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From Discovery to Innovation...

NRC Framework for Evaluating Socio-Economic Impacts of Research

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Agenda/Content

- Context
  - Overview of NRC activities/programs
- Overview of Framework
  - Background & evolution
  - Design Imperatives
- Impact Metrics, Methodology & Measurement
  - Data, models and analysis methods
- Examples of Recent Impact Evaluation Results

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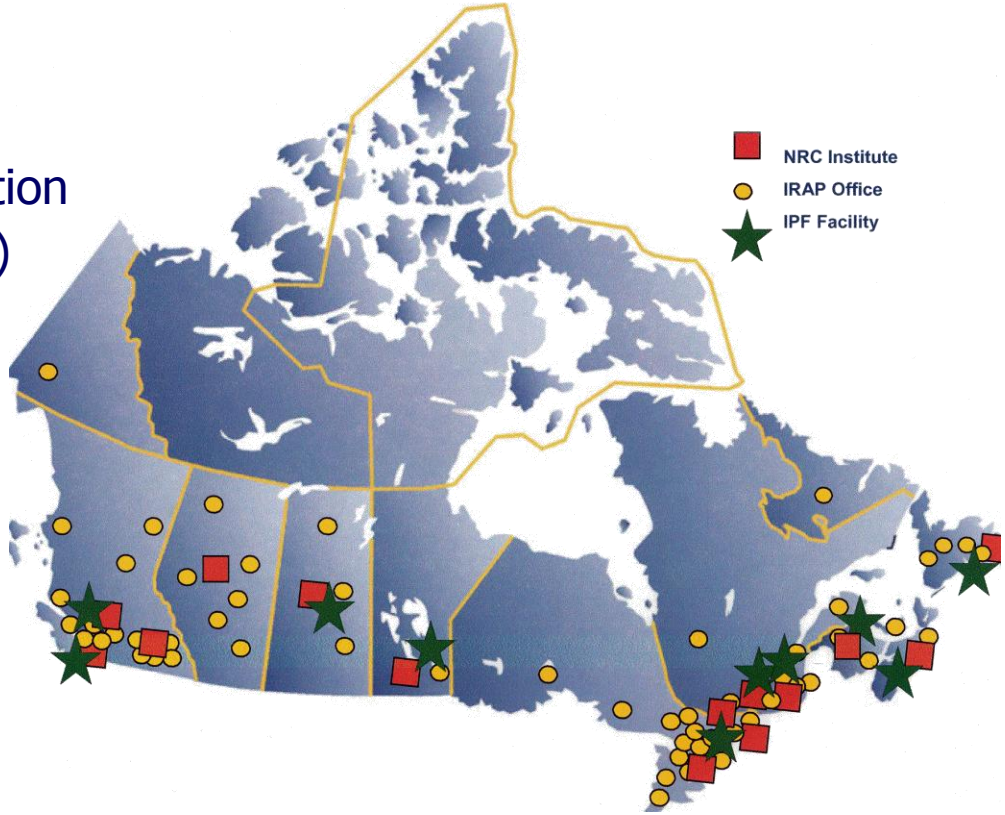
Quick Overview of NRC

- 18 Research Institutes
- 14 Key Economic Sectors
- 2 Industrial & Community Innovation Programs (G&C to SMEs, Clusters)
- 2 National S&T Infrastructure Programs
- 4,780 employees
- Total expenditures
  ≈ $1 Billion (Cdn) ≈ € 625 Million



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Need for Developing Framework

- Increasing pressure on NRC and R&D funding agencies to demonstrate, quantitatively, socio-economic impacts and return on investment
  - Increasing pressure from central agencies & IC to demonstrate socio-economic return and "value for money"
  - Various Ministerial statements about not knowing the return on investment from the $12 Billion the federal government spends annually on R&D
  - Specific commitments in a recent federal S&T Strategy
    - "*improve the understanding of Canadian S&T developments and the impact of federally performed S&T*"
    - *"greater sophistication in measuring the impacts of our science and technology investments"*

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Implementation Overview

Proposed framework has evolved as follows:

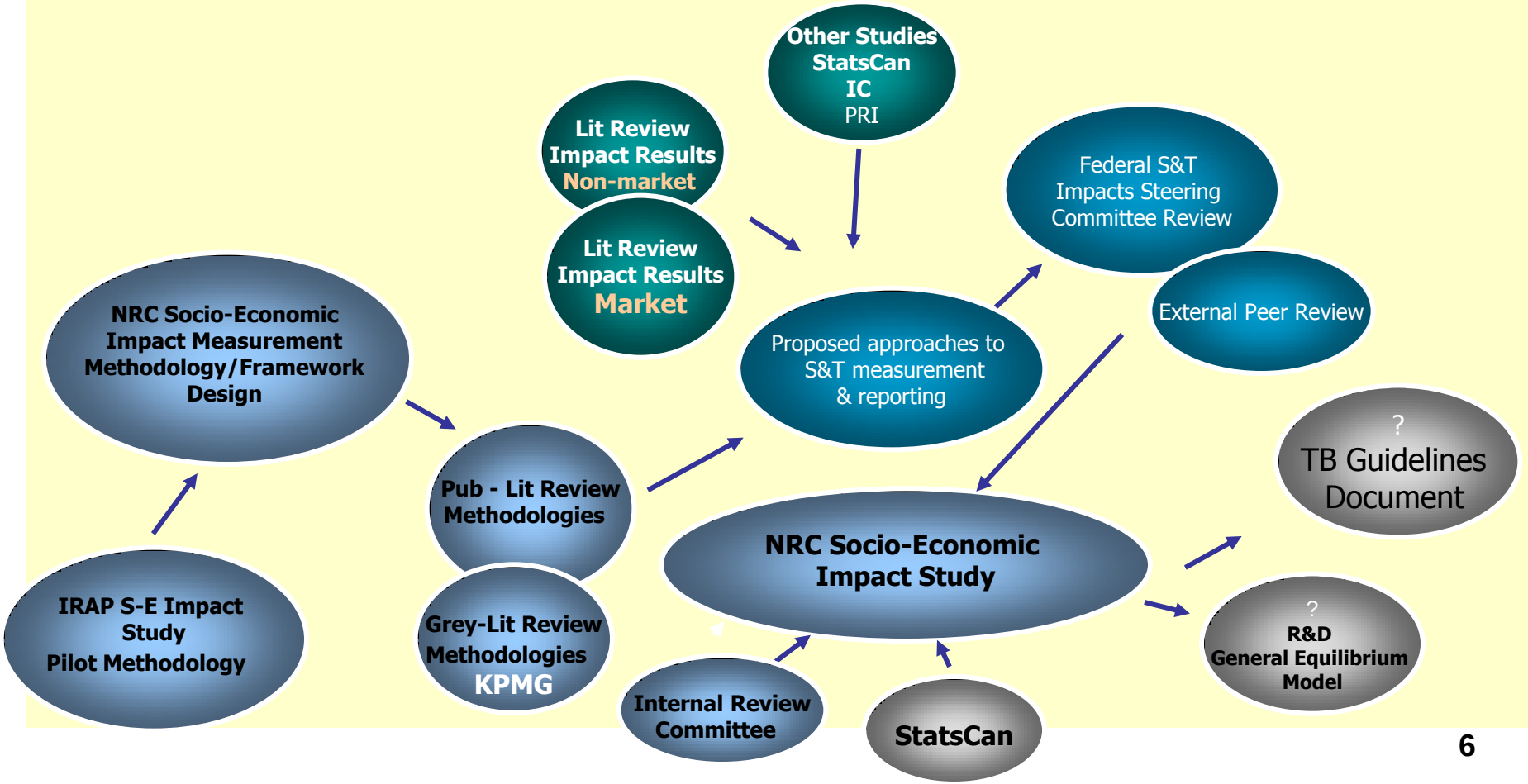
- Extensive literature/model review – Fall 2006
- Initialize framework – Spring 2007
- Pilot impact evaluation – NRC-IRAP – Fall 2007
- Expanded literature review – Spring 2008
- Update proposed approach – Summer 2008
- External peer review – Fall 2008
- Complete expanded analysis of all NRC Activities – Summer 2009

Methodology Development & Validation

NRC Work on Measuring S-E Impacts of Programs/Expenditure

Horizontal Policy Research Project (PRI Lead) - Improving Measurement and Reporting on the Impacts of Federal S&T

Collaboration P with Other G Departmer Agencies



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Framework Design Imperatives

- Objective, transparent, repeatable
- Accepted guidelines and methods
- Multiple / converging lines of evidence
- Macro and micro approaches
- Comparison of NRC clients with non-clients

