edmonton – Nanotechnology for next-generation firms

- In collaboration with the Province of Alberta and the University of Alberta.

Regina – Innovating Urban infrastructure Management Systems

- Working with local firms to turn new technologies and methodologies for managing infrastructure into business opportunities in Canada and abroad.

Saskatoon – Plants for Health and Wellness

- Saskatoon accounts for 30% of Canada's agricultural biotechnology activities. It is also home to the BioAccess Commercialization Centre which helps new firms break into the commercial market
- Cluster has been in place for over 20 years

Winnipeg – Saving Lives with biomedical technologies

- Home to the NRC Centre for the Commercialization of Biomedical Technology which helps technology organizations bring pioneering innovations to market.

Ottawa – Harnessing light in new applications

- Canadian Photonics Fabrication Centre is a cornerstone of this cluster, allowing companies to use simulation, design, fabrication, testing and prototyping services to reduce time-to-market for their products

Saguenay – Pioneering aluminum transformation

- Conducting research into the most profitable ways of transforming aluminium into durable, lightweight components for several industries.

Halifax – Health and life sciences technologies

- Positioned to become a global leader in linking brain research to advanced patient care.

Moncton/Fredericton – Information technology and e-business

- NRC collaborates with industry and universities to develop information technologies that address Canada's needs in health care, learning and the electronic marketplace.

Charlottetown – Nutrisciences and health

- Using bioresources – renewable, naturally occurring land-and-sea based resources – to produce pharmaceuticals, nutraceuticals and dietary supplements.

St. John's – Ocean technologies

- Regional and national innovation networks are being established in Arctic operations, marine safety, ocean energy and national security.

Source: www.nrc.cnrc.gc.ca/eng/dimensions/issue1/clusteroverview.html

Focusing on technology clusters is one strategy regions can use to create technology-led economic development. Clusters require concentration on multiple entities in a single industry and are unlikely to be a viable option for most regions in Saskatchewan.

The potential to participate as a smaller centre networked in to a regional knowledge ecosystem will have far greater opportunities for success based on the sparse population and large geographical regions of most areas of the province.

Fostering Partnerships

Economic development agencies have an important role in technology-led economic development. Technology-led economic development does not happen without a deliberate strategy coordinated by an agency to ensure that collaboration occurs between entrepreneurs, researchers, scientists, business service providers and industry. The role of the economic developer is as a facilitator to create a structured process for information sharing and educational activities that have an opportunity to be commercialized.

To accelerate the process of commercializing innovation taking place in a region, the facilitator of the process must combine the scientific knowledge, market awareness, business know-how and complementary investment programs in one place. The economic developer has an important role in identifying and marketing regional strengths so that the competitive advantages of a region are clear and communicated to all potential innovation and technology businesses – in order to create economic growth driven by technology. (Bendis, 2008)

For economic developers to effectively facilitate a technology-led economic development strategy they must arm themselves with information and contacts that can assist them to successfully partner entrepreneurs, researchers, and government programs.

Entrepreneurs

Local economic developers should ensure that they are visible and available as a local resource to innovative and creative entrepreneurs – as well as potential entrepreneurs in their communities. When economic developers have visibility in the community, they are more likely to have the opportunity to guide an entrepreneur to the right resources, creating greater opportunities for ideas to migrate into commercialized products and services that will generate economic growth.

Economic developers should have a resource directory listing available sources of assistance for entrepreneurs that are starting a technology business. Entrepreneurs are not likely to have all the expertise they require to go through all the stages necessary to establish a successful business directly from the birth of an innovative idea.

For budding entrepreneurs who are still in university in the province, the Wilson Centre for Entrepreneurial Excellence is another resource with a mission to promote innovation and entrepreneurship specifically for students. The Centre believes that aspiring entrepreneurs that are given an education in entrepreneurship and an opportunity for mentorship will inspire a stronger entrepreneurial culture and greater opportunities for success.

Universities and Research Capacity

In Saskatchewan, Innovation Place is a Saskatchewan Crown Corporation that has developed and operates three research parks in the province. Saskatoon, Regina and Prince Albert all have parks that are partnered with the province's universities.

Innovation Place designs and constructs specialized buildings primarily for technology companies. Entrepreneurs that find that they would like to be located in a technology cluster or want to be in closer

proximity to the university resources have an opportunity to lease space in one of these parks in the province. Regina and Saskatoon also have Industry Liaison Offices on campus of the universities which work with university researchers, faculty and students to commercialize technology.

The National Research Council has a substantial presence in 11 technology clusters across the country, two of which are located in Saskatchewan. The clusters work across national boundaries to ensure they are attracting the best ideas to Canada and building a pool of skilled workers. International relationships are key to a successful technology cluster. Their presence in the clusters includes federally funded labs and equipment, incubation space and business development mentoring.

The NRC has been participating in cluster development for over ten years. The full economic impact of a technology cluster is not felt for decades. Some of the lessons they have learned over the years include the importance of having visionary and strategic leadership, community-based champions and risk capital providers. Clusters also require specialized suppliers, a shared R&D infrastructure and networking opportunities as well as expertise in managing intellectual property and challenges of commercialization. The NRC has identified the following assets as being required in a community before financing is ought for a cluster initiative:

- A good local economy
- Key employers
- Universities and research institutions
- Enough attributes to attract highly qualified workers
- Community leaders with expertise in the sectors that are being mobilized - in order to define a vision for the anticipated cluster, to assess gaps and opportunities, and to build the necessary networks
- An action plan with community and network support must be developed
- Plans must be reviewed and revised as cluster organizations begin taking shape
- There must be sufficient leadership and financial support during the development years to ensure the cluster reaches self-sufficiency

Source: www.nrc-cnrc.gc.ca/eng/dimensions/issue1/clusterbestpractices.html

The Saskatchewan Research Council, located at Innovation Place in Saskatoon provides applied research and development and technology commercialization. They are an important resource that economic developers should be aware of when dealing with inventors, innovators and potential entrepreneurs. Their five strategic sectors include:

- Agriculture, Biotechnology and Food;
- Alternative Energy and Manufacturing;
- Energy;
- Environment and Forestry;
- Mining and Minerals.

