



**Canadian Photonics Consortium
Consortium photonique du Canada**



Aims of the CPC Study

- Build an inventory of photonics producers and users in Canada
- Get a measure of the “value” of photonics to the Canadian economy
- Perform a SWOT analysis of Canada’s position by sector
- Understand the challenges faced by companies developing and using photonics
- Assess the impact of photonics on HQP and our ability to train them
- Recommend how Canada can best position itself to have a share of a rapidly growing industry
- Position Canada to be a creative user of photonics
- Raise the awareness of the impact of photonics among decision makers and the general public



Why photonics is important to Canada

- Photonics and photonic enabled products is a \$700 billion global industry
- Photonics is the “new electronics”
- Photonics impacts every aspect of our daily lives
 - Our entertainment
 - Our communications
 - Our transport
 - Our healthcare
 - Our security
 - Our energy
 - Our manufacturing industries
- Photonics adds value to every sector of the Canadian economy
- Photonics is an energy saving, “green” technology



Methodology

- Company surveys
- Industry led workshops
- Industrial and Academic Advisory Group to steer study and endorse the recommendations



Surveys

- Consolidated existing Quebec (QPN) survey
- Collaborated on Ontario survey (Ontario Centres of Excellence)
- **Initiated additional surveys**
 - Prairies (TR Labs)
 - British Columbia (Nanotech BC)
 - Atlantic Provinces (ACOA)
- **A mix of questionnaires, face to face and telephone interviews, databases**
- **Standardized questionnaire**



Workshops

Workshop	Venue	
Photonics in Manufacturing	Toronto, Oct. 24 '07	
Photonics in ICT	Ottawa, Nov. 30 '07	
Photonics in Defense and Security	Montreal, Feb. 1 '08	
Photonics in Energy & Environment	Edmonton, Feb. 28 '08	
Photonics in Life Sciences & Health Care	Toronto, March 18 '08	

- Industry led
- Typically 30 participants by invitation
- Technology and business trends for sector
- SWOT for Canada in sector



Advisory Group

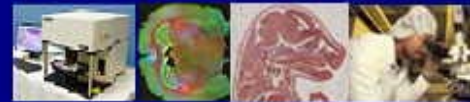
DALSA

**SERVO
ROBOT**
THINKING HI-TECH

BOMBARDIER

EXFO
EXPERTISE REACHING OUT

BPI
Panoramic Digital Fluorescence Microscopy



Biomedical Photometrics Inc.
www.confocal.com

Lunch – 12
SWOT Exer

ELCAN
Optical Technologies
A Raytheon Company

Fin
Optech

STI photonic
systems Inc.



UNIVERSITY OF
ALBERTA
EDMONTON, ALBERTA, CANADA

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The Statistics



Photonics Companies in Canada

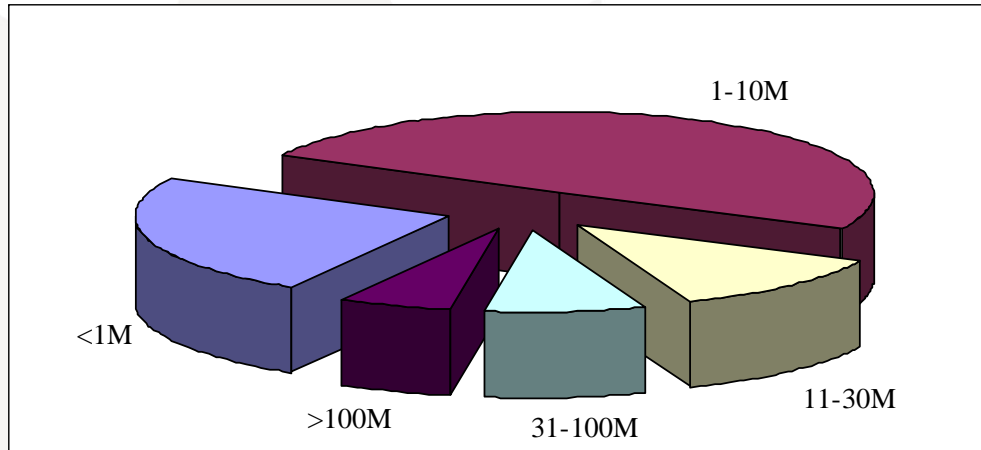
- ~ 400 photonics companies
- ~ 20,000 employees
- ~\$4.5bn revenues
- ~85% exports

