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Telecommunications Equipment
Value Chain Study

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Prepared by:

Icegate Solutions Inc.
1590 Winterport Way
Ottawa, Ontario
Canada
K4A 4C2

Tel: (613) 834-9176
Fax: (613) 834-5034
Email ken@icegate.ca

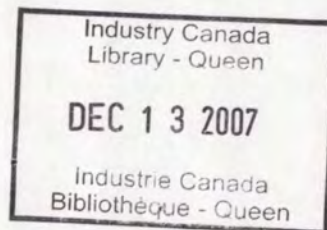
Contract IC 5018819 - Telecommunications Equipment Value Chain Report
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Icegate Solutions Inc.
info@icegate.ca

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1 Executive Summary

Telecommunications is an industry with a long history in Canada. Equipment Manufacturing has been a major activity for approximately 100 years.

As technology in general has evolved dramatically over the past 20 years, so has the telecom equipment industry. The beginning of the twentieth century ushered in telephone service and now the twenty first century ushers in the expansion of Internet services. This new means of communicating for business and people has helped to stimulate a whole new set of technologies that help expand networks. In addition, the constant desire for communications mobility and portability drives a continued expansion and improvement in mobility technology. Canada has many companies, large and small, that participate in this dynamic industry.

This study endeavours to understand how Canadian companies fit within the context of the global value chain for telecom equipment. We try to identify what functions of this complex process are still being performed in Canada, which have left and why. In addition, suggestions for government policies and programs that will enable Canadian companies to remain competitive and players in the international arena are discussed.

Icegate Solutions (Icegate) has developed a pictorial representation of the new global value map and illustrated the functions that are undertaken by companies in the development and manufacturing of telecommunications equipment. Evolution of this industry has taken it from a strong vertical orientation (one company performs most functions) to a highly disaggregated orientation (companies specializing in functions not necessarily products). This unravelling of integrated functions, combined with the importance of software to the technology and the rapid changes in hardware, has created a very complex chain of players involved in delivering final product to users.

In order to validate this value map we have interviewed fifteen companies, of which five are multinational players and ten are small/medium enterprises. Each one produces a different product and some are suppliers to others. However, there are some trends and ideas that have emerged as consistent themes:

- More sophisticated functions are becoming software based, while basic transport functions are hardware based
- Manufacturing of mass-market products is leaving Canada for lower cost regions.
- Sourcing of most electronic components currently comes from Asia and Mexico.
- Canada needs to ensure that higher-level education and resources remain on the cutting edge and deliver high quality resources to the labour pool.
- Fundamental research and early design are functions that are still performed here and we are considered a strong resource community for those needs – this is also a time sensitive advantage.
- Innovative emerging companies are being purchased before they can accumulate a large customer base and grow into multinational companies in their own right.
- New companies often do not even consider manufacturing and go directly to Contract Manufacturers/Electronic Manufacturing Services companies – this can include aspects of New Product Introduction and late stage design.
- Partnerships are now a strong component of Distribution and are a growing component of R&D/Sourcing
- System Integrators are as important in the distribution stream as large OEMs and this is fostering new types of partnerships

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- Access to capital is a fundamental and growing need for smaller companies to be successful
- The sector is trending away from large, all encompassing companies (e.g. Nortel), toward smaller sized, product/market focussed companies
- All companies want access to foreign markets to foster larger market share



2 Introduction

Global competition is well documented. Product and service companies face enormous pressures. Competition covers the entire value chain, from strategy, to design, to distribution, to post-sales service. Information travels rapidly around the world, making innovation widespread and competitive advantage rare. Companies increasingly produce products and services from global or regional components or services, rather than producing entire products within one country.

"If present trends persist, businesses will continue to align along global or regional supply chains in order to produce goods and services more efficiently. That means competition for those parts of the process that can move from country to country—whether for goods such as electronic components, or services such as data management—will intensify."¹

Supply chains can help increase market share and create strategic advantage through more agile supply chain strategy, structure and performance. A supply chain or logistics networks is a co-ordinated system of organizations, people activities, information, processes, and resources involved in moving products or services physically or virtually from supplier to customer². Supply chain activities transform raw materials and components into a finished product or service delivered to end customers. Supply chains link value chains (a term popularized by Michael Porter) to denote a framework for organizations to analyze value added activities that create value and competitive advantage.

"In this environment, it will be even more critical to create policies that enable Canadian businesses to seize the benefits of increased global involvement. Governments will need to ensure that policies in Canada and elsewhere do not impede companies' ability to source or buy globally that which others can make more efficiently. (This should, of course, be balanced against other policy considerations.)"³

The focus of this project is to understand the evolving telecommunications industry and the types of functions that are being performed in Canada. With this comprehension, the government intends to identify policy areas that can benefit the country and generate employment so as to ensure a strong and globally competitive sector.

This study will be used to:

- Identify current strengths and weaknesses of Canadian companies as a group and develop measures to help Canadian companies to benefit more from global value chains
- Identify the nature of current business opportunities for Canadian SMEs (Small and Medium Enterprises) and develop an understanding of how best to facilitate linkages with MNE (Multinational Enterprise) value chains.
- Identify issues that point to policies and programs needed to attract and retain investment in the Canadian ICT sector
- Help develop a more targeted investment campaign by identifying functions in the production value chain where Canada is/can be competitive

The main objective of this project is to improve the federal government's understanding of the:

¹ Danielle Goldfarb and Kip Beckman, "Canada's Changing Role in Global Supply Chains", (Ottawa: The Conference Board of Canada, March 2007), p. 20.

² Wikipedia

³ Danielle Goldfarb and Kip Beckman, "Canada's Changing Role in Global Supply Chains", (Ottawa: The Conference Board of Canada, March 2007), p. 20.



- Current state of telecommunications equipment industry in Canada
- Nature of the global value chain (which components build which that sell to what market)
- How Canadian firms fit into this global value chain

Icegate has used analysis methods based on Porter's Industry Value Chain model and the Diamond of National Advantage model. In this project, the value chain is not specific to a company rather the industry. As such it is really a system. The dynamics of the system are important as well as the relationships, who delivers what in the chain and to whom. A company's position in the value chain of the industry reflects where its' business is currently positioned and what opportunities may be available for tomorrow. Porter's models provide a strong base for identifying the current status and flow of components and supply through the Industry. This will help identify areas that are essential and where Canadian companies should focus opportunities and linkages with Multi National Enterprises.

The Diamond model helps define a nation's competitiveness in a specific industry. This model, lists the determinants of our environment in which companies are born and learn to compete. The diamond as a system affects the aspects for achieving international competitive success and can be the focal point for assessing Canadian companies as a group for strengths and weaknesses. In addition, the Diamond helps identify areas where policy and government programs may assist in enhancing Canada's competitiveness.

The government plays an important role in Porter's diamond model. Like everybody else, Porter argues that there are some things that governments do that they shouldn't, and other things that they do not do but should. He says "Government's proper role is as a catalyst and challenger, it is to encourage – or even push – companies to raise their aspirations and move to higher levels of competitive performance..."⁴ Governments can influence all four of Porter's determinants through a variety of actions such as subsidies to firms (either directly (money) or indirectly (through infrastructure)), tax codes applicable to corporations, business or property ownership, educational policies that affect the skill level of workers, etc.

This study uses primary research (interviews) on specific representative companies in the Telecommunications sector as well as secondary research to provide insights on the specific efforts undertaken to address the competitive positioning of the companies. Appropriate analytical methods are used to provide an overarching report summarizing unifying themes/trends that emerge from the interviews. This report includes a mapping/diagram of the telecommunications global value chain, highlights of the literature review, methodology and interview guide, analysis based on discussions with 15 companies and recommendations for policy and programs.

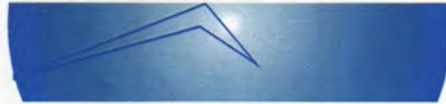
⁴ The Competitive Advantage of Nations, Micheal Porter

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3 Scope

The study was carried out in two phases, corresponding to the government fiscal year. The studies enabled comparisons between company's supply/value chains because they used a consistent methodology. Ten Canadian SMEs and five MNEs were studied. MNEs with development or manufacturing facilities in Canada, regardless of country of ownership, have been considered.

The information developed by this project will be used by the Information and Communications Technologies Branch, Industry Canada to direct policy, inform industry analysis, support the development of vibrant ICT sector (including telecommunications equipment and applications), design new initiatives and enhance existing programs to attract, retain, and support business in Canada, and to help Canadian firms participate in global value chains and make them competitive in a global market. Issues that have been addressed include:

- Identifying issues that point to policies/programs on government behalf
- Identifying new business opportunities and linkages with value chains based on the model
- Identifying where Canada is in production value chain to help focus investment and planning
- Identifying strengths and weaknesses of Canadian companies and develop objectives to help companies focus on their key strengths and evolving opportunities



4 Methodology

Icegate Solutions developed a model of the Global Telecommunications Equipment Industry Value Chain and tested that model through primary, (interviewing different companies), secondary literature and web based research. Through additional research with secondary sources, we identified trends and opportunities in the evolving industry related to Canadian companies competitive positioning in a global environment. The proposed analytical framework to related industry to policy is the Diamond of Competitive Advantage developed by Michael Porter. This model was devised to help analyse issues related to a company's global competitive position. The dynamics of this model assisted in providing direction on potential policy opportunities for Industry Canada related to supporting this sector.

To develop the Global Value Chain, Icegate first tried to focus on particular sectors of the industry. Telecom has become a large and diverse industry and there are multiple technology paths. This alone is causing great confusion and divergence in equipment manufacturing. We thus, looked at the industry and divided it into sets of technologies to enable us to maintain the project within scope. Icegate conducted secondary research from a variety of sources (including leading academic and industry sources) to increase knowledge of the evolving industry. With over 70 years experience in the Telecom industry and the breadth of our skilled resources, Icegate identified new trends and shifts in the general industry. We researched different methods for mapping value chains and leveraged this combined set of knowledge sources to develop our model of the Global Value Chain.

In order to validate this model the project included discussions with 15 companies about their products, supply chain and competitive positioning. The first phase of the project included 5 interviews with companies identified as Multinational Enterprises (MNEs). The remaining 10 interviews were completed in Phase II and focused on Small and Medium Sized Enterprises (SMEs).

For each of the companies interviewed, Icegate analysed their fit within the Global Value Chain. The fit identified which functions they are completing within the company and where the locations are globally. In addition, based on our overall research of each company, we identified as many suppliers or partners in their value chain and which locations they may be operating in. In many cases, the supplier list for an MNE can be in the hundreds and identifying all was not possible. We were able to identify the key suppliers for the critical functions.

