



**NRC-CNRC**

*From **Discovery**  
to **Innovation...***

# **NRC Framework for Measuring (socio) Economic Impacts of S&T**

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Session A2 – Taking the Measure of Federal S&T**

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National Research  
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Conseil national  
de recherches Canada

**Canada**



- NRC has been working on the development of an (socio) economic impact measurement framework for almost 4 years.
  - ❖ **Increasing pressure, both internally and externally, to demonstrate, quantitatively, socio-economic impacts and return on investment to taxpayers**
    - 2007 Federal S&T Strategy (Mobilizing Science and Technology to Canada's Advantage )
      - ❖ *"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"*
    - 2010 Budget – Federal S&T expenditure review



# Presentation

- General Description/Illustration of Impacts to Measure
- Overview of Measurement Framework
  - ❖ Design Imperatives
  - ❖ Data, Models, Methods, Metrics
- Examples of quantitative impact results



## Measuring the Economic Ripple Effects



- Spillover Impacts – technology and knowledge transfer to non-targeted clients and sectors of the economy
- Client / Stakeholder Impacts – impact on performance of targeted clients/stakeholders of S&T activities
- Expenditure Impacts – immediate / direct impacts from expenditures & engaging resources – multiplier effects from expenditures with local suppliers and enterprise

Economic ripple effects caused by S&T activities



## Framework Design Imperatives

- ❖ Objective, transparent, repeatable
- ❖ Accepted guidelines and methods
- ❖ Multiple / converging lines of evidence



# Overview of Main Framework Components

## ■ Main components include:

- ❖ Modeling 8 separate S&T activities
- ❖ 5 main analytical methods
  - Econometrics – Cost-Benefit – Input/Output – Comparative - Risk/Sensitivity
- ❖ 15 impact metrics
- ❖ Data on over 30,000 clients & non-clients
- ❖ 10 to 15 Int. Ext. datasets





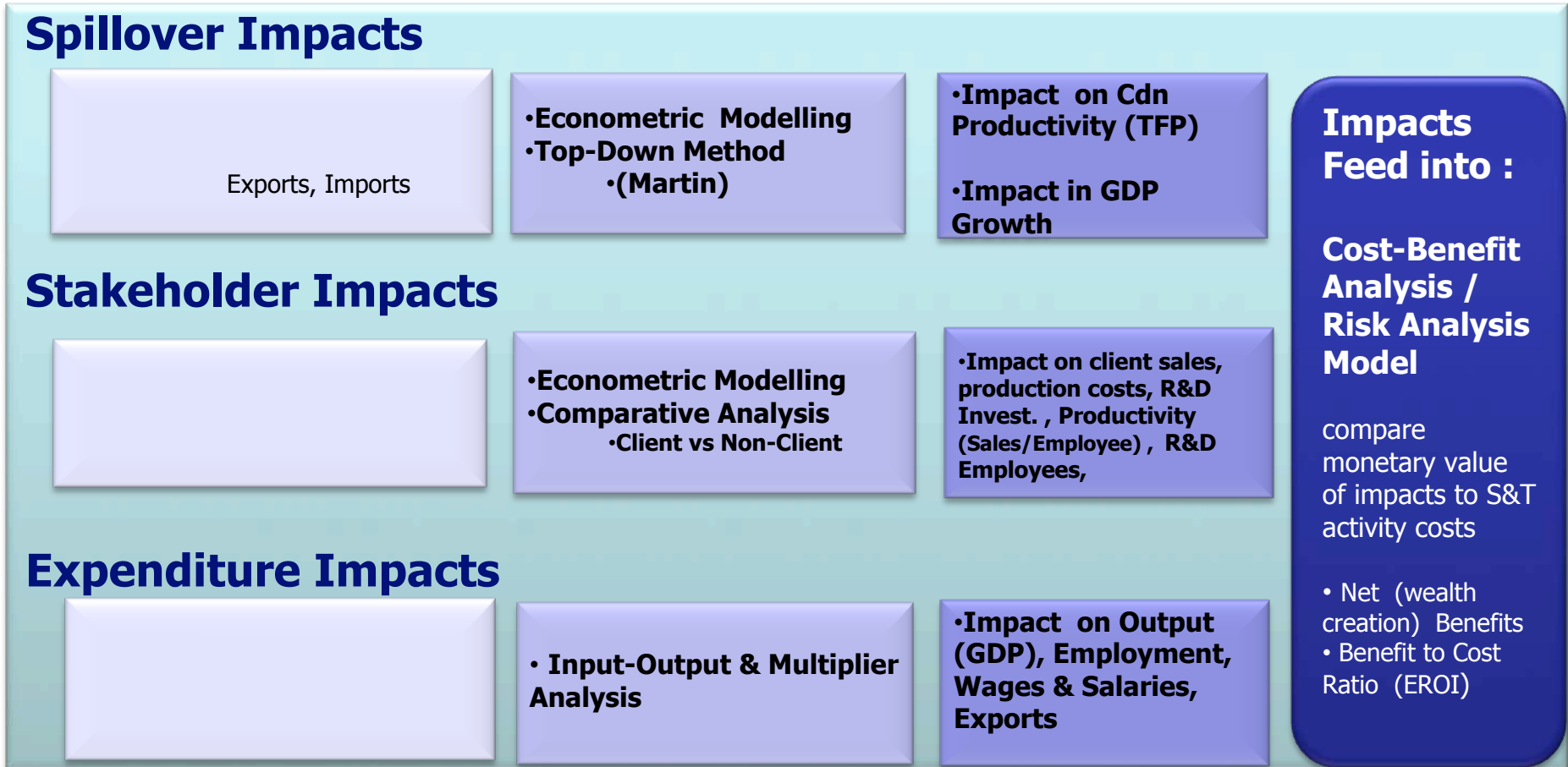
# Overview of Approach to Measure Impacts & EROI

