



Ontario Centres of  
Excellence

## **Innovation at the Edges**

# **Nano and Giga Challenges in Electronics, Photonics and Renewable Energy**

Don Wilford, OCE, Centre for Photonics

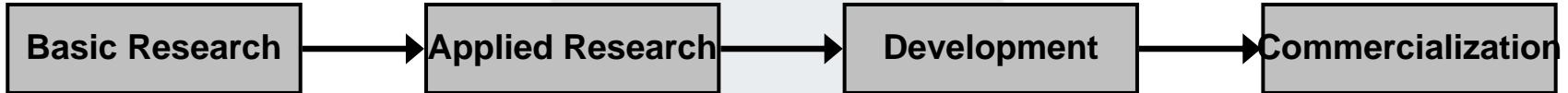
# Agenda



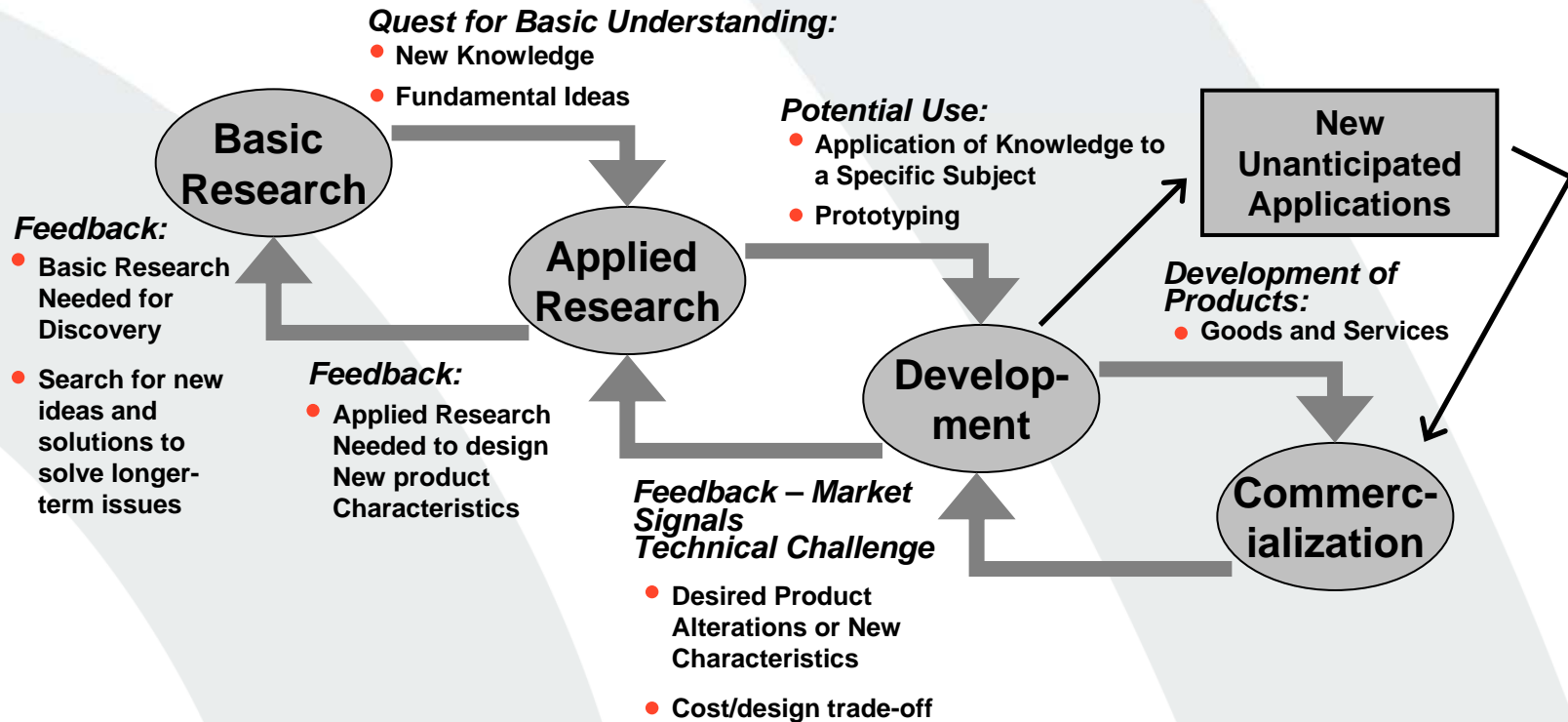
- **Some thoughts...**
- **About OCE**
- **OCE's Photonics WhitePaper**
- **OCE's Nanotechnology WhitePaper**
- **Summary**

# Innovation is chaotic

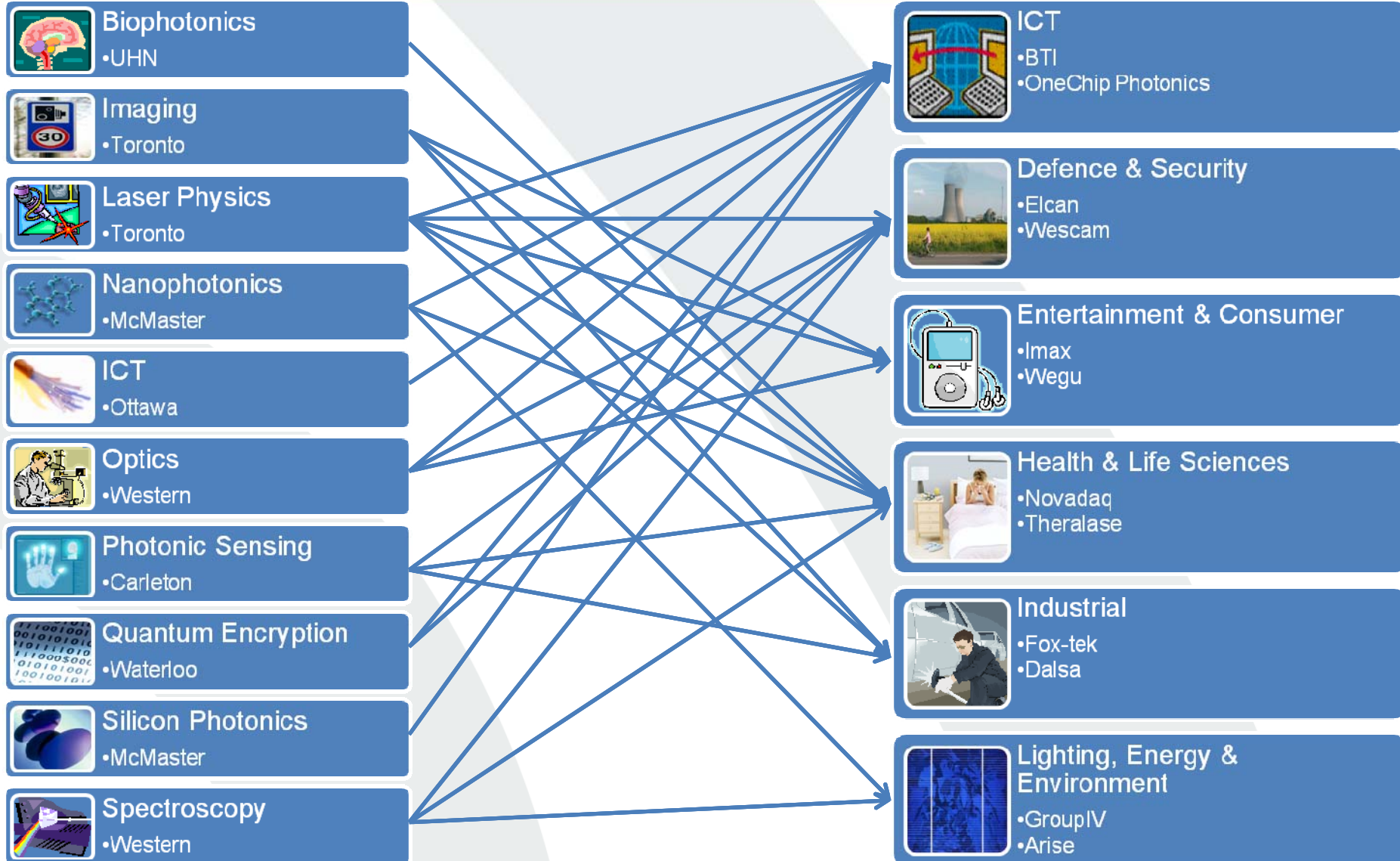
## Linear models don't properly describe the innovation process



## Feedback models more closely describe what actually happens



# Technologies and End Markets are not the same thing



# North America is Losing its Technology Dominance

## Highly polished Injection-Molded Case

**MADE IN CHINA**

### REASON U.S. supplier

base eroded as the manufacture of toys, consumer electronics, and computers migrated to Asia.

## Flex circuit connector

**MADE IN CHINA**

REASON U.S. supplier base eroded as the manufacture of consumer electronics and computers migrated to Asia.

## Electrophoretic display

**MADE IN TAIWAN**

REASON Its manufacture requires expertise developed from producing fl at-panel LCDs, which migrated to Asia with semiconductor manufacturing.

## Lithium Polymer Battery

**MADE IN CHINA**

REASON Battery development

and manufacturing migrated from the U.S. to Asia along with the development and manufacture of consumer electronics and notebook computers.