Enterprise Saskatchewan is another resource for small and medium-sized businesses that are looking for support. Through their SMART Program (Saskatchewan Market Assessment of Research and Technology) that is jointly funded by the National Research Council and Enterprise Saskatchewan and administered by the Saskatchewan Advanced Technology Association (SATA), businesses can gain access to industry specialists. Businesses must have developed or be developing a new product, process or system based on an innovative application of science and technology, or have acquired a technology that is not currently in use in Saskatchewan from another company or university through a technology transfer process.

The goal of all these programs is to get innovations into the marketplace for the benefit of the Saskatchewan economy, but these programs cannot accomplish their goals without being linked to the entrepreneurs with ideas. Local economic developers can be key partners in making these linkages happen.

Other organizations such as BioAccess and Ag-West Bio are also available to work with entrepreneurs who need assistance getting through the hurdles of commercialization.

Access to Capital

This will be explored in more detail later, but economic developers must be proactive in identifying sources of capital for entrepreneurs and technology if they want to have commercialized developments in their community. The most successful regions are those that network entrepreneurs, with capital and commercialization expertise within their region. Innovations that are developed and funded within the region are more likely to have economic impact and will stay within the region.

Organizations such as the Entrepreneurial Foundation of Saskatchewan are available to assist entrepreneurs who have a product and need assistance to get their companies “investment-ready”. Having a great idea, having a marketable idea and having the ability to pitch it effectively to investors are all distinct skills. Entrepreneurs need to be connected to the expertise and resources that will help them get their product to market.

Regions with a commitment to a technology-led economic development strategy must keep themselves informed and networked to be able to make the right linkages for entrepreneurs.

Technology Resources

Technology is a critical component of basic business infrastructure. It is no longer simply the realm of high tech firms and innovative researchers at the university level. Telecommunications, computers and many pieces of equipment that businesses now consider standard requirements are technology based infrastructure.

Small, local businesses need to stay competitive, viable and profitable by keeping up with the advancements in their respective industries. For example, parts in agricultural equipment businesses are primarily ordered online and researched for availability through internet databases with suppliers. Mechanics are diagnosing vehicle breakdowns with computerized processes. Consumers expect to be able to use credit cards and debit cards with chip imbedded technology when making purchases. Embroidery shops are using computerized templates downloaded into sewing machines for everything from monogramming a one- time gift to mass producing souvenir merchandise. Couriers use handheld scanners to verify deliveries, to receive electronic signatures at the point of delivery and to instantly communicate package locations for their online package tracking systems. Manufacturing firms are incorporating technology to make their processes lean and more profitable.

Businesses that are not staying up to date with changing technologies will not be able to effectively compete. Technology is critical to non-technology firms to maintain productivity and efficiency. For non-technology firms, the process is called modernization. There are various reasons why businesses may choose not to modernize including: shortage of capital, lack of expertise with new technologies, -day to day management that does not allow time to research new processes, risk-adverse managers and owners or a shortage of skilled workers to implement changes. (IEDC, 2006)

Information about businesses in a region is critical to determining if there is a need for modernization assistance in the community. Regions that undertake a Business Retention and Expansion Program will have the opportunity to discover if there are areas of concern with any of the existing businesses. Mature companies may have the resources to modernize and may be keeping up with all emerging trends, or they may be at a crossroads trying to determine if the investment will pay off prior to exiting the business. Over time, companies that postpone modernization may find that they are not able to remain cost competitive in the market or that the business has lost market value to potential new owners if the operations and equipment are not up to date.

The role of the economic developer is to identify potential areas of concern for existing businesses and work with them to find the resources they need to stay competitive, if they are struggling to manage that aspect of their business. The impact on the local economy can be devastating if a major employer is lost to the community.

Preparing a Technology Strategy

What Successful Technology Regions Have

Regions committed to successful development, expansion, retention, and attraction of innovative businesses should be aware of the following factors which are almost always present in areas with technology based economic development *(IEDC TLED Manual, 2006)*:

1. Presence of Research Institutions *(*smaller communities should find ways to link to the larger universities that are not present in their communities)*
    - These can be universities, private or public research facilities
    - The institutions must have the desire and ability to commercialize innovations
2. Access to Capital
    - Options for new and expanding businesses to find capital must be available in order to attract and expand technology businesses.
    - Options can include private equity, Angel networks, venture capital or even government programs
3. Support for Entrepreneurial Development
    - A strong entrepreneurial culture with support networks creates an attractive environment for innovative businesses.
    - Support structures include active business networks, business development centres, research facilities, technical assistance, programs for opening new markets, start- up capital and physical space
4. Educated and Talented Workforce
    - Strong workforce development programs are in place in technology regions
    - Technology led companies require a quality workforce and will locate where they can find one
5. Provincial and Local Commitment
    - Support for a tech friendly environment will be evidenced by access to capital, specialized services, facilities such as incubators, strong leadership that supports growth in the economy by making it easy for businesses by keeping public sector regulations efficient and easy to work with.
6. Established Technology Structure
    - Physical infrastructure and knowledge-based infrastructure. To have a successful technology economy there must be individuals with innovative thinking to drive the developments
    - Physical infrastructure must support the needs of a technology led economy. This could include fibre optic networks, technology incubators, connectivity abilities and capacity for growth. Transportation is critical for moving products to market and most dynamic regions have airports.
7. Quality of Place
    - To attract and retain a quality workforce, they must be attracted to the place. The innovative and educated talent that drives a technology led economy are

highly mobile and firms will be competing globally to attract them. Universities that educate this talent cannot guarantee that they can retain them in the workforce of the community they are located in post-graduation.

- Quality of life and quality of place are distinctly different. Quality of life may include affordable housing, short commutes and a family friendly environment. Quality of place goes further and must not just be adequate, but be attractive for different types of people at different stages of life who are looking for diversity in their cultural experiences, recreation and educational options.

Advanced technology companies that succeed and thrive are knowledge-based, highly flexible, and innovative. They commonly have a high percentage of their products exported and have extensive research and development operations. Employees are generally highly trained specialists, may require specialized facilities such as labs and must have extensive and up-to-date infrastructure such as broadband access. Communities must recognize that these companies have different needs than more traditional businesses and identify how they can meet the needs of technology firms in order to attract and retain them in the region.

