



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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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





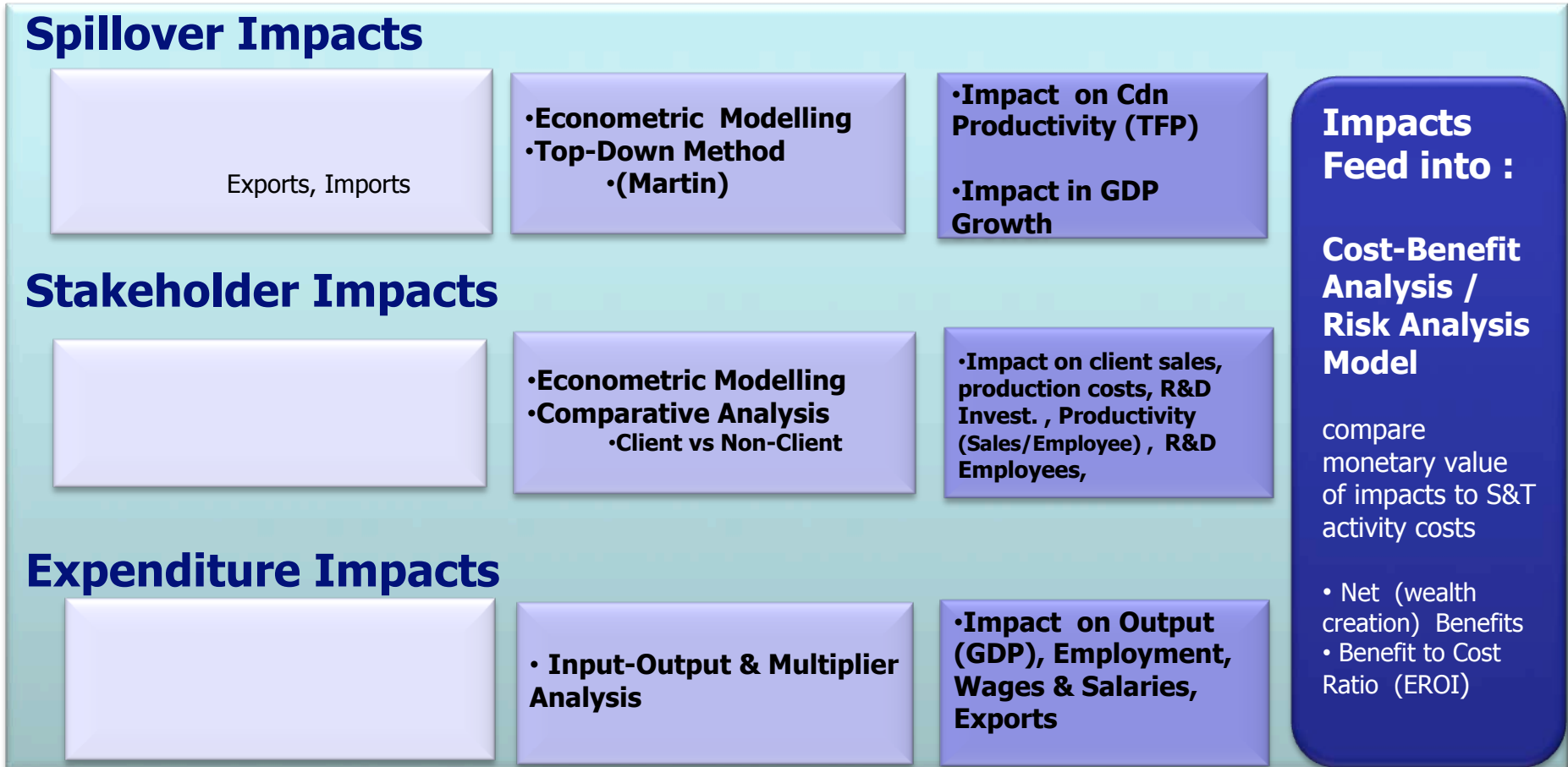
Overview of Approach to Measure Impacts & EROI

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
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 Costs ²	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.



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 ¹	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.