- Photonics is used in every sector of the Canadian economy

	Companies	Employees	Revenues
Quebec	104	4750	600M
Ontario	117	10200	3000M
Prairies	95	2990	330M
BC	50	2010	430M
Atlantic	8	310	36M
	373	20260	\$4.4B

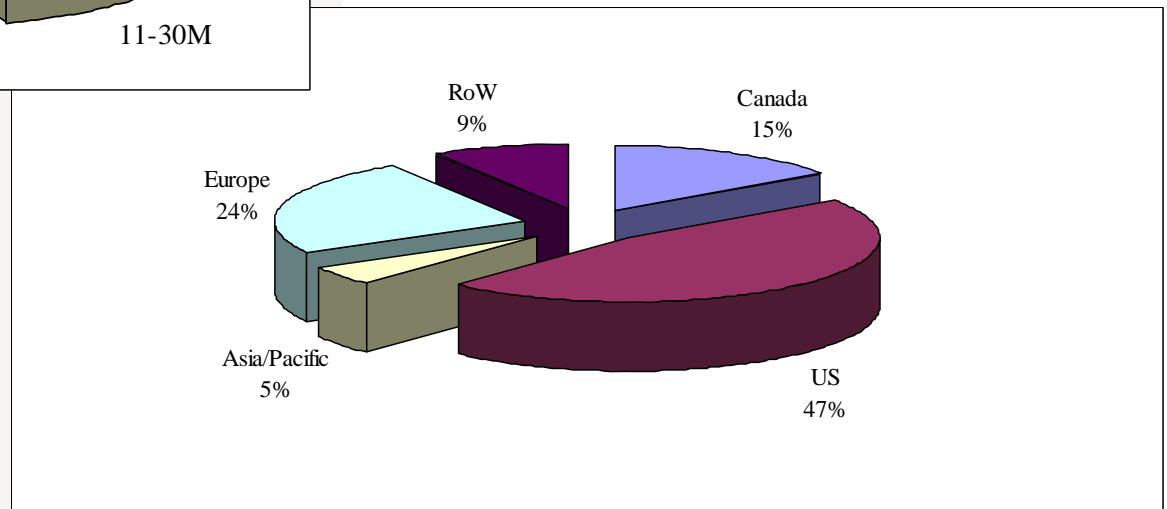


Revenues



Revenues (\$)

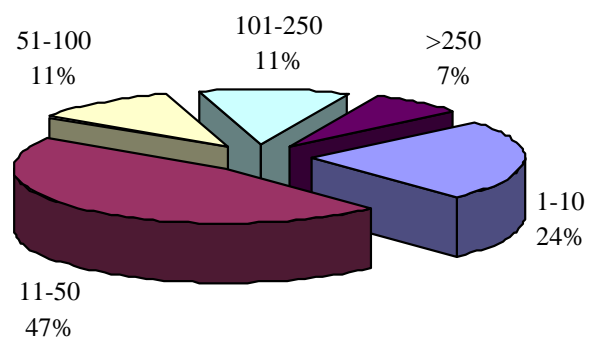
- 70% of companies have less than \$10m in revenues
- 85% of revenues are from exports