Technology companies must be located where they have ability to retain and attract a skilled workforce. They also need to be able to quickly establish R & D capabilities. Firms will look for areas that already have innovative companies doing R & D or universities that do extensive research. Creative companies can be stimulated by the innovations of other related firms.

Technology companies must have infrastructure that includes a strong network of video, voice and data communications. The presence of this infrastructure opens opportunities for e-commerce and telecommuting.

What Firms Are Looking For

Fred Steinmann of the Nevada Small Business Development Centre identified several factors that high technology and technology-oriented firms consider when they decide to locate in a specific community:

- They like the presence of different and varied research institutes
- Access to capital, especially for start-up high tech and tech-oriented firms
- High levels of support for entrepreneurial development in the community, province and country
- An educated and talented workforce: they do not want to spend a lot of resources on training an unskilled workforce nor do they want to spend a lot of money on moving the needed workforce from one community to another. They want an established workforce that is already educated and talented in various technology fields
- Established technology infrastructure: physical and knowledge-based. i.e. fibre optic networks, technology incubators, connectivity abilities and the capacity for growth
- High “quality of place” in order to attract an educated and talented workforce. This means a high diversity in all aspects of life including education, culture, entertainment and recreation to support people at different stages of life.
- Housing and transportation are also important.

What Regions Can Do

There are several organizations and agencies in Saskatchewan that fill the various specialist roles in the technology development process. Local economic developers do not have to be specialists in all areas, but they should keep up to date on the services that are available for entrepreneurs so that they can effectively link people with resources. Economic development agencies should know how to find these resources:

- Technology development:
  - Finding resources for conducting research
- Business development and marketing:
  - Coordinating and initiating activities involved with starting or expanding a business venture focused on a technology innovation
  - This could include: obtaining financial and personnel resources, analyzing existing market conditions, making informed market forecasts, developing advertising and marketing plans and strategies, developing pricing strategies and identifying potential distribution channels
- Financing
  - Constantly search for appropriate financing sources for researchers and private entrepreneurs

Communities must be prepared to make an investment in a technology-led economic development strategy to ensure that it has the resources that are needed by the industry.

To be successful at attracting new technology firms, communities should identify the industries already present in the region and their needs, and assess how well the community is meeting those needs. If there are already technology firms in the area and there are gaps, then the region must fill those needs for its existing companies to make the area more attractive to other technology firms.

It would be advisable to conduct a regional competitive advantage appraisal to determine if attracting technology firms is a viable strategy for the community and then identify prospective businesses that would be attracted to the community based on the identified competitive advantages.

Communities cannot just decide to become good at a specific sector. All regions are different and have different strengths and competencies and must develop different strategies for success. It is not sufficient to create a strategy that mimics a successful strategy in another region. Strategies for a specific region must be built on a strong base to support the ventures that they undertake.

Idea generation is an important source of innovation, but regions that do not have this asset can develop relationships with others that do. (U.S. Economic Development Administration (EDA), 2001)

The U.S. Economic Development Administration developed a strategic planning guide for communities wanting to develop innovation led economic development strategies. After reviewing the results of several communities that have adopted such strategies they identified some important lessons learned from those communities that have adopted tech strategies (U.S. EDA, 2001)

- For a region to reach its potential, it has to imagine what it might be, even if that image is contrary to anything that has come before.
- A good plan builds on existing strengths – as well as encouraging investment in new areas
- Visionary leaders with strong ties to the community are critical to success.
- While leadership is a vital ingredient, collaborative institutions and organizations are needed to sustain development over time.
- Widespread participation in the planning process leads to a strong sense of ownership of the results.
- Moving quickly from planning to implementation greatly improves the prospects for success
- Success can bring a new set of challenges, which must be addressed with the same determination and collaboration as the original issues.
- Developing a shared, similar mindset among participants is crucial for success. (It often starts as enlightened self-interest and evolves to a sense of community betterment.)
- Economic development is a process, not a product.

Some Tools for Strategic Action

The following list was compiled by the U.S. Economic Development Administration to assist regions that want to create an innovation economy. It is not an exhaustive list of all the tools that can be used to develop an innovation economy and it is not necessary for regions to have all of the tools. These are the most common ones that communities have used on their road to successful innovation-led economic development:

- Technology training institutions
    - Ensures the region's technical workforce maintains its competitiveness.
- Research and development consortia
    - Strategic alliances among firms, research universities and/or federal labs formed to pursue the creation and development of new technologies of mutual interest
- technology business incubators
    - Nurture young firms, helping them in their vulnerable start-up period. They provide hands on management assistance, access to financing and orchestrated exposure to critical business or technical support services.
- Technology transfer and commercialization programs
    - Facilitate development of new technologies through technical assistance, licensing agreements, cooperative research and development and information exchange. Commercialization programs aim to bring new technologies to market.
- Technology business development centres
    - Most are found at universities
- Entrepreneurship support networks
    - Aim to support members in growing their businesses.
- Venture capital funds and networks
    - Venture capital networks facilitate the interaction, in-person or on-line, between individual investors and entrepreneurs seeking capital
- Invention/Product development support networks
- Research Parks
    - Often has a formal relationship with a university

- Technical assistance services
    - Aid corporations, primarily manufacturers in improving process technologies or business practices
- Targeted business attraction programs
    - Marketing a region to firms located elsewhere.
- Key infrastructure investments
    - Transportation facilities, telecommunications, energy, water and sewer. Growth very much depends on a region's ability to move people, goods, power and ideas across the region and beyond.