## Controller board

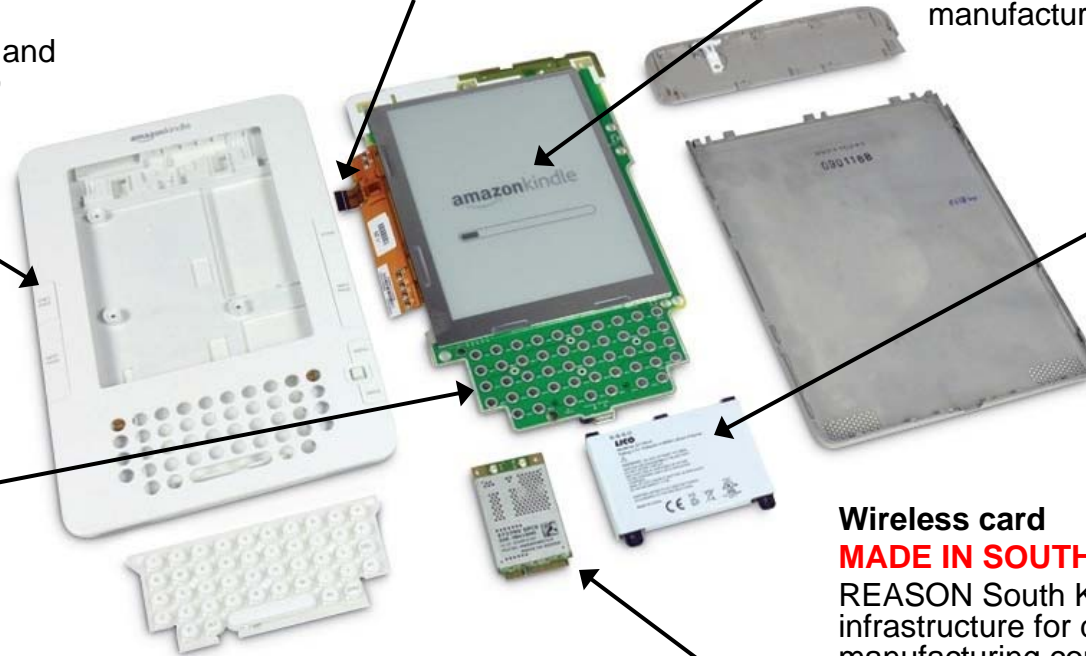
**MADE IN CHINA**

REASON U.S. Companies long ago outsourced the manufacture of printed circuit boards to Asia, where there is now a huge supplier base.

## Wireless card

**MADE IN SOUTH KOREA**

REASON South Korea used its infrastructure for designing and manufacturing consumer electronics to become a center for making mobile phone components and handsets, especially products using CDMA technology, which is widely used in South Korea.



# High Impact Firms

- High-impact firms account for almost all employment and revenue growth in the economy.
- There are probably less than 500 HIFs in Ontario.
- On average HIFs are 25 years old.
- Nearly all job losses are attributable to low-impact firms with more than 500 employees.
- High-impact firms exist in all industries – not just high-technology.
- Manufacturing as a whole does very well, with numbers that compare favourably with other sectors.
- What makes a firm hi-impact?

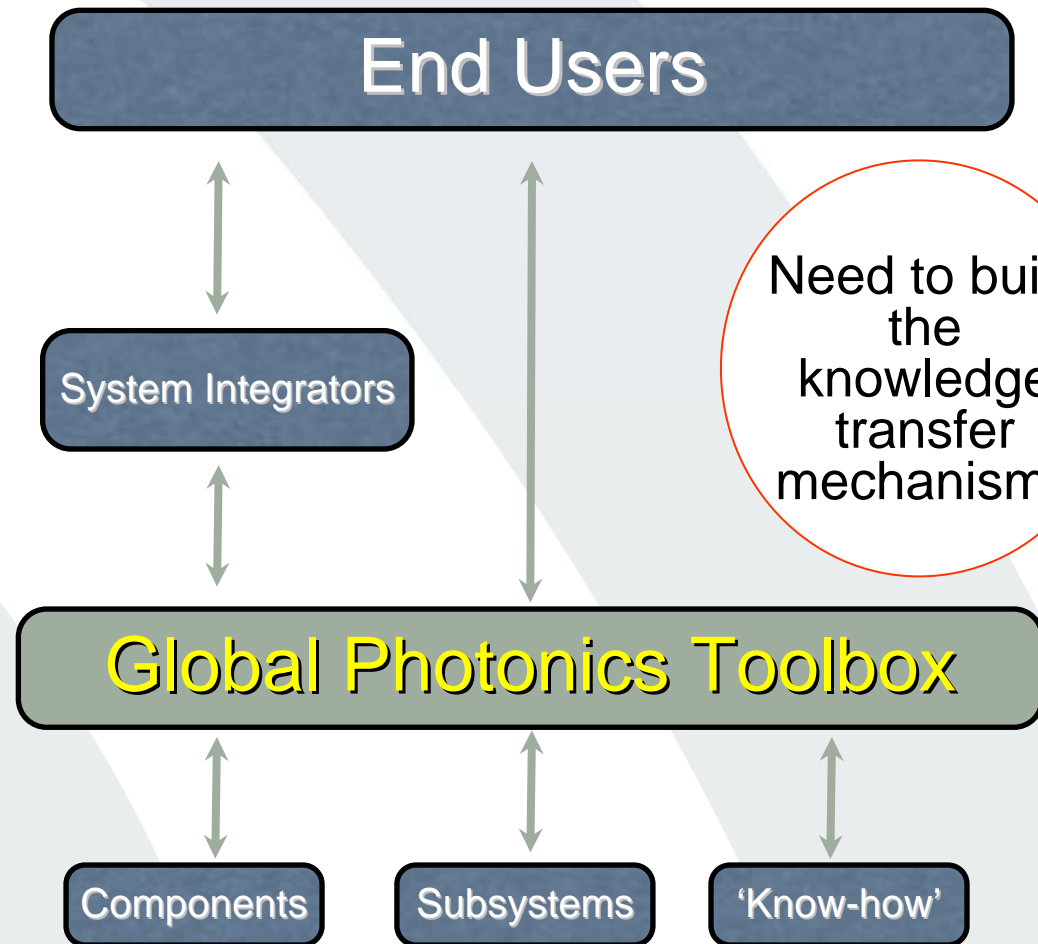
# The Photonics Toolbox



Every sector  
of the  
economy uses  
photonics

A Canadian  
strength

Canada makes  
a significant  
contribution  
to the tool box



Need to build  
the  
knowledge  
transfer  
mechanisms

Knowledge Interface

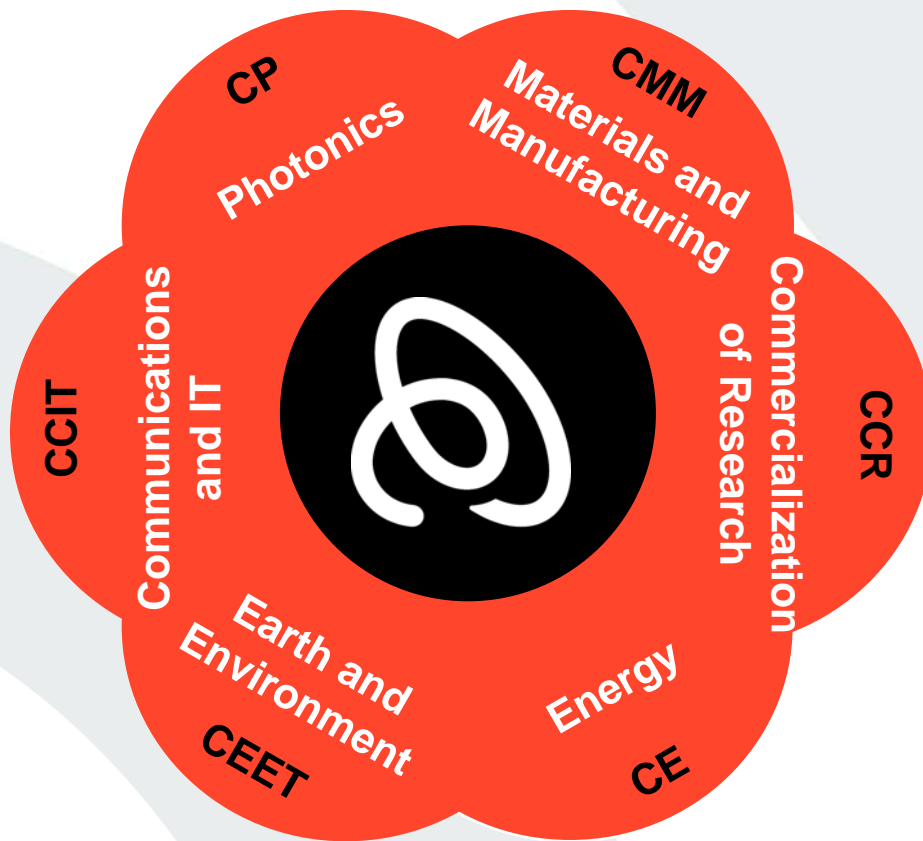
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- **Some thoughts...**
- **About OCE**
- **OCE's Photonics WhitePaper**
- **OCE's Nanotechnology WhitePaper**
- **Summary and Recommendations**



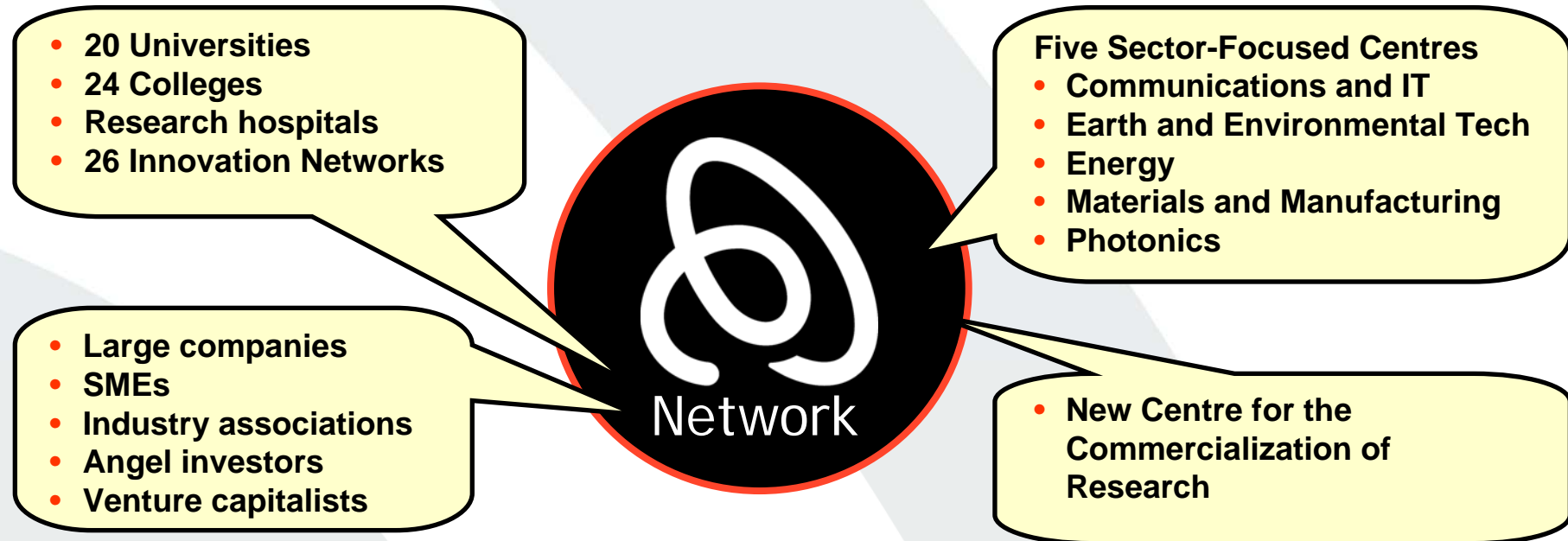
- OCE's mandate is to facilitate economic growth through:
  - support for industrially relevant R&D
  - commercialization of leading edge discovery
  - opening new market opportunities
- OCE's integrated programs support innovation from research to first investment to revenue
- OCE's extensive networking strongly promotes the critical feedback that leads to innovation