Porter's Diamond model was used as a framework to relate policy areas to both the industry and to Canada's position from a global perspective.



5 Telecom Equipment Industry Global Value Chain

5.1 Industry Evolution

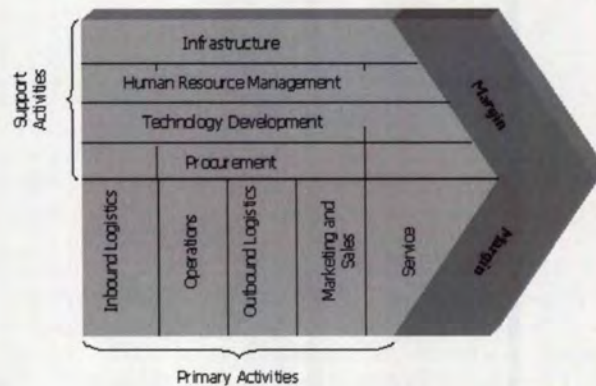
The telecom equipment industry has evolved tremendously over the last 10 years. Despite the decline in the industry in the 2000 era, many other factors have been involved in the evolution that has brought the industry to where it is in 2007.

Technology has been evolving constantly over the last 100 years of telecom deployment especially in North America and Europe, but the pace of technology evolution has dramatically increased over the last 20 years. Prior to that, the pace of evolution and network growth (addition of more geographic coverage, especially in Canada) was slow. The original telecom network was a simple set of wires that connected locations with a switchboard, and was originally operated by human hands. As the network grew, technology evolved and the manual switchboard was replaced with mechanical switches (this took decades). These first step-by-step switches were then replaced by cross bar switches, where again the technology evolution took about two to three decades. While this was happening, the telephone became more pervasive in businesses and homes, and the communication network grew. Eventually new technologies that connected to the network, such as the facsimile, were also developed.

While these changes to the network were happening, technology in general was evolving. Punch card computers evolved to more powerful technology. As semiconductors and silicon based chips started to evolve so did the ability to program the chips and have them do different functions. Over time technology became refined and smaller, and the personal computer became viable.

The evolution of semiconductors enabled the evolution of telecommunications equipment. Switching and transport equipment evolved to be more compact, have higher degree of functions and incorporated much of the new technology. The devices connected to the network became more sophisticated and could have more functions embedded in them. In addition, the personal computing evolution occurred. With the introduction of modems, it became possible to connect the computers to the telecom network, and give users a new means of communicating.

Even as these technology introductions and evolutions were taking place, telecom equipment manufacturers were evolving as well. The companies that were manufacturing cross bar switches started developing their own semiconductors and manufacturing new digital equipment. They developed the new phones and other components that are used like key systems and conferencing systems. In doing so each company had its own Value Chain as described by Michael Porter in 1980. Figure 1 below is a picture of the Value Chain that would be internal to a company.



Porter 1985

Figure 1 – Company Value Chain

Each company had to find suppliers of the raw or base components and then they would build their own boxes. Each manufacturer would conduct their own research and development to create their boxes/devices. Each manufacturer would then assemble their products and establish their own distribution mechanisms/channels. Distribution means are directly associated with the type of customer you serve. Thus, there is a different channel to consumers than to businesses.

An Industry Value Chain, as depicted in Figure 2, was one where many of these value chains were set side-by-side showing an end-to-end view of how a final product (Box A) may be delivered. Thus, if the product required a metal box frame, we would see a supplier or set of suppliers of sheet metal providing to Box A manufacturers, who would then assemble that with the other components for final product. However, as discussed above, the telecom manufacturer would be making the functional components inside Box A.

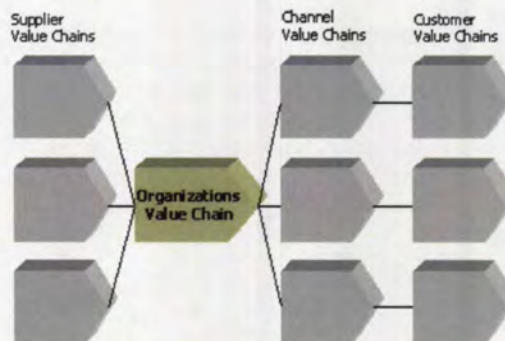


Figure 2 – Industry Value Chain

In the past twenty years, the computing, semiconductor and software industries have evolved at a break neck pace, and there has been a shift in the supply and manufacturing sectors of the industry. Part of this change is based on the availability of different components. As



semiconductors became commonplace in thousands of everyday devices and then became programmable, there was no longer an economic need for each telecom manufacturer to make their own unique components. Companies manufacturing components for other industries recognized the ability to service telecom as a means to grow their business. Thus, components became a piece of the puzzle that could be purchased, often less expensively through a supplier.

Over time, as the global economy also evolved, manufacturing became a skill for developing countries. Their lower standards of living enabled them to pay people much less than more developed countries (although it is a substantial income for their native society) and thus outsourced manufacturing became a new opportunity. Companies started to outsource their assembly and shipping functions to other companies as they could lower their overall costs. This applied pressure to other industry competitors who eventually had to find ways of lowering their costs as well. Most large telecom equipment manufacturers no longer completed the assembly and shipping functions. Many sourced a multitude of components (especially those, like semiconductors, and ASICs that are now considered commodities).

At the same time that technology changes were occurring, other changes in the industry and related industries were also taking place. Distribution took on new roles and new opportunities were discovered. Retail distribution ceased to be through the phone service company as retailers of electronic goods were able to now sell handsets. A role for resellers of equipment became available. As the technology became more complex, even a small business with multiple lines would need a box (e.g. key system) and would have to hire a company with expertise to install and maintain this new technology. These became channels for the enterprise network components as well as handsets. A shift enabling distribution of both data and telephone equipment arose as computing became more fundamentally integrated. Thus, a new route to market emerged that did not require equipment manufacturers to maintain the same levels of direct sales force.

With the introduction of the personal computer, handheld devices, and cell phones, communicating took on a whole new value for many end users. Software became a growing industry and with the advent of new hardware, came new software. Every new device created many opportunities for programmers to develop new ideas and services that could be used in different situations and applications. Software is now a component that can also be sourced from a different vendor. Some software acts as a base, similar to commodity hardware components, and can be purchased with the ability to program new functions on top of that platform. Many new devices are set up so the base functions can be programmed and available to programmers who develop independent modules to provide other functions.

In addition, deregulation has enabled a new and evolving technology path to provide opportunities for companies. New technologies have allowed new players to enter the telecom service industry and compete with traditional providers. In some cases, new technologies, such as computers, have initiated new uses of the network, thus creating an explosion of options and capabilities. Deregulation also altered the rules for new players to participate. Many saw an opportunity to take advantage of new wireless technologies to compete with the traditional wireline providers. They could buy technology and operate at a lower cost (less people, less processes, lower salaries) thus enabling them to compete with the carriers. This has facilitated more equipment manufacturers competing in more categories than ever before. Small equipment companies are able to be successful by focussing on a niche of the market instead of trying to fulfill all requirements of the market (which was the position of most traditional manufacturers).



5.2 Canadian Value Map

5.2.1 Description

A typical view of a supply chain for an equipment manufacturer, based on Porter's original value chain theory is shown in Figure 3 below. This classical view illustrates a set of functions that are occurring sequentially in time (even if they are not in the same organization). The perspective is that once R&D is complete and mass assembly is about to begin you source your inputs and then move into assembly and distribution to the appropriate channels. This process was not perfectly sequential (often equipment manufacturers would engage in sales discussions while product was in final stages of testing for assembly). The cycle was long and for products that were large and being created for large carriers, there was quite a bit of effort. During this time, manufacturers did have some customer relationships where there was input to the R&D process for product but much of it was for product functions and refinement and not the original ideation (the initial product concept) stage.

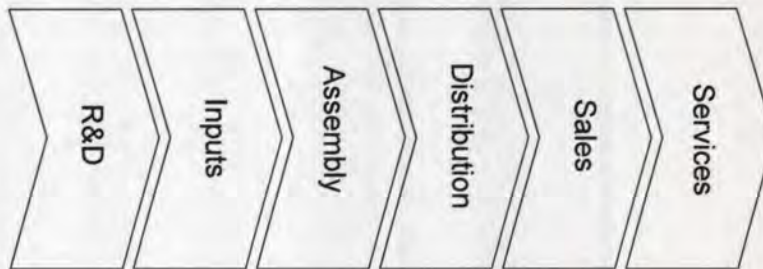


Figure 3 - Supply chain for an equipment manufacturer

In this fast evolving world with many factors interacting, it can be difficult to understand how decisions are made and which factors have had the most bearing on those decisions. There is no doubt however, that with world economic factors related to lower costs of labour for some functions, and other countries assisting businesses to improve their economic position, that Canadian equipment manufacturers are and will continue to be impacted. Given these changes, the theory of the Company Value Chain has been altered. Although the end customer may perceive that the product delivering what they need has been provided via the company they interacted with, there may be many partners each delivering a unique value to support a product. Thus, the company Value Chain has truly evolved to an industry value chain where players try to compete by delivering a focused product or service to a large group of customers.

The evolving world created a Generic Value Chain for industry that more closely aligns to Figure 4 below.

For this view, main categories have been grouped so that changes in the supply/value chain can better be identified. Since not one company is manufacturing most/all components of a product, the distribution function has been altered. Distribution is a function that occurs many different times in the process. For players in the supply/value chain, there is a need to distribute their particular output (often a component of a larger product). Supply chain logistics has evolved greatly in the past 10 years to better support delivery of components. One final product may have hundreds of supply components and not all may be inventoried at the final assembly location. Thus, co-ordination of these pieces to ensure sufficient supplies are where they need to be to fulfill product orders is essential. This new model shows distribution as a function that flows



across the map and not just at the sales cycle side. The Sales stays on the right hand side as it is still a required function.