The purpose of studying economics is to avoid being deceived by economists

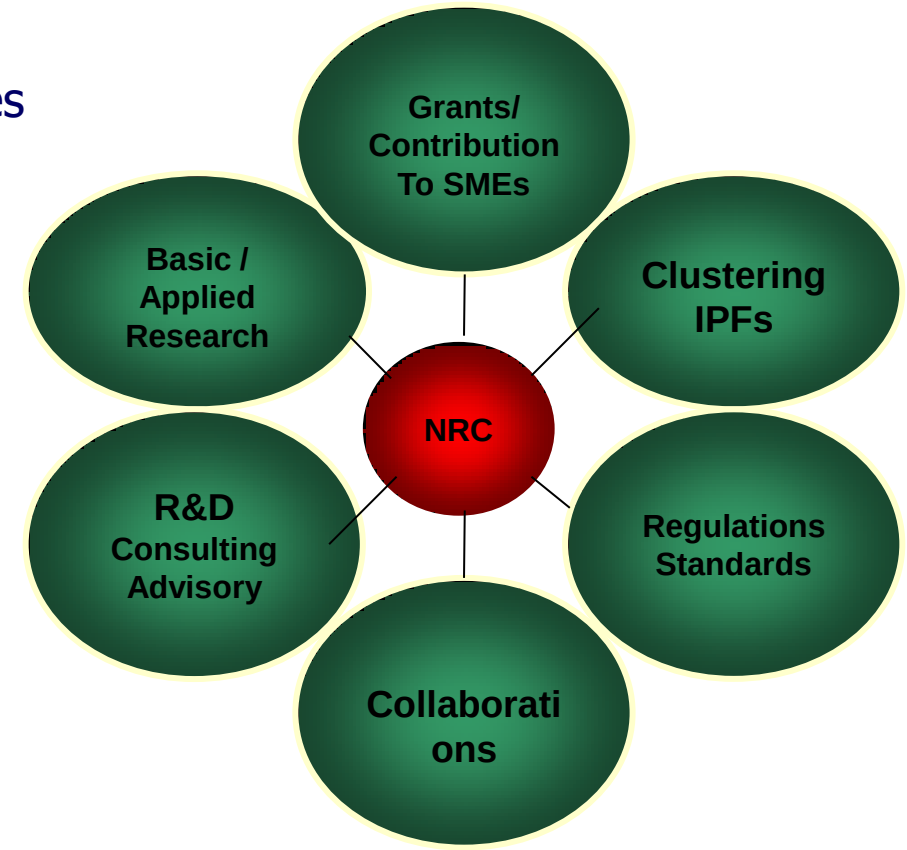
Joan Robinson

If you torture enough data – it will eventually reveal the truth

Anon. Econ.

Overview of Main Framework Components

- Main components include:
  - 4 main analytical methods
    - Econometrics – Cost-Benefit – Input/Output - Risk/Sensitivity
  - Modeling 8 separate R&D activities
  - 15 impact metrics
  - 14 key economic sectors
  - Data on 40,000 clients & non-clients
  - 10 databases
    - Including 5 External – Statistics Canada