## OCE's Business Model:

- **Six Centres**
- **Flexible and scaleable**
- **Integrated, efficient and effective**
- **Strongly networked**
- **Market driven**
- **Client focused**
- **Entrepreneurial**
- **Key areas of convergence:**
  - ✓ Biomedical technologies
  - ✓ Clean-tech
  - ✓ Digital media

# OCE Delivery - Program Areas



**Research Programs**  
( *Innovate* )

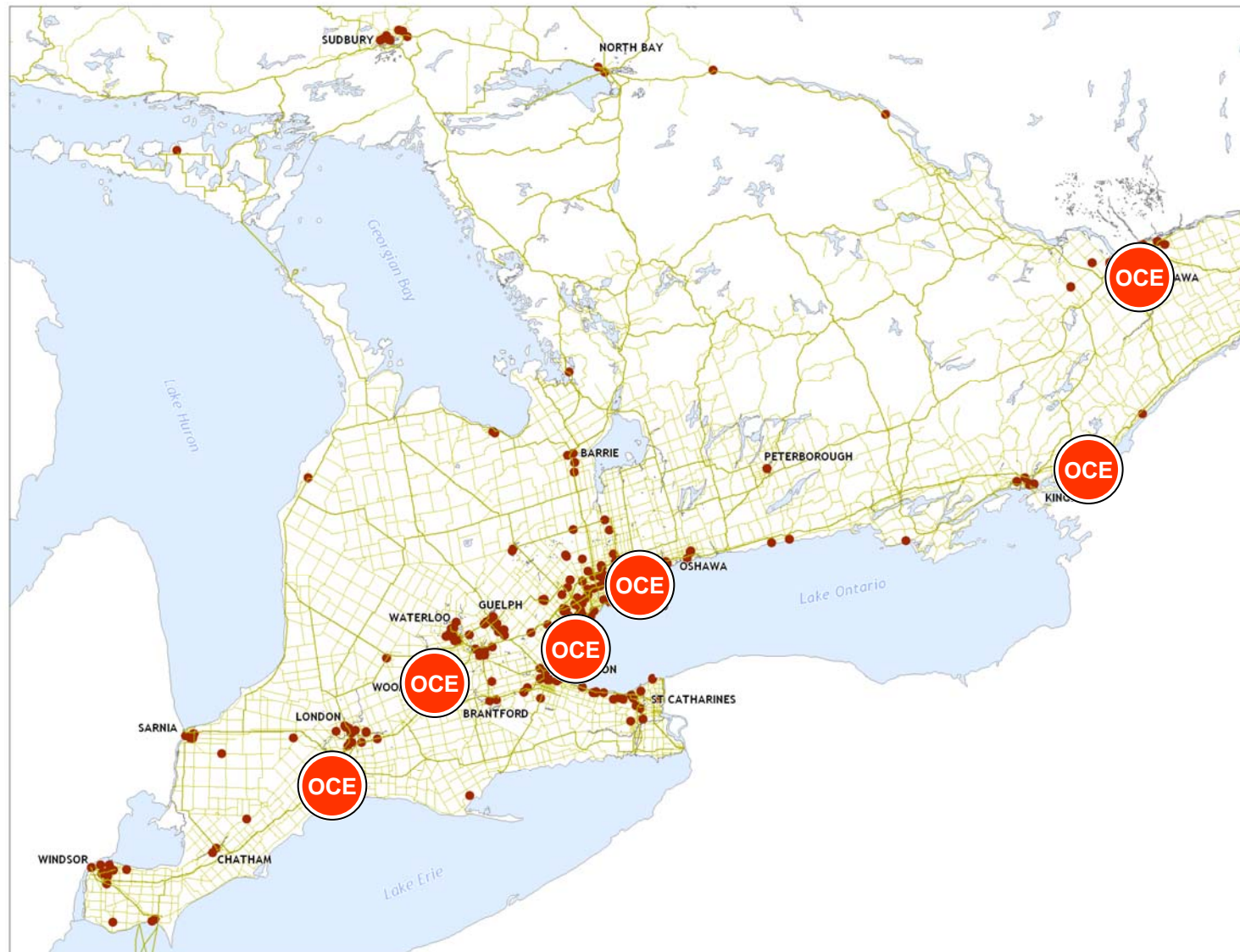
**Commercialization Programs**  
( *Accelerate* )

**Talent Programs**  
( *Cultivate* )

# OCE Delivery – Regional Nodes

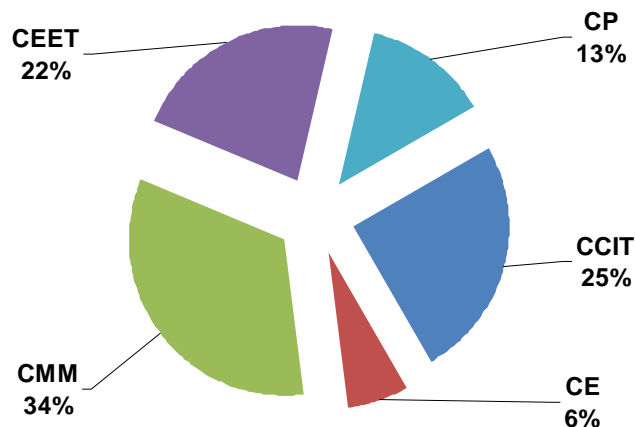


Ontario Centres of Excellence

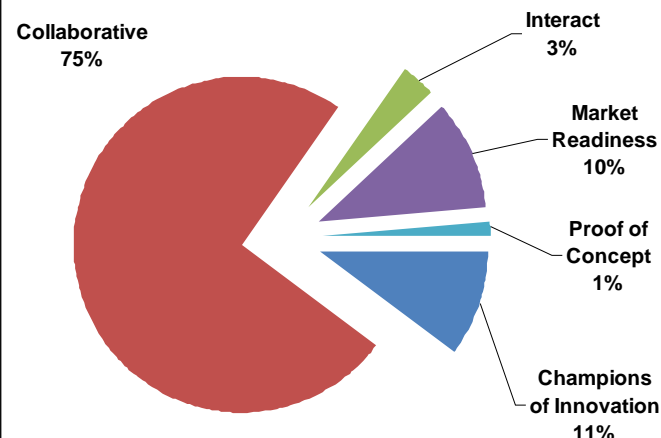


# Programs Summary by Centre

## Funding by Centre



## Funding by Program



<u>Number of Projects</u>	CCIT	CE	CMM	CEET	CP	OCE
Champions of Innovation	3	2	25	0	19	49
Collaborative	87	19	159	83	33	381
Interact	27	17	89	27	15	175
Market Readiness	38	9	33	6	12	98
Proof of Concept	4	0	10	5	3	22
<u>Average \$ per project</u>						
Champions of Innovation	\$ 257,017	\$ 145,800	\$ 133,607	\$ -	\$ 133,746	\$ 141,714
Collaborative	\$ 147,641	\$ 166,096	\$ 98,024	\$ 162,318	\$ 141,128	\$ 130,488
Interact	\$ 13,789	\$ 13,500	\$ 11,974	\$ 14,367	\$ 14,437	\$ 12,983
Market Readiness	\$ 66,413	\$ 60,347	\$ 63,085	\$ 115,282	\$ 88,059	\$ 70,378
Proof of Concept	\$ 41,000	\$ -	\$ 33,509	\$ 38,292	\$ 100,565	\$ 45,102

# OCE Outcomes\*



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OCE invested **\$ 16,428,879** in research projects last year

OCE supported projects **451**

Over 4,000 researchers and students were involved in OCE supported research programs

Researchers	<b>730</b>	17%
Post-doctoral fellows	<b>282</b>	7%
Doctoral students	<b>587</b>	14%
Masters students	<b>718</b>	17%
Undergraduates	<b>1301</b>	30%
Private sector employees	<b>424</b>	10%
Other	<b>250</b>	6%

OCE connected researchers with industry challenging **637** companies to develop solutions to industry challenges

OCE's 95 start-ups attracted **\$ 85,358,452** in carry-on investment from capital markets last year

**19** New leading-edge companies created through OCE supported research

Investment leveraged from the following sources last year: **\$ 33,586,778**

Industry Partners	<b>\$ 30,970,376</b>
Government Partners	<b>\$ 2,616,402</b>

Companies and individuals that connected with OCE **36,810**

Universities / Colleges / Research/ Hospitals engaged **25**

Peer reviewed publications supported by OCE **1,066**

Refereed publications by Centre researchers **897**

Patent applications submitted with support from OCE **110**

Patents granted with support from OCE **24**

Established licences **25**

Active licences that were supported by OCE **86**

# Agenda



- **Some thoughts...**
- **About OCE**
- **OCE's Photonics WhitePaper**
- **OCE's Nanotechnology WhitePaper**
- **Summary**

We visited Executives of 41 firms in Ontario with a core competence in Photonics.

