Towards a Canadian Photonics Strategy

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The photonics sector pervades all aspects of our society. Canada can, and should play an important role in global Photonics development and manufacture. It cannot do so, without taking a more strategic view of this domain.

The Federal and Provincial Governments invest approximately $150 million annually on optics, photonics and lasers-related research in universities, government laboratories and other R&D centres while the US Government invests more than US$1.1 billion in photonics each year.

In Europe, the European Commission reserves, within its Horizon 2020 program, 100 million EUROs each year to photonics as a key enabling technology. In addition, each European Country invests in photonic research. As examples, the French laboratories such as CNRS, CEA LETI, ONERA and CNES have research activities in photonics while the Fraunhofer and Max-Plank Institutes are also very active in Germany.

Fully Utilize Government Support

In Canada, the Photonic Industry has access to a small number of Government programs to support their research and commercialization. The Scientific Research and Experimental Development (SR&ED) supports industry R&D. It complements the NRC-Industry Research Assistance Program (IRAP) which provides consulting and research funds.

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The Federal Government has recently created the Build in Canada Innovation Program (BCIP) to help companies bridging the pre-commercialization gap by procuring and testing late stage innovative goods and services within the federal government before taking them to market. It would be important to extend this program to include early development phases to better compare with the US Small Business Innovation Research program.

User Engagement is Critical

Photonic companies need to be more engaged with the user community to develop solutions that provide leadership to key Canadian industries and to provide new export opportunities. With the participation of industrial partners in the technology transfer process, technology flow and transfer between the academic and industrial sectors will increase.

As photonic industries grow in many regions, we need to create regional photonic clusters organizing local activities and networking opportunities and a national cluster to develop collaboration and partnership between the clusters and to organize national and international activities.

Canada still needs to develop its own photonics strategy to identify sectors that are critical to the growth of the Canadian economy and the involvement of industry, academics and R&D centres would be mandatory for such an endeavour. The Canadian Photonic Industry Consortium is uniquely positioned, both in expertise, and impartiality to assist in this mission. ■

About the CPIC

The Canadian Photonic Industry Consortium assists Canadian companies to optimize operations and to improve profits by facilitating and accelerating the application of photonic technologies that improve quality, productivity and profitability. ***http://www.photonscanada.ca/***

Photonics in Canada

Photonics enables us to generate, transmit, measure and use light in a myriad of applications that have already enhanced our daily lives. While the late 20th century was the age of electronics, the early 21st century will belong to photonics.

Canada has always played a major role in the world-wide photonics community. We've invested strongly in photonics research, have made a number of important contributions to photonics technology and are now home to several clusters of photonics companies and research institutions distributed across the country. The Canadian photonics companies are involved in most if not all the application domains.

A ubiquitous technology

The photonics revolution is virtually invisible to the very consumers who have embraced its rapid assimilation into their daily lives. Compact flat-screen, liquid-crystal, LED computers and tablets are now a commodity. CDs, DVDs and now flash memories are the norm for flexible, permanent and temporary storage of data, music and video. Photonics also contributed to the reduction of microelectronic components which increased significantly the capabilities of computers and hardware memory components. Meanwhile, low-cost light-emitting diodes and liquid crystal displays are revolutionizing portable devices such as cell phones and PDAs, enabling incorporation of cameras and full-colour displays suitable for high definition video. Internet and wireless mobility brings us virtually free access to instant information and entertainment through the global fibre optic backbone that connects most cities and towns in the developed world.

Light is an efficient and non-invasive tool for medical diagnosis and treatment and laser-based systems are commonly used for both internal and external surgery. Laser treatments are also increasingly in demand for procedures such as

sight correction, removal of skin and pigment irregularities, and hair removal. Photodynamic therapy, the use of light-activated drugs that are selectively absorbed by malignant cells is faster, more precise and less traumatic than conventional treatments for many cancers. Dentists are replacing conventional high-speed drills with laser-based devices, and are using 3D imagers to produce high precision implants.

High-brightness light-emitting diodes (LEDs) are now the preferred source of all lighting. Solid-state lighting is extensively used for signage, architectural and security applications. LEDs already used extensively in North America's traffic signals also glow from the dashboards and tail lights and head lamps of vehicles, and have become common in the cabins of most trains and planes.

Photonics-based advances that make solar cells more efficient are contributing to the move from fossil fuels to renewable energy sources. Vehicles have now incorporated laser-based devices such as lidars and imagers into their collision-avoidance and rear-view systems. And, for both terrestrial and avionic entertainment and monitoring systems, plastic optical fibres are increasingly displacing traditional copper wiring looms resulting in significant savings in both space and weight.