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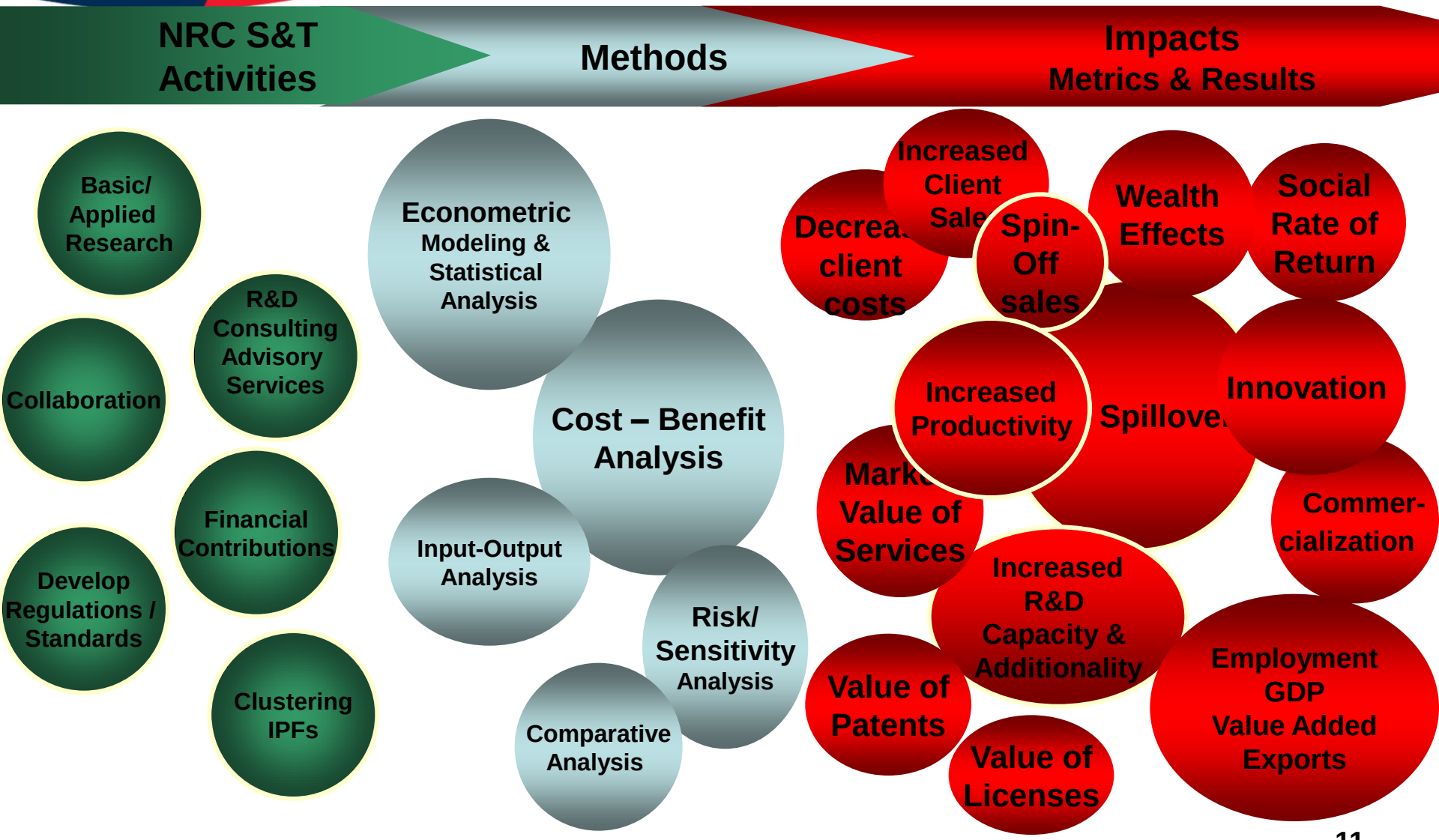
Measuring the Economic Ripple Effects

Economic ripple effects caused by R&D activities and expenditures
Measuring outer ripples is key - presently only measuring the surface

S&T Activities – Methods – Impacts



Overview of The Approach

- Breakout into S&T and R&D activities
- Separate by Micro and Macro impacts
  - Micro – through client and spin-off SMEs
    - productivity, sales, costs, complementarity
  - Macro – through impact on overall productivity, spillovers, employment, GDP, exports.
- Micro models
  - Econometrics to determine significance and derive attribution rates
  - Feed attributions and extrapolated sales, costs and value of services into a CBA model
  - Solve for ROI and Wealth Effects (net benefits, Benefit-Cost Ratio)
- Macro models
  - Econometrics to determine impact on productivity - spillovers
  - Use Input-Output Analysis to derive R&D multipliers – impact on Employment, GDP, etc.
  - Augment CBA to include spillovers

NRC-IRAP Impact Evaluation
Review of Impact Results

- Industrial Research Application Program – IRAP
  - Provides Financial Contributions to SME clients to conduct R&D – $200 M 2009/10
  - Provides advisory services – ITAs

Example of Evaluation using the Framework

- 2007 Impact Evaluation of the NRC-IRAP Program
  - S-E Impacts referred to in terms of "Innovation Capacity"
  - Operational Database and 2 Surveys – over 2,000 responses
  - Impact Metrics
    - Wealth Creation
      - Impact on SME Sales
      - Impact on SME Costs
      - Value of Services
    - Commercialization
      - New Products – Services - Processes
        - » Frascati Manual – StatCan Innovation Survey
    - SME Growth & R&D Capacity
  - Used econometric analysis to establish significance and attribution
  - Used cost-benefit to establish total wealth creation and ROI

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Contributions to Wealth Creation in Canada

- Finding: The extent to which NRC-IRAP stimulates wealth creation within Canada is illustrated in the overall net socio-economic benefits that it generates.