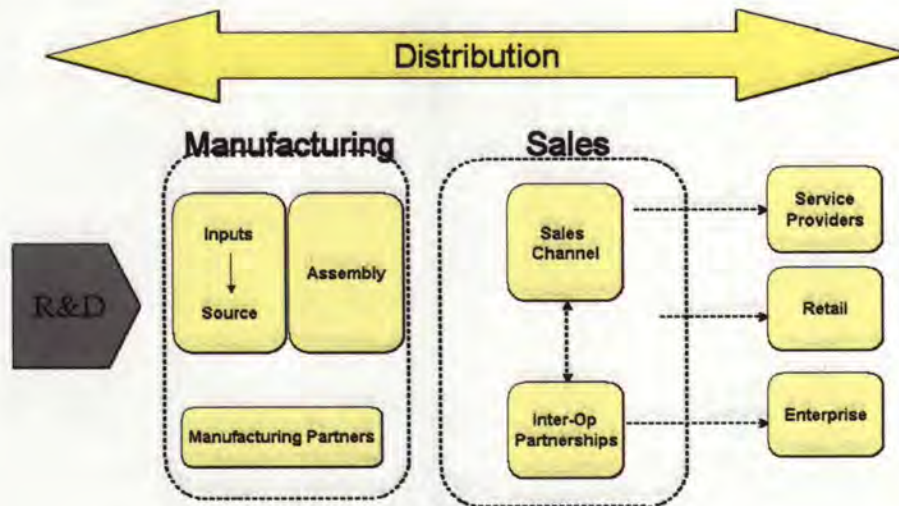


Figure 4 - Generic Value Chain for Industry

Another change is in the function and role of partnerships. Over time as the functions have been outsourced, and as more components try to complement or enhance each other, partnerships have taken on increasing value. Initially, many partnerships were focused on the sales distribution side, and often channel partners are still the main Partner list for many equipment vendors. However, as technology evolved in the 90's, many technology companies partnered. In many relationships there was some sharing of product knowledge as one or both companies tried to enhance the other's product. Due to the challenging complexity of the equipment (integration of functions between hardware and software), it was often necessary for vendors to choose one or several key partners that make their product unique. This process has created partnerships all through and around the value map. Each partnership focuses on the value that can be created from that relationship alone and then the nature of the agreement can be developed. The model thus displays partnerships as a function that crosses the remaining functions.

Functions such as R&D, Sourcing, Assembly, and Distribution have been subdivided to better reflect the shifting functions of value in the map. As software has become a more important component (as a product and integrated with hardware), many of the value functions reflect portions related to software. Some still encompass the hardware/physical aspects such as assembly. These functions have been defined based on the current state of product manufacturing and groupings of technology that were defined in the first step of the project.

Thus, the new picture is more like a map than a chain, although there is still a sequential process required to deliver a product in its end stage. This change in terminology reflects that not all the value is delivered in a true linear fashion and for some products in the telecom equipment industry; some steps may no longer be required. So like a road map, the value map provides markers for different value functions and for different products the route may vary. In some cases, competitors for different products may choose different routes, focusing their competitive differentiation with different functions. This is shown in Figure 5 below.

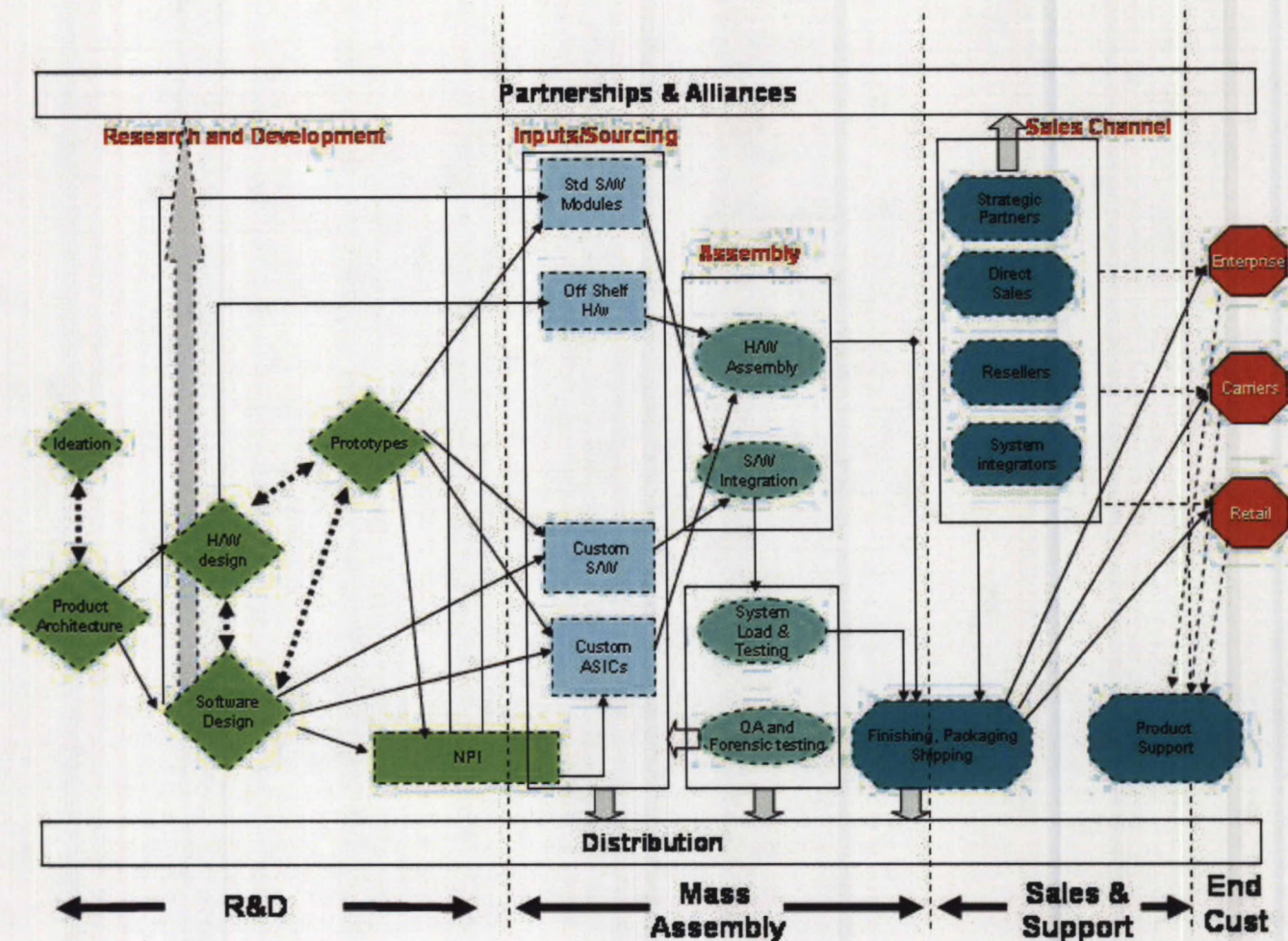


Figure 5 - Global Value Map for Telecommunications Equipment Industry

To complete the analysis and identify patterns, Icegate focussed on using this Value Map as a means to identify where Canadian equipment companies are functioning in Canada. Each company has their own map, reflecting their operations and supply decisions. We thus generated a generic Canadian Value Map identifying the areas where most companies are focused and the trends that fit with those observations.

5.2.2 Value Chain Functions

From the diagram above we have re-categorized the segments of the value chain and separated them into separate functions. The functions represent different discrete activities within a segment. These have been separated as different functions in a segment may now be outsourced and others kept in house.



R&D

Research and Development is a segment where new ideas and product concepts are created and tested. The following functions are contained within R&D:

- Ideation – this deals with the initial product concept and often the kernels of intellectual property are formed here
- Product Architecture – this entails the complex process of developing the overall architecture design for a new product or for enhancements of existing products
- Software Design – this represents the detailed and complex development of the software required for a product. This may require integration of other software products – Prototyping often occurs in this stage
- Hardware Design – this involves the detailed and complex development of the hardware for a product. This may require integration of other hardware components - Prototyping often occurs in this stage
- New Product Introduction (NPI) – this is an activity that in its final stages, extends into mass assembly. Many companies perform the NPI function on newer products to make sure that it performs the way it was intended (often called the Beta test/stage in technology)

Mass Assembly

This segment deals with the ability to mass-produce the product that has been developed. Here we have grouped Inputs and Sourcing and Assembly from the older models:

- Standard Software modules – this refers to standardized software products, often protocol stacks or other modules that can be purchased from a supplier. These are standard tasks or functions that are desired to operate for a product
- Off Shelf Hardware – this deals with hardware components that are standard and can be purchased from suppliers; this includes circuit boards, containment boxes, chips etc.
- Custom Software – this deals with software that is not standardized. It is often in this area where the intellectual property of a new product is contained especially with the evolving telecom industry
- Custom ASICs – this deals with developing custom made chip sets/components that are required to perform specific functions not available from off the shelf hardware.
- Hardware Assembly – this is concerned with the physical assembly of the product
- Software Integration – this integrates the software into the hardware
- System Load and Testing – this is the integration of all the software modules that comprise the product. Once integrated, it is tested to ensure everything works together as designed. The output from this is often called Rev 1 of the product and is now ready for shipping to the customer
- QA (Quality Assurance) and Forensic Testing – this deals with assessing the quality of the sourced components/software and the final product. This function often provides feedback into areas of R&D as well as supplier control
- Finishing, Packaging, Shipping – this represents the finals stages of the product integration, cosmetics, and packaging so it is ready for customer use. It is typically shipped to a warehouse point for distribution to the customer in the Sales and Support segment.



Sales & Support

This segment deals with the sales of the product to the various types of customers through different sales channels, as well as the product support required to ensure it can be used and maintained by the customer. These functions are highlighted below:

- **Finishing, Packaging, Shipping** – As identified in the Mass Assembly section above, this function addresses the distribution of the product to the customer.
- **Sales Channel** – this identifies the typical conduits through which product flows to the customer. Strategic Partners, direct sales, resellers and system integrators are all potential vehicles that can be used to interact with the customer in order to sell and deliver the product. The cost, type and complexity of the product, size and location of the customer, and business model of the manufacturer are all aspects to consider when choosing the sales channel for the product.
- **Product Support** – this provides the post sales interaction with the customer should there be a problem with the product they have. User education, repair, warranty issues, product upgrades and replacement are some of the issues that are addressed here. While this function has evolved into call centre type operations for most of the telecom products, there is still a requirement for engineering resources to travel to the customer site to resolve issues in many instances.
- **End Customer** – this represents the three types of customers that are typical users of telecom products. These include businesses (Enterprise), service providers (Carriers) and Retail (sales to the consumer)

Partnerships and Alliances

This function is shown across all the segments. This is because partnerships are not confined to one area of the value chain. Today, partnerships are used at various different times along the chain to offer different benefits. R&D partners help to share IP and create new products that are marketable and efficient. In the Mass Assembly segment, partners support the build process of the product. Partners can represent key suppliers or inputs that can help with competitive differentiation and meeting timing issues. Sales and Support partnerships are often formed to help with developing channels to market. This is an area where partnerships have been used for a long time. Partners often help with carrying product to market especially in foreign countries where language and culture can create barriers.