Markets

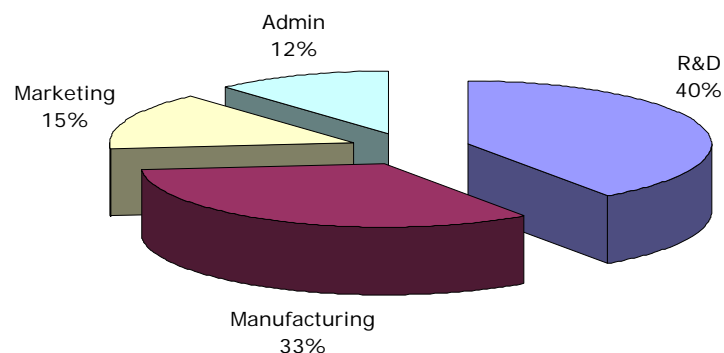


Photonics companies by size



Number of employees

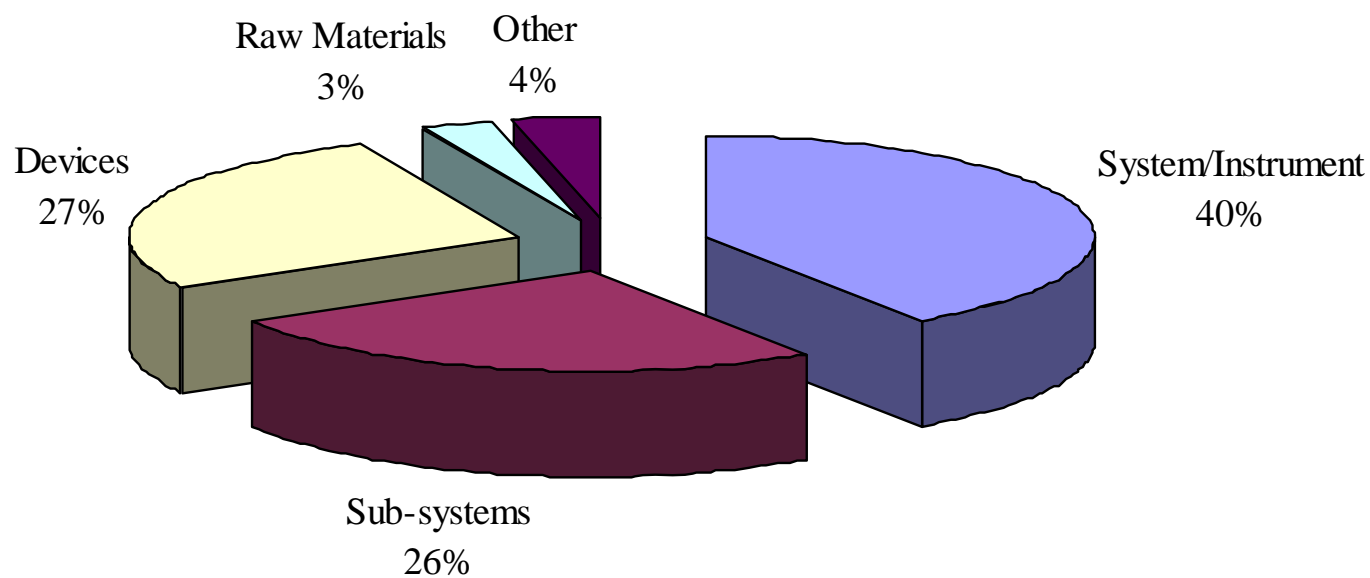
- 70% of companies have less than 50 employees
- Companies are R&D intensive
- Many manufacture in Canada



