A VISION OF HIGH -TECHNOLOGY ACTIVITY IN EASTERN ONTARIO DURING THE PERIOD FROM 2000 TO 2030

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The greater Ottawa area currently has about 72,000 high-technology employees and if previous growth trends continue, that number could exceed 425,000 by the year 2030. The greater Eastern Ontario area (the area bounded by Cornwall, Napanee, and Pembroke, but excluding Ottawa) currently has about 6,200 high-technology employees and that number could exceed 36,000 by the year 2030.

About 30% of this projected employment would be in Kingston where the emergence of a strong Life Sciences industry is predicted. Its prospects will be heavily dependent on the building of a stronger venture capital industry in Canada, particularly one that is more knowledgeable in the Life Sciences industry and more dispersed throughout Ontario.

Renfrew County and Lanark County are predicted to grow almost as rapidly as Kingston but their growth will be heavily influenced by the expansion of Ottawa's telecommunications industry, most of which is (and will be) located in the western part of the greater Ottawa region. Another major influence will be entrepreneurs who establish new companies after accumulating pools of capital through stock ownership with their current employers. It is predicted that Lanark County will grow from 900 employees to 5,000 employees, and that Renfrew County will grow from 1,000 to 6,000.

Brockville already has a strong presence in telecommunications and in electronic assembly. It is predicted that its employment will grow from 2,000 to 10,000.

Cornwall is predicted to have a strong electronic assembly capability. Its employment is predicted to grow from 550 to 2,100. C-MAC Industries of Montreal recently expanded into Cornwall and this could push the 2,100 figure much higher.

Hawkesbury has the potential of capitalizing on Ottawa's photonics industry which is predicted to expand into the eastern part of the region and on the National Research Council which is aggressively pursuing the commercialization of its technology.

There will be two corridors of activity along Highways 416 and 43. This area currently has about 200 employees and this number is predicted to grow to 1,000. It could be much higher if the Ottawa technology cluster expands south of the airport.

There are certain potential accelerators like improved venture capital and new local economic development strategies that could push the 36,000 figure to 44,000. There are also some potential decelerators like increased brain drain and deteriorating currency valuation that could reduce the figure to about 29,500.

1. INTRODUCTION

This report is an attempt to describe the high technology industrial activity that could occur in Eastern Ontario between the years 2000 and 2030. It is intended to assist policy makers at all three levels of government who are likely to be in a position to influence that activity. It will also be helpful to those who are responsible for providing supporting services such as education, transportation and communications and to suppliers of high-technology products and services.

Because such activity will be so heavily impacted by the Ottawa technology cluster (OTC) the report will dwell at length on how it might evolve during the period under study. The current impact of that activity on the region is limited mostly to those communities that are within commuting distance of Ottawa. However, as the OTC continues to expand and as communities throughout Eastern Ontario come to realize its potential as a market for their products and services, nearly every community in the Cornwall/Napanee/Pembroke triangle will be heavily impacted by it.

The report will deal primarily with the OTC influence. Obviously, many of the areas will be impacted by other technology clusters, particularly those in Montreal and Toronto.

A study carried out by Doyletech Corporation in late 1999 indicated that the OTC purchases approximately $2.4 billion worth of products and $1.5 billion worth of services annually just for use in the actual supply of its own products and services. In other words, those figures apply only to the accumulated cost of goods sold (COGS) for the 1,000 or so companies that made up the OTC at the end of 1999. There are additional opportunities to sell products and services to those companies; for example, they purchase sales and marketing materials, capital equipment and fixed assets, as well as legal and accounting services. However, the Doyletech study was limited to COGS purchases because they are easier to quantify, they represent the largest single item of expense on a high-technology company's income statement and they are continuous in nature. They therefore represent the largest single sales opportunity to outside suppliers.

Because there is a great deal of confusion on the part of industry observers about what constitutes high-technology activity, it is important to begin with a definition as it will apply to this report.

2. A DEFINITION OF HIGH-TECHNOLOGY ACTIVITY

There are several organizations throughout the world that track high-technology industrial activity. The major ones are the Organization for Economic Co-operation and Development (OECD) and the U.S. Department of Commerce, both of which use research and development (R&D) intensity as the key metric. In fact, the U.S. Department of Commerce uses two definitions, one based on products and another based on industry sectors. For the product classification, all those products which require a certain level of R&D (usually 10% of sales or greater) for continued market presence are classified as high-technology products. For the industry sector classification, all those products that come from a sector that spends beyond a certain level of sales on R&D (again usually 10%) are classified as high-technology products. The latter is a broader definition because there are many companies that supply both low-technology products and high-technology products and that spend in excess of 10% of sales on R&D. Their sales tend to all get classified as high-technology sales.

One of the shortcomings of all definitions when it comes to economic impact is that they refer mainly to products and not to services because products are more easily exported than services and therefore dominate trade figures. As the Doyletech study revealed, there are plenty of sales opportunities for services as well as for products, particularly within a local market such as the one being discussed here.

The definition that will be used in this report will be focussed on individual companies and will parallel that which is currently used by the Ottawa Economic Development Corporation (OED). It is not limited to those companies that spend beyond a certain threshold on R&D nor is it limited to products. The best way to describe the OTC definition is that it includes all those companies that employ people who would normally be in demand by those companies that do spend more than 10% of sales on R&D. For example, a firm engaged in consulting work would be classified as high-technology if most of its employees could be recruited away by a firm such as Nortel or Alcatel. . If a given firm gets classified as a high-technology firm, then all of its employees automatically get classified as high-technology employees even though they are not all performing R&D activities or activities that require advanced technical skills.

It is not a perfect definition for either companies or employees, but it is one that seems to work for OED. It is also fairly compatible with definitions used in other high-tech centres such as Boston, San Jose, Austin and Calgary. It therefore facilitates comparisons of the various centres.

Using that definition, the OTC currently has about 1,300 companies (October 2000) and they employ about 72,000 people. By way of comparison, Silicon Valley in California employs about 600,000, Austin about 150,000 and Boston about 250,000. So Ottawa is still relatively small by North American standards but if one uses either R&D per capita or exports per capita as the criterion for high-technology performance, Ottawa can clearly claim the title of the high-technology capital of Canada. Another characteristic of the OTC is that it is much more export-oriented than its counterparts in Montreal and Toronto because a large percentage of the high-technology presence in those cities is made up of foreign-owned sales subsidiaries. The OTC therefore offers better opportunities to Canadian suppliers of goods and services. Other clusters with a strong export orientation are located in Calgary, Vancouver and the Waterloo/Guelph/Cambridge area. The latter is referred to as Canada's Technology Triangle (CTT) and has 380 high-technology companies and 7,000 employers. (Source: Ottawa Citizen, July 31, 2000)

The outlying communities have about 100 companies and they employ about 6,200 people. There is very little linkage between the OTC and the outlying communities at this time. Hopefully, this report, along with the Doyletech work mentioned earlier, will improve that linkage.

3. A SEGMENTATION OF OTTAWA'S CURRENT HIGH TECHNOLOGY ACTIVITY

OED categorizes the OTC activities into seventeen sectors as follows:

1. Aerospace, Defence and Security Technology – The major defining characteristic of this sector is that the purchasing authorities are mainly government agencies involved in aerospace and security.

2. Computer Hardware – This sector includes manufacturers and distributors of computer systems and their component parts.

3. Electro–Mechanical Technology – The major defining characteristic of this sector is that the products typically include a combination of electrical and mechanical parts.

4. Electro-Optical Technology – The products are a combination of electronic and optical components.

5. Energy Technology & Resource Management – Companies in this sector are engaged in the generation, transmission, or transformation of energy of various types.