Business Strategy and Operations in the Knowledge Economy

Technology businesses are operating in a different environment and must learn to adapt and change in order to stay competitive. The following are some best practices deemed important to technology businesses and general trends in the industry:

- Companies are focusing on what they are best at and what makes them most valuable, and outsourcing and spinning off functions that they think other businesses can do more efficiently.
- Businesses are developing strategic alliances with other businesses to develop new products and services, and making strategic acquisitions that bring in complementary intellectual property and knowledge workers.
- Companies are locating operations in places that offer unique advantages that enhance creativity, speed and flexibility. With distance less of an impediment to communication, many firms are locating each distinct function in a locale appropriate to that function. Headquarters, research, production and service can be in separate regions, even countries. Location decisions are not considered permanent.
- Firms are encouraging creativity among all employees, recognizing that good ideas, crucial to competitive success, can come from anyone.
- Businesses are going to great lengths to attract and retain knowledge workers, reducing workplace formality, increasing compensation, and allowing work from home and near-home locations.
- Firms are emphasizing productivity in their operations, adopting new technologies and practices. While product uniqueness is very important, keeping costs low remains important as well.
- Companies are struggling with how to best use emerging technologies that compete with current in-house technologies with which there is years of experience and millions of dollars in investment. (U.S. EDA, 2001)

Research indicates that regions should adjust their strategies to innovation led economic development versus technology-led economic development. (Bendis, 2008) A focus on creating an environment for innovation can keep a region from focusing on one industry that could easily change as the economy changes, to focusing on creating innovations that will use skill sets of the region to stay in tune with current needs and demands of the economy. A culture of innovation can use the local knowledge base to change as required. This can only happen in a region that has an entrepreneurial culture that is comfortable and inspired by change.

Regions must identify their critical assets to have a culture of innovation. This is their local knowledge base, which includes: local researchers, scientists, entrepreneurs, government officials and representatives of business and industry. A region dependent on a single market is vulnerable to economic changes, but a region focused on innovation has a greater opportunity to overcome changes in an economy by focusing on solutions and outcomes versus a specific product or market. (Bendis, 2008)

Innovation led economic development will not happen solely with structured programs and strategies. Leadership skills are critical to have successful regional development in this sector. Some of the key strengths that are present in successful leaders of technology strategies are:

- Knowledge of technology management,
- Regional connectivity
- Business operations
- Investment and commercialization

Bendis (Innovation America) described these individuals as "full-time entrepreneurs in residence with the know-how and the know-whom and the trust and reputation for success". The University of Saskatchewan has adopted a strategy in their Industry Liaison Office that incorporates this concept. They have established an Entrepreneur in Residence program to assist prospective technology businesses improve their opportunities to reach commercialization.

Strategic Planning For Technology-Led Economic Development

The U.S. Economic Development Administration created a guide for innovation-led economic development. These are some of the key factors that should be considered when developing a strategy to attract technology industries.

- Not every region will be a major biotech area or have a technology research park, therefore every region must identify its own assets and strengths and build a strategy around their specific assets.
- Regions should not attempt to copycat another region. Another region may have very different assets to work with either in infrastructure, talent pool or entrepreneurial culture. Identify unique attributes that can be used. Replicate their process of strategic planning and how they identified their opportunities, but do not measure your successes on the visible outputs and inputs of another region (research parks, technology councils, incubators, venture capital funds)
- Strategic planning should be an opportunity driven and demand driven process for a region. The process should stimulate the region to mobilize its assets to put the community in the best competitive position.
- Innovative, technology –related ideas can be used in all areas of economic development, not just in high tech sectors.
- Strategic planning processes should facilitate relationship building across a region – collaboration is key to an innovative process

- Strategic planning should be flexible and adjust as the economy changes and new opportunities to advance a region become apparent
- Not planning or unproductive planning is costly and ensures that a community will be unable to move itself forward on a tech strategy
- Economic growth can be achieved with the development, adoption and creative application of new technologies
- Technology advancements have enabled companies around the world to have relatively equal access to materials, equipment and financial capital
- Industries are much more competitive due to the expansion of global trade, with firms producing the next new product leapfrogging over one another as industry leader and old firms transforming themselves so they do not disappear. As technology allows firms to differentiate their products, competitive advantage is increasingly based on value – unique qualities of performance – rather than cost.
- Competitiveness now requires creativity in generating new viable ideas, speed in getting these new ideas to market, and flexibility in adjusting to market circumstances. As a result it has driven an enormous growth in the number of strategic alliances, acquisitions, outsourcing arrangements and spin-off companies
- Successful innovation-led economic development strategies are built on how a region makes use of what it has, rather than what it hopes it has.

Technology Marketing

The International Economic Development Council has identified several strategies that can be used by regions to market their community to attract technology business.

- Making the area attractive to businesses
  - Community assets: The "Creative Class" as described by Richard Florida, are drawn to communities that provide high quality amenities
  - Communities that want a high tech industry must be focused on how to attract a workforce not just how to attract a company.
- Closing Community Gaps
  - Create a business-friendly environment by removing barriers that may hinder doing business in the area
  - Fill the gaps of the area's available resources that are needed by technology firms that the community wants to attract
  - Market research is critical. If improvements are made that are not needed by the industry that is being targeted, it will have no significant impact on attracting that industry.
- Incentives
  - Incentives are used to attract investment by lowering the cost of establishing or doing business. Incentives are not likely to be the most important factor in a location decision for high tech firms. They are interested in infrastructure, proximity to research and a quality labour force.
- Marketing the Community
  - Goal is to attract, retain and expand business; improve the community's image internally and externally; and to promote policies and programs
  - It must distinguish itself from other communities and regions. If the community is not suitable for high technology firms, it cannot successfully attract those companies with marketing. Messaging must be credible, valid, distinctive and be consistent over an extended period of time.
    - The most common marketing techniques:
      - Web based marketing and GIS
        - Most initial site selection is done through the Internet and communities will not be contacted during the initial investigation by companies
        - Communities can be quickly eliminated as potential locations if the information is not readily available, current and well laid out on the web site.
      - Establishing relationships
      - Advertising
      - Publicity and working with the press
      - Promotional materials
      - Direct mail
      - Personal selling

Transferring an Innovation to the Marketplace

Universities traditionally conduct research, however, the economic impact of the innovations they develop is only felt when there is a commercial application for the innovations. If a commercial application can be found for the innovation, there is an opportunity to partner with industry to transfer the innovation to the marketplace.