Distribution

Like partnerships distribution is a function that works across the different segments. This is due to the evolving nature of the value chain. With more functions in R&D and assembly being outsourced to other companies, it is necessary to distribute different components or parts as well as final product. Thus, it does not seem sufficient to refer to distribution as a function for final product only. With the Internet and other electronic networks, software can be distributed over networks from one location to another in a few minutes instead of hours or days.



6 The Diamond of Competitive Advantage

6.1 Background

In the 70's and 80's Michael Porter while teaching at Harvard, developed a theory of company value chains. His numerous research studies into the structure of businesses and competition in many different industries then supported the creation of his competitive positioning framework called 5 forces. Porter and others employed his methods to evaluate a specific company's position in its industry. This type of evaluation aided the companies in designing strategy, products, and to analyze potential market opportunities.

Porter discovered in the 80s however, that these methods alone were insufficient to analyze how nations competed within industries (or companies based in different nations). Since there were many elements involved in how businesses function in different areas, he decided that a new method was warranted. His research team studied an enormous number of companies in varying industries across the globe. As the world was evolving and globalization of many companies was becoming a reality, it was important to help companies understand issues that were relevant to competing with players in different nations. In addition, as economic development was a never ending concern of governments, it would also be a tool that could benefit governments understanding what policies may be helpful in supporting specific industries as they position themselves in a global environment.

The culmination of that research work was documented in "The Competitive Advantage of Nations", a text rich in theory and case studies. It also provides direction for policy makers and companies on how to use the methods to their benefit in developing their various strategies and positions.

6.2 The Model

The Method developed by Porter analyzes four different dynamics of a nation. The four different determinants of the system are plotted as a diamond in Figure 6 below:

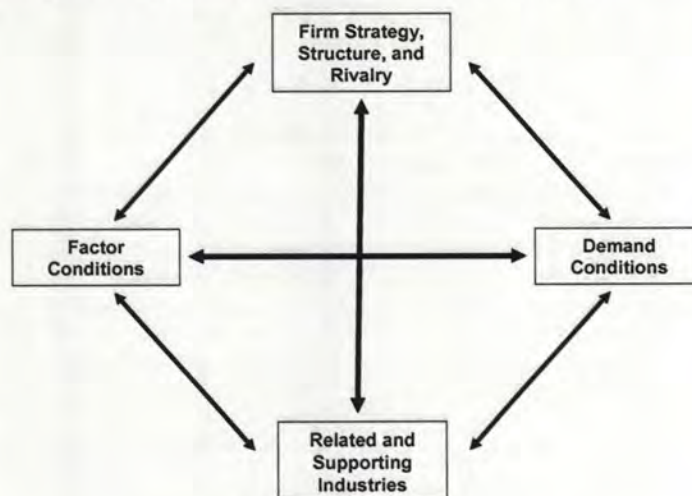


Figure 6 – Porter Diamond Model

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It is within these determinants of a nation that companies are created and learn to compete. Each of the determinants has a contribution to the success of a company or industry within the national context. However, achieving success is not dependent on understanding or leveraging one or two of the determinants while ignoring the rest. It is the system that is created by these that creates an environment and it is within that environment that companies come into existence. Thus, each determinant has a role to play in how success can be created and managed on an ongoing basis. As nations and governments evolve and change, so to does the home environment of a company. Each company and industry must recognize the changes and adjust accordingly to ensure long-term success can be maintained.

According to Porter, "When a national environment permits and supports most rapid accumulation of specialized assets and skills - sometimes simply because of a greater effort and commitment - companies gain a competitive advantage. When a national environment affords better ongoing information and insight into product and process needs, companies gain a competitive advantage. Finally, when the national environment pressures companies to innovate and invest, companies both gain a competitive advantage and upgrade those advantages over time." Thus it is not necessarily best to excel in only one dynamic, as it may not be sufficient to keep companies competitive over a longer term.

It was Porter's work and through studying the dynamics of competitive advantage with this method that lead to insights on industry clustering. This is the premise that specific companies within an industry are co-located based on some efficiency and competitive cooperation. Thus companies that are making similar products are often close geographically. In addition, industry or companies that support the first set of competitors are also close by, thus creating competitive clusters. In his article "Clusters and the new economics of Competition" Porter states the following:

"The sophistication with which companies compete in a particular location, however, is strongly influenced by the quality of the local business environment. Companies cannot employ advanced logistical techniques, for example, without a high quality transportation infrastructure. Nor can companies effectively compete on sophisticated service without well-educated employees. Businesses cannot operate efficiently under onerous regulatory red tape or under a court system that fails to resolve disputes quickly and fairly. Some aspects of the business environment, such as the legal system, for example, or corporate tax rates, affect all industries. In advanced economies, however, the more decisive aspects of the business environment are often cluster specific; these constitute some of the most important microeconomic foundations for competition."

Factor Conditions

These are aspects that are related to a nation's resources - labour, land, natural resources, capital and infrastructure are the most common elements. Factors are essentially inputs and the standard theory of trade has been based upon these factors of production. The theory is that a nation will make use of its factor assets and it will trade that which it has in excess. Porter stresses that this is far too simple a theory for the evolving globe of international trade. He argues that the most important factors to competitive differentiation are not inherited, but rather are created within a nation. "Thus, the stock of factors at any particular time is less important than the rate at which they are created, upgraded and made more specialized to particular industries. More surprising, perhaps is that an abundance of factors may undermine instead of enhance competitive advantage."⁵

Porter is also quick to point out that some factor endowments are comparable among nations. Post Secondary Education for example may no longer be a factor that can be considered a

⁵ The Competitive Advantage of Nations, Micheal Porter

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differentiating advantage on a national basis, as many countries today have a sufficient supply of graduates in varying fields. In addition, he is quick to point out that resources such as labour can be considered mobile. That is, they will leave a nation if the opportunities abroad are more appealing. Thus, just because a nation has the resource (i.e. they are citizens and educated in home country) it can no longer be considered an option that is bound to the nation.

Demand Conditions

The second determinant is the home demand conditions for the industry's product or services. One of the key components of the home demand (obviously scale is one) is its influence on dynamics. "It shapes the rate and character of improvement and innovation by a nation's firms."⁶ Porter describes the following three attributes of home demand:

- Composition of home demand (nature of buyer needs)
- Size and pattern of growth of home demand
- Mechanisms by which a nation's domestic preferences are transmitted to foreign markets

Porter argues that it is the quality of the home market demand that is significant in determining competitive advantage and not the quantity.

This model indicates that the composition of the home demand drives the firm in how it characterizes and responds to customer needs. The customer base can provide the firm with a better vision of what the needs are and can enable them to be better positioned against foreign competitors. When the home market applies pressure for the firm to innovate and increase sophistication, this also provides benefits to competing in global markets.

The size and pattern of home demand can lead to a complex set of variables that influence a firm and its products. Large does not always translate into quick success and small does not necessarily indicate faster to meet market. The model focuses on the following five characteristics of size and pattern:

- Size of Home Demand
- Number of Independent Buyers
- Rate of Growth of Home Demand
- Early Home Demand
- Early Saturation

Each of these characteristics provides different market signals and contributes in different ways to defining, shaping and responding to market; "the size and pattern of growth of home demand can amplify this advantage by affecting investment behaviour, timing and motivation."⁷

Home Demands also contribute to internationalization of domestic demand, essentially how a nation's products and services are pulled into the international arena. One aspect is if the buyers are multinational or mobile. Buyers who are abroad or travel can create opportunity and aid in establishing international presence quite quickly. Another aspect is the influence on foreign needs. This means refers to transfer of domestic needs to foreign buyers. One of the most common aspects is when training occurs for foreigners in the home nation. They return to their

⁶ The Competitive Advantage of Nations, Micheal Porter

⁷ The Competitive Advantage of Nations, Micheal Porter



nation and carry with them the values and processes they were taught. This aids in creating a foreign pull for services and products.

Clearly, the different aspects to Home Demand contribute in varying ways and must be assessed for a particular industry relative to its global context. In some cases, Home Demand helps with an emerging market and creating initial demand. Other instances may indicate where Home Demand can contribute to a more stabilizing and possibly longer-term success.

Related and Supporting Industries

This third determinant deals with the ability of an industry to work with its required suppliers. A base of suppliers in the home market can offer some potential advantages (some short lived), for a company. A supporting industry, if well developed, can offer the nation an advantage for new companies in a particular industry. This is especially true in new areas where products are new and emerging with a growth market. When supplier industries are strong and co-located, they can contribute to efficiencies, speed and cost effective inputs. Porter indicates, "the most important benefit of home-based suppliers however, is in the *process of innovation and upgrading*."⁸ Essentially the ability of a company and its suppliers (or key suppliers) to work closely provides a better response to market needs, and leads to success. This relationship, which can develop out of close geographic proximity, can help a company gain access to information, insight and supplier innovations. Likewise, suppliers gain access to information about markets and products that enable them to innovate around their inputs and processes.

Similarly, the presence of related industries can offer competitive advantages to a nation and its industries. Firms that have similar or identical functions in their value chains can co-ordinate or share efforts, especially in their development efforts. Competing companies can benefit from cost savings, production and innovation opportunities. Complementary industries can benefit from cost savings or innovations that can create new opportunities previously unrecognized.

Firm Strategy, Structure and Rivalry

The fourth determinant in the Diamond, and element of the system, is Firm Strategy. This is the context in which companies are created, organized and managed. Since creating and operating companies varies from nation to nation, it is obvious that some situations contribute to enabling success while others provide less opportunity. There is no right answer for any given industry. Rather, success comes when there is a good fit between management operations and the industries' sources of competitive advantage. This area is very broad and contains influences such as the goals of the company, the investment into industry/companies and the sources and pressures from rivals. Such components are very contextual and need to be assessed within the bounds of the industry.

Government Role in the Diamond

The role of government is to influence the four determinants within the diamond. These influences can be either positive or negative depending on their impact for the industry and the nation. Policies directed at capital markets and education impact factor condition. Subtle influences on the market can support demand conditions. Often, government is a major purchaser of certain goods and services. This is the case with telecommunications. Government offices are major purchasers of services and devices to ensure communications among individuals. Government policy can also shape firm strategy and structure through its impact on capital market regulations, tax policy, and antitrust laws.

⁸ The Competitive Advantage of Nations, Micheal Porter



We have used this Diamond model to assess the telecom industry. After identifying patterns in the telecom equipment industry we used the determinants to assess what areas need focus to improve or maintain Canada's competitive positioning in an ever-evolving industry.