Cost-Benefit Analysis	2002-03	2003-04	2004-05	2005-06	2006-07	Present Value of 5 Years
Benefits						
Total Benefits 1	666 861	1 201 803	1 804 848	1 737 933	1 900 444	6 508 707
Program Costs						
Total Program Costs2	114 200	122 500	124 900	125 200	115 500	602 300
Net Benefit3 & Benefit-Cost Ratio4						
Net Benefits	552 661	1 079 303	1 679 948	1 612 733	1 784 944	5 965 008
Benefit Cost Ratio (High Estimate)	**5.84**	**9.81**	**14.45**	**13.88**	**16.45**	**11.97**

[1] Benefits include increased sales and reduced production costs attributed to the program as well as the estimated value of advisory services provided in each year.
[2] Cost figures based upon Total Program Full Costs (80% of costs attributed to the core NRC-IRAP program and the remaining 20% of costs being attributed to YES & TPC). NRC-Finance Branch. August 2007.
[3] Total program benefits minus program costs.
[4] Total program benefits divided by program costs.

SME Growth & Increased Capacity

- The extent to which NRC-IRAP has contributed in each of these areas of innovation capacity is evidenced by:
  - **derived / estimated impacts following NRC-IRAP assistance; and,**
  - **impacts as stated/perceived by clients.**
- SME clients (funded and non-funded) have exhibited growth in innovation capacity over the evaluation period.

- *NRC-IRAP has positively stimulated overall innovation in Canadian SMEs and in Canada as a whole.*
- *The program has contributed to innovation capacity in a number of areas.*

Average Growth Rates of NRC-IRAP Clients (funded and non-funded) over the Evaluation Period		
R&D Capacity	R&D Expenditures	20%
	R&D Technical Staff	12%
Management, Marketing, Finance Capabilities	Management, Marketing	7%
	Finance	6%
Firm Growth	Sales	28%
	Employment	30%
	Assets	15%
New Knowledge Creation	Patents	49%
	Trademarks, Copyrights, Confidentiality Agreements	18%

Impact Attribution

➢ *The infusion of NRC-IRAP funds has the complimentary effect of inducing firms to increase their spending on R&D and increase their capacity.*

- Based on regression analysis of survey data, NRC-IRAP has a positive and significant contribution to innovation capacity
- Regression results are consistent with clients' estimates of impact of program – just over 10% for sales and just under 20% for employment

Impact of NRC-IRAP Funding and Advisory Services on NRC-IRAP Clients (Funded and Non-funded)		
R&D Capacity	R&D Expenditures	13%
	R&D Technical Staff	3%
Firm Growth	Sales	11%
	Employment	14%
Wealth Creation	Productivity (Sales to # of Employees)	12%
	Decreased Costs (Production)	3%

Commercialization

➢ *Although not a key focus of the program, NRC-IRAP has enhanced client SMEs' abilities to commercialize products and services*

- The 32,000 new commercializations/ innovations can be compared to 39,000 in the 2001-02 evaluation.
- Based on SMEs surveyed, NRC-IRAP is responsible for:
  - 35% of all IP; and,
  - 16% of revenues generated by patents and 23% of revenues generated by trademark, copyrights and confidentiality agreements are directly attributable to NRC-IRAP.

Commercialization Elements	Average per Firm	Total Extrapolated to Funded Client Population1	Attributed Average per Firm	Total Attributable Extrapolated to Funded Client Population
New or significantly improved goods	3.36	13 776	0.537	2 204
New or significantly improved services	1.43	5 863	0.228	938
New or significantly improved methods, logistics, processes.	3.11	12 751	0.497	2 040
Number of new commercializations / innovations per firm	7.90	32 390	1.262	5 182

[1] Extrapolations based on a multiplication of averages per firm by the total number of distinct firms funded during the evaluation period of 4,100.

Value for Money - Effectiveness

- *With no benchmarks available, it is difficult to properly address the issues surrounding whether NRC-IRAP is minimizing the costs of its outputs and outcomes.*

- *With respect to the delivery of advisory services, when compared to prices for comparative services in the marketplace, the program can be considered cost-effective.*

- It was possible to measure the cost-effectiveness of providing advisory services by comparing the cost of program outputs to the cost of purchasing those same services within the private sector.

- Based on program cost data and ITA survey data,.
  - **estimated that the average cost of an hour or advisory service provided by NRC-IRAP is between $80 and $130**
  - **the average market hourly rate identified by clients for an hour of consulting service was identified at $125. (ranging from $84 an hour for promotion and trade show services, to $191 an hour for access to legal services).**

- Other contributing factors - assured objectivity and confidentiality and access to network of advisors