Employees by function



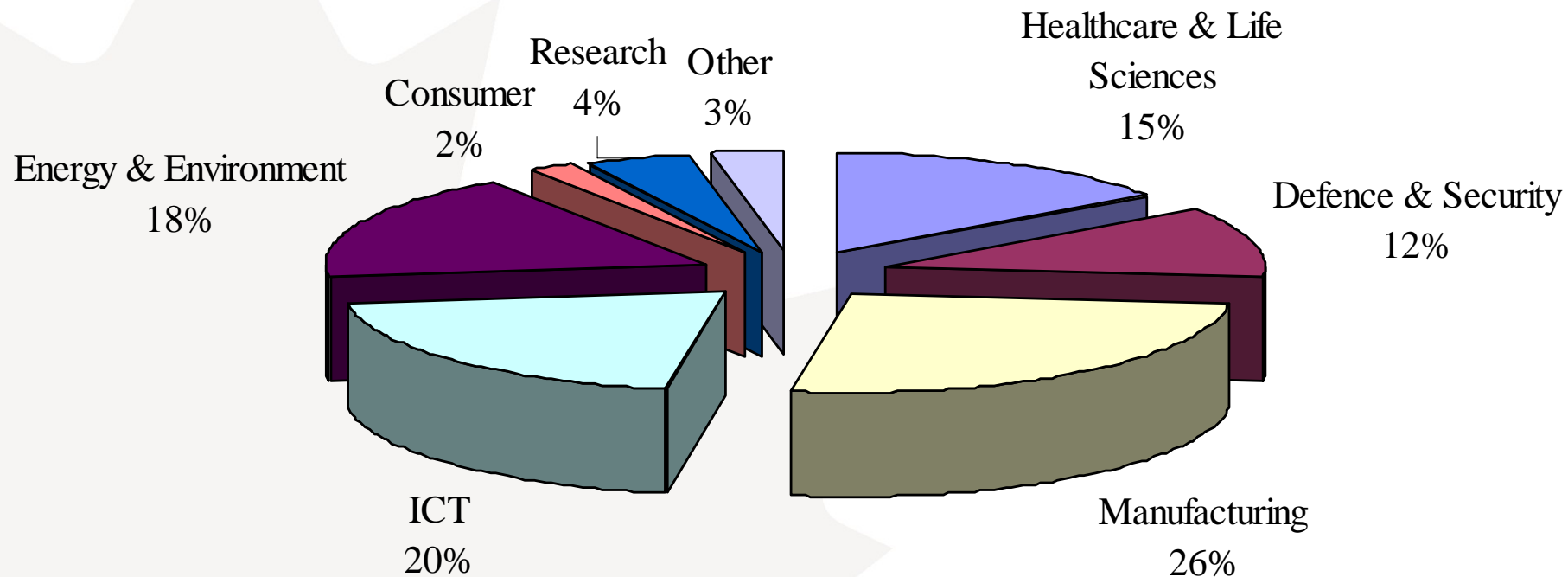
Position in food chain



- Canada's strength is photonic systems integration



Companies by Market Sector



- Only 20% of companies now address communications sector



Some Canadian photonics companies and their markets

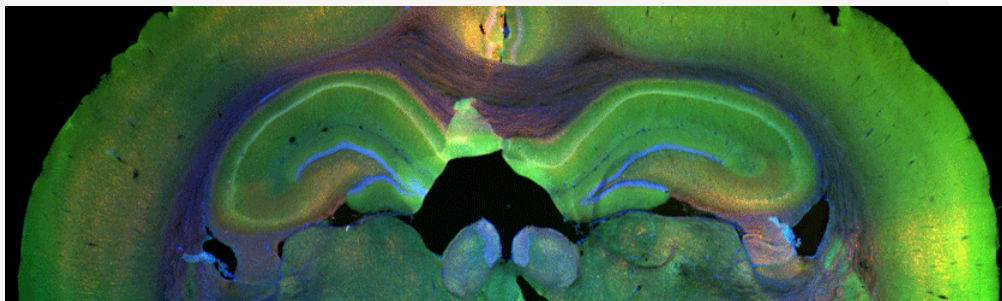


Health Care and Life Sciences

- **Surgery and Medicine**
 - Medical imaging
 - Photodynamic therapies
- **Biology and Biotechnology**
 - Visualization techniques
 - Measurement and analysis techniques
 - Micromanipulation techniques
 - DNA analysis techniques



Near IR spectroscopy of skin lesions



Fluorescence microscopy of stained section of rat brain

Spartan[™]