6. Environmental & Geosciences – Examples of companies in this sector are those that supply water purification systems or systems for measuring ground water contamination.

7. Industrial Technology Processes and Manufacturing – Companies in this sector supply instrumentation and solutions to a wide variety of industrial and fabrication measurement problems, ranging from air monitoring to precision machining & measurement.

8. Information Technology Components, Sub Assemblies, and Controls – These are suppliers of physical deliverables that typically form part of larger systems that are used to solve problems in the information technology industry. Such deliverables can be hardware products such as microwave devices or software products such as tools for designing electronic circuits.

9. Information Technology Systems – The deliverables in this sector are usually large and complex systems, both hardware & software, which require a great deal of project management skills and supporting technical resources.

10. Internet Technology & E-Commerce Specialists – The major defining characteristic of this sector is a detailed knowledge of internet technology on the part of the suppliers.

11. Medical & Biotechnology – Companies in this sector supply products and systems that are in some way related to the delivery of medical care or the application of biotechnology.

12. R&D Laboratories, Testing & Measurement – These are companies that provide a wide range of evaluation, test and measurement solutions. Customers may be in any field of technology.

13. Software – This sector includes companies that provide software products, services, or systems to a broad range of markets. It should probably be segmented further for this analysis because the income statement models are very different for each of the above activities.

14. Technomedia – The major defining characteristic of this sector is a knowledge of the application of technology to multimedia solutions.

15. Telecommunications, Satellite & Mobile Communications – This sector includes companies that design, manufacture and distribute products and systems that are in some way related to the solution of communications problems. Customers range from individual consumers to educational institutions to telephone companies.

16. Transportation – These companies supply products and services that exploit technology for the solution of transportation problems. Examples are information systems for couriers and mobile data terminals for police and fire departments.

17. Other – This is a "catch-all" category used to capture companies that do not fit in any of the above sectors.

This categorization will undergo significant change in the next thirty years just as it has in the last thirty. For example, the following sectors would have been non-existent (at least in their current forms) thirty years ago: Electro-Optical Technology, Internet Technology and E-Commerce Specialists, Software, and Technomedia.

It is reasonable to assume that in thirty years time, at least half of the seventeen sectors will be replaced by new ones and that some of the newer sectors (especially Electro-Optical Technology) will survive and will be broken into other sectors. There will be a sector entitled Video Communications (or something similar) as video communications over the Internet and other broadband media become more and more practical. There certainly will be a sector entitled microelectronics (there should be now) that includes the companies that design and distribute semiconductor devices and related components and systems. An attempt will be made in a later section to forecast the major technological developments that could impact on the OTC activity over the next thirty years.

4. CURRENT OTC SALES AND EMPLOYMENT BY SECTOR

Of the seventeen sectors, Telecommunications, Satellite and Mobile Communications is by far the largest, accounting for about 37% of total employment and almost 40% of total sales.

Figure 1 is a listing of employment and sales by sector as determined by Doyletech Corporation in late 1999. It should be noted that the total employment was 56,949 at the time of the analysis. By October of 2000, the figure had grown to over 72, 000 but the breakdown by sector has not been upgraded.

Figure 1 – OTC Employment and Sales by Sector

Sector	Employment	Sales Per Employee (000's)	Sales ($ Millions)
Aerospace, Defence and Security Technology	2,823	190	536.4
Computer Hardware	764	180	137.5
Electro-Mechanical Technology	361	150	54.2
Electro-Optical Technology	6,279	225	1,412.8
Energy Technology & Resource Management	74	150	11.1
Environmental & Geosciences	353	150	53.0
Industrial Technology Processes and Manufacturing	759	150	113.9
Information Technology Components, Sub Assemblies, and Controls	2,496	200	499.2
Information Technology Systems	12,051	215	2,591.0
Internet Technology & E-Commerce Specialists	2,450	150	367.5
Medical & Biotechnology	1,489	120	178.7
R&D Laboratories, Testing & Measurement	427	200	85.4
Software	5,035	235	1,183.2
Technomedia	362	150	54.3
Telecommunications, Satellite & Mobile Communications	20,945	225	4,712.6
Transportation	226	120	27.1
Other	55	120	6.6
Total	**56,949**	**Avg 211**	**12,024.5**

5. OTC GROWTH PROJECTIONS BY CURRENTLY DEFINED SECTORS

The OTC employment has grown at an average compound annual growth rate (CAGR) of 6.5% over the past thirty years. Because of the sharp employment increase between October 1999 and October 2000, a realistic method of projection would be to apply a 6.5% CAGR to the average of the 1999 and 2000 figures which is 64,500. This results in a 2030 figure of 426,000. The same result can be obtained by applying a 6.9% CAGR to the 1999 employment figure of 56,949. This is what will be done later when 2030 projections are done by sector. The reason for using the 1999 figures is because employment and sales breakdowns by sector are only available for 1999.

It is generally assumed that every high-technology job creates three indirect jobs. However, that level of spin-off is probably optimistic in the case of the OTC for two reasons. The first is that when this multiplier is used, a much more restricted definition of a high-technology job applies and the second is that a great deal of supporting infrastructure is already in place and it will not grow as fast the OTC itself. In fact, many of the 426,000 direct jobs are really infrastructure jobs (e.g. printed circuit board assembly). However, even if the multiplier is only 2, the high-technology industry could account for about 1.2 million jobs in 2030. This is not grossly out of line with the OED population projections which call for about 1.7 million residents in 2030. A more realistic number would appear to be 2.5 million. This would put the direct high-technology employment at 16% of the total population as compared to about 10% today.

5.1 IS A 6.5% COMPOUND ANNUAL GROWTH RATE SUSTAINABLE?

The rate at which the OTC will grow in the next thirty years is dependent on several factors, some of which are unknown at this time. However, in the near term, the following will be the most important:

- The growth rates of the key markets being addressed by OTC companies.
- The availability of skilled people.
- The availability of risk capital.
- The availability of privately-funded infrastructure (e.g. housing and commercial buildings).
- The availability of publicly-funded infrastructure (e.g. roads, schools and hospitals).

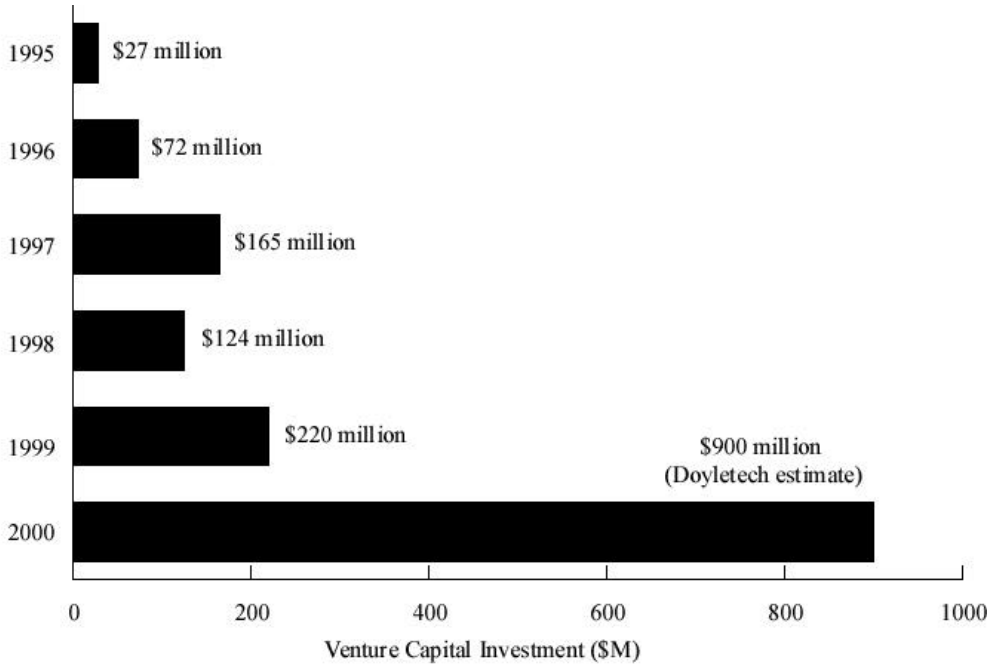
To address the issue of growth rates of key markets first, the ones that will be most important to the region in the foreseeable future are Electro-Optical, Information Technology Systems, Software and Telecommunications. Their growth rates all exceed 20% per year at this time. According to Industry Canada (Competitiveness Profile) the Canadian telecommunications equipment sector had a CAGR of 6.6% between 1981 and 1995. At one time, the OTC's high-technology activities were heavily focussed on defence markets but they currently account for only about 3% of total sales and employment. The OTC is in the fortunate position of being heavily focussed on the high growth sectors. If market growth were the only determinant, a much higher projected growth rate could be justified.

