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An Analysis of the Classification of Government R&D Funding

A report to Industry Canada

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Introduction

The classification of research and development expenditures for most of the time is the interest of a relatively small group of professional statisticians, and academic analysts. The exceptions to this are when organizations are trying to fill the questionnaires in or when politicians want to understand why research dollars are being spent within various categories. Although our current classification system based on the OECD Frascati manual, first developed in the 1960s, attempts to make it as simple as possible for the first group, it can obscure information for latter group.

This paper focuses on the issues relevant to designing an R&D classification that might be helpful for government decision-making. Such a classification is not envisaged as a replacement for the existing classifications but as a complement to them. In the process of exploring this issue we investigate government activities in Australia, New Zealand, the UK and the USA. The paper reveals that to some degree all of these countries have invented additional classifications for their own purposes, often associated with particular structures for evaluation. However, such approaches are typically idiosyncratic as well as being either convoluted (the New Zealand case) or too simplified (UK and USA). Instead, a different approach to the challenge is suggested in the second half of the paper. A policy relevant classification system to live longer than the next change of government and be useful needs to be based in a model of innovation in government. This paper sketches out a view on this and from it tentatively outlines a framework for the classification of government R&D. More importantly, we propose a research strategy that could test our framework and develop the data necessary to design an R&D classification that is relevant for public sector management.

Background

Canada has shown substantial increases in R&D expenditures over the past decade. Based on estimates of 2006 GDP, it is likely that Canadian GERD/GDP will be approximately 2.1%. The federal government is the second largest funder of R&D See the table below), accounting for approximately 18% of the total. This figure does not include much of the R&D expenditures by higher education, which are indirectly funded by the federal government through transfer payments to the provinces for education and health.

Table 1: R&D Funders and Performance , Canada, 2006, ($M)

Performer→ Funder↓	Federal Govt.	Provincial Govt.	Business	Higher Education	Private Non-profit	Total
Federal Govt.	2083	4	265	2828	47	5227
Provincial Govt.	8	303	60	1257	16	1644
Business	54	38	12239	899	15	13245
Higher Education	0	0	0	4948	0	4948
Private Non-profit	0	0	0	842	35	877
Foreign	0	0	2286	116	14	2416
Total	2145	345	14850	10890	127	28357

Source: Statistics Canada

Thus the federal government plays a major role in stimulating and supporting the national innovation system. It is important that these expenditures be categorized so that policy makers and Parliament can make informed choices on the distribution of funds and ensure that these expenditures take place in a transparent fashion.

Existing classification systems for federal R&D expenditures

At present, Statistics Canada collects information on R&D expenditures (as well as S&T expenditures) from departments. The data appear annually in "*Federal government expenditures on scientific activities*", Statistics Canada, cat.# 88-001-XIE These are classified in a number of ways, by:

- department or agency,
- type of expenditure (subsets of R&D and Related Science Activities),
- performing sector,
- type of science (natural versus social sciences), and
- socio-economic objective

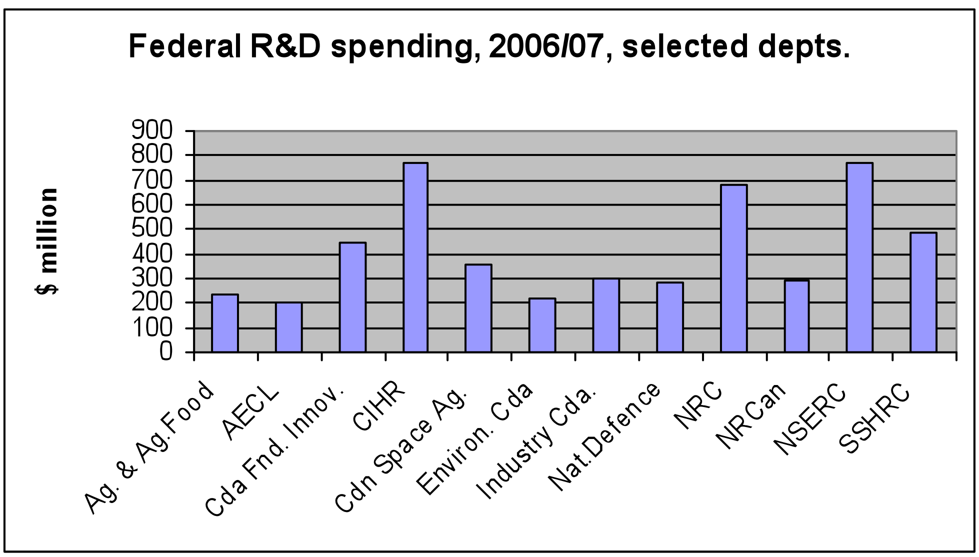
For the purposes of this paper, we will restrict our discussion to federal government R&D expenditures, and comparable expenditures in other nations, where "R&D" is defined using the definitions prepared by the OECD and published in the Frascati Manual (2002).

The OECD has established a number of statistical standards to establish a common reporting framework so that OECD nations can benchmark various socio-economic activities at the national level. The Frascati Manual was first published in the 1963; there have been a number of subsequent editions, and other manuals related to various statistical series concerning scientific and technological activities in the member nations. Statistics Canada has strived to maintain comparability with the OECD standards to enable Canadian policymakers to follow our progress compared to our major trading partners and economic competitors. Thus any new system for classifying R&D expenditures must complement the OECD system, not be put in place of it.