Rapid DNA analysis



Sensing and Imaging

- A Canadian strength
- Lidar remote sensing
- Fiber optic sensors
- CCD image sensors
- Biological sensors
- Digital cinematography



Optech's *LYNX* Mobile Mapper

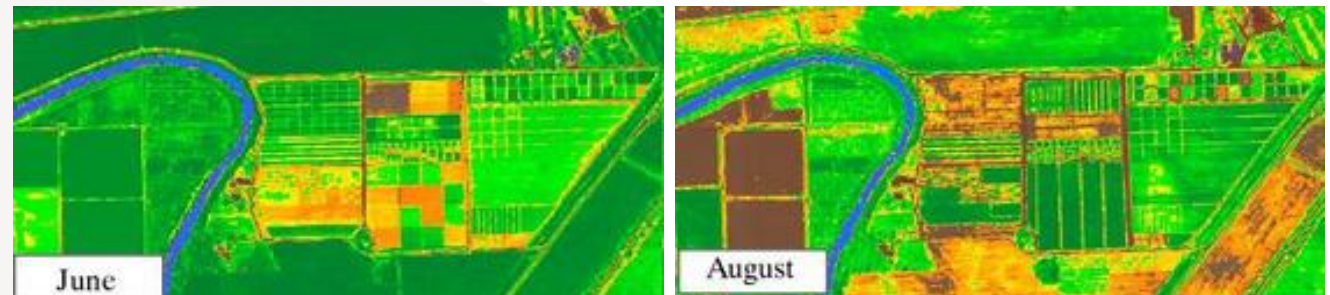
DALSA



DALSA-built sensors on the camera bar of the Mars Exploration Rover



Albion Hyperspectral Remote Sensing Systems & Solutions





Energy and Lighting

- Photonics for a "green" world

- Solid state lighting (LEDs)
- Advanced solar cells

Cyrium Technologies



High efficiency GaAs solar cell



Solar lighting



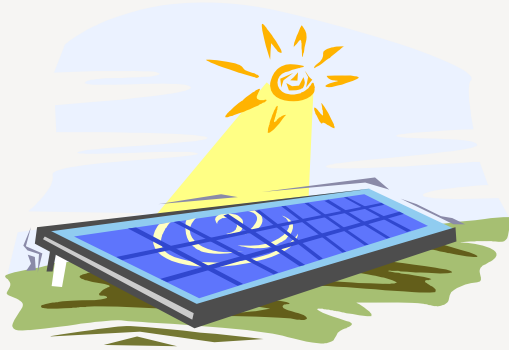
Solar farm - PEI



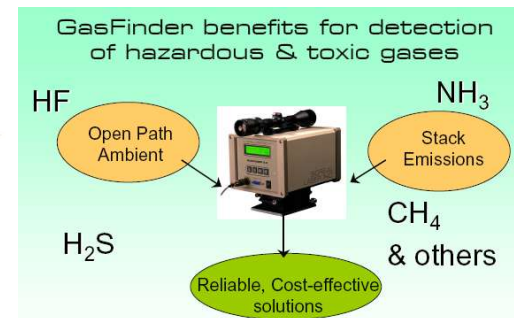
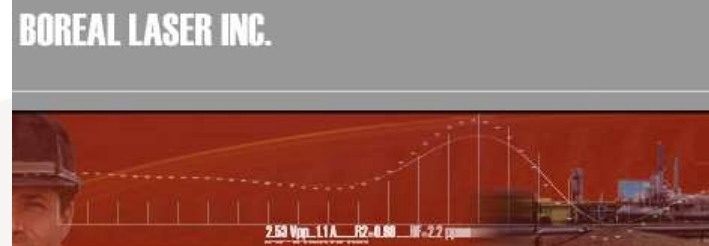
Environmental protection