To address the issue of skilled people, Ottawa should have no difficulty in accommodating a 6.5% CAGR. While it may be unreasonable to expect the local colleges and universities to produce graduates at this rate, the city has no difficulty in attracting graduates from nearly every part of Canada. Also, there are now more than 30 private training schools operating in the OTC that are focussed on retraining workers. Companies will have to do more training than they do now. Smaller companies are particularly delinquent in this regard, but this is because most of them are inadequately funded. As the venture capital industry matures this problem will be addressed.

Regarding risk capital, the explosive growth of such capital invested in the OTC in recent years has been well documented (see Figure 2). The impact of the increased flow is

evident in both the number of companies being created and the increased employment. Doyletech estimates that the number of companies created between the period from October 1999 to September 2000 exceeds 100 or 10% of the total number of companies. Total employment increased from 57,000 to 72,000 during that same period, which translates into a 26% growth rate. It would appear that about a third of the 15,000 new employees are due to new company formation and two thirds to the expansion of existing companies. This would suggest that the 100 new companies created about 5,000 new jobs. So the venture capital sector seems to be working.

Figure 2: Total OTC Venture Capital Investment (1995-2000)



Source: Mary Macdonald & Associates, company press releases and other sources.
2000 estimate by Doyletech Corporation.

Regarding privately-funded infrastructure, Ottawa has always had a very sophisticated supply capability and this is not likely to be an impediment. However, many of the builders, land developers and property managers are poorly informed about where the growth is likely to be in terms of geography or facility requirements. This could result in temporary shortfalls during the next thirty years but the industry should have no difficulty in supporting a 6.5% growth rate.

Publicly-funded infrastructure could be another story. Ottawa has not experienced this kind of growth and change since the second world war and government authorities at both the federal and provincial levels are reluctant to accept it as a long term trend. One result could be traffic congestion on a scale that will cause the area to lose its attractiveness. The lack of suitable schools and health care facilities will have a similar effect.

Local government must do everything in its power to keep higher levels of government informed of possible future needs. It must also be prepared to adjust its own planning variables to accommodate this level of high-technology employment or face the fact that some of it will occur elsewhere. As stated earlier, the current regional plan calls for a total population of 1.7 million by 2030 and this figure appears to be too low. A population figure in excess of 2 million would seem to be more appropriate and with the right planning, it could be accommodated without any deterioration in quality of life. It may require a totally new approach to the funding of infrastructure. The high-technology industry generates much more tax revenue for higher levels of government than for the municipal level and it is probably unreasonable to expect municipalities to assume as much of the costs (and risks) as they do at the present time.

In summary, a 6.5% CAGR is probably reasonable, if not overly conservative. The major uncertainty would appear to be related to the availability of publicly-funded infrastructure. (By way of comparison, the CAGR in Austin, Texas during the past twenty years has been 12%).

5.2 PROJECTED GROWTH BY SECTOR

Figure 3 provides an estimate of how the 426,000 direct jobs will be broken down by sector in the year 2030.

Figure 3 – 2030 Projected Employment by Sector

Sector	Current Employment (1999 Doyletech Nos.)	Projected CAGR (%)	Projected Employment in 2030
1. Aerospace/Defence	2,823	3	6,852
2. Computer Hardware	764	6	4,388
3. Electro-Mechanical	361	4	1,170
4. Electro-Optical	6,279	8	63,183
5. Energy	74	4	2,400
6. Environmental	353	3	857
7. Industrial	759	4	2,462
8. Info Technology	2,496	8	25,116
9. Info Technology Systems	12,051	6	69,215
10. Internet Technology	2,450	10	42,751
11. Medical and Biotechnology	1,489	9	19,755
12. R&D Laboratories	427	6	2,452
13. Software	5,035	7	38,327
14. Technomedia	362	10	6,317
15. Telecom	20,945	6.5	138,446
16. Transportation	226	6	1,298
17. Other	55	6	315
Total	**56,949**	**6.9**	**425,304**

The following are some explanations for the growth rate assumptions.

- ***Electro-Optical.*** There has been considerable growth in this sector in the past year. The current employment is likely closer to 10,000, which means that a growth rate of less than 6.5% would be adequate to provide the 63,183 jobs projected for the year 2030. This is one of the most difficult sectors to predict because it will be impacted heavily by changes in the technology, the products and the markets.
- ***Information Technology Components, Subassemblies, and Controls.*** This sector includes "fabless" semiconductor manufacturers like MOSAID and Tundra Semiconductor. Canada has developed a strong expertise in this area and the sector could grow at a much higher rate than the 8% predicted here.
- ***Internet Technology.*** A high growth rate has been applied to this sector to reflect the impact of new technologies such as video.

6. THE OTC IN THE YEAR 2030

A report issued by The Ottawa Partnership (TOP) in the spring of 2000 identified the following clusters as the future economic generators for the region:

- ***Telecommunications Equipment.*** This would parallel the Telecommunications, Satellite and Mobile Communications sector very closely.
- ***Professional Services***. This would include several sectors such as Information Technology Systems, Internet Technology & E-Commerce Specialists as well as activities which would not normally be considered as high-technology such as legal and accounting services. However, it also includes activities such as consulting for achieving and adhering to standards such as ISO and CSA.
- ***Tourism.*** There is little or no overlap between this economic generator and any of the sectors discussed in this report.
- ***Software and Communications Services***. This would include Information Technology Systems, Internet Technology and E-Commerce Specialists, Software and some of the Telecommunications Satellite and Mobile Communications sectors.
- ***Photonics***. This would include the Electro-Optical Technology sector and some of the Telecommunications, Satellite, and Mobile Communications sectors.
- ***Microelectronics***. This would include most of the Computer Hardware and the Information Technology Components, Sub-assemblies and Controls sectors. It should be noted that the Information Technology Components sector includes semiconductors; this is one of the fastest growing sectors in Ottawa today and is likely to be for at least the next decade. It includes the "fabless" suppliers mentioned earlier.
- ***Life Sciences***. This would include Medical and Biotechnology sectors as well as portions of some of the other sectors such as software and computer hardware.

It is important to understand the correlation between the above economic generators and the OED sectors because as time goes on, more and more of the tracking information will likely focus on the generators as opposed to the sectors. The seventeen high-technology sectors will be condensed into the six technology-related generators or clusters. Also, for simplicity, some of the forecasting that will be done in this report will be limited to the generators. From the perspective of both size

and growth rate, the Telecommunications Equipment and the Photonics sectors are the ones to watch.