Partnerships are successful when there is mutual benefit to both parties. The International Economic Development Council has identified several reasons why Universities would have reason to pursue commercialization of their innovations:

- Sponsored research
- Revenue
- Equipment donations
- Student employment and training
- Faculty attraction and retention incentives
- Specialized adjunct faculty
- Prestige
- Recognition as a community player, which may help universities manage tense town-gown relations
- Enhanced knowledge
- Wider networks and contacts

Agencies That Can Assist With Commercialization

Technology transfer offices have been established on campuses of universities that are interested in research and commercialization of that research. Both the University of Saskatchewan and the University of Regina have commercialization departments. They are called the Industry Liaison Offices.

The Industry Liaison Offices in Saskatoon and Regina are in place to help with the commercialization process for researchers at the University, faculty, staff and students. They assist with identifying inventions that arise from research as well as protecting new technologies. The office acts as a portal between business and the University. Companies that are looking for new innovations or solutions to technical challenges can approach the university for assistance. Technology transfer teams work with the companies. (**www.uregina.ca/uilo/)**

Investors looking for unique opportunities in the technology field can contact the university to review any opportunities they may have that are ready for commercialization. Creating university spin-off companies, protecting intellectual property and developing partnerships with industry are all handled by these offices. In addition to these services, the University of Saskatchewan has also established an Entrepreneur-in-Residence program to further assist budding entrepreneurs who are navigating through the complex process of establishing a technology business. (www.usask.ca/research/ilo/)

Commercializing a new technology is a complex process involving technical, legal and financial expertise. Saskatchewan has several agencies with expertise in these areas that can walk entrepreneurs through the process.

For new entrepreneurs or existing companies that are not associated with an educational institution and looking for assistance in the advanced technology sector, Saskatchewan also has an organization called the Saskatchewan Advanced Technology Association (SATA). SATA is a support network for technology companies that seeks to identify barriers to growth and to facilitate communication between academia, industry and government. The organization develops education, networking, marketing and advocacy programs. As a contact point for companies in the sector, they ensure that their members are aware of all government and private support programs that can assist technology companies start and grow their businesses. (SATA, 2011)

Saskatchewan entrepreneurs can also receive assistance from SpringBoard West Innovations. The organization is staffed with a team of advisors, mentors and coaches to provide management guidance and technical assistance to companies, entrepreneurs and researchers who are interested in taking an innovation to market. SpringBoard also has rental space and provides some incubation services to clients if needed.

All of the agencies specifically mentioned, as well as previously mentioned organizations that provide commercialization assistance such as the National Research Council, the Saskatchewan Research Council, Ag-West Bio, and the BioAccess Commercialization Centre are all entities with public support. There are also other private sector resources available in the province to guide entrepreneurs through this complex process of commercialization, but the critical information is that economic developers need to invest in networking. This ensures that they stay aware of the resources and agencies that can provide valuable referrals to the right partners to help move technology to the market.

Commercialization Options

IEDC has identified three basic options for commercializing a technology:

- licence or sell the technology to a third party
- develop and sell the technology as a venture strategy
- industry sponsored research agreements (where industry pays universities to undertake commercial research)

Licensing

Technology licensing is a contractual agreement where the licensor sells the technology idea, product or know-how to a third party for an agreed compensation that could be a one-time fee, a royalty or some other arrangement that is acceptable to both parties. In this scenario the inventor loses control of the technology, but will receive financial compensation for the idea. Inventors may not always have the expertise to commercialize their own ideas and this offers a benefit to the inventor without the financial risk.

- To be able to sell a license for an innovation, the inventor must be able to clearly define what the technology is and what unique advantage the product offers.

- Steps must also be taken to protect the intellectual property. The risk to the investor is much greater if the concept has not been protected. Non-disclosure agreements are also critical at this stage.
- Inventors must also do a lot of legwork to find an appropriate buyer for the license. Many companies prefer to commercialize products that are created in-house to avoid potential complications in dealing with outside inventors. The onus is also on the inventor to prove to a company that the idea is commercially viable. The uniqueness of the idea may signal to a company that there is not a commercial need for the idea.
- Legal advice should be used to negotiate an agreement if a buyer is identified. (IEDC, 2006)

Developing and Selling the Technology

Inventors can choose to bring their innovation to the market themselves. When commercializing a new idea there is an extensive amount of work required to develop the market as well as developing efficient production. Some of the issues faced by inventors taking on this challenge include:

- Inadequate financing
- Lack of management skills
- Unrealistic assessment of the market
- Highly competitive environment
- Short technology life cycle

Technology commercialization is a high risk venture. Developing new technology can be a long process and it can be a race to get an idea commercialized before someone else creates a similar solution to a perceived issue. If the idea finally passes all the technical tests as a viable technology, it must then pass the marketability test. Not every product will be market success. Strong business skills are required to make the connection between an innovation and the market. If the market does not perceive a need or want for the product it will have no commercial value. (IEDC, 2006)

The Role of Economic Developers in Commercializing Technology

The International Economic Development Council recommends the following action plans for economic developers in order to move the process forward efficiently and effectively.

- Business development assistance including business planning, market analysis and referrals to appropriate specialists who can help move the innovation forward. This could include organizations such as Springboard West Innovations, Industry Liaison Offices of U of S and U of R, Saskatchewan Advanced Technology Association, National Research Council IRAP Program, Saskatchewan Research Council, Entrepreneurial Foundation of Saskatchewan, venture capital funds. It will also include assisting them with creating a list of appropriate questions for accounting and legal professionals who specialize in patents and commercial business.
- Access support networks and maintain contact with Industry Liaison offices and the organizations listed above that specialize in technology commercialization
- Keep databases of contacts and networks that can assist them with protecting their intellectual property and the technology. Ensure that they receive all necessary product evaluations and approvals needed to take the next step.