6.3 Government Policy and Porter Diamond

It is significant to understand that government policy can impact a nation's competitive advantage both positively and negatively. Policy only influences what happens. Porter identifies that there must also be proper underlying circumstances that make the industry successful, "Governments do not control national competitive advantage, they can only influence it."⁹

Porter lists several premises that guide government policy to enhance national competitiveness. They are as follows:

- Firms compete in industries, not nations
- A nation's competitive advantage in industry is relative
- Dynamism leads to competitive advantage, not short term cost advantages
- National economic prosperity demands that industries upgrade
- A nation's competitive advantage in industries is often geographically concentrated
- Competitive advantage in a nation's industries is created over a decade or more, not over three or four year business cycles
- Nations gain advantage because of differences, not similarities
- Many categorizations used to distinguish or prioritize industries have little relevance.
- The process of sustaining advantage may be intensely uncomfortable for firms and those who work in them.

In his book, Porter discusses the many ways that government policies influence different determinants of the diamond. It is important to recall that the determinants interact with each other and that no one determinant operates alone to provide a nation with significant or sustainable advantage. Policy areas can actually influence multiple determinants, some positive and others negatively. It is important for policy makers to consider how positive policy in one determinant area may eventually cause undesired impacts in another determinant area. This is not always the case, but as time progresses and industry evolves it is possible. A system is never truly stable. Policy must adapt, but at the rate the industry changes, not as government changes.

6.3.1 Factor Areas

Factor determinants are related to a country's productivity. Companies succeed when they have access to an improving pool of skilled labour, scientific knowledge, economic information and infrastructure. Not only is it important for policy to support these factors in a positive way, but it is also important for firms to upgrade their own factors to enhance their competitive position in their environment. According to Porter, "Nations gain advantage not as much from the factors available today as from the presence of unique institutional mechanism to upgrade them continually."¹⁰

⁹ The Competitive Advantage of Nations, Micheal Porter

¹⁰ The Competitive Advantage of Nations, Micheal Porter



Education and Training

Improving the skills and abilities of the labour pool are significant to enabling higher productivity and increasing competitive advantage in a global environment. This quote from Porter sums up the impact nicely; "there is little doubt from our research that education and training are decisive in national competitive advantage. The nations we studied that invest the most heavily in education had advantages in many industries that could be traced in part to human resources. What is even more telling is that in every nation, those industries that were the most competitive were often those where specialized investment in education and training had been unusually great."¹¹

Following this philosophy, if Canada deems telecom to be a priority industry and is to remain competitive, there is an immediate need to assess their investments in education and research and determine if it is adequate. It is not enough to have the government invest in the educational systems and other mechanisms. It is equally important to ensure that policy links educational system to industry and stimulates the industry to create its own training priorities and investments.

Science and Technology

Improving the economic status of a country is directly related to improving its level of technology. This concept is widespread and well understood. Governments, including Canada, have many policies that encourage and motivate industry to conduct and invest in research and development. In this vein, "Policy to stimulate commercial innovation must go beyond science and technology, and include policy related to competition, regulation and other areas impacting the "diamond."¹² Porter cites that investments and tax incentives are important. However, equally important is creating knowledge sharing forums and activities within an industry and between firms. It is this exchange of knowledge and ideas that stimulates more development and new products. When this happens, the overall economy and skills training improve, thus creating benefits for all companies. It is important in a world where private companies are forced to focus on their own prosperity to demonstrate that efforts around sharing knowledge today will benefit all in the future.

Infrastructure

In our fast paced world of instant communications, infrastructure continues to play a key role. Infrastructure in advanced logistics, transportation and telecommunications are becoming the lifeblood of 21st century companies. This is especially true, as we have noted as companies become disaggregated. As more functionality is shifted out of a single company (to contractors etc.) and often out of the country, the dependency on logistics, computing and communications becomes exponential. These aspects become critical to delivery and that affects competitiveness. If we cannot enable our businesses to have access to the highest quality infrastructure we will fall behind.

It is interesting to note that over the past 25 years, many countries that were considered poor in the 1970's and 80's (relative to North America) made significant investments in infrastructure. India spent hundreds of millions on buildings and telecommunications to stimulate the software industry. Now they house a huge portion of the world's software developers at a fraction of North American costs. South Korea invested heavily in telecommunications infrastructure, and today the average home has 50 Mbps access at a cost of approximately \$30 a month. Not only have

¹¹ The Competitive Advantage of Nations, Micheal Porter

¹² The Competitive Advantage of Nations, Micheal Porter



they developed their electronics industry dramatically over the last 15 years (with Samsung and LG increasing their share dramatically), they are now developing world-class network and application software for mobile technologies. Again, where the average labour cost is below Canada's, they have been able to move ahead. Policy needs to assess if we can remain competitive with the infrastructure we have and what priorities are required to support all our industries.

It is important to note that not all infrastructure is related directly to the business needs. It is important to ensure that our urban centers have a good mix of recreational and cultural infrastructural as well. These aspects become important in attracting talent from other nations. Policy makers need to understand where these complementary areas have an impact on supporting Canadian business.

6.3.2 Demand Areas

"The upgrading of competitive advantage in a nation's industry requires advanced and sophisticated home demand."¹³ As outlined in the Diamond section, demand in a global market benefits directly from strong demand in a home market. Porter's theory is that, as opposed to creating aggregate demand, there is more significance in the demand conditions of an industry. He believes that the principle aim of government should be to improve the quality of the home demand. This in turn will influence foreign demand.

Government Procurement

The most direct impact government can have is as a purchaser of goods and services. The following circumstances demonstrate when government procurement can have a positive influence on an industry:

- Early demand – helping create market for new products
- Demanding and sophisticated buyers – agencies use specifications to seek sophisticated products, not just settling with domestic suppliers
- Procurement reflecting international needs – specifications should be set with understanding of what is valued abroad, so that product development is not focussed on what it is like here
- Procurement processes that facilitate innovation – methods that make innovation easier – enabling government agencies to test new products and gauge market acceptance, issues etc.
- Competition – important to allow some foreign purchases as it forces local companies to innovate and focus on new product development

There is also an opportunity for a negative impact to occur when the government becomes a guaranteed market. The assurance of purchases tends to discourage innovation and competitiveness because of the knowledge that the customer will always be there.

Government procurement has a large role to play in telecommunications due to the importance of the technology to the operations of government. As indicated it is not to say that government should force that purchases be made from local providers. However, if government are not considering/evaluating Canadian products as comparable to foreign products, then we are not aiding our industry efforts to move forward.

¹³ The Competitive Advantage of Nations, Micheal Porter



Stimulating Early or Sophisticated Demand

There are many opportunities for policy to help stimulate markets in the home country. Some examples include establishment of financing agencies for corporations to purchase new advanced products and incentives such as tax rebates or discounts to encourage market adoption of new technology or services. It is important while supporting the stimulation of early markets; to make sure that the product set has attraction to foreign markets. This means that the product set has to be robust enough to be transferable and not something unique to this nation's users only. Another important need is that domestic competition for the products exists. This ensures that companies are motivated to keep improving their products and not become idle.



7 Analysis

7.1 Trends in Telecom industry

Software shift

In essence, telecommunications is evolving in a manner that means transactions between people are facilitated through some type of computing device (even mobile phones are becoming computing platforms). Since the earliest times, man has used communications to share ideas, information and culture. As the ages have passed the methods that support such communications have also changed; hand delivered messages, ships and horses, trains, trucks, planes, phones, and now computers. The desire and needs of the human exchange has not changed as much as the path for sending the message. The increasing number of devices that enable communications creates a more demand for networks that facilitate traffic and applications that support those opportunities. This in turn is creating an industry that is becoming more and more dependent on software, both for applications to enhance the end user experience in addition to delivering fundamental functionality in the network connection capability.

This user environment, coupled with the evolving mobile/cellular technology explosion has created an environment that is dependent upon software to function. In the twentieth century the network for connectivity was predominately hardware based and, toward the end of the 1990s, some software, working on hardware platforms. In the new century, the network components still have these critical factors but important functionality is becoming fundamentally embedded in the software. Hardware becomes simply a means of making the necessary connections to the network. The network is essential, as without it the messages could not flow, but functions that were once embedded in the hardware are being imported to software which then rides on standardized, sometimes commodity, hardware components. To this end, hardware is becoming commoditized and software is becoming the competitive advantage or differentiation point.

Channel Shift

Traditional telecom service providers still deliver many services to the residential and business markets. However, in the business market they now vie with companies referred to as Systems Integrators (SI). SI companies have traditionally delivered computers and services related to the deployment of computing systems (software platforms, networking, etc.) to businesses. Today even smaller businesses rely on these services as technology becomes more complicated and more essential. Many smaller telecom equipment vendors developing technology look to these SI companies to formulate key distribution agreements. Voice over Internet (VoIP), security, wireless LAN or Wi-Fi all benefit from relationships with SIs that can integrate their service offerings with the new technology (installation, network configuration and management). To increase their market share these small technology companies also form relationships with the large OEM/MNE; however they do not limit their channels to this traditional environment.

Capital Pressures

As the industry was growing in the late 1990s there was a large increase in jobs, companies and equipment in a rush to service a predicted exponentially increasing network. However, as the new century was ushered in, this increase did not come to fruition. As a result, new companies trying to create new products have had limited availability to capital in the past 7 years. This would not have been a demanding need in decades past as large companies were manufacturing the majority of products and leveraged capital for research, development/commercialization through a balanced financial portfolio.



As we move forward in the 21st Century the Canadian telecom industry landscape is changing. Due to labour cost pressures and a general outsourcing trend, the new face of the Canadian industry is one of predominately small private companies. Most of these companies are new (start ups) or are older companies that are evolving their products. For the new companies they require funding to initiate their business and commence Research and Development. Twenty years ago, larger companies had sufficient cash flow (or financial means) to start new Research. However for a small company with no history, no sales and the need to fund salaries and other expense, cash becomes a fundamental component. Due to the nature of business, many of these new companies turn to Venture Capitalists for funds. Banks are not traditionally lenders of cash to organizations that have no short-term revenue capability or assets to leverage.

With limited access to funds in Canada, many companies turn to US VCs. Some companies seek these investors to help create the illusion that they are a US company for their potential US customers. Some use this set of sources because they may have contacts or leads. Others use this means when they have exhausted their sources in Canada.

This exposure to foreign markets enables foreign investment but it also positions for a potential foreign buyout. If labour rates are not cheaper here then the foreign buyer may choose to relocate the company, reducing jobs here.