Unfortunately, neither the economic generators nor the sectors have been broken into standard industry classification (SIC) codes nor any of the other classification systems that are used to gather information on industrial activity at the provincial and federal levels of government. An attempt should be made to do so in future updates of this vision document.

6.1 POSSIBLE NEW SECTORS

Just as many of the sectors, and even the generators, did not exist thirty years ago, it is possible that in thirty years time, a completely new slate could appear. The following are some technological changes that could influence the list in 2030.

- It appears that semiconductor devices will reach an upper limit in their performance, in that the number of transistors packaged into a microprocessor chip will top out at about 190 million by 2005, up from 25 million today. It is possible that, around 2014, silicon-based microprocessors will have become about as fast as they can ever be, and electronic devices will have become as small as they will ever be. (Source: PriceWaterhouseCoopers Technology Forecast 2000). This should not have a major impact on Ottawa semiconductor companies because none of them are tied to any one semiconductor foundry (chip plant). However, it will cause a major shakeout in the semiconductor foundry industry. The industry is well aware of this upcoming "bump in the road" but it continues to invest heavily in plant and equipment. At least twelve chip plants are being planned at this time (Source: National Post, July 10, 2000). It will accelerate the application of photonics technology and the development of entirely new computing technologies such as quantum computing. In quantum computing, devices can assume any number of logic states as opposed to the two (on/off) states used today. (Incidentally, this report assumes that there will be no chip plant built in the area during the period under study.)

- As fascinating as the Internet is today, it will be totally transformed by the year 2030. A major R&D project at the Massachusetts Institute of Technology in Boston is aimed at the development of Internet II. It will have wider bandwidth and will be more flexible in the way it handles traffic. A company that was recently acquired by JDS Uniphase is already supplying products to the project. One of the outcomes is that the Internet will be capable of handling video traffic without the "jerkiness" we see today in the pictures. One major impact of this is that there will be more and more video devices on the market. This is why it is safe to assume that there will be a "Video" sector as early as 2010.

- There will be a convergence of some segments of the information technology industry and the biotechnology industry as more use is made of genetic coding and decoding.

Based on the above observations and other trends in the industry, it is assumed that by 2030:

- There will be a new sector called Video Technology (or Broadband Internet) which may incorporate the present Internet sector.

- There will be a new sector called Genomics or Bioinformatics which will incorporate components from several sectors.

- There will be a merging of the Environmental and Geosciences sector and the Energy Technology and Resource Management sector. It will include Geomatics.

- The Electro-Mechanical sector will evolve into a microstructures sector to reflect the trend towards the design and distribution of micromachines and very small devices (e.g. sold state motors).

- There will be a new sector called Wireless Communications which will include companies that supply products and services for applications such as wireless Internet and tracking of people and devices. Ottawa already has several such companies.

- There will be a new sector called Electronic Manufacturing Services (EMS). Such activity already exists but will become more sophisticated and widespread as more and more companies contract out their manufacturing services. It will warrant the status of a sector because companies engaged in it will be required to perform significant R&D to develop new manufacturing technologies.

6.2 GEOGRAPHIC DISTRIBUTION

The three economic generators that will have the greatest influence on Eastern Ontario in the next thirty years are Telecommunications, Microelectronics (primarily semiconductors) and Photonics. At the present time, Telecommunications and Microelectronics are concentrated mainly in the west end of Ottawa while Photonics is concentrated mainly in the south and the east ends. Because proximity to the airport will become more and more important to all sectors as the city expands and as traffic congestion increases, it is conceivable that all of the area to the immediate north of the airport (Hunt Club/Rideau River area) will have been filled in with high-technology companies by the year 2030 and a new area will be under development south of the airport. This will have a major impact on communities like Cornwall, Morrisburg and Prescott because they will be within reasonable commuting distance of at least a portion of the Ottawa high-technology community.

That in turn will result in the creation of home-grown companies in those areas as the workers become more and more familiar with the technology and the opportunities it presents. Since the activity that moves south of the airport is likely to be heavily photonics related, these companies are more likely to be photonics companies. Also, it is anticipated that the linkages strategy being implemented by Doyletech will result in the creation of facilities that will serve the photonics industry (e.g. micro-machining facilities).

Traditionally, the east end of Ottawa has not been a hotbed of high-technology activity. However, that is likely to change as the photonics industry makes its way in that direction and as the National Research Council's focus on company incubation continues to show results. Interestingly, much of that incubation activity has also been photonics-related.

The activity in the western end of the city will continue to grow but it is less predictable than the south or east ends. One of the factors that could have a major influence is the influx of branch R&D plants, mainly from Silicon Valley. Cisco, Cadence and SS8 are examples. There have been very few spin-offs from those facilities but they have the potential to create a much more diversified industry in the west end. Also, there are now many very wealthy young people living in Stittsville, Carleton Place, Arnprior and the surrounding territory and they have the potential of creating hundreds of new firms. However, distance from the airport will cause this area to be less attractive than the new south end areas that are likely to be developed.

7. THE EVOLUTION OF INDUSTRIAL LINKAGES WITH THE OTC

While this paper assumes that most of the high-technology activity that will occur in places like Cornwall, Brockville, Kingston and Pembroke will be heavily influenced by what happens in Ottawa, it should be understood that most of these communities already have some form of high-technology activity, some of which is influenced by Ottawa and some of which is not. For example, Cornwall has printed circuit board manufacturers (which in the context of this paper are classified as high-technology), that are heavily influenced by the OTC, Brockville has a telecommunications industry which is not, Kingston has a life sciences/biotechnology industry which is not, and so on. And of course, all of them have Internet Service Providers (ISPs) which are also classified as high-technology in this report.

7.1 INFLUENCES AND STRATEGIES

In developing a scenario for the future development of these centres, the concept of influences and strategies will be applied. An example of an influence in Kingston is Queen's University (academic) and an example of an influence in Brockville is Eastern Independent Telecom Ltd. (telecommunications). It is assumed that whatever high-technology activity develops in those two cities, it will be heavily influenced by those institutions, even if it is the result of a linkages strategy.

Dr. Guy Steed, an Ottawa expert on cluster development, lists the four major influences or environmental factors that are likely to impact on the development of high-technology in a given community as follows:

1. Local Entrepreneurship. He cites Boston and San Jose as examples of areas where local entrepreneurs seized upon opportunities with the help of local investors. (There are certain people who are going to create new business ventures no matter where they live. Terry Matthews, the founder of several Ottawa companies, is an example).

2. Research/Academic Influence. He cites the example of Research Triangle Park in North Carolina where the universities cooperated in the formation of research park facilities. They also pursued innovative technology transfer programs. In Canada, the CTT (Waterloo in particular) is an example of such a cluster.

3. Manufacturing Influence. The high-tech clusters that have evolved in places like Phoenix, Scotland, and Ireland are the result of manufacturing facilities that were established to take advantage of such things as the supply of skilled labour and tax incentives.

4. Large Government High-Technology Presence. He points to the large U.S. government spending that occurred in places like Huntsville, Alabama and Houston, Texas and has resulted in the creation of several supporting high-technology companies. On a smaller scale, the Canadian Microelectronics Corporation which is funded by the Natural Sciences and Engineering Research Council (NSERC) and is housed at Queen's University is an example of a national influence. The National Research Council in Ottawa is another.

It is interesting to note that the OTC is the result of a combination of the first, second and fourth influences, but the manufacturing influence is now kicking in as more and more Ottawa companies outsource their manufacturing requirements. The companies that undertake such manufacturing are generating unique high-technology requirements of their own, such as management reporting and production scheduling software.