- Assist where possible in improving and being actively involved in communications between universities, government and industry. This may contribute to helping inventors find appropriate industry to license their innovation or to find the right market for it.
- Create and maintain a database of technology and innovation in the region. Knowledge of existing technology is very useful in creating a tech-led strategy and to attract new innovations to the region. It may also serve as a valuable tool in finding potential companies to license new products.
- Stay informed in respect to organizations and resources available in the province to assist with technology commercialization. Technology clusters in North America are primarily regional in nature and in the case of Saskatchewan, the research parks and educational institutions are located in urban centres, but are available to all developers in the province.
- Inventors and start-up ventures will experience the most success when they receive the right advice in the beginning. As new ventures and inventors, their experience likely does not cover all the areas that they will require expertise. Ensure that they are referred to specialists for business management, legal advice, accounting assistance and marketing strategies.
- Ensure that local government regulations are business-friendly and will not discourage high-tech development. Work with local governments to review areas where they can streamline regulations as necessary.
- Actively work to link suppliers and end users. Business networks and deliberate communication strategies are effective ways to have a higher rate of commercialization success.
- Encourage and support the development of incubators and the use of Saskatchewan's three major research parks.
- Stay linked to Industry Liaison Offices at the Universities and other federal and provincial programs that provide assistance to developers of technology.

Research Parks and Incubator Programs

Technology led development has been largely characterized by partnerships of government, universities and the private sector, developing a regional economy into a centre of excellence for specific high technology applications. The results of these partnerships have traditionally been research parks and business incubators.

Research Parks and Incubator Programs have had some success in creating an environment that assists both universities and start-up businesses commercialize their innovations.

Incubator Programs

Technology incubators are different from general business incubators. The technology incubator is established with the primary purpose of connecting start-up technology companies with resources that may otherwise be difficult for them to find. Technology entrepreneurs are provided with services that will help minimize the risks of all the things they need to learn when venturing into a technology business. Incubators for these types of businesses can also be more expensive to set up than traditional business incubators because of their high tech communications requirements and the need for specialized labs.

It is common for these types of incubators to be located close to universities to take advantage of the resources available at those institutions for commercialization of their innovations. These incubators have often been set up for the purpose of encouraging more university based research to reach a commercialization stage. Graduate students from the universities also provide a source of high quality low cost labour for the start- up companies that locate nearby.

Another common service at technology incubators is access to capital. The incubator stays connected to angel networks and private investors that have an appetite for these types of businesses. Successful entrepreneurs who were given their start at a technology incubator are also a source of potential investment in new companies or as mentors to new entrepreneurs starting out.

Incubators may also be in the form of an organization that is available to provide management, financial and legal advice as needed to companies that may not be in the same physical location. "Incubators without Walls" are services that can make the prospect of becoming part of a technology incubator possible for businesses that are not located in our urban centres in Saskatchewan. They can still access the advice and resources of the expertise that would be available to them in one of our research parks.

"Centres of Excellence" is a common term for technology incubators that are focused on a specific technology. The expertise that is provided is focused on specific sectors within the technology field.

Successful technology incubator development requires:

- A sponsoring research university or medical centre
- Existence of larger technology companies in the area
- Public support for infrastructure, real estate or build out
- Community and business support, especially in leadership

- The willingness to accept the inevitability of subsidy
- A good incubator manager. (IEDC, 2006)

Without a technology base from which to build, it becomes very difficult to create an environment that can support a technology incubator. Identifying existing technology companies in the area is an important first step. Research parks also require existing businesses to be successful. They cannot survive solely on commercializing their own internal research.

Research Parks

Research Parks are specialized real estate developments that cluster technology companies together. They are often associated with universities. The purpose of these parks is to partner research conducted by universities and their students with an entrepreneurial culture to speed up the process and success rate of commercializing technology. (IEDC, 2006) It is hoped that more university research will reach commercialization stage as well as providing research and technical support to entrepreneurs that want to build businesses with a new innovation they have created.

These parks are often partnered with government. When many of them first appeared across North America, it was hoped that they would provide an economic development spark to economies struggling with industrial development. High technology ventures are risky, but successful ones have high payoffs in both profits and average salaries to those employed in the sector. The economic impact on a region to have successful technology sector is enough to warrant the risk for many communities that have chosen a technology-led economic development strategy.

According to IEDC, research parks may take 10 - 15 years to become self-sustaining and 30 years to generate revenue and economic benefits. Many have also resorted to becoming mixed use parks and encouraged other commercial and residential uses within the park to ensure that all the spaces in the park are filled if they have not been able to attract enough research and development activity to make them viable with that narrow mandate.

Role of the Economic Developer

The role of the economic developer in developing the types of networks that are found in incubators and research parks is to begin to understand the technology businesses within the community and region. It is important to understand their strengths, weaknesses as well as any needs and concerns they may have. Economic developers need to conduct research as well as visit with company management and executives to get a thorough understanding of the businesses operating in their region to determine what networks and collaborations are needed to have the most economic impact.

- Identify what provincial and federal resources are available to these companies
- Identify if there are connections that can be made between research and industry in the region and who is available to assist with making that happen
- An economic developer is a facilitator in this process. The role is to bring parties together that will enhance technology development and commercialization for the best economic benefit to the companies, the researchers and the region. The parties must see that there is some benefit

to be gained from their cooperation in these discussions and the economic developer must have established a relationship and credibility with the players to ensure that it is successful

Examples of Regions with Technology –Led Economic Development Strategies in Canada

Calgary Technologies Inc.

- Built a technology park behind the university (Abbotsford News – www.srctec.ca)

Mississauga, Ontario

- Has a booming high-technology industry (Abbotsford News – www.srctec.ca)

Fraser Valley, BC

- Sumas Regional Consortium for High Tech (SRCTec) formed in 2006.
- Targeting Abbotsford, Chilliwack and Mission
- First phase will be to build a technology park including a research facility that could host an educational institution
- Second phase would incorporate a conference centre that could host trade shows.(Abbotsford News – www.srctec.ca)

> "I think the general comment is that if this area is going to be industrialized, people are all for it because it is going to be clean form of industrialization. We will be creating a white-collar workforce as opposed to facilities which can be harmful to their way of life."
>
> *– Raymond Szabada, Abbotsford businessman behind the development.*

The presence of a science park is not enough to create a successful technology economy. Area Development Magazine included an article entitled *Cities Hot for Technology* in their November 2010 issue which identified the following elements needed in a comprehensive technology strategy:

- At least one major success story – a brand name draws world-class talent to a city. It also generates a stream of talented workers who often venture off and start their own spin-offs.
- A major research institution
- High-Tech Talent – whether from area universities or existing companies, only a place with a rich talent pool can claim to be a tech city.
- Venture Capital – there must be venture capitalists that understand the high risk/rewards of the technology industry.
- Proper infrastructure – this includes web designers, high-speed Internet connections, and law firms, banks and business services that focus on high tech.
- Collaboration – Needed between business, government and educational institutions.