- Environmental and atmospheric monitoring
- Water monitoring and purification

TROJAN UV™
WATER CONFIDENCE



UV water purification system

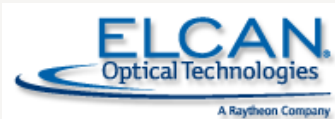


Detection of hazardous gases and pollutants



Defence and Security

- Surveillance
- Night vision
- Chemical and biological species detection
- Secure communication networks
- Encryption
- Anti-counterfeiting



Missile windows



Infrared night sights

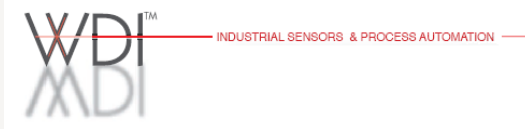


Airborne imaging system

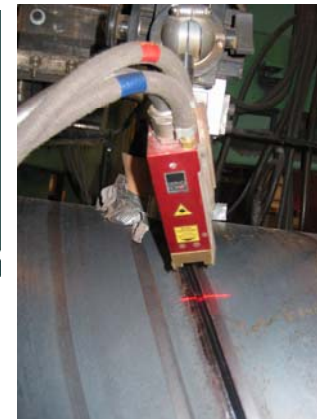


Manufacturing and Process Control Equipment

- Laser marking, writing
- Laser welding, cutting, machining, drilling
- Machine vision systems for process control



Auto focus system used in LCD manufacture



Laser tracking system for pipes



Communications

- Still a Canadian strength
- Nortel is still a leading supplier of optical equipment
- Over 20 companies in Ottawa alone
- Post-bubble companies are successfully exploiting triple play and fiber to the home



Network management



Enablence GPON transceivers



Underwater plant



Canada is a major user of photonics



Trains and planes



- Laser welding of assemblies
- Accurate laser alignment of parts
- Bar code identification of parts
- On board communications
- Sensing devices
- Precise drilling of small holes
- Ambient lighting in trains and planes