There are many other influences that can impact on a region's high-technology development. Dr. Roger Voyer, another Ottawa expert on cluster development, uses an octagon to measure a region's readiness for such development. Some of these "readiness factors" are related to the above influences, but some of them are not. They are listed here to provide another dimension to the thought process even though only the above four influences will be used in the analysis which follows: The factors are:

- A recognition of the potential of knowledge-based industries by local/regional leaders.
- The identification and support of regional strengths and weaknesses.
- The catalytic influence of local champions.
- The need for entrepreneurial drive.
- The availability of investment capital.
- The cohesion provided by formal and informal information networks.
- The need for educational and research institutions.
- The need to have "staying power" over the long term.

In addition to the four environmental influences, there will be the influence of the economic development strategies that are pursued by the various civic authorities. The Doyletech publication "Making Technology Happen", groups those strategies as follows:

1. **A Grow-Your-Own strategy** in which the emphasis is on the creation of locally owned firms.
2. **An Importation strategy** in which the emphasis is on the importation of branch plants and branch offices of firms that are located outside the region.

3. **A Linkages strategy** in which the emphasis is on helping local companies supply products and services to a nearby technology cluster.

The assumptions that will be made about the evolution of high-technology throughout eastern Ontario will be based on the above influences and strategies and on the scenarios for the expansion of the Ottawa cluster that were discussed in the last section. For example, in the case of Kingston, the major influence is likely to be Research/Academic and all three strategies are likely to be pursued, with a stronger emphasis on "grow-your-own" and "linkages". In fact, in the analysis which follows it will be assumed that all municipalities will be placing a greater emphasis on these two strategies than they have in the past. In assessing the impacts of the various influences and strategies, the following assumptions will be made:

1. **The Local Entrepreneurship Influence** can be the most effective of all in terms of the time required to have a meaningful impact and in terms of longevity of the resulting cluster.
2. **The Research/Academic Influence** will be stronger and more pervasive throughout the region than it has been in the past because publicly funded institutions are now doing a much better job of technology transfer than they have in the past. Also, companies wising to access such institutions can now do so more efficiently by electronic means.
3. **A Manufacturing Influence** will initially generate a lot of low-technology activity but as time goes on, the supply companies will move up the supply chain and others will be formed as entrepreneurs become more familiar with the industry.
4. **The Large Government High-Technology Presence** influence will probably be less than all of the others. Government purchasing power does not play the same role in high-technology development as it did when Dr. Steed published his work on cluster development. An example of where it is likely to have an influence elsewhere in Canada is the Montreal area because of the Canadian Space Agency's presence at St. Hubert, Quebec. Nevertheless, organizations such as the Canadian Microelectronics Corporation should be viewed as a "government presence" that can accelerate the formation of new companies and new product lines in existing companies.

It is assumed that the federal government will spend a lot of money in the future on upgrading its information systems. This activity is already underway. It will likely have a greater impact on OTC companies than on those outside the region.

The analysis will focus on the following areas: Cornwall, Brockville, Kingston, Hawkesbury, Lanark County, Renfrew County and two corridors along Highway 416 and Highway 43. The Highway 416 corridor is dominated by Grenville County and the Highway 43 corridor includes the town of Smiths Falls. The next seven sections will describe how the high-technology industry in each of those areas might evolve as a result of how the above influences and strategies might interact.

The employment figures will be based on the most likely scenario. Best case and worse case scenarios will be presented later in the report and they will be based on such factors

as a more favourable investment climate, the decentralization of the venture capital industry and a higher priority on new economy issues by federal and provincial governments. They will be discussed under the headings "Potential Accelerators" and "Potential Decelerators".

8. CORNWALL PROJECTIONS

All current indicators point to Cornwall being influenced mostly by manufacturing. It has always been a manufacturing centre and some of its manufacturing facilities (e.g. machine shops) can be re-tooled to meet the needs of the OTC. With assistance from Doyletech Corporation, it has embarked on both a Linkages strategy and a Grow-Your-Own strategy.

An event that is likely to have a profound influence on its future is the recent establishment of an electronic manufacturing services (EMS) facility by C-MAC Industries of Montreal. This will almost certainly result in the creation of several companies to support this manufacturing activity. The city already has a significant printed circuit board (PCB) manufacturing industry. A Doyletech study conducted in January 2000 identified PCB sales of $15M to Ottawa alone and the related employment was 150.

However, an aggressive Grow-Your-Own strategy could accelerate the formation of new companies. Most of these are likely to be software oriented (because of the low cost of entry) and will be aimed at solving manufacturing problems.

The current high-technology employment in Cornwall is about 550. The future growth rate is assumed to be 4.5% per year which is about 70% of OTC's CAGR; the rationale for a lower growth rate is that most OTC companies are focussed on reducing their COGS and EMS sales growth will not keep pace with total OTC sales growth.

This would put Cornwall's high-technology employment at about 2,100 by the year 2030. The number could be much higher if the OTC does expand south of the airport as suggested, because this would put a large portion of that cluster (and the fastest growing portion) within reasonable commuting distance of Cornwall. As time goes on, the commuters* will start companies of their own. Also, the influence of the Montreal market could be significant, particularly in the EMS area.

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* It should be noted that the present and projected employment figures refer only to those people who are employed by firms within the area in question and not to people who commute to the OTC.

The following is a summary of the Cornwall situation:

- Current high-technology employment……..550
- Projected CAGR……..4.5%
- 2030 high-technology employment……2,100
- Major influence……Manufacturing
- Major strategies……Grow-Your-Own
  Linkages

9. BROCKVILLE PROJECTIONS

Brockville's high-technology activity has traditionally been centered around telecommunications manufacturing (Automatic Electric, Philips, and Eastern Independent Telecommunications are examples) and EMS (Aimtronics, formerly Compas, is an example). The city can benefit from the application of all three strategies (Import, Grow-Your-Own and Linkages) but particularly from the last two. In terms of influences, Entrepreneurship and Manufacturing are likely to be the most significant. The city will also benefit from the southward migration of the OTC.

It is assumed that the existing base of telecommunications and EMS activity (which accounts for about 1,800 employees) will grow at 4.5% per year. About 75% of the employment is in EMS and 4.5% CAGR is used for that sector for the same reason as for Cornwall. While the telecommunications activity could grow faster than this, a 4.5% figure is used for it as well. This would result in an employment figure of 6,700 in those two sectors by the year 2030. Outside of these sectors there are about a dozen firms employing about 200 people; a CAGR of 6.5% is applied to them because they are a microcosm of the OTC.

It is also assumed that there will be several new firms created, particularly if a Grow-Your-Own strategy is pursued. They will likely be involved in new telecommunications technologies such as photonics and in software. The software activity will likely be focussed on telecommunications and EMS applications. A total figure of 10,000 is projected for year 2030; this translates into a composite CAGR of 5.5%. All three strategies will be effective. The following is a summary of the Brockville situation:

- Current high-technology employment……2,000
- Projected CAGR……5.5%
- 2030 high-technology employment……10,000
- Major influences……Manufacturing
  Entrepreneurship
- Major strategies……Import (mainly from OTC)
  Grow-Your-Own
  Linkages

10. KINGSTON PROJECTIONS

The Kingston cluster is more likely to be influenced by R&D/Academic activities than any of the others. However, as mentioned earlier, it also has what could be referred to as a national institution, namely the Canadian Microelectronics Corporation which is operated out of Queen's University. It coordinates the activities of Canadian post-graduate students who are involved in the design of microelectronics devices and systems. In terms of strategies, the Kingston cluster will benefit from all three, but particularly from a Grow-Your-Own strategy, for a variety of reasons. Firstly, there has always been a readiness on the part of local angel investors to fund early-stage high-tech companies, even though many of their past investments have turned out badly. (The city has had more than its share of unrealistic entrepreneurs). Secondly, PARTEQ, the Queen's University technology transfer facility, has developed a strong expertise in the launching of new ventures. It also manages a pool of venture capital. Thirdly, there are now some early-stage companies that show good potential and the entrepreneurs who are managing them will serve as role models for other entrepreneurs.