These characteristics are the common themes of successful regional technology centres around the globe, from Silicon Valley to Brazil to Bangalore.

Financing for Technology Businesses

It is common for technology businesses and budding entrepreneurs with innovative and creative ideas to struggle with accessing financing. Their skills are frequently in science and technology, not in preparing business plans and thorough cash flow models for presentation to financiers. Great ideas may miss the opportunity to become commercialized simply because the business plan was not presented effectively.

Technology businesses are also considered to be high risk investments. Great research and development can take a lot of time, requiring a lot of seed and start-up capital and does not always translate into a marketable product or process. Inventors are also more likely to not have proven management skills in previous ventures. Their focus and experience is generally on creating and innovating rather than commercializing their ideas.

Some of the best things that economic developers can do to assist technology companies that need access to capital are:

- Develop and provide lists of public and private financing resources for technology businesses
- Educate local bankers on the needs and requirements of technology-based businesses. Saskatchewan has had limited experience in financing technology companies, therefore the more education that can be provided to potential sources of capital the better the chances of success for the technology companies
- Assist with creating opportunities for local entrepreneurs and venture capitalists to connect
- Provide technology businesses with a clear list of resources and services that are specifically geared toward technology businesses
- Circulate information on a regular basis to technology companies to ensure that they are up to date and aware of the service that are available to them
- Provide referrals and matchmaking between investors and businesses
- Offer training for venture capital presentations (Entrepreneurial Foundation was established to assist businesses in becoming investment-ready prior to presenting their plans to venture capitalists or other sources of financing)
- Referrals to angel networks (Saskatchewan Angel Investor Network - SAINT)
- Refer technology firms to specialists that can provide them with technical assistance where required. (IEDC, 2006)

There are several options for technology companies to pursue for financing at various stages of their development. Ag-West Bio has gathered a list of funding agencies and identified the stage of commercialization in which these agencies will consider providing funding. (www.go-bio.ca)

Federal Programs

- Business Development Bank of Canada (BDC)
- Canada Small Business Financing Program (CSBF)

- Community Futures Development Corporations funded by Western Diversification
- Department of Foreign Affairs and International Trade – various programs for research stage and development of international collaborations
- Agriculture Canada – sector specific funds
- ecoEnergy for Biofuels – sector specific
- National Research Council Industrial Research Assistance Program
- Scientific Research and Experimental Development Credit
- Women Entrepreneurs
- Various other programs are available for specific sectors

Provincial Programs

- Ministry of Agriculture – various programs, sector specific
- Ag-West Bio – sector specific
- SAINT (Saskatchewan Angel Investor Network)
- STEP (Saskatchewan Trade & Export Partnership) MAP (Market Access Program)
- Various other programs may be available for sector specific projects.

Private Programs

- Venture Capital Firms
- Banks and Credit Unions

Building the Regional Capacity to Innovate

The following elements are essential to creating an innovation-led economy (U.S. EDA, 2001)

- Support and help mobilize facilitators – people, institutions and organizations. Build Networks.
    - Economic Development Officers, Chambers, government agencies, universities, community development groups all need to help develop networks and opportunities for people and organizations to exchange knowledge and ideas and work together on opportunities and challenges.
- Invest in Assets
    - People are the most important asset in technology-driven economies. Long term, consistent investments will pay off
- Seek to catalyze innovation and entrepreneurship
    - Innovation and entrepreneurship require focused support for the following activities: idea generation; incubation; commercialization and application of new technologies; and new business formation and growth.
- Foster an innovation mindset and entrepreneurial culture
    - A region that can view failure as a lesson in how to succeed is one that encourages risk-taking and it will value and help build the infrastructure necessary to support the development of new products, processes and services and new business formation.

The Economic Development Administration of the Department of Commerce in the U.S. conducted extensive research in 2006 and identified five resources that were required to support entrepreneurship for a tech-based economy.

Technology:

- Technology generators such as universities, non-profit research institutions, large corporations are typical, but commercialization centers indicated that the majority of the technologies that they assisted with commercialization were from private, start-up companies
- No matter the source, access to commercializable technology by entrepreneurs is critical. Relationships between economic development agencies, technology transfer offices at universities and the connection to entrepreneurial and investment communities is necessary to accelerate the commercialization of locally-generated research.

Know-How:

- Experienced management talent will determine whether a technology will result in successful commercialization and enterprise creation.
- Serial entrepreneurs who have weathered some failures on their road to success can be good judges of quality deals and often look for new opportunities.
- Leading a start- up requires more than general management skills. Early stage companies require experienced management.
- Experienced entrepreneurial management can give companies a better opportunity to be successful in getting financing. Venture capitalists understand that many promising

technologies do not ultimately fill a market need, but if the market does not evolve as predicted an experienced management team can find other attractive opportunities in the market.

- Serial entrepreneurs are often willing to share their experience through a mentorship relationship after they achieve their own successes.
- Communities determined to create an entrepreneurial culture in their region will aggressively pursue serial entrepreneurs and successful entrepreneurs that may have left the region to lure them back to the area. These communities will simultaneously try to encourage the growth of entrepreneurs in their community. Entrepreneurial training programs are becoming more common in the form of seminars to university credit programs. The desired outcome is to introduce the concept of entrepreneurship as a career path and provide interested people with the skills to increase their chances for success.

Capital

- Sufficient funding at each stage of development must be accessible. Shortage of angel and seed funding can inhibit entrepreneurial growth in a region

Social Networks

- Entrepreneurs are open to learning from others who have encountered or are encountering similar obstacles.
- Networking can lead entrepreneurs to sources of technical and financial resources that they did not know were available
- Networking can provide encouragement to continue the work. This is critical in areas that may not have a supportive entrepreneurial culture.
- Networking can be unstructured events where people can mingle or events where entrepreneurs make prepared presentations to investors, or recognition events or even casual interactions in an incubator or research park setting.