	Ontario	
	Sample	OCE Data
Number of Firms	41	117
Large	10	21
SME	20	76
Start-ups	11	20
Employees <sup>[1]</sup>	5,900	10,200
Revenue (\$B)	2.4	3

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

Here's what we found...

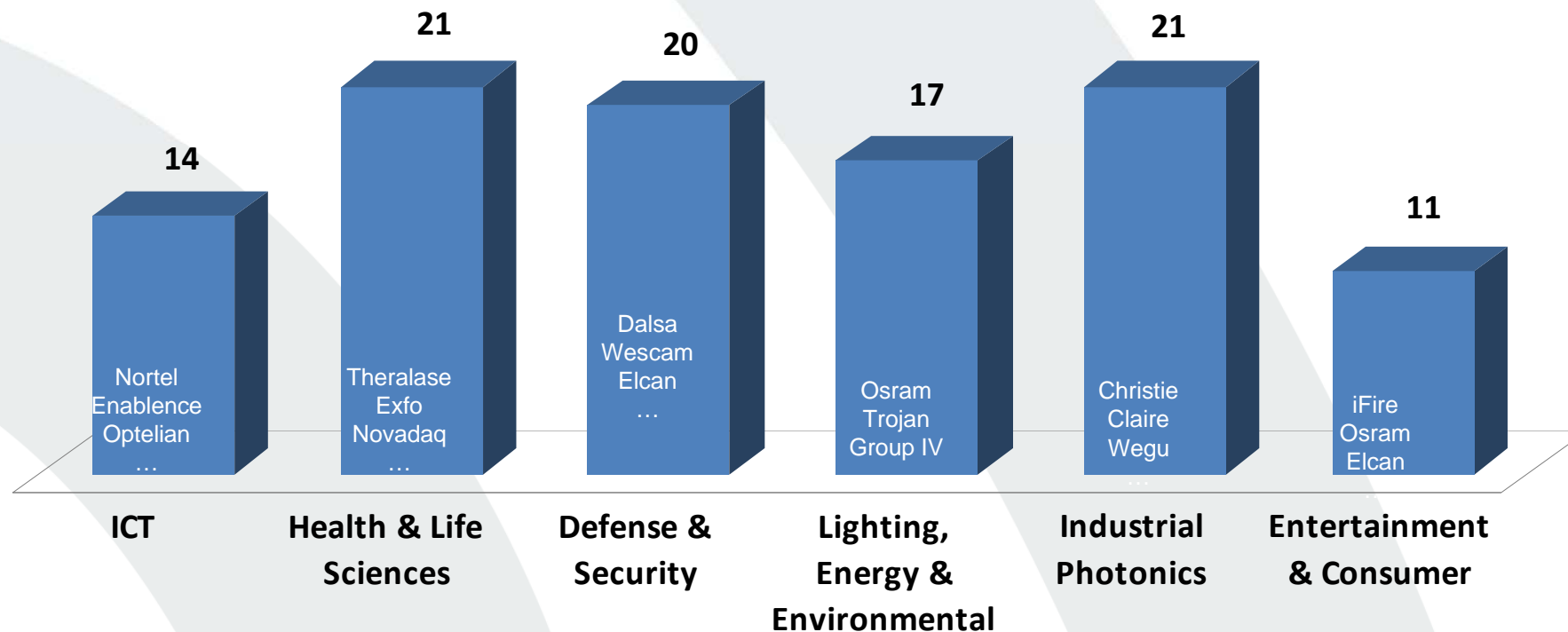
<sup>1]</sup> Nortel is still a dominant player with 1,400 employees in Ontario – 1,100 in R&D. 16

Firms exploiting photonics-related technologies have a proven track record as an engine of economic growth, high-value jobs, innovative products and success in global markets

Ontario's photonics industry sector is mature and successful including globally competitive large firms, nimble SMEs, and a small but vibrant start-up community.

# Diversified End-Markets...

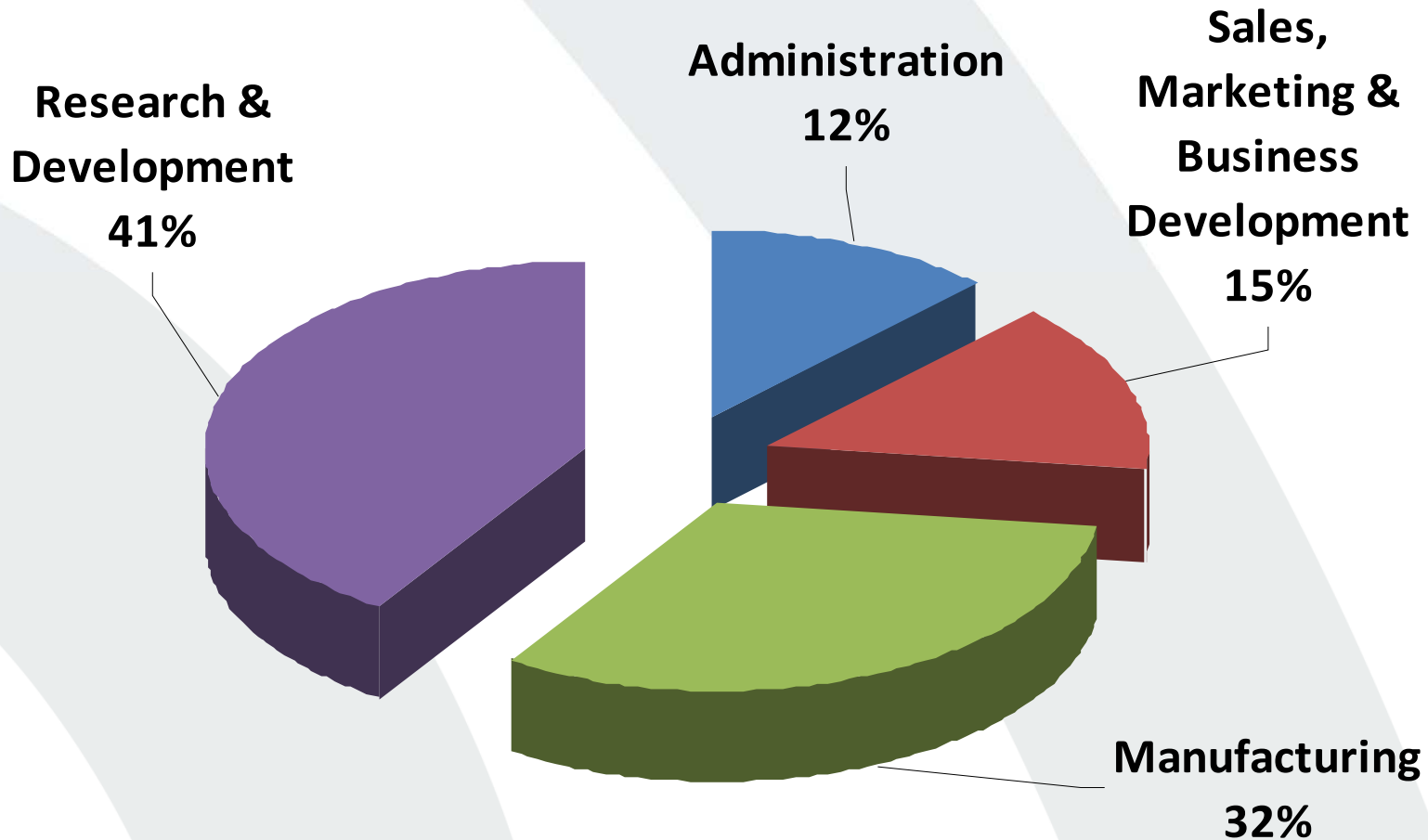
Firms are active across six identified end-markets. ★



(★) Interviewed firms only – several firms are active in more than one area

# A Significant Employer...

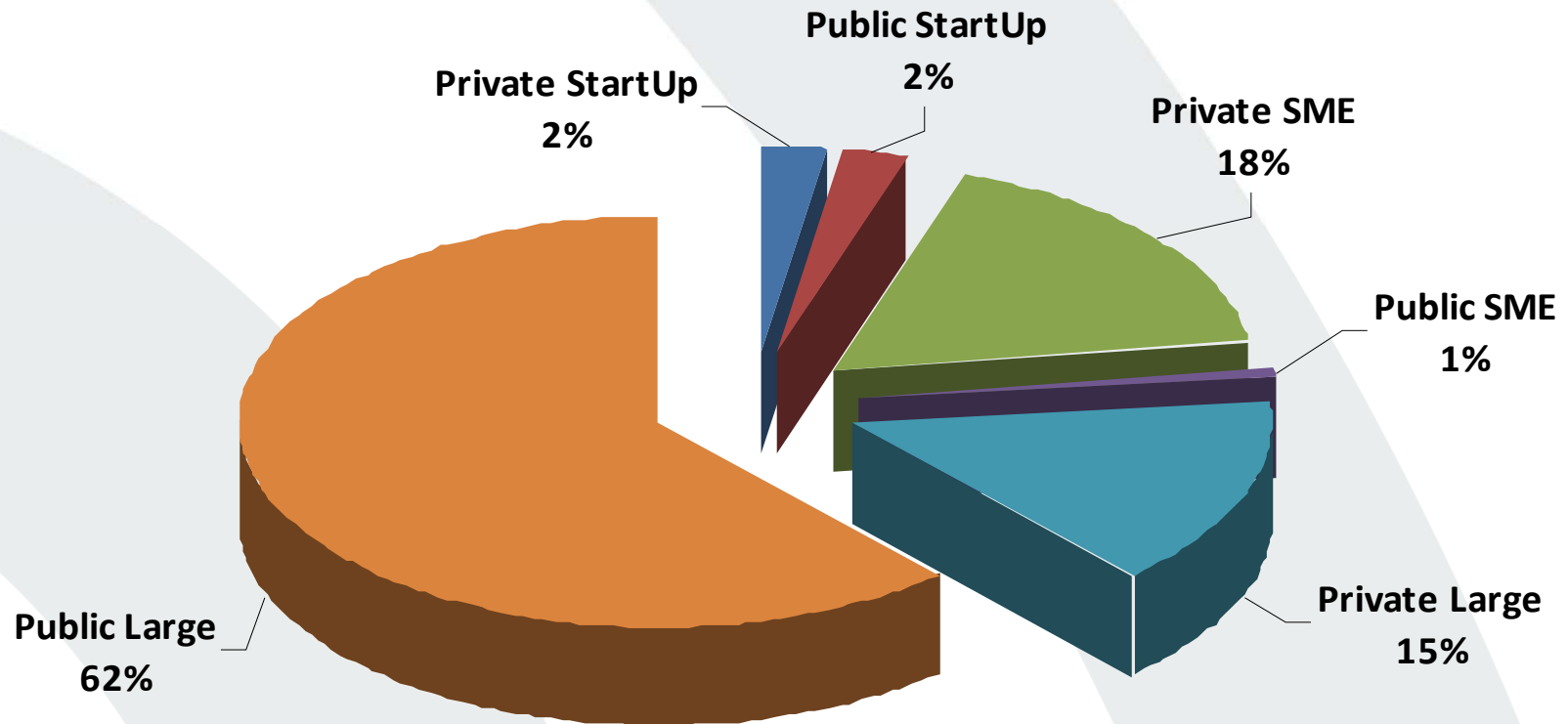
10,200 high-value jobs in Ontario★



(★) Interviewed companies have 5,900 employees

# Employee Distribution

Employment is predominantly in large, public firms  
(often foreign owned)