**Data**

**Analysis**

**Impacts**

**Economic Return**





## Recent Measured Results Impact of Gov. R&D on Productivity

- Impacts of R&D on productivity - based on **19 OECD Countries**
  - ❖ 2001 - OECD (Guellec, van Pottelsberghe)
    - TFP – R&D Cap. Stock – Panel – Findgs: BERD & Public (HE+GoERD) Sig. ,Pos.
  - ❖ 2006 - IC Working Paper (Acharya, Coulombe)
    - LP – R&D Expenditures – Panel - Findings: BERD Sig., Pos. – HERD only slightly significant and GoERD not significant
- Impacts of R&D on productivity - using **Canadian Data**
  - ❖ 2007 - NRC (Ghazal, Kijek, Nikzad, Sedigh) – Cambridge Business Review
    - TFP – R&D Cap. Stock – Time Series – Findgs: HERD and GoERD Sig., Pos.
    - LP – R&D Expenditures – Time Series – Findgs: HERD and GoERD Sig., Pos.
  - ❖ 2007 - Conference Board
    - validated NRC findings – concern insufficient observations - 23 years of data
  - ❖ 2010 - NRC (Ghazal, Kijek, Nikzad, Sedigh) – yet to be published
    - TFP – R&D Cap.Stock – Panel – Findgs: NRC R&D (prox. Gov) Sig., Pos.
    - LP – R&D Expenditures – Panel – Findgs: NRC R&D (prox. Gov) Sig. Pos





## Example of Measured Stakeholder Impacts

- 2007 Impact Evaluation of the NRC-IRAP Program
  - ❖ IRAP Provides Financial Contributions & advisory services to Cdn SMEs
    - G&C \$200 M 2009/10
  - ❖ S-E Impacts referred to in terms of “Increased Innovation Capacity”
  - ❖ Operational Database and 2 Surveys – over 2,000 responses
  - ❖ Impact Metrics
    - **Wealth Creation**
      - Impact on SME Sales & Production 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



# SME Growth & Increased Capacity

- *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.*

- 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.

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%



## 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
<b>Benefits</b>						
Total Benefits 1	666 861	1 201 803	1 804 848	1 737 933	1 900 444	6 508 707
<b>Program Costs</b>						
Total Program Costs <sup>2</sup>	114 200	122 500	124 900	125 200	115 500	602 300
<b>Net Benefit<sup>3</sup> &amp; Benefit-Cost Ratio<sup>4</sup></b>						
Net Benefits	552 661	1 079 303	1 679 948	1 612 733	1 784 944	5 965 008
<b>Benefit Cost Ratio (High Estimate)</b>	<b>5.84</b>	<b>9.81</b>	<b>14.45</b>	<b>13.88</b>	<b>16.45</b>	<b>11.97</b>

<sup>1</sup> 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.

<sup>2</sup> 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.

<sup>3</sup> Total program benefits minus program costs.

<sup>4</sup> Total program benefits divided by program costs.



# 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 Population <sup>1</sup>	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

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