R&D phases, (Ideation, Product Architecture, and Prototyping) can take up to two years to complete. The need to hire qualified staff to complete the work creates a need for cash. During this period a new company has no revenue and must search out funding sources. This is a shift from the former model where large corporations performed the R&D and the afforded the process on the shoulders of their revenue stream from existing products. In order to get through these phases there is a need to have sales staff working with key lead clients who can help define the product requirements and focus the development on key criteria for deployment. Funds are also needed to get through the early commercialization period. Early revenues are needed to sustain the company but also aid in continuing product development/production as well as starting the return on investment for the investors.

7.2 Canadian Telecom Value Chain evolution

Shifting Job Functions

For both the large and small companies, there is less and less physical assembly and testing done in Canada. While companies have retained many of their R&D functions, most companies outsource production and assembly to Electronics Manufacturing Services (EMS) or Contract Manufacturer (CM) companies as they can perform the functions more cost effectively. While many have offices in Canada and some perform high complexity functions here, many complete the bulk of process elsewhere. (It is important to note that a few companies indicated that it can be cost competitive to perform manufacturing in lower cost regions of Canada). There is a rising trend to partner or contract EMS/CM companies to do the New Product Introduction and Prototyping function described in Section 5.2.2, although most companies indicated they have the ultimate accountability and control over these stages. The increasing trend of outsourcing these early development stages had placed a significant demand on documenting processes and testing requirements. In order for the contractor to perform the activities to the level that the OEM would like, there needs to be very clear information with details on the expectations of functions and features as well as design specifications. Many indicated this as an absolute requirement, but one that takes time for to complete.

As noted previously, software is becoming an increasingly more important component of the technology. For R&D functions of the value map, there is a need to hire software engineers. An

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increasing number of the companies are starting to send early design functions and some software programming offshore as well (not necessarily to an EMS/CM). Many indicate that if the work can be segregated and is not integral to main platform functionality, this can be cost effective. There is an indication that outsourcing requires new management techniques, especially if the work is being done in time zones that are opposite to ours, but most indicated reasonable results with their experiences in hiring skills abroad. There was an indication that these skills were not only cost effective to hire abroad, but that it was too difficult to find sufficient labour resources here to complete the work.

Partnerships Intensify

As the number of small equipment vendors and the level of competition increases, partnering with key suppliers becomes more important. In some products, there is a dependency on components for critical functionality or performance specifications. In products where such a synergy exists, the companies have formed partnerships to enable mutual benefits. This is critical in areas where the ultimate performance of the product may enable a competitive differentiation. Companies will form these relationships if there is mutual benefit and where the design company desires to have a superior quality/performance position in their market. Design companies that only require standard or commodity components to complete their projects do not have these types of relationships.

Distribution partnerships have also been on the rise. Partnering to increase market penetration and channels to market is a standard practice in many industries. While telecom has had such relationships for many years, their intensity and numbers are increasing. Smaller companies often produce excellent cost effective technology. However, they do not have the staff/money to develop large sales forces. Instead, these vendors have turned to a variety of channels to enable them to reach the market penetration they need to become stable and profitable. A main distribution channel for network-based equipment is traditional large OEMs (e.g. Nortel). Many smaller Canadian companies rely on this level of vendor to carry them to the traditional carrier and large enterprise customers. Some also use these relationships to enter foreign markets in order to reach larger customers.

Another key emerging relationship is with System Integrators (SI). As noted earlier with voice communications migration to Internet Protocol for transport, there is emerging integration between telecom and computing. System Integrators are a strong channel to reach very large corporations, government bodies and now into Small and Medium enterprises (smaller SIs). For many small vendors this is an excellent sales and marketing channel that often has a close and strong relationship with end-customers. Once the SI can integrate the technology with other components they can reach a much broader market than carriers alone. The evolution of the industry can have traditional carriers, large OEM vendors and SIs targeting the same market (medium and large enterprises). For the small vendor having multiple distribution channels increases their ability to penetrate markets quickly and efficiently.

7.3 Canadian Company Relationships

As part of the analysis of the industry in Canada, it was essential to consider the relationships between companies. As the project focussed on two types of companies, Multi-national enterprises (MNE) and Small/Medium Enterprises (SME), there are four potential relationship types as illustrated below:



Figure 7 – SME and MNE Relationships

Many of the MNEs compete with multiple product portfolios so there is little relationship building between MNEs for mutual gain. However, the industry often sees mergers or acquisitions where one MNE purchases another. This has been common over the last decade. MNEs that were focussed on data networks were often merged with MNEs that were traditional telephony vendors. In addition, acquisitions of strategic software MNEs also had occurred. As the industry is passing through its natural cycles of evolution, there has also been a pattern where MNEs from one country merge with MNEs from other countries. In the ever-increasingly globally integrated economy it has become apparent that there may be more benefit for companies to merge than to compete for the same customers. This has resulted in global job shifting as well as reduced overall job positions in the industry.

The relationship of SME to MNE is one where the smaller companies are producing either components of a larger product, or niche products that complement an MNE product/where the MNE is a distribution channel. In this era of small design companies, there are many who develop high-quality products that fit into a bigger product that is a network component. Certainly as the telecommunications equipment industry evolves to a stronger software oriented place, this is often the case. It is not uncommon for a company to develop an application or software module intended for use with some other product that delivers some network connectivity or device to the end user. This relationship can often start as supplier and become either a partnership or an acquisition of the smaller company by the larger.

In a SME to MNE relationship, the MNE can play a strong and important role in helping the SME access customers. As illustrated in Section 7.2, small companies benefit from the sales channel opportunity that MNEs offer. For the MNE, the benefit is often a product that supports their portfolio or fills a gap that they either have not developed or have been slower in developing. This is a nice balanced relationship where both sides gain in the process.

Based on discussions conducted for this research it is clear that there are strong sets of relationships in the realm of SME to SME. Smaller companies cannot cost effectively develop everything on their own and therefore look to leverage skills and opportunities with other small companies. Collaboration between companies and leveraging complementary products or skills enables them to share the benefits without duplicating functions. This leads to potentially profitable opportunities for the companies rather than a win/lose situation as a result of direct competition. Clustering is a result of such activities. Companies with similar skill requirements or market focus tend to congregate in certain locations so that there are more concentration on a particular type of research or development. Complementary skills are then attracted and a base of those develops thus leading to clusters of companies that develop similar products or complementary products for the same market. As mentioned, clustering occurs naturally when an industry is in a growing and strong position. Canada has had a strong telecom industry for many years and thus there is a core set of skills and knowledge that are still benefiting from these clustered effects in several regions.



The SME to SME relationship is similar to the SME to MNE. Two companies with complementary products may be approaching different markets or have different channel strategies. By forming strategic distribution partnerships they can often increase their market penetration resulting in a win for both players (or a win-win situation).

7.4 Policy and Industry

Policy Influence

Based on private business growth and change, industry evolves. As mentioned earlier, government policy does not form the market or create an industry, but it can be a strong influencer on how an industry evolves. Policy areas vary and many have different impacts. A policy can be set to achieve a focussed set of goals and outcomes, but it may impact other areas indirectly in ways that were not always expected. The diagram below tries to illustrate the flow of the influences and the nature of the system effect that government policy can have on any industry and country.

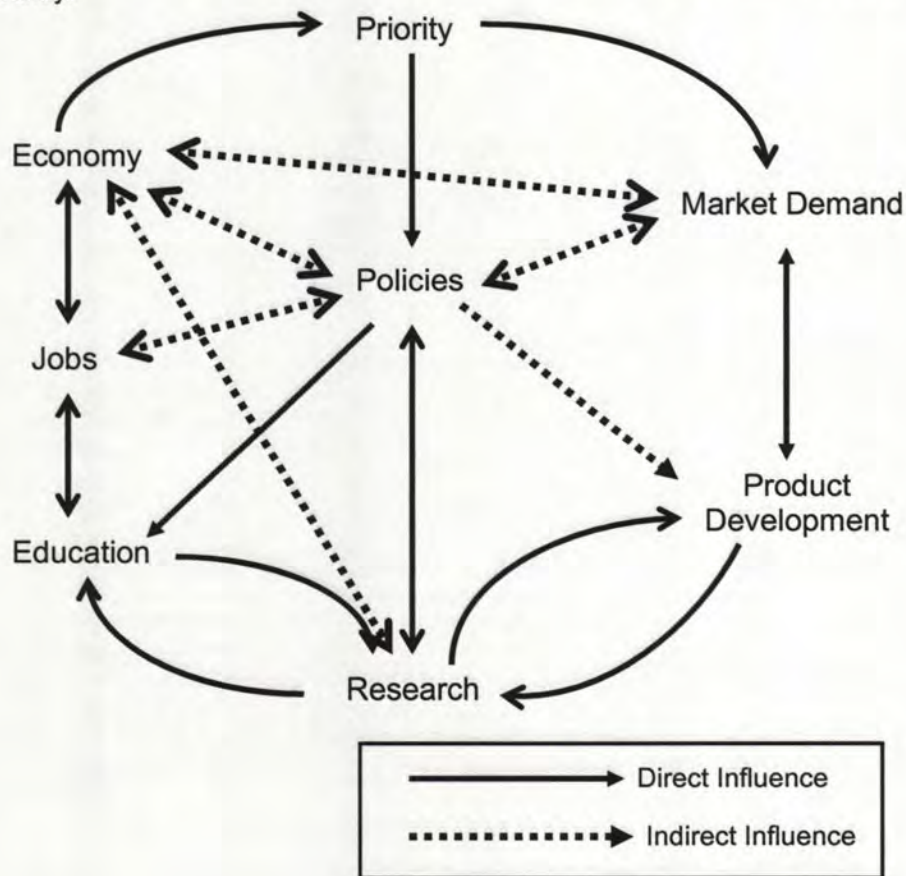


Figure 8 – Priorities and Policy Influence Diagram

In Figure 8 above, there is the expectation that there are overarching priorities that are driving policy decisions and directions in different areas. These priorities can directly influence the marketplace by providing signals to investors and businesses. These signals indicate an

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expectation of investment and future strength, and can drive a market to be created for various services and products. When there is strong market pull there is an increased pressure and focus on development and research (to improve and create new products).

Research and strong economic sectors often drive education. This influence creates a future job focus and directs new research areas. Jobs push the economy, which then in turn pushes on priorities for a nation. As the diagram illustrates, the priorities direct policy. This is especially true of strategic priorities where government needs to consider not only short-term impacts but also the longer-term impacts of their policy. In this manner, policy makers should also consider the indirect influence that it can have on the other areas. For example, policies around education can later impact the types of jobs that an industry creates. Insufficient education opportunities, institutes and direction, can create a shortage of skills in key industries or functions. The end result can have a negative impact on the economy.