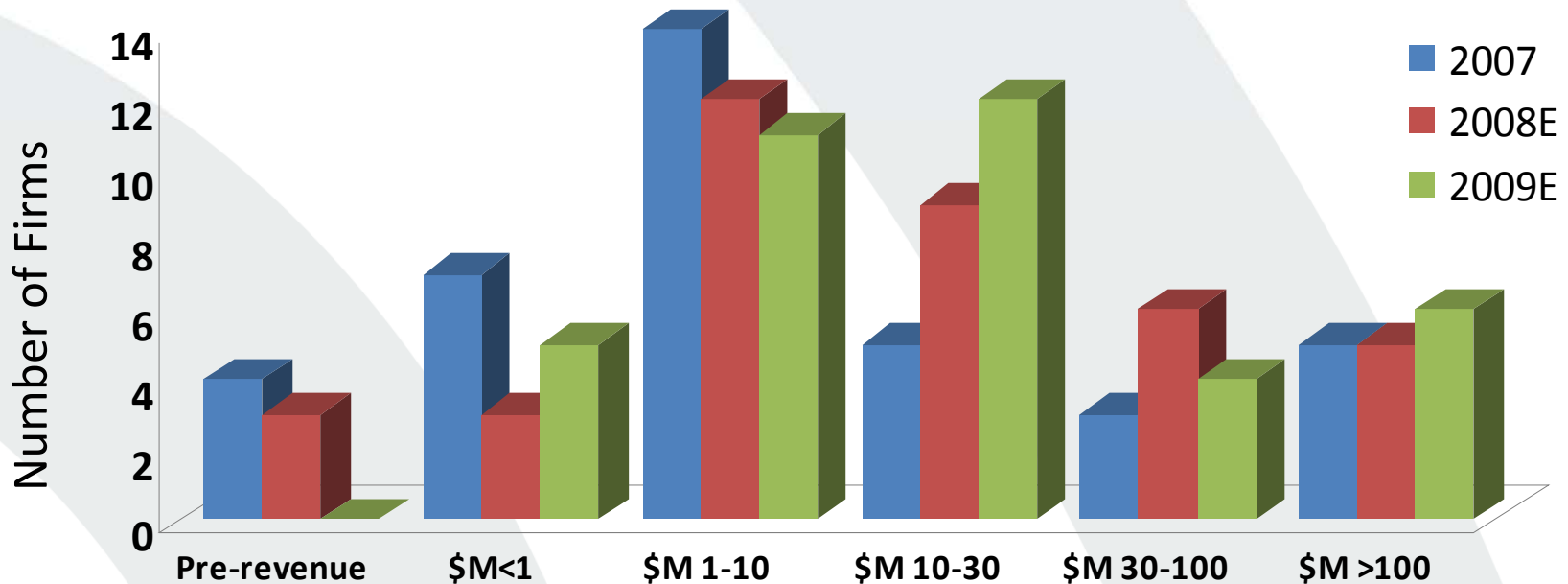


(\*) Interviewed firms only  
SME =<250 employees, autonomous AND operating at break even