Facilities

- Appropriate and affordable physical space is important for start-ups. It is more difficult for tech companies that require wet lab space to work.
- Incubators have been established in some regions where space was previously limited. They also enable new entrepreneurs to be located in close proximity to each other where they can learn from each other and potentially receive technical assistance from the managers of the incubator.
- Some areas that have not invested in physical space have indicated that they would prefer to use their resources for funding programs and services. Real estate ventures require an extensive amount of capital.

Methods of Assisting Start-Ups

- Entrepreneurial training
- Entrepreneurial directories that outline what resources are available to them
- Mentoring and coaching entrepreneurs
- Providing access to funding - having a relationship with investor networks and funding programs or venture capitalists.
- Preparing entrepreneurs to present to investors
- Networking events
- Incubators

Saskatchewan examples:

- Entrepreneurial Foundation of Saskatchewan's On-line Evaluation Tool for entrepreneurs to self-evaluate their readiness for investment and the stage of their company development.
- Business Plan Competitions (i.e. RROC) the Kauffman Foundation's Centre for Entrepreneurial Leadership has studied the results of such competitions and learned that it encourages graduates of post-secondary programs to be more likely to consider entrepreneurship based on the percentage of graduates who started businesses.
- Wilson Centre for Entrepreneurship at the University of Saskatchewan

Promoting a Culture of Entrepreneurship

Interviews conducted by the U.S. EDA in 2006, produced the following advice for practitioners wanting to encourage the development of an entrepreneurial culture in their region. Economic developers must drive quality deal flow, encourage angel investors to invest locally, educate the media and community leaders, and recruit high profile entrepreneurs to act as role models, champions and spokespersons.

Factors which contribute to a vibrant entrepreneurial culture identified by the interviewees were:

A spirit of risk-taking

- A region where risk-taking is instinctively frowned upon and failure is considered shameful is a tough environment for starting and growing innovative companies

Angel Investment Activity

- A region needs an abundance of angel investors who are serial entrepreneurs with money and experience to act as connectors. The health of the entrepreneurial environment can be assessed by the extent to which local investors actively invest their money locally versus investing it elsewhere.

Entrepreneurial Faculty

- Strong entrepreneurial communities generally have academic institutions with entrepreneurially-minded faculty and are encouraged by their institutions to commercialize their research.

Strong Support Infrastructure

- A depth of skill sets located in the community to support entrepreneurs is important. This includes professional services, accounting, legal and manufacturing capability

Entrepreneurial Corporate Culture

- The number of new spin off companies that come from businesses and research facilities in the community will be a result of the degree of risk-taking culture that is present internally in those institutions and businesses. The culture of a major employer in a community can impact the culture of the community that it is in. When a large company closes or re-locates it can also create a number of new small entrepreneurial ventures as the skilled employees that were released put their talent toward their own business start-ups.

Community Support

- Strong, individual leaders in a community can have a profound effect on keeping the energy going in a community. The loss of such leaders can also impede continued progress. Recruitment of high profile community leaders can help drive progress in a region.

Communications and Branding

- Strategic communications efforts focused on an effective branding message can help build an entrepreneurial environment. The message must talk about the entrepreneurial climate and the core competencies of the community to attract entrepreneurs. It can help change the mindset within the community as well as attract new entrepreneurs from outside the region. Do not try to be an entrepreneurial centre for everything, but focus on the core competencies of the region to ensure that the message is credible. Do not market the community as a technology hot spot if there are very few existing tech entrepreneurs. The message must match the reality.

Informed Media Coverage

- The tone of the local media when covering business start-ups, failures and the state of the local economy can significantly contribute to a positive or negative entrepreneurial culture. A focus on failure rather than what can be done to improve things will create a negative environment. Media may also require an education on the difference between traditional small businesses and technology businesses and their unique challenges. They also need to understand the difference between “wealth creating” businesses and “wealth circulating” businesses. Good relationships with media are important to ensure that they are part of the process and that you can get their attention when you need it.

Assess the community, look for gaps in services or infrastructure and find ways to fill the gaps. Don't look for a cookie cutter approach. Every community is different and is starting with a different climate, infrastructure, resources and politics. Be prepared to wait for results. Communities should expect to wait 10 to 30 years to see a real impact from a program to grow an entrepreneurial culture. Organizations trying to lead the process must be credible with entrepreneurs and investors to be effective.

Quality leadership is the most important element in the implementation of any technology-led economic development strategy.

Resources

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http://www.iftf.org/index.php?q=node/2701

http://www.socialmediatoday.com/SMC/113788

http://www.areadevelopment.com/viewpoint/Oct09/future-knowledge-ecosystems-richard-wallace010.shtml

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http://intelligentcommunity.org/index.php?src=news&refno=409&category=Facts%20%26%20Figures%20Library%20-%20Knowledge%20Workforce

http://www.i-capitaladvisors.com/2010/06/12/five-steps-to-building-a-regional-innovation-ecosystem/

http://www.iftf.org/node/2701

http://www.ghgpec.com/services_ht.html

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http://techno-economics.blogspot.com/

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http://www.innovationamerica.us/index.php/publications-and-presentations/white-papers/90-a-new-direction-for-technology-based-economic-development

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http://www.nrc-cnrc.gc.ca/eng/dimensions/issue1/clusteroverview.html

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www.techtriangle.com/recognized_**technology_cluster**

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http://www.agwest.sk.ca/about/index.php

http://www.gov.sk.ca/programs-services/

http://www.enterprisesaskatchewan.ca/researchinfrastructure

http://www.enterprisesaskatchewan.ca/adx/aspx/adxGetMedia.aspx?DocID=b46b05c6-73af-44b5-ad57-8e0c71f71f64&MediaID=966&Filename=WEPA+Strategic+Themes+-+January+2009.pdf

http://www.enterprisesaskatchewan.ca/smart

http://www.enterprisesaskatchewan.ca/factsheets

http://www.src.sk.ca/html/about_src/quick_facts/index.cfm

http://www.bioaccess.ca/

http://www.saint.sk.ca/about_background.php

http://www.usask.ca/wilsoncentre/home.php

http://www.efsk.ca/

http://www.rti.org/brochures/rti_knowledgeecosystems.pdf

http://www.thewcmp.org/uploads/muslim.pdf

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