What is important to realize about the diagram is the complexity of the indirect influencers and the opportunity that policy makers can influence activities in areas where the policy is not directed.

Diamond and Policy

The Porter Diamond model looks at the system of an industry in four determinants. Table 1 below has linked the different determinant areas of the diamond, with policy areas, using influencers as a connector. Based on the model, government policy has the most direct impact on the industry if it is in an area of Factor conditions and/or Demand conditions. This is due to the fact that these areas impact the business case scenarios for any industry, creating the most direct linkages to policy and priorities. The other diamond areas should not be ignored, as they too, are part of a system, where indirect impacts can be supportive or devastating over time.

Determinants	Influencers	Policy Areas
Factor Conditions	Cost of Labour, access to skills, capital, infrastructure	Education and Training, immigration, foreign investment, tax credits, tax incentives, access to capital (financing options), Innovation and commercialization policy, Science and Technology policies
Demand Conditions	Home market, government purchasing, foreign markets	Incentives (tax or purchase based), innovation policy, procurement policy, International trade, Education/training
Firm Strategy	Organizational structure, location, tax structure, access to capital, knowledge sharing, access to skills	Tax incentives, capital access, tax credits, innovation policy, education, immigration, trade, foreign investment
Related and Supporting Industries	Skills development and transfer, knowledge transfer, infrastructure,	Education, infrastructure, innovation, capital access, tax incentives

Table 1

The key areas of policy overlap are education (which included training), international trade, access to capital, innovation and tax credits. As mentioned earlier the diamond is a system. No one area creates national competitive advantage. Government policy and decision makers need to consider that policy set to aid one set of determinants, may interfere with others.

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7.5 Interview Analysis

Observations

The following list compiles some of the most common ideas that were shared. The list is a collective perspective, and does not reflect a single company view. While not all companies may have discussed each of the bullets, these observations occurred in at least three or more companies interviewed for this research.

- Manufacturing for electronics is increasingly leaving Canada. While we have maintained some aspects of more complex manufacturing, this will be a short-lived advantage.
- New companies often do not even consider manufacturing as they go directly to Electronic Manufacturing Services or Contract Manufacturing companies – this can include aspects of New Product Introduction and late stage design
- Fundamental Research and early design are functions that are still performed here and we are considered a strong resource community for those needs – this is also a time sensitive advantage
- Equipment companies do prefer reasonably close proximity to designers and manufacturers
- MNEs do not specifically target or choose Canadian companies as key sources for their products
- Innovative emerging companies are bought by larger companies before they can grow
- Partnerships have become a key relationship for manufacturers to develop, assemble and distribute their products, especially on a global scale
- Access to higher order skills (software engineering, etc.) are decreasing from a domestic market view
- Trade commissioner services are excellent in aiding companies establish offshore relationships and opportunities
- Access to capital is key requirement and time consuming activity for small companies – detracting them from the important function of producing
- Canada has different labour cost zones – some companies can compete on worldwide scale when they are manufacturing in lower cost regions of the country

Many of the companies mentioned common theme areas in their interviews. Some may have been prompted by the interview guide (see appendix) while the companies themselves initiated others. The table compiles the most common trends with an 'X' entered for each company that mentioned or discussed this trend area. The trends have then been assigned a policy area based on the diamond framework and Table 1 in Section 7.4. Based on the analysis, the four key common areas are: tax credits (SR&ED), access to capital, education and trade. This is in alignment with the analysis of the Porter model, which generically indicates those as major areas of influence on the Diamond system.

These areas for policy focus consider the importance of the market as well as the evolving industry. In order to remain competitive Canadian industry needs to build quality and innovative products. In order to do this, Canada needs an ever-improving workforce. These skills are enabled by a progressive and challenging education system. To compete in foreign markets, firms need channel partners (as described in the sections above) to ensure efficiently and strong access to the end market. This enables the manufacturing company to keep direct sales staff to a minimum, thus reducing overhead costs. For small companies to commence R&D functions in their early years they need adequate access to capital and other financial benefits (tax credits).



Canada has some policy in these focal areas. However, some of the policy areas are not keeping pace with changes within the industry or its fast paced needs. It is important that policy can support industry as it evolves to ensure that our competitive position does not slowly slip away. Some of these policy areas can be managed and have impacts in the immediate term (1-2 years). Others are more strategic, and take time for change to occur. For example, it takes time to actually educate the students, so while a new educational policy may quickly be put in place, it still takes time for the citizens to reach the desired skill and education level.



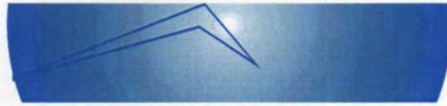
Policy Category	Trend	MNE 1	MNE 2	MNE 3	MNE 4	MNE 5	SME 1	SME 2	SME 3	SME 4	SME 5	SME 6	SME 7	SME 8	SME 9	SME 10
Tax Credits	SR&ED beneficial and key to business	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Access to Capital	SR&ED audit process/timing of reimbursement is unpredictable and inconsistent						X			X	X	X	X		X	
Tax Credits	NPI should be considered a legitimate SR&ED claim		X										X			
Access to Capital	IRAP, SR&ED and other government opportunities are process laden and slow, not keeping up with speed of industry	X	X				X	X		X	X	X	X		X	X
Access to Capital	EDC is helpful to insure international sales	X		X			X		X				X		X	
Education/Skilled Workforce (Immigration)	Qualified and experienced workers are diminishing (current and future snapshots)		X		X	X	X	X			X		X	X	X	
Education/Skilled Workforce (Immigration)	Immigration of specifically skilled people is very difficult and costly		X									X				
Education/Skilled Workforce (Immigration)	Involvement with universities is part of business strategy	X	X	X	X		X		X		X	X				X
Trade	Necessary to deliver to foreign markets (Strategic Customers)				X		X	X	X		X	X		X	X	X
Procurement	Government needs to be a customer			X					X			X		X		
Trade	Virtual trade commissioner is valuable, but not promoted								X	X				X		

Table 2 – SME/MNE trends



The following list expands on the items in Table 2 above. The table groups the common areas to derive the link to policy areas.

- SR&ED beneficial and key to business
 - Small companies often rely on the credit as a key portion of their financial balance sheet
 - Required program that benefits companies, research community and economy, and thus should continue to focus on supporting industry
- SR&ED audit process/timing of reimbursement is unpredictable and inconsistent
 - Auditors change too often and many do not have good understanding of the products or industry before starting the evaluation
 - Process is overly complex, often consumes excessive valuable productive time and is based on knowing the "right" language to ensure approval
- New Product Introduction should be considered a legitimate SR&ED claim
 - As industry evolves this process has become more experimental, despite market interaction
 - For some companies this effort generates new impacts for further research and development but seems not to be considered an eligible cost
- IRAP, SR&ED and other government opportunities are process laden, slow, and do not keeping up with the speed of industry
 - Processes are not good fit with the pace and speed of the industry
 - Need to consider the context of the applicants and create mechanisms that meet as best with their needs while ensuring required accountability
- EDC is helpful to insure international sales
 - This is a useful service and well understood
- Qualified and experienced workers are diminishing (current and future snapshots)
 - Declining enrollment in engineering, applied sciences and technologist schools
 - Reduced access to skilled workforce makes it easy to invest in foreign operations, outsourced operations
- Immigration of specifically skilled people is very difficult and costly
 - Many companies encountered large difficulties with immigration when bringing in highly skilled persons with good credentials, essential to the companies research and development capabilities
- Involvement with universities is part of business strategy
 - Companies need the skills and they work to develop them prior to entry to workforce
 - Canada benefits from industry based participation with teaching institutions to produce higher quality and quantity of skilled labour
- Necessary to deliver to foreign markets
 - Despite manufacturing good, competitive products, the Canadian market is often too small for most companies to make profits they desire or need
 - Small market influences the desire to supply internationally, thus products must have universal appeal
- Government needs to be a customer
 - Government procurement stimulates domestic and foreign markets positively



- Policy does not have to ensure purchases but should consider Canadian companies for all product/service opportunities – indications from discussions is that Canadian companies are sometimes not given fair chance
- Canadian companies have a difficult time making it onto the standing offer list, and therefore it is easier to buy from large competitors who are already listed
- Virtual trade commissioner is valuable, but not promoted
 - Those who used this service found it very beneficial
 - Some that used it indicated they “stumbled” onto it and it is not well understood
 - Those that had not used it did not seem to know much about it.



7.6 Strengths, Weaknesses, Opportunities, Threats

After reviewing general industry trends, the Canadian environment, and holding discussions with the targeted 15 companies, the following SWOT was developed for the Canadian telecom industry.

7.6.1 Strengths

Quality skills/labour pool for Research & Development and product commercialization

Historically Canada has developed solid labour resources with strengths in the telecom industry. Our post secondary education system produced quality engineering and technical resources to support the industry. Canada has had research and knowledge sharing institutions that help support the industry and enhance skills development.

Canadian reputation as telecom leader

Our strong labour resources enabled a global reputation as a leader in technology and product development. This reputation has aided in bringing in foreign investment to Canadian companies. During the boom years, this was important and has become even more critical in the last five years. Due to limited access to venture capital funds in Canada, many companies have turned to the United States for financial support. The strong historical record and recognition of capability has enabled Canadian companies to benefit.

Proximity to the United States

Having a market that is more than 10 times the size of your own national market adjacent to you is an excellent strength to leverage. The physical ease of moving people and product to this large market creates a more financially stable environment for Canadian companies. Many companies not only access funds from the US but also use the proximity to the larger market to appear as if they are a US based company.

Infrastructure to support companies

In urban settings we have sufficient infrastructure to support the needs of companies. Infrastructure items include shipping, transportation and communications. In our larger areas all of these are sufficiently developed, thus enabling Canadian companies to be able to move their products to the national and international markets. In less dense rural areas there are some gaps, but impact is limited as there are fewer companies in these locations.

Strong trade programs for support in International markets

There are several indications that service provided by the trade commission offices have been invaluable in aiding companies to develop foreign markets. The officers have handled introductions and references for some companies. In others they have worked to identify the key partners for identified functions and helped companies to close the deals. This service is beneficial and should work on increasing its profile to aid more companies in more international endeavours.

Strong policies for SR&ED credit

To date Canada has had a good credit program associate with R&D. The program helps companies claim credits and develop a return on research investments. This program has been of great benefit to many companies large and small. The program should continue to develop through working with industry to understand the evolving research and development functions in Canada.