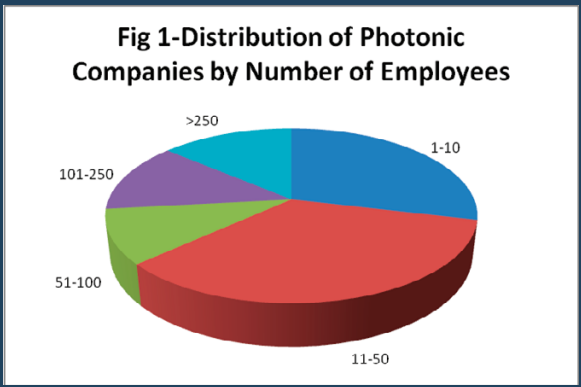
Photonic sensors offer important safety applications too. Embedded in structures such as bridges, they can give early warnings of potential failures. Accurate security systems such as a single optical fibre laid around the multi-kilometre perimeter of a sensitive site can pinpoint intrusion to within a few metres.

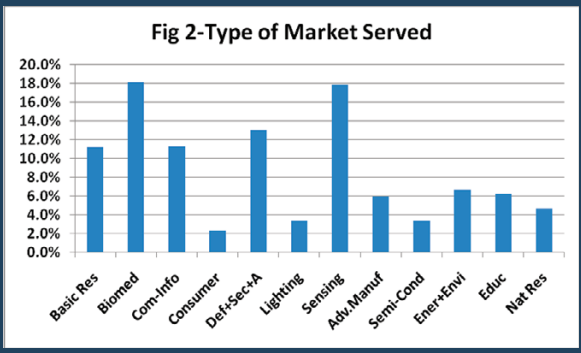
The defence sector invests heavily in photonics-enabled equipment, from advanced sensing technologies such as infrared night vision systems to laser guidance and weaponry. Leading-edge military aircraft and weapons are equipped with compact and accurate fibre optic gyroscopes. The "fly-by-light" concept is becoming a reality.

One major development in advanced manufacturing has been the use of lasers for cutting precision shapes in materials as diverse as metals and clothing fabrics. Laser-positioning and welding have become standard on many modern automobile-production lines. Additive laser manufacturing and 3D-printing are new technologies for weight reduction, tailored and corrosion resistant materials which enable the faster production while reducing the amount of material required. Sophisticated laser-vision systems are rapidly becoming the norm to monitor online production processes and quality control. And as we all know, most of the goods we buy are identified and tracked by laser marking and bar-code scanning.

The Canadian Photonics Industry

As for many countries, Canada's photonics industry is dominated by small companies (Figure 1) and it is interesting to note that 86% of the Canadian photonic sales are done by 20% of the companies. Nearly three quarters of the 400 companies have less than 100 employees while 30% have fewer than 10 employees. These companies employ 25,000 people and are mainly located in Quebec and Ontario for 77%, British Columbia follows with 13%, while 7% are in the Prairies and 3% in the Atlantic region.





Photonics companies' revenues was about $4.6 billion in 2014 and the companies expected an annual growth of 10% in the coming years. About 65% of the revenues accrue from exports, with the United States being the dominant market, accounting for 34% of sales. Europe accounts for 17% of the sales and Asia for 12%.

In the last 5 years, Canadian photonics companies have moved up the "value-chain". These companies range from developers and components manufacturers (e.g., of lasers, fibre optics) to complete photonics-based instruments (fibre lasers, sensors, cameras, projectors, scanning microscopes, etc). Only 24% of these companies develop and sell components: those that do, typically have niche positions in specialty devices such as fibres and filters. The majority of the country's photonics companies (63%) provide subsystems or systems and instruments as their end product.

Since the telecom downturn, the Canadian photonics industry has clearly diversified. The biomedical sector and sensing are now the two main drivers of photonic sales as shown in Figure 2. Fewer than 11% of sales are now claimed to address the communications sector, and 13% addresses the defence and security sectors, historically the two main pillars of Canada's photonics community.

It is expected that sales in energy and environment will significantly increase with the trend toward green energy which represents an opportunity for Canada's photonics companies to build global leadership in an area which is core to Canada's economy. Consumer, lighting and semi-conductors which are predominantly high volume, cost-sensitive markets are dominated by Asia. Canadian photonics companies address most end-markets and many of them address several ones: for example, companies that were founded to make devices for telecom now address the life sciences or industrial markets with the same technologies. ■