In the analysis which follows, the Gananoque and Napanee regions will be included as part of the Kingston cluster.

A report prepared by Coopers and Lybrand Consulting (now PriceWaterhouseCoopers) for the city of Kingston in 1998 grouped Kingston's high-tech activity into three broad sectors: Information Technologies and Telecommunications (ITT), Health Sciences and Advanced Materials. It estimated annual sales for the three sectors as follows:

ITT	$ 166 million
Health Sciences	$ 17 million
Advanced Materials	$1,060 million
TOTAL	$1,243 million

Assuming a sales-per-employee figure of $200,000, this would put Kingston's high-tech employment figure at about 6,000. This figure appears high, particularly when compared with the CTT which was mentioned in Section 3 as having only 7,000 employees. A survey conducted by Doyletech Corporation in the summer of 2,000 as part of a linkages study indicated that, using the OTC definition of high technology, Kingston had about 1,500 employees. Most of the Advanced Materials activity identified in the Coopers report cannot be classified as high technology.

The Coopers study also quantified the public sector activity in each of these areas and estimated that if the public and private sectors were combined, the total annual outputs would have been as follows:

ITT	$ 266 million
Health Sciences	$ 492 million
Advanced Materials	$1,140 million
TOTAL	$1,898 million

What these figures suggest is that there are very powerful "technology engines" in the ITT and Health Sciences sector which could be tapped for the creation of new companies and new product

lines in existing companies. For example, the difference between the two figures in the Health Sciences sector was $475 million and this suggests that there were nearly 5,000 people employed in the public Health Sciences sector. There was no breakdown showing the R&D activity as a percentage of the total but it is assumed that at least 1,000 of these Health Sciences employees were involved in R&D. This is a significant figure; at the time when the OTC was beginning in the early fifties the National Research Council had about 2,000 employees in Ottawa. Northern Electric (now Nortel) established its R&D facilities in Ottawa in 1962 with about 200 employees. It now has over 15,000 employees. Those two research facilities have been the cornerstone of Ottawa's technology engine over the years.

The most probable scenario for the ongoing development of a high-technology industry in Kingston is the successful exploitation of the upcoming convergence between Life Sciences and Telecommunications. Kingston has a good pool of technical know-how to engage in such exploitation but it suffers from a lack of knowledgeable investors in this area which is known broadly as Bioinformatics. That lack of knowledge is not limited to local angels, but to the Canadian venture capital industry as well. In the discussion on accelerators and decelerators in sections 17 and 18, possible changes in the investment climate will figure prominently.

Using the definitions of the six Ottawa technology-related economic generators, and adding Advanced Materials, the following table shows Kingston's current employment, anticipated growth rates and 2030 employment.

Cluster	**Current Employment**	**Anticipated Growth Rate (CAGR)**	**Multiplier Factor**	**2030 Employment**
Telecommunications Equipment	20	6.5	6.6	132
Professional Services	370	6.5	6.6	2,442
Software & Communications Services	500	6.5	6.6	3,300
Advanced Materials	100	6.5	6.6	660
Photonics	30	10.0	17.4	522
Microelectronics	180	6.5	6.6	1,188
Life Sciences	300	8	10.0	3,000
Total	**1,500**	**6.9**	**7.5**	**11,244**

These projections are very tentative for several reasons. Firstly, the total number of current high-technology employees is not well defined. Secondly, the breakdown by sector is imprecise. Thirdly, it ignores the formation of entirely new sectors such as Video as was discussed in section 6.1. The CAGR for most of the sectors is assumed to be the same as for the OTC with the exception of Photonics and Life Sciences which are assumed to be 10% and 8% respectively. The 11,244 figure for 2030 is probably conservative.

In summary, it is assumed that Kingston's high-technology employment is about 1,500, about a third of which is in Software and Communications Services and the figure will grow to about 11,000 in the year 2030. Because the makeup of the industry is likely to be somewhat different from that

of the OTC, it could take on a character of its own. For example, if Life Sciences does end up with almost a third of the total high-technology employment as suggested in the above table, the industry will take on a Life Sciences character.

Another scenario to consider is the emergence of companies involved in teaching tools The city has a very high concentration of education facilities and such tools will be as much in demand thirty years from now as they are today. It should be noted that Waterloo's high technology industry got its start from companies that developed unique teaching tools. While it had companies like Marsland Engineering and Electrohome as far back as the 1950's, the new wave of high-technology activity was created by software-oriented companies that came on the scene in the early seventies and were heavily influenced by the University of Waterloo's requirement for unique teaching tools. The WATFOR compiler came out of that requirement.

Two areas that will benefit greatly from the Kingston activity will be Napanee and Gananoque. (They are lumped in with Kingston for this analysis.) Their combined high-technology employment is currently about 300. The recent Doyletech linkages survey uncovered some capability in the supply of machined and fabricated parts. Their best prospects lie in the creation of new companies that are farther up the supply chain and that sell to either Kingston or OTC companies. It is assumed that the economic development authorities will concentrate on both a Grow-Your-Own strategy and a Linkages strategy.

11. HAWKESBURY PROJECTIONS

The following is the most likely scenario for the evolution of a high-technology industry in the Hawkesbury area.

1. The number of high-technology workers who commute to Ottawa will increase dramatically during the next thirty years as the eastern end of Ottawa begins to share in the region's high technology explosion.
2. Those workers are likely to be more involved in photonics than in any of the other sectors because the east-end activity is likely to be more photonics related.
3. Some of those workers will form companies of their own as they become more familiar with the technology and as they identify market niches that will support new ventures.
4. A cottage industry will evolve to supply unique product and service requirements. An example of a product requirement will be machined parts (miniature connectors, etc.) and an example of a service requirement will be consulting for supporting the photonics manufacturing activity.
5. The influences that will impact most on the area will be Manufacturing and Entrepreneurship.

Assuming that the local economic development authorities aggressively pursue a Linkages and a Grow-Your-Own strategy, it would not be unreasonable to expect a photonics sector employing about 500 by the year 2030 and a software and communications sector employing another 500. All of the other sectors combined could account for another 500, bringing the total high-tech employment to 1,500. In addition, there could be significant activity in machined parts, mechanical sub-assemblies, printed circuit boards, and cabinets, some of which will not qualify as high-tech activity. It is very difficult to predict Hawkesbury's high-technology activity, mainly because of the

absence of any significant base. Nevertheless, a community within a one-hour drive from the OTC should be able to build an industry of 1,500 employees within thirty years. Another factor that is not taken into account is the impact of the Montreal market, most of which is also within a one-hour drive.

12. LANARK COUNTY PROJECTIONS

Lanark County will show unusual high-technology growth over the next thirty years, mainly because of its proximity to the OTC. Carleton Place is the nearest town and it already has several small companies that can be classified as high-technology and several others that supply products and services to the high-technology industries, not just in the OTC, but throughout North America. For example, it has always had an active printed circuit board industry. It also has excellent machine shop facilities which can supply products and services to the OTC.

The current high-technology activity is in sectors such as Aerospace/Defence, Telecommunications, Environmental and Geosciences, as well as Electro-Mechanical Technology.

The following is the most likely scenario for the development of Lanark County's high-technology industry over the next thirty years.