# A Growing Revenue Base...

Current revenues of over \$3B★

Average revenue per employee \$195,000◆

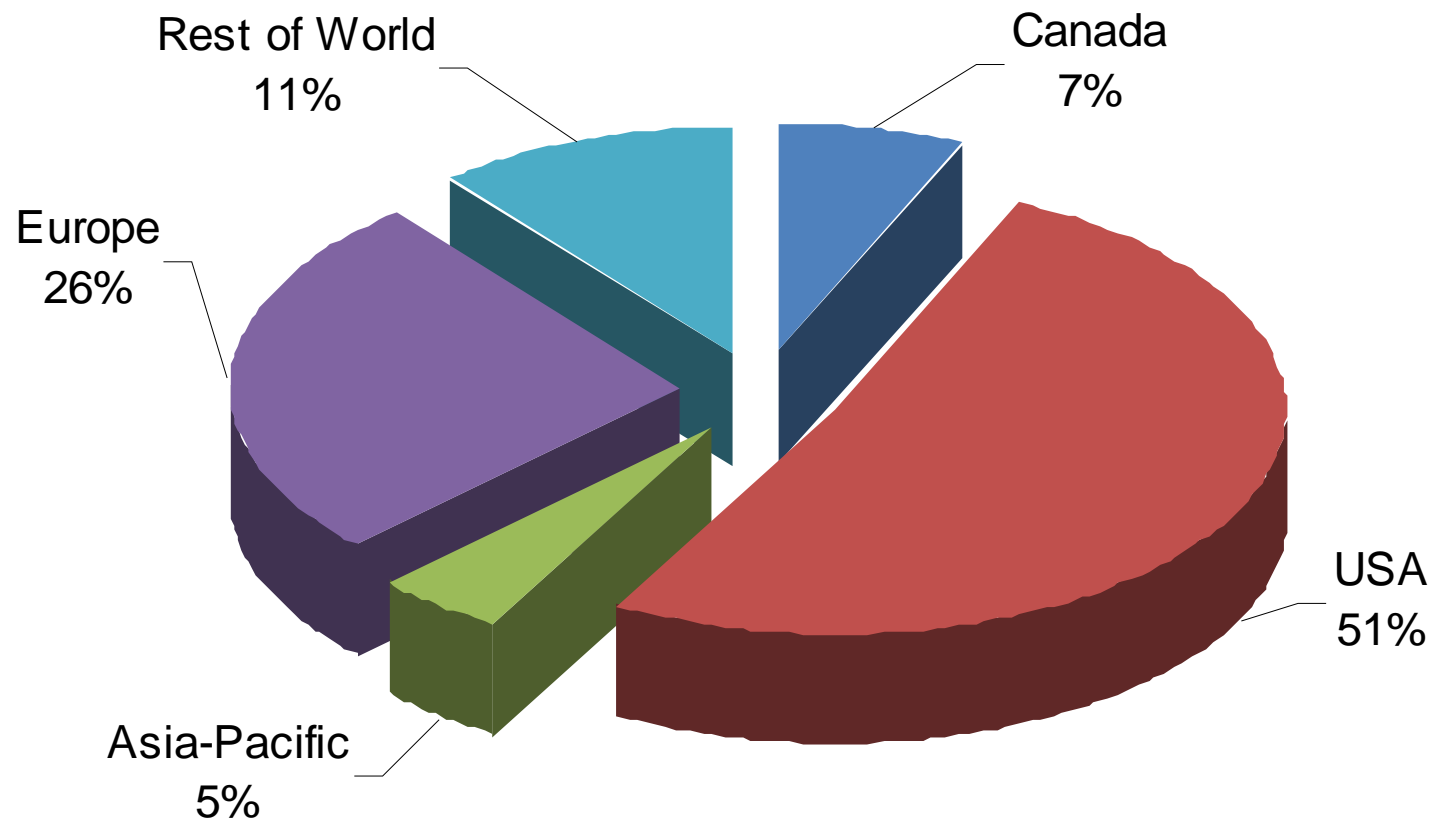


(★) Interviewed companies have revenues of \$2.4B

(◆) excluding Nortel

# Export Driven Businesses...

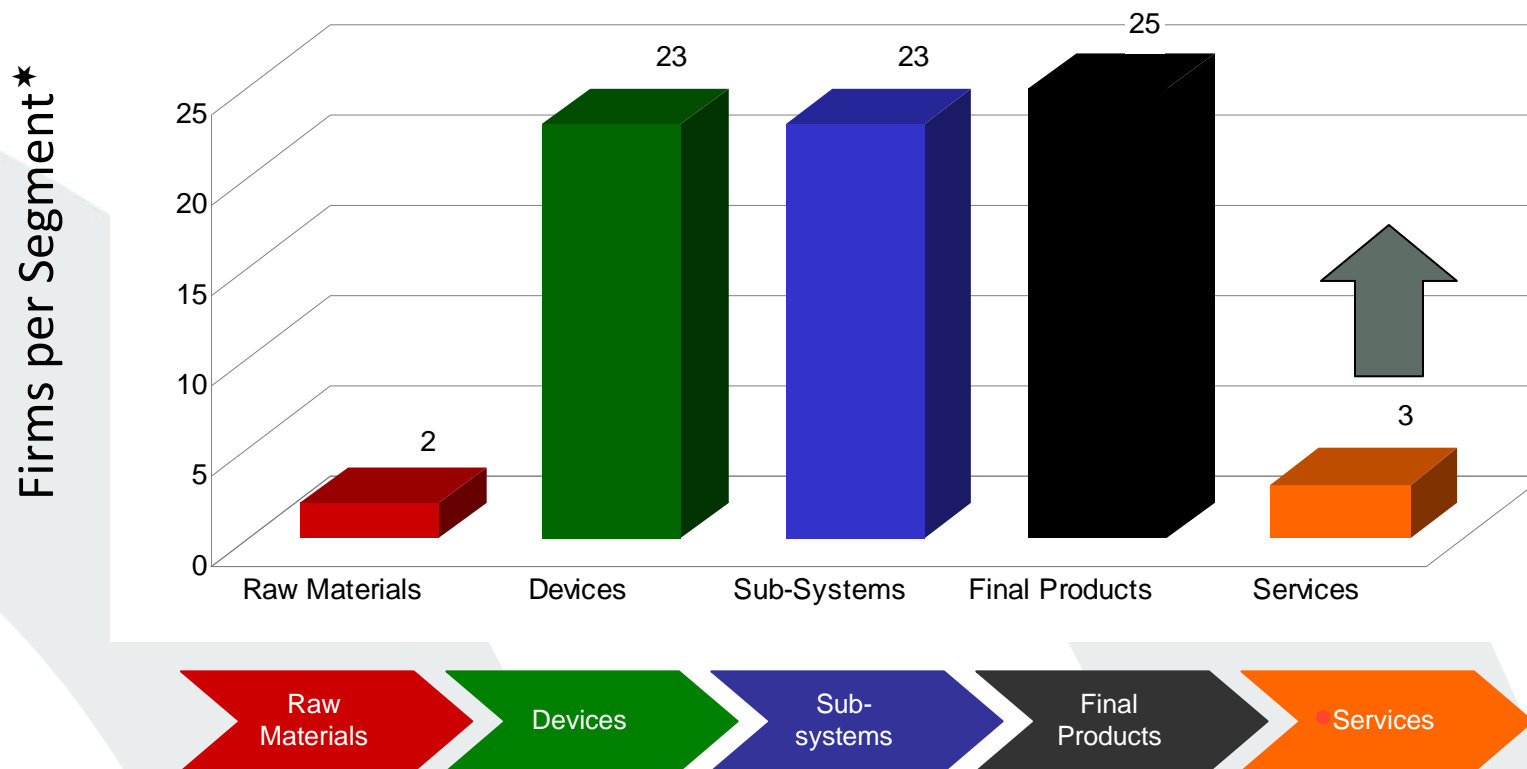
Ontario Exports of \$2.8B★ pa.



(★) Interviewed companies have exports of \$2.1B. (93% of \$3B=\$2.8B)



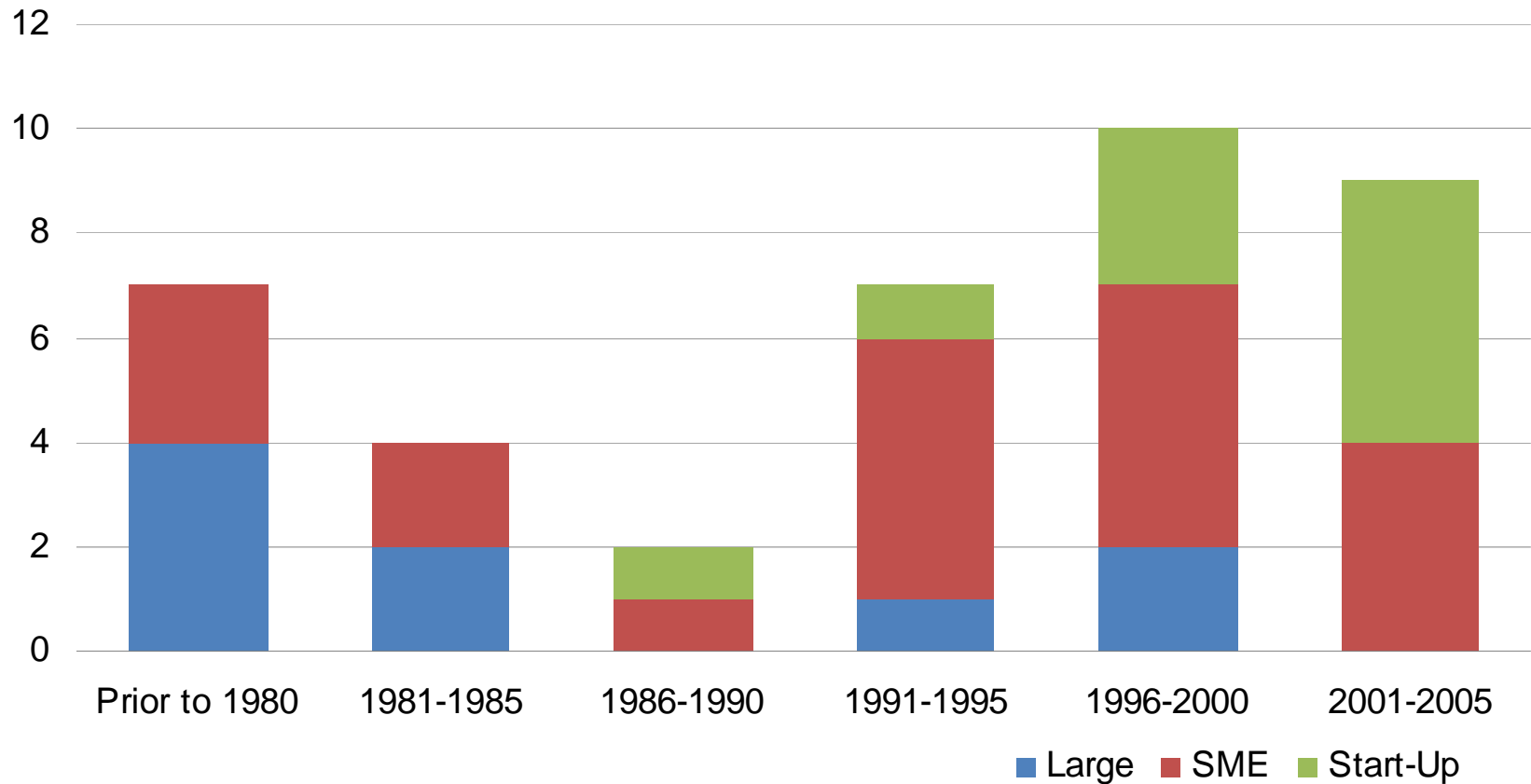
## Services: a growth opportunity?



(\*) Interviewed firms only – several firms produce more than product type

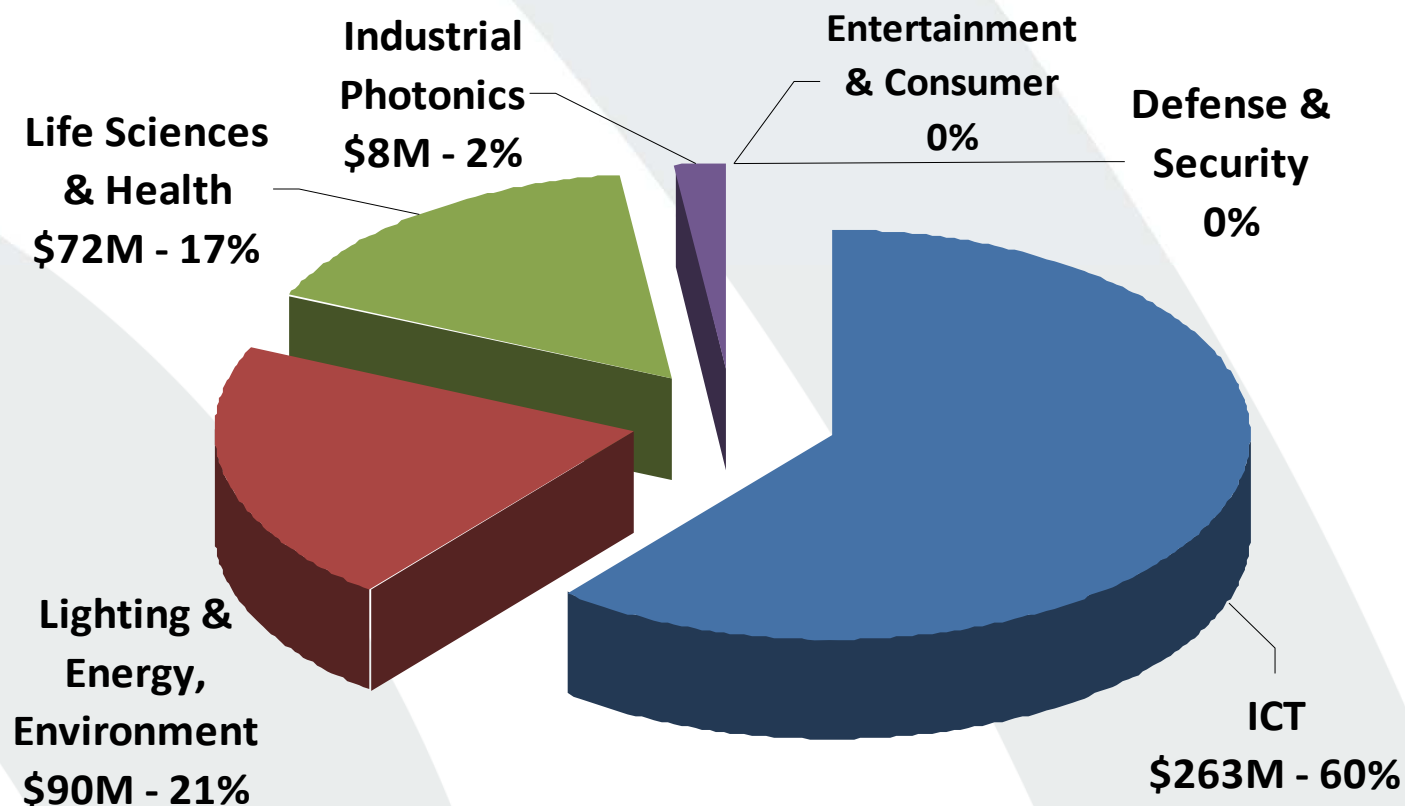
# Sector Maturity...