7.6.2 Weaknesses

Education not keeping pace with evolving technology

Despite having historical strength in labour resources this area is starting to fall behind world standards. We are producing fewer engineers in general and software specifically.¹⁴ Since the industry is evolving to contain a much higher degree of software, this is a key area. Strategic investments by other countries years ago, are resulting in increased employment opportunities, often at lower costs. This has the impact of shifting jobs away from Canada in favour of these low cost regions (India, Korea, China, etc.) When cost is the only factor, there is limited out migration of jobs. However, many of the companies indicated that the quality of the software designers/engineers in these countries is meeting their expectations, thus increasing the migration.

Domestic market is limited

The Canadian market is small compared to many foreign markets thus creating an environment for limited opportunities. With the increase in small companies, many are producing products that compete, even if only peripherally, dividing a small market further. It is essential for companies to look at foreign markets. This requires strong policies and programs that assist companies' especially small ones in expanding into foreign markets.

High Labour Cost

Certainly in many of the larger centers in this country, our costs are higher than some of the off shore countries mentioned earlier. As noted, some foreign locations have invested for many years and the results now coming to fruition. Engineers, technologists and software programmers are becoming almost as effective as those here in Canada. This, combined with the current lower cost of living in these countries, results in the ability to have the work done there at less cost. These savings help the product companies remain competitive in a global marketplace. Manufacturing started leaving Canada and other high-cost countries more than a decade ago. While there is still manufacturing in Canada, it is on a small scale, with most facilities that operate here having fewer jobs then previously. Based on our analysis, the design and product development functions of telecom equipment appear to be heading in the same direction.

Too difficult to find services and stay informed

The government has a number of different services available to companies and those who have used many of them indicate they have resulted positively for the company. Some firms have expanded into foreign markets, while some have accessed cash (IRAP and BDC) to get their companies started and product ideas developed.. Users indicate that had they not had prior knowledge or "stumbled" into finding out about the service, they may have never found it. For smaller companies working in this fast paced and intense environment, searching for services is too costly in terms of time. Due to the pressures of cost of labour and competition, most companies have to focus on delivering their product and securing customers. This does not leave much time to search for programs/opportunities and contact the right people.

7.6.3 Threats

US Market is diminishing

Although this seems unlikely, there is rationale for this concept. With more products being developed by more companies, the market share potential for any one company decreases. In

¹⁴ http://www.ocri.ca/email_broadcasts/newsreleases/012006news_e.html



addition, with the evolution of technology moving away from telecom as a separate network from computing, the market shifts as well. This creates a unified market (where there were really two before) resulting in a lower overall size. A focus on technology that is suited to this new computer communications network is required. Canada does not hold the strongest global position in current development on these software and hardware products. Without renewed focus on priorities for the longer-term future, Canada will not shape its education, knowledge sharing and financial policies in the directions that may be needed.

Processes too bureaucratic, companies not benefiting

When programs like the SR&ED credits become too cumbersome, they end up hindering companies rather than helping. Many indicated that they relied on the credits to support their bottom line financials in the early years. When the process takes a long time to deliver the cash and comes with difficulty in preparing the documentation, this hinders companies' effectiveness. Many users indicate that it takes months to prepare for the audit (these were small companies) and if the wording is not precisely what is needed their applications are rejected or more depth is required. Methods to streamline this process, while ensuring adequate documentation is produced, are desperately needed. All programs that deliver cash (either as credits or as grants/loans) need to ensure that they have processes that fit with the environment of the private sector while ensuring adequate documentation and accountability. Processes that focus on the later, not recognizing the time sensitivity of the money on the business, do not deliver the best solution for the industry.

Lack of strategic focus of policy for promoting Canadian telecom industry

Policy that does not focus on the long-term scenario does not provide adequate opportunities for the industry. The impact flow is documented below. Thus, government policy should align with a set of priorities that have long-term view of what future environment is desired. Priorities drive markets that drive research and development. This in turn drives the economy that should then drive future priorities. Government priorities should also drive policies. The policies then have direct and indirect influences on most of the other aspects. These influences impact how the businesses function and their viability.

7.6.4 Opportunities

Innovation capital funds help continue development of new areas

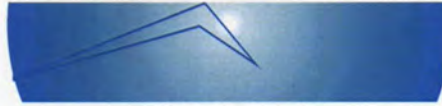
To date there have been programs that have offered funding for new research and product development. Continuing to ensure there are programs in place is essential to helping for the future. Programs should be managed to be easy to implement for both the applicant and the government. Focus should be put into priorities with funds dedicated towards those priorities.

Marketing Strategy for government services

Many companies indicated that they did not know about some programs or had difficulty finding information on programs. There is an opportunity for the government to develop a marketing strategy specifically focussed on small and medium companies that would communicate the variety of programs available (across different departments) that may help them expand or even start their business. With programs available from a variety of different departments, with very different mandates, it is difficult for the businesses to understand which ones will offer the best benefits.

Focus on new skills development

Government needs to enact policies that support the future skills required for the industry. Policy needs to develop education and knowledge sharing forums that will boost the skills development



for the future. Immigration policy should support assisting people with the needed skills to enter the country.

Encourage government to buy Canadian

Many companies indicated that it is harder to sell to a Canadian government body (local through Federal) than it is to a foreign government. Government purchases play a key role in formulating the Demand dimension of the Diamond. Without this opportunity Canadian companies, especially small companies, not only lose a sale but also the ability to leverage the credibility that comes with supplying to their own governments. Policies that encourage Canadian purchases can be viewed as anticompetitive, however many foreign governments find ways to support their SMEs through procurement policies.

Evaluating Canadian companies against others should not be precluded. Some companies indicated that they believed they were not fairly judged in procurement requests against foreigners. They indicated that their technology matched if not was better yet a foreign supplier won. Their perception is that in order to appear that the government is not favouring Canadians they purposely de-value the Canadian products.



8 Recommendations

Education and training are a priority factor for the telecommunications equipment industry or indeed any high-tech, high-value sector.

In developing policies around education and training, government needs to consider what it wants the industry in Canada to look like in the future and work backwards (over 10 years) to strategically align policies and programs. In the near-term government and industry should consider methods to stimulate increased enrollment in computer science and engineering over the next 3-5 years. The long-term strategy for education and training related to the telecom industry should look at public-private partnerships on research and other institutions that enhance knowledge sharing and advanced education opportunities. Also, emphasis should be given to programs that focus on on-going development of skills in the areas of software engineering, architecture development and security for workers already in the sector.

Increase access to capital for Canadian telecommunications companies as a means of increasing Canadian development capacity.

A major component of small companies' ability to launch research and development is access to capital. Many have to rely on venture capitalists due to the difficulty in raising funds. A variety of programs exist (BDC, EDC, etc.) but should be better communicated and aggregated. Small companies often lack the resources to search out all possibilities and many do not understand how government departments or agencies are set up. There is little co-ordination between departments offering cash (under different terms) and programs that offer loans or grants.. A new approach could leverage investment from different departments streamlining the delivery through a single agency and reduce reporting requirements from the company. A process that engaged the industry, working with their industry or regional agencies would be beneficial to these small companies who may not understand how to find government opportunities.

Review and update SR&ED program to reflect the new business models in effect in the Telecom industry.

SR&ED tax credit is a fundamentally important mechanism. This process is a credit however, which means that the benefit is accrued after the work is done (unlike the need for capital indicated above). It is the lifeblood for many smaller and newly started companies. However, the bureaucracy and overheads in the process make it difficult and time consuming for companies to engage in the process. New means of implementing the program, which align with the industry and its language and modus operandi, should be considered. The incentive is meant to help stimulate activity and thus its managers should work in a mode that fits with the industry, while enforcing reasonable accountability.

Enhance the SR&ED program to provide incentives that work with industry structure.

The definition of what is Research and Development needs to be reviewed. Many of the industry activities completed are considered parts of the development stage. However, the program is geared towards scientific research. If this program is not designed to handle the dynamics of the industry, which are broader than scientific research, then a new program with more focus on commercialization and innovation should be considered. Such a program would review development activities such as prototyping and New Product Introduction as applied research/development and look at providing some type of incentive or credit for those activities.

Promote the purchase and utilization of Canadian technology and products by all Government departments.

All levels of government need to ensure that they actively investigate Canadian companies offering technology comparable to foreigners when engaged in procurement activities. This activity aids in stimulating the demand markets for Canadian solutions. They should also offer to



engage in lead customer design focus, and in aiding in credibility with the larger market. Canadian companies do not necessarily have to be given preference but should be evaluated equally with other competitors. Another focus would be to streamline the process of standing offers for Canadian companies.

Government should improve alignment and marketing of programs that deliver complementary services to companies.

The variety of agencies and departments with programs should work collaboratively. Services like EDC and Trade commission should work together to ensure that companies working abroad (or investigating expansion abroad) know of all the service available to them. Small companies often lack the resources and knowledge of the broad base of services available to assist them. Developing foreign markets is a requirement to success for many of these companies as they rely on a market bigger than Canada to stabilize their revenue streams and grow their business in a highly competitive global environment. One potential mechanism is to develop programs where government agents visit with companies, through face-to-face discussions to ensure that companies increase their knowledge of the opportunities with government.. Such a method would ensure that companies with limited resources are informed, and at the same time enables the government to keep pace with the evolving industry and its pressures and concerns.



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Appendix A – Interview Guide

Question	Response	Diamond Fit
How much product do you ship internationally? How does national/local market help focus innovation and future opportunities?		Demand
- Do you find a difference serving int'l customers vs domestic customers?		Demand
- How does international competition impact your position in the chain? What resources help you be competitive?		Demand
- Does operating within a global supply chain require different investments in capital? Workforce? Other resources?		Factor
- What factors are the most important when considering companies as suppliers?		Factor
How do your business linkages impact productivity, costs, jobs, and skills?		Factor
- How does access to skilled labour impact the establishment of your business/offices? How do your labour assets provide an advantage in operating in a global supply chain?		Factor
-In what ways do suppliers from other countries meet your needs as a growing/competitive company?		Related Supporting Industry
-Have you considered changing your Canadian function(s) in the supply chain? Can you think of any triggers that would make you consider shifting your position?		Factor
- What factors do you consider in developing next generation products and new products? How does a global supply chain support you in these activities?		Strategy
- How do the supply chain connections impact innovation/product development for you? For Canada?		Strategy
- How do partnership agreements work into your decision making process for selecting suppliers?		Strategy
Have you shifted any supply relationships in the last five years? What were the factors in making those changes? Were Canadian companies considered as suppliers?		Related Supporting Industry
-How do you define your competitive advantage for your role in the supply chain? Does operating in Canada provide benefit to that advantage?		Strategy

Do you have a Canadian supplier that you would recommend we include in our list of companies to interview?

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