1. Some of the high-technology workers who are currently commuting to Ottawa will start their own companies. These will likely be in the telecommunications sector because most of the commuters will be working in the west end of the OTC, which is where most of the telecommunications activity is located. Also, there are many young people living in Lanark who have become wealthy through stock options in firms like Newbridge (now Alcatel), Mitel and Nortel.

2. One or more of the larger firms will establish facilities in the Carleton Place area to take advantage of lower land prices and skilled workers. This will act as a catalyst for further spin-offs.

3. A significant cottage industry will evolve that will supply products and services to the OTC. It will consist of very small enterprises (one or two people) operating out of their homes.

The following is a reasonable expectation for the year 2030.

1. High-technology employment will reach 5,000.

2. The activity will be concentrated mostly in Telecommunications.

3. The influences will be mainly Entrepreneurship and Manufacturing.

4. The strategies that will be the most effective will be an Importation strategy aimed at OTC companies and a Grow-Your-Own strategy aimed at the entrepreneurs.

13. RENFREW COUNTY PROJECTIONS

The above discussion on Lanark County is almost directly applicable to Renfrew County. There are many workers who are commuting to Ottawa and the conditions are ideal for more high-technology startups. Arnprior, like Carleton Place, has a significant high-technology industry as well as manufacturing facilities that can act as suppliers to the OTC. The county's main drawback (particularly its northern end) is its distance from the Ottawa airport. The western part of Lanark County has the same drawback.

However, there are certain types of high-technology activity that can be carried out relatively easily in remote locations and do not require as much airport access. Examples are those that involve the delivery of products and/or services over the Internet. The remote areas of Lanark and Renfrew counties will be attractive to companies supplying software products or solutions. Recent advances in wireless Internet technology and the laying of more and more fibre optic cable make the appropriate communications services available to those remote areas at reasonable cost.

Including Boeing's facility in Arnprior, but excluding Atomic Energy of Canada's facility in Chalk River*, the current high-technology employment figure is assumed to be 1,000. Using the sector definitions that were followed in section 5, most of the activity is in Aerospace and Technomedia.

The most likely scenario for future development is very similar to that outlined for Lanark in the last section. The commuters will turn into entrepreneurs specializing mainly in telecommunications because the western part of the OTC has a high concentration of telecommunications activity.

The Manufacturing and the Entrepreneurship influences will be more predominant than the others and all three strategies (Import, Grow-Your-Own and Linkages) should be effective. It should be noted that the R&D and National Facility influences are given a higher rating than for Lanark because of the presence of the Atomic Energy facility in Chalk River. BTI Technologies is an example of a spin-off from this facility. The Communications Research Centre acts as an R&D influence on both Lanark and Renfrew.

An employment figure of 6,000 is assumed for the year 2030. Like the 5,000 figure for Lanark, it could be much higher if some of the larger telecommunications companies in the western part of the OTC decide to establish branch plants in those areas.

14. HIGHWAY 416/HIGHWAY 43 CORRIDORS

The above projections cover the Cornwall/Napanee/Pembroke triangle with the exception of a strip running east and west just north of the St. Lawrence Seaway and north and south along Highway 416. Future activity in these corridors is difficult to gauge because it will depend very heavily on the southward expansion of the OTC that was discussed in section 6.2.

* This was done for consistency. Government laboratories are not included in the OTC employment figures.

However, there are already some very sophisticated high-technology companies operating there that are in the delivery of software products and services, some of it over the Internet. This is the type of activity that is likely to evolve in the more remote areas of Lanark and Renfrew counties. M.B. Foster Associates of Chesterville is an example of such a firm. ASATTE Systems of Kemptville is another.

The area has excellent communications facilities and they are being improved as a result of a strong community effort. Another result of the strong community effort is the establishment of a pool of venture capital in the County of Grenville. This will create a strong Entrepreneurship influence and should assist in both a Grow-Your-Own and a Linkages strategy. The proximity of all parts of the area to the Ottawa airport (in terms of driving time) will be a significant asset.

It is assumed that the companies within these corridors currently employ 200 people and that this number could grow to 1,000 by the year 2030. This projection is probably the least reliable of all those given in this report because the boundary between this area and the OTC will become blurred.

15. SUMMARY OF PROJECTIONS, INFLUENCES AND STRATEGIES

Figure 4 shows all of the employment projections discussed in the last seven sections. It indicates that the total employment will grow from 6,200 to over 36,000 between now and 2030. Each of the areas will be influenced differently and the degree to which the three strategies will work will vary from one area to the next.

The rating system for the influences is meant to reflect the relative impact of each of the influences on a scale of 1 to 10. For example, Kingston is expected to be heavily influenced by R&D/Academic, National Facility and Entrepreneurship but less so by Manufacturing. Cornwall is almost the exact opposite although Entrepreneurship was given a rating of 5. The rating system for the strategies reflects the importance that each of the strategies should be given and that will be given. Brockville, Lanark and Renfrew are given high ratings for Importation because they may be able to encourage overflow from the OTC. Otherwise it is assumed that Grow-Your-Own and Linkages strategies will be the most effective everywhere.

The overall CAGR turns out to be slightly lower than for the OTC. This is to be expected because some of the areas have little or no existing activity. Others are still operating at the lower levels of the supply chain. However, it should be emphasized that the projected activity applies mainly to the OTC influence on future growth. There will likely be other growth from other influences.

16. MECHANISMS

Throughout the above analysis, certain assumptions were made about the mechanisms by which growth would occur (e.g. commuters becoming entrepreneurs and low-technology suppliers becoming high-technology suppliers) but very little was given by way of explanation of those mechanisms.

Figure 4 - High-Technology Employment Projections, Influence & Strategy Ratings

Municipality/Area	High Tech Employment			Influence Rating 1=Low 10=High				Strategy Rating 1=Low 10=High			Comments
	Year 2000	CAGR %	Year 2030	R&D	MFG	National Facility	Entrepren-eurship	Import	Grow-your-own	Linkage	
Cornwall	550	4.5	2,100	1	9	4	5	3	7	7	C-MAC will have a strong manufacturing influence
Brockville	2,000	6	10,000	1	8	4	6	6	8	7	A strong communications base already exists
Kingston	1,500	7	11,244	8	3	7	6	2	9	8	Will develop a cluster of its own
Hawkesbury	50	12	1,500	3	7	4	5	2	6	8	National Influence rating high because of NRC
Lanark County	900	6	5,000	4	6	4	9	5	7	7	OTC expansion westward will be a major factor
Renfrew County	1,000	6	6,000	5	6	5	8	5	7	7	AECL is a National Facility influence
416/43 Corridors	200	5.5	1,000	1	7	3	8	3	6	6	Venture capital fund in place
TOTAL	6,200	5.9	36,844								

16.1 COMMUTERS BECOMING ENTREPRENEURS

Probably the best example of this was West End Systems, an affiliate of the former Newbridge Networks Corporation, which was founded by a Newbridge employee who had been commuting from Arnprior. (Unfortunately, the company did not survive and was folded into Newbridge).

Canada does not have much of a history of commuters becoming entrepreneurs, but it happens frequently in U.S. centres, particularly more congested ones like Boston and Silicon Valley. (Cray Computers was an example in the Minneapolis area).

The areas where this is expected to be a major mechanism are Hawkesbury, Renfrew Country, Lanark County and the Highway 416/43 corridors. The Hawkesbury scenario is little more than a wild guess, but in Renfrew and Lanark, there are many very wealthy people who are still very young. Some of them are still commuting to the OTC and if they are not inclined to start companies of their own, they will make excellent investors in other companies because they are still very knowledgeable about a broad range of technologies – particularly telecommunications.