Firms are typically 15 years old, or more



# Strong Investor Attractiveness

Over \$450M has been invested since 2005 in Ontario photonics-related start-ups

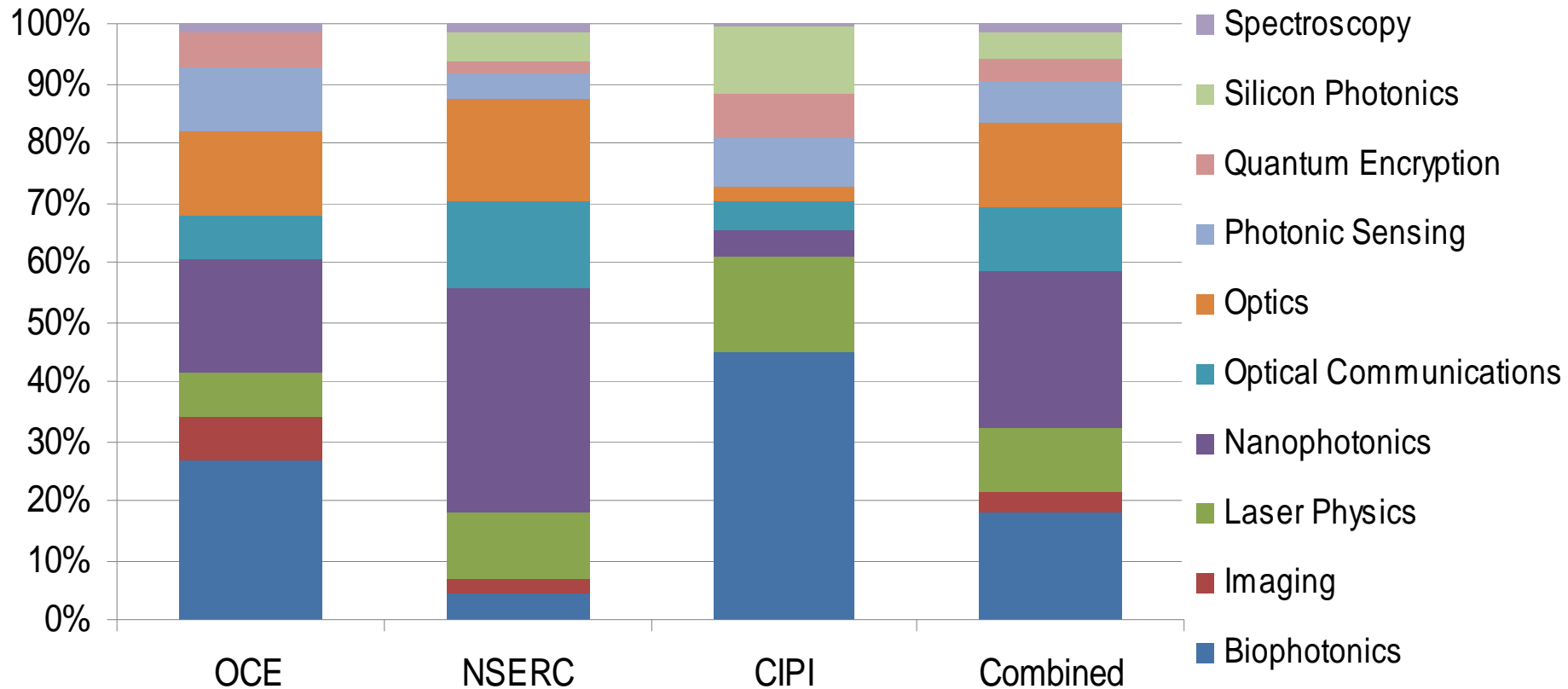


Investment still dominated by ICT.  
Market demand or Ontario's comfort zone?

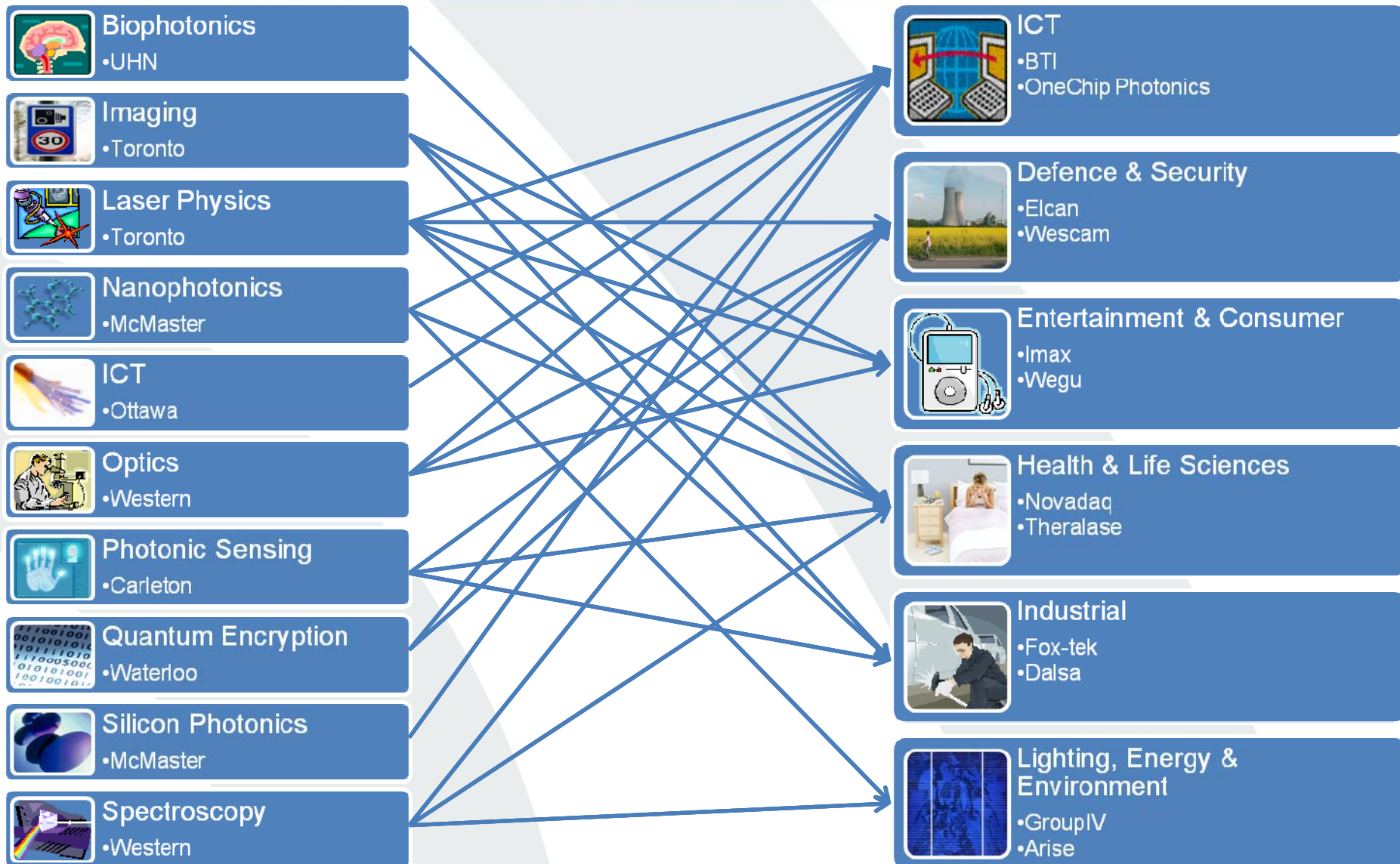
Ontario has world-class academic photonics capabilities and research institutes.

Ontario has a strong photonics academic base with more than 100 PIs and 400 HQP. 14 new photonics-related Canada Research Chairs have been established since 2003.

# Distribution of Funding by Agency and Topic



# Academia-Industry Linkages



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# Nano WhitePaper Methodology

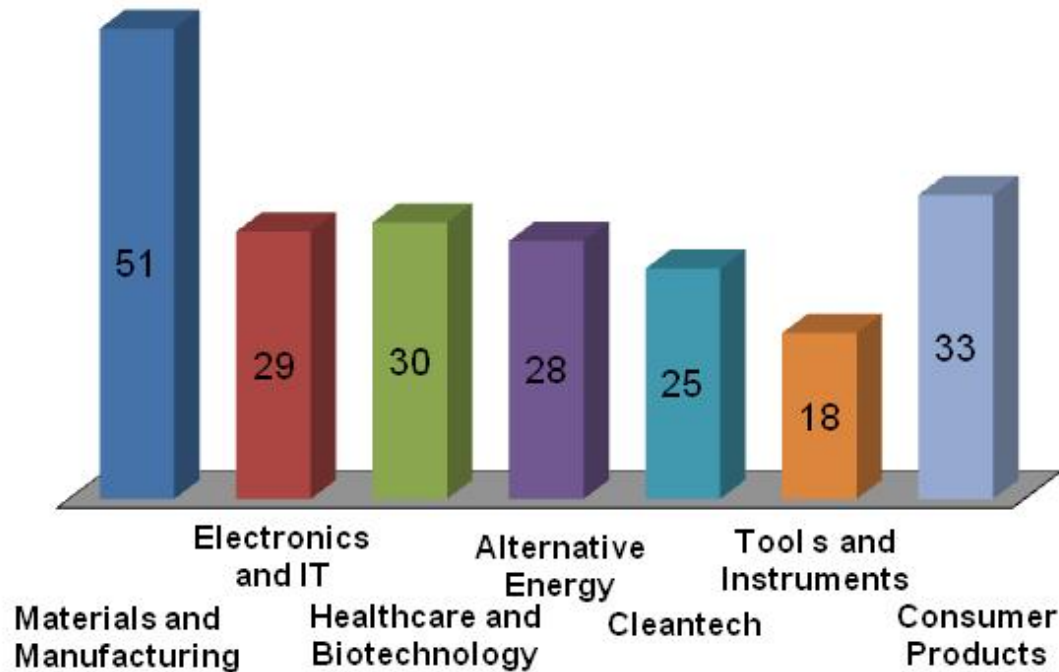
We have visited 9 firms in Ontario with nanotechnology business.

	Ontario	
	Sample	OCE Data
Number of Firms	9	93
Large	4	35
SME	1	43
Start-ups	4	15
Employees	3.5	19.9
Revenue (\$B)	1.1	6.1

Here's what we found...