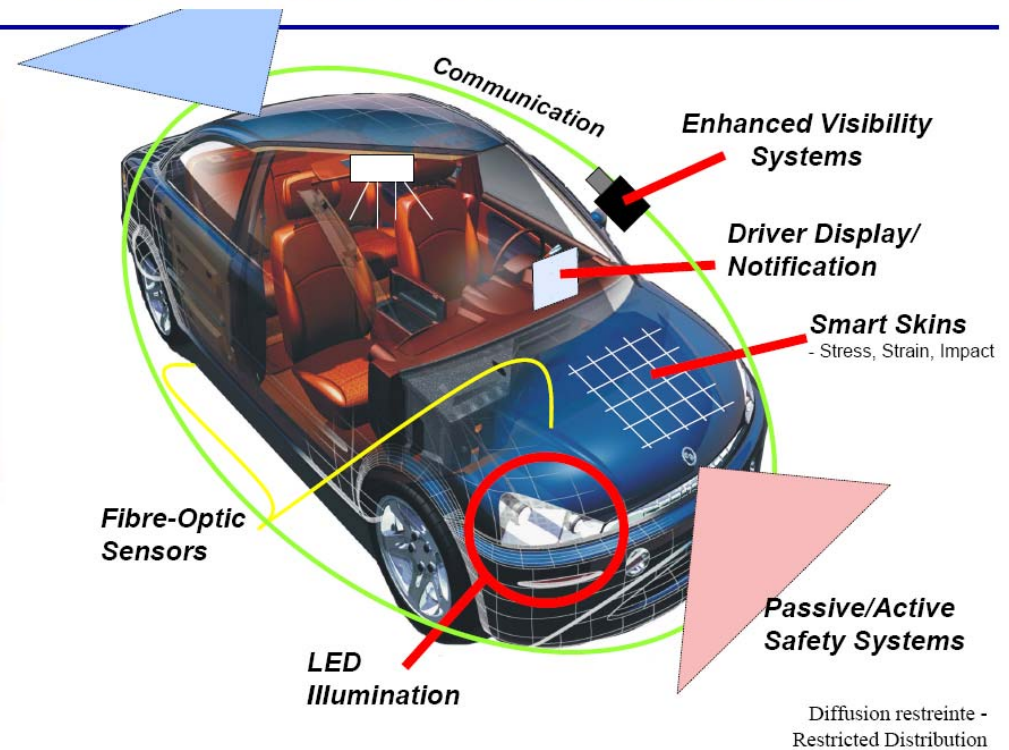


Auto manufacture

The Photonics Enabled Automobile

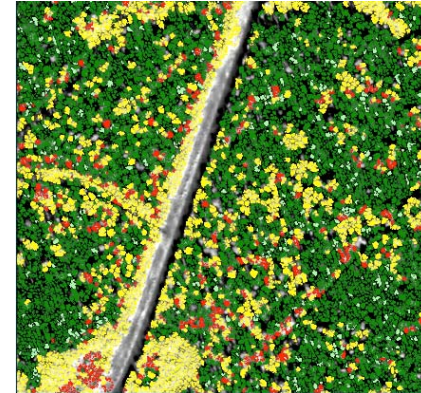


Laser joining of car and bus bodies

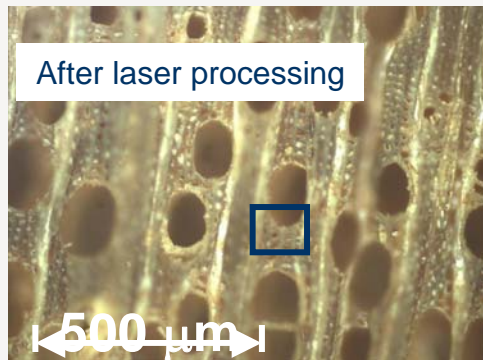
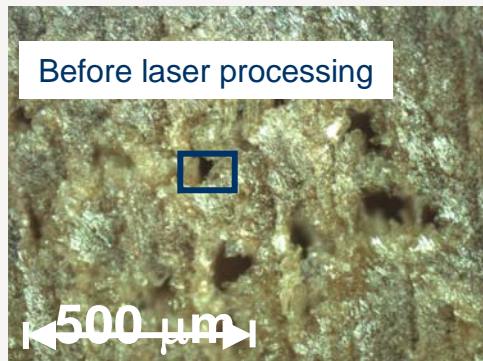