16.2 MOVING UP THE SUPPLY CHAIN

There is plenty of evidence of this happening in Ireland, Scotland and certain U.S. cities like Phoenix and Albuquerque, both of which were (and still are) high-technology manufacturing centres. In the case of Ireland, this has been a major thrust of its Company Development Program. Even though Ireland started out as a supplier of low-technology products to high-technology companies, it currently has over 600 software companies (many of them EMS-related) and about fifty new companies are being formed each year. (Source: "ICT Innovation: A Contact Sport" by Dr. Roger Voyer of PriceWaterhouseCoopers).

16.3 COTTAGE INDUSTRIES

A cottage industry is typically defined as one made up of suppliers operating out of their homes. Towns like Carleton Place and Almonte have had a high level of such activity since the mid sixties, much of it aimed at supplying products and assembly services to Digital Equipment of Canada Ltd. That is how Carleton Place built its printed circuit board capability. Since the closure of the Digital plant in 1998, those suppliers have turned their attention to other OTC companies. Cottage industries evolve for a number of reasons such as plant downsizing or outsourcing decisions, but they rely very heavily on personal relationships.

Such facilities have to be within reasonable commuting distance of their customers because they may have to visit them on at least a weekly basis. That is why this activity is predicted for Hawkesbury (it assumes expansion of the OTC's east end) and the areas of Lanark and Renfrew that are closest to the OTC. It will also apply to the Highway 416/43

corridor. As C-MAC ramps up its production facility in Cornwall, a cottage industry may evolve there as well.

17. POTENTIAL ACCELERATORS

This section will speculate on events that could occur or policies that could be implemented by any of the three levels of government to accelerate the growth of Eastern Ontario's high-technology industry. It will conclude by suggesting a multiplier that could be applied to the figure of 36,844 for total employment that was discussed in the last section.

17.1 VENTURE CAPITAL

Canada's venture capital industry, although much healthier than it was a few years ago, is still much smaller than its U.S. counterpart on a per-capita or a per-GNP basis. The most positive things that government could do are:

a) Decentralize it so that more investment decisions are made at the local level – at least in Ottawa, in the case of Eastern Ontario. Some of it should also be managed in Kingston. (A small fund is already being managed from there). As a minimum, more venture capital companies should be encouraged to have representatives operating out of Ottawa and Kingston.
b) Encourage the formation of pools of early-stage venture capital.
c) Encourage large institutional funds (e.g. pension funds) to funnel more of their money into venture capital.
d) Encourage large resource-oriented companies to establish venture capital funds for commercializing more of the technology that they develop in-house.

17.2 AN AGGRESSIVE APPROACH TO A LINKAGES STRATEGY

The reception to the Linkages strategy being implemented by Doyletech has been very favourable. There are many companies that are now much better informed about the needs of the OTC. However, it will require an ongoing effort to keep it going. Economic development authorities are being left with guidelines for its continuation.

As firms throughout Eastern Ontario begin selling their existing products and services to the OTC, they will uncover other opportunities that are higher up on the technology scale.

17.3 AN AGGRESSIVE APPROACH TO A GROW-YOUR-OWN STRATEGY

This will require a different approach to economic development than that which is currently being pursued by most municipalities. It will also require a different set of skills on the part of most economic development officers. For example, it will require the formation of local capital networks that will start out as advisory bodies to entrepreneurs but could evolve into municipal venture capital pools.

17.4 STRONGER PUBLIC SUPPORT FOR HIGH TECHNOLOGY

Until very recently, high technology activity evoked either neutral or negative reactions from most Canadians. It was looked upon as an industry that we could not compete in or that eliminated jobs. Politicians and people who are in a position to influence public attitudes should take it upon themselves to inform the public that technology is essential to the building of new economy industries and that Canada must participate more fully in the new economy if it is to stop the slide in its standard of living relative to other industrialized countries.

17.5 THE POTENTIAL UPSIDE

If all of the above factors were to come into play, it is possible that the figure of 36,844 employees for the year 2030 could be increased by 20%, which would bring it to slightly more than 44,000. In fact, the 36,844 figure may be in jeopardy if dramatic changes are not made in Canada's venture capital industry. For example, there is very little investment expertise in the Life Sciences field and what exists is nearly all located in one firm located in Toronto. Kingston would benefit the most from a more decentralized Life Sciences venture capital industry.

18. POTENTIAL DECELERATORS

Obviously, the inverse of the above accelerators are potential decelerators. For example, if Canada's venture capital industry gets off the growth track that is in on at this time, this will impede the development of Canada's high-technology industry overall, not just in Eastern Ontario. However, the following are some identifiable decelerators that are independent of the above accelerators.

18.1 A FURTHER SLIDE IN THE VALUE OF THE CANADIAN DOLLAR

While there are certain pockets of the Canadian high-technology industry that benefit from a weak Canadian dollar (e.g. those pockets that are labour intensive), it is harmful to the industry in general. It is a global industry and a large proportion of the costs incurred are in U.S. dollars. For example, it is becoming prohibitively expensive for small Canadian companies to build proper U.S. sales and support teams and this is limiting them to the supply of products and services that can be distributed and supported by third parties. This makes it very difficult for Canadian companies to compete in the U.S. market whereas U.S. companies find it very easy to compete in Canada. It also makes Canadian companies very attractive acquisition targets and it makes it difficult for them to attract experienced people from the U.S. The impact of the Canadian dollar valuation on new-economy industries is an issue that requires more attention.

18.2 THE BRAIN DRAIN WORSENS

Although the weak Canadian dollar is one cause of the brain drain to the U.S., others are Canada's high level of taxation and fewer managerial and technical opportunities than exist in the U.S.

18.3 DETERIORATING EDUCATION SYSTEM

Canada's education system is doing an admirable job of meeting the needs of the country's high-tech industry. However, many of our universities and community colleges are finding it extremely difficult to keep their teaching tools and their physical infrastructure up to modern standards. Again, the teaching tool problem is related to the weakness in the Canadian dollar, because most of the tools are imported.

18.4 REDUCED SPENDING ON PUBLICLY-PERFORMED R&D

Publicly-funded institutions like the Communications Research Centre (CRC) and the National Research Council (NRC) are important components of the OTC technology engine. Unfortunately, there is a trend towards lower funding and higher cost recovery for services rendered to industry. This could have the effect of reducing their ability to help early stage companies because such companies do not make good industrial partners since most of them are starved for working capital.

18.5 A WORLDWIDE SLOWDOWN IN THE BUILDING OF COMMUNICATIONS INFRASTRUCTURE

The last decade has seen an unprecedented level of spending on the building of networks and other communications infrastructures and this has been the major driving force behind the OTC expansion. An economic recession could have a very negative impact on such spending. The challenge for OTC telecommunications companies under this scenario would be to ensure that they can operate in a maintenance mode (and still show growth) until the spending resumes.

18.6 THE POTENTIAL DOWNSIDE

There are other potential decelerators (e.g. runaway inflation and a major recession) but the three listed above are the most significant. Some inflation and some form of recession is bound to occur in the next thirty years and are already factored into the 36,844 figure. The above three could depress this figure by 20%. In other words, the figure could be as low as 29,500.

19. CONCLUSION

Communities in the area bounded by Cornwall, Napanee and Pembroke stand to benefit greatly from the explosion of high-technology activity that is underway in the OTC. As communication facilities continue to improve, more and more high-technology work can be undertaken in rural communities. Also, this area does have a reasonable base of activity from which to grow. However, a better understanding of the influences and the strategies will help the area to at least keep pace with the OTC.

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