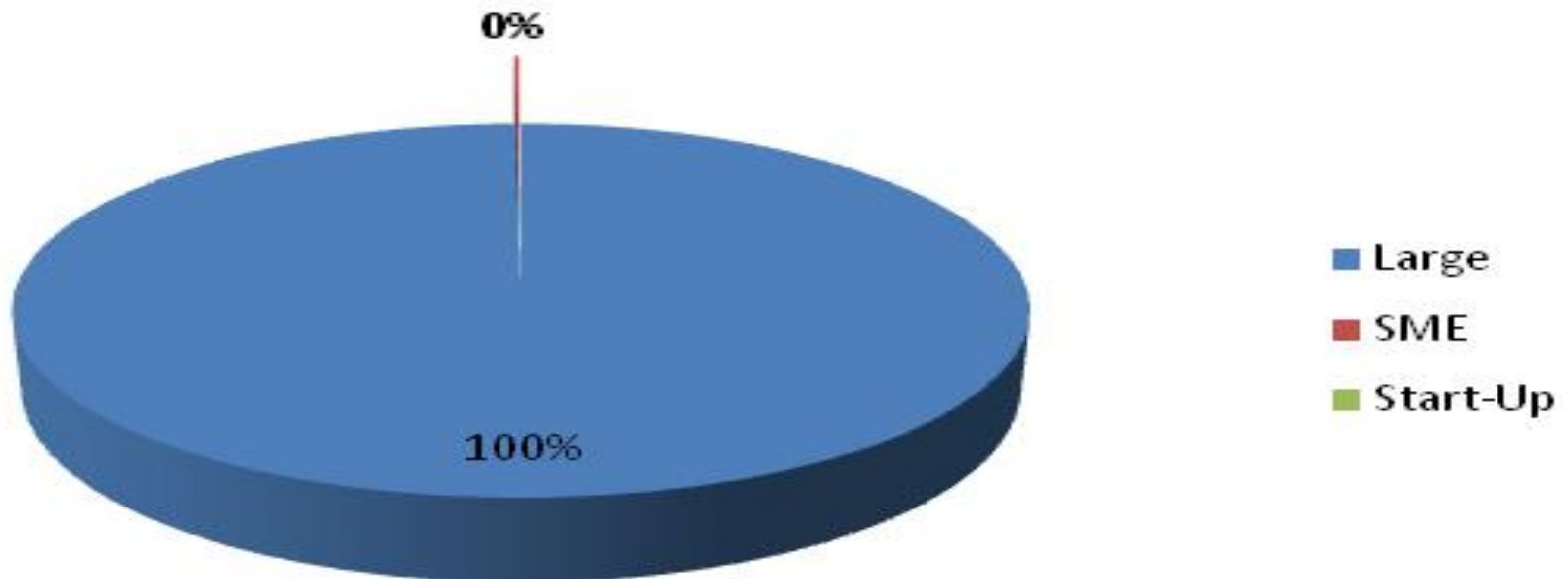
# Diversified Nanotechnology End-Markets

Firms are active across seven identified end-markets



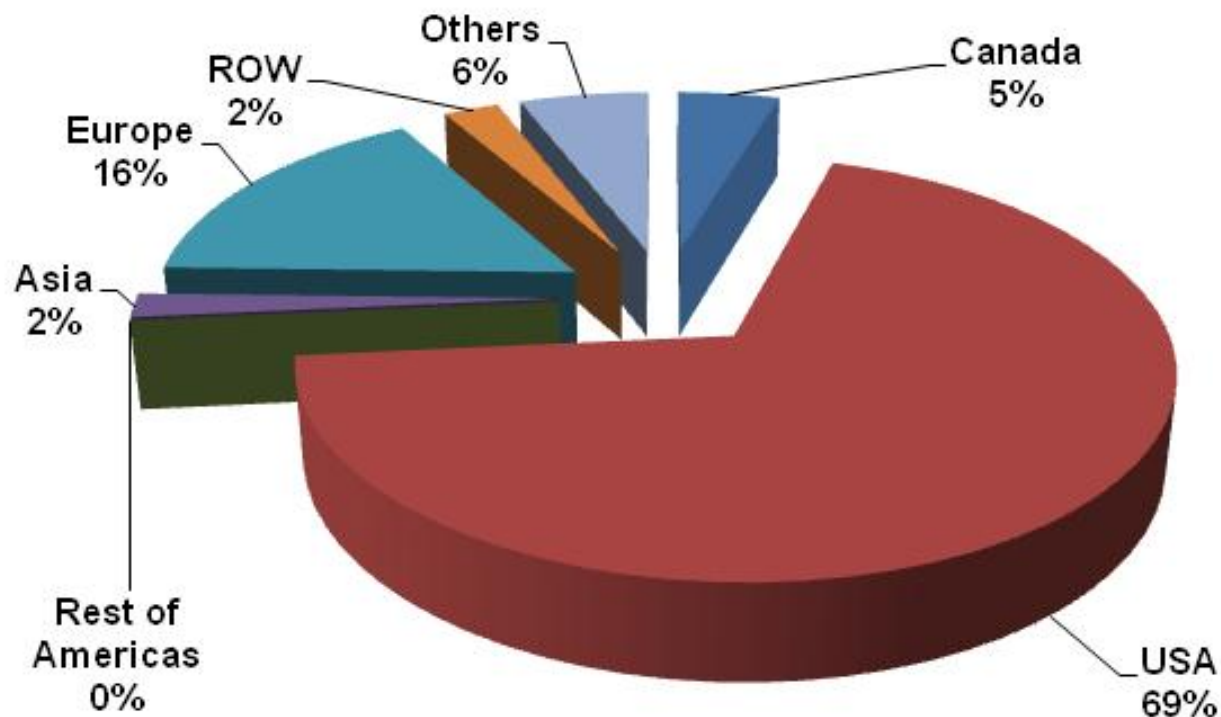
# Nanotechnology Employs almost 20,000 people in Ontario

Employment is predominantly in large, public firms



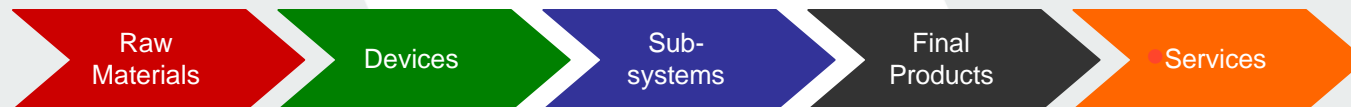
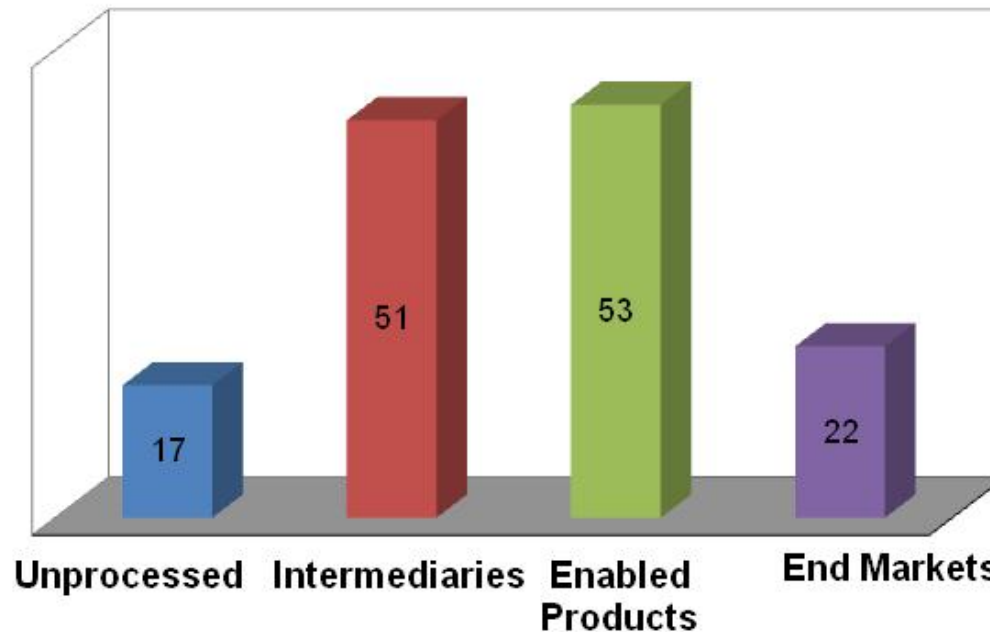
# Export Driven Businesses...

## Estimated Ontario Exports of \$5.8B



# Products & Services Positioning...

Ontario firms are well-positioned in the value chain?



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# Summary – Photonics Industry

- Photonics supports over 10,000 high-value jobs in Ontario, with revenues in excess of \$3B.
- Photonics is an area of opportunity and growth for Ontario. It has a balanced cross section of mature firms with proven track records, as well as SMEs and start-ups covering diverse market segments.
- Large companies tend to dominate their niche markets; SME's employ diverse business strategies from highly specialized niche markets to diverse portfolios; start-ups cover a diverse portfolio and have attracted over \$450M of capital market investment.
- Job growth opportunities come primarily from small SMEs growing into large companies. There are few formal strategies to foster such growth.
- A key concern for all companies is fluctuations in value of the Canadian dollar.
- Ontario's photonics companies play a key role in achieving both the Canadian and Ontario innovation agendas.

# Summary – Photonics Academia

- Ontario has world-class academic photonics capabilities and research institutes.
- Public funding is \$10.7M pa compared to \$150M pa in capital market investment and over \$500M pa in industry R&D spending.
- Research funding is heavily focused in biophotonics and nano-photonics
- Ontario might benefit from a more balanced research strategy covering start-ups, SMEs and large companies.
- A key weakness is the lack of participation of large companies to drive research agendas and large-scale funding initiatives.

# Summary - Nanotechnology

- Nanotechnology supports almost 20,000 high-value jobs in Ontario, with revenues in excess of \$6B.
- Ontario's nanotechnology sector is primarily large, well-established companies.
- Ontario exports \$5.8B of higher value-added nanotechnology products.
- More to come...



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# Where Next Happens