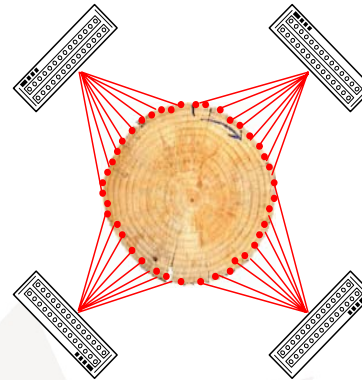
Forestry and Paper



Disease detection



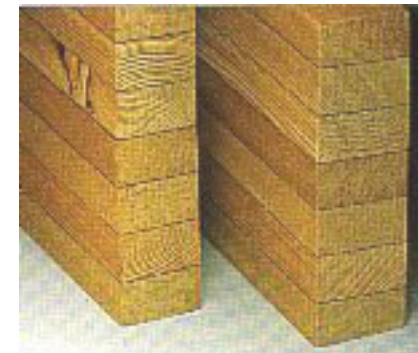
Surface finishing



Log profiling



Paper quality monitoring



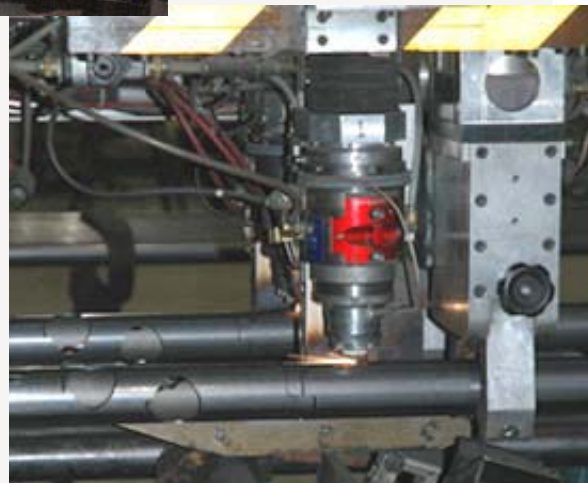
Quality inspection



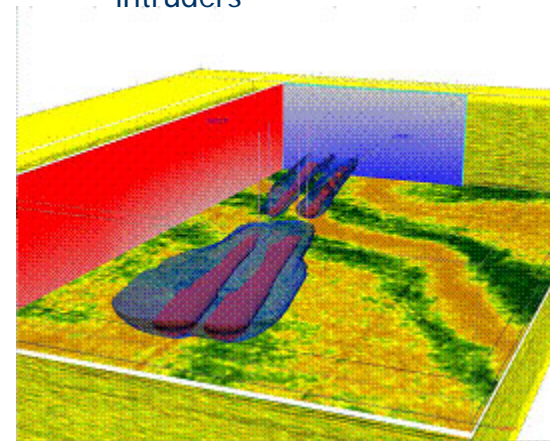
Oil and Gas



Laser machining of charge tubes



Monitoring of plant – leaks, intruders



Temperature profiling of wells



Research and Training



Government investment in Photonics

- **Government has invested over \$300m in photonics related facilities since 2000**
 - Canadian Photonics Fabrication Centre
 - Canadian Light Source
 - Institut National d'Optique
 - Advanced Laser Light Source
- **Provincial and federal governments invest about \$135m annually in photonics related research**
 - approx \$35m spent in universities
 - approx \$100m spent in government labs and facilities
- **Over 25 strong academic photonic groups nationally**
 - many have prominent international standing
- **Strong focus on industry / academic partnership**
 - CIPI
 - OCE
 - CMC
- **However, with exception of IRAP (\$3.5m) little direct funding of industry (unlike US and Europe)**



Government Investment

	\$m
Canadian Light Source	173
National Optics Institute	80
Photonics Fabrication Centre	65
Advanced Laser Light Source	21
	339

Capital and operating investments

	\$m
NRC	50
DRDC	20
NSERC	18
INO	15
CLS	14
CIHR	5.5
CIPI	4
IRAP	3.5
OCE	3
FQRNT	2
CMC	1
	136

Annual operating investments



Education and Training

- There is little formal education and training in photonics
- Most occurs at the PhD and Masters level through hands-on research
- Only 5 taught courses at Bachelors and masters level
 - graduate ~50 students per year
- Very little photonics technician training
 - 2 diploma courses
- The average EE in a Canadian University has little or no exposure to photonics



Summary and Recommendations



Canada's photonic strengths

- Strong research capability and infrastructure
- Skills pool
- Strong brand
- Strong industry-academic clusters in Ontario and Quebec

- Systems integration
- Optical communications
- Image sensors and vision systems
- Short pulse laser technology
- Emerging bio-photonics capability



Some challenges

- **Many photonics companies are SMEs and face the same challenges as similar enterprises in other sectors**
 - Difficulty in attracting finance
 - Small domestic market
 - Lack of SBIR vs US competitors
- **The domestic market is small**
- **Academic research in photonics is unfocussed**
- **Connectivity between industry and academia is not optimal**
- **Commercialization of technology needs improvement**
- **There is a lack of knowledge and where to get it among potential users of photonics**
- **Canada produces a lot of very good photonics PhD's but not enough technicians**
- **The typical engineer has very little exposure to photonics**



Recommendations

- The photonics producer community must better engage the user community
- Facilitate knowledge exchange between companies and between industry and researchers
- Improve photonics education and awareness at all levels
- Increase commercialization of Canadian photonic technology
- Focus photonics R&D on areas of strategic importance to Canada
- Expand the cluster model to other parts of Canada (Edmonton, Vancouver)



Canada and the "Photonics Toolbox"