As with any system there are a number of strengths and weaknesses. In general its strengths are that it has been rigorously examined over a number of years by many experts and represents an ongoing compendium of best practice in the collection of R&D expenditure data. This is also Frascati's weakness: it looks only at R&D expenditures. Other manuals in the Frascati series look at R&D personnel and innovation activities, but they are not as widely used (although, again, Statistics Canada follows these standards when it carries out HQP and innovation studies).

Since much of government program management is related to expenditure management and control, the Frascati system has served the government well. It deals with how much is being spent, and who is spending it (Fig.1), but it does not attempt to answer what are the R&D projects that government funds, and why are they being carried out.

Figure 1: Federal R&D spending, FY 2006/07, selected departments



Source : Statistics Canada

Federal R&D spending in 2006/07 was divided into $5,259K for operations, $275K for the administration of extramural programs, and $129K for capital expenditures. As can be seen from table 1, there are three major performers of federal R&D: intramural facilities, Canadian business enterprises, and universities. For reference the numbers are:

Table 2: Federal R&D Spending by performing sector and type of science ($M)

	Natural Sciences	Social Sciences
Intramural	2027	118
Canadian Business	708	5
Higher Education	1974	491
Cdn. Non-profit Institutions	116	12
Prov. & Municipal govts.	6	0
Foreign	128	53
Other Canadian	21	5
Total	4979	684

Source : Statistics Canada

Statistics Canada also classifies the expenditure data by socio-economic objectives (SEOs). These are defined by the OECD in the Frascati Manual. Table 3 shows the complete list:

Table 3: Federal R&D spending 2004/05 by OECD Socio-Economic Objectives ($M)

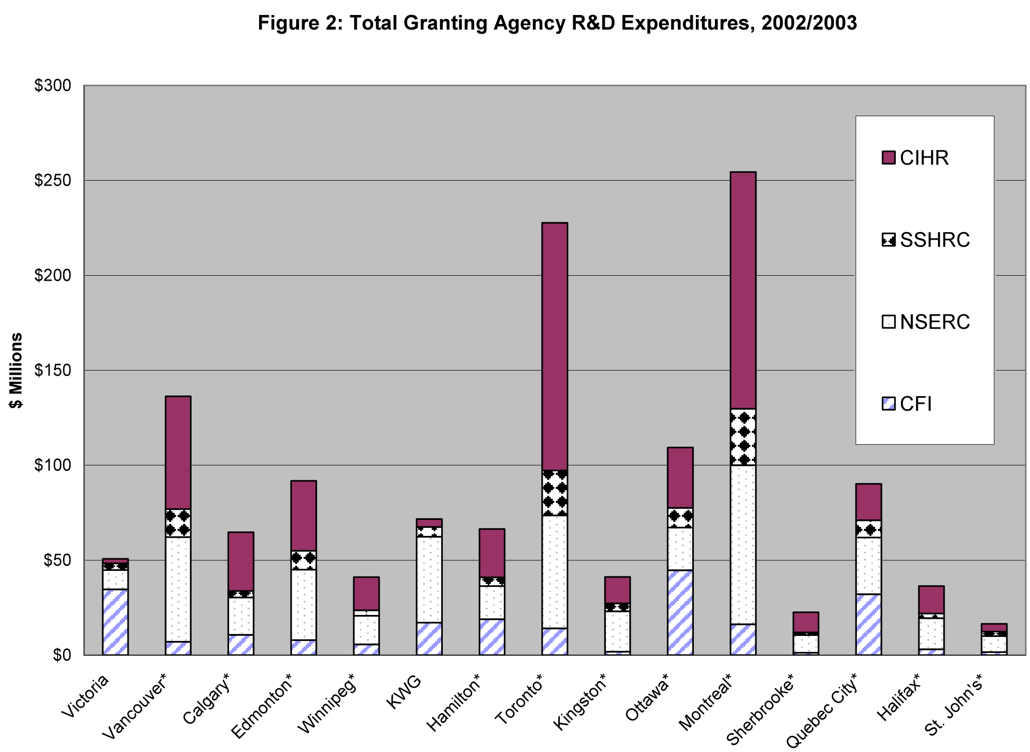
Objective	Sub-objective	Intramural R&D	Extramural R&D
Exploration and exploitation of the earth		98	55
Infrastructure and general planning of land use			
	Transport	53	27
	Telecommunication	43	30
	Other	38	28
Population and protection of the environment		181	155
Public Health		203	988
Production, distribution and rational utilization of energy		199	181
Agricultural production and technology			
	Agriculture	269	79
	Fishing	44	26
	Forestry	71	49
Industrial production and technology		174	732
Social structures and relationships		62	190
Exploration and exploitation of space		125	190
Non-oriented research		208	428

Other civil research		15	2
Defence		191	94
Other		10	119
Total		1983	3371

As can be seen several of the SEOs are "department specific", as, for example public health or defence. This system, which is intended for use at the international level, does not discriminate among the objectives of research expenditures that are internal to the federal government's policy making or management requirements. What is needed is a system, that aids decision making and management, while being meaningful to the individual science-based departments and agencies, and which can be applied relatively easily within existing data collection activities.

Funding data can also be parsed by location of expenditures. While this can be difficult to do for all federal R&D expenditures, Holbrook and Clayman (2006) have done this for the granting agencies, since the location of the recipient universities are well known. The results, and particularly the changes in these data over time, give an interesting glimpse into the changes of federal university R&D funding policy over time.

Figure 2: Granting Agency expenditures by city, FY 2002/03 ($ M)



Source: Holbrook and Clayman, 2006

Another approach is to look at administrative data that is collected as part of the Management and Resources Reporting Structure (MRRS), established by the Treasury Board of Canada. A key component of the MRRS is the Program Activity Architecture

(PAA). The PAA links all departmental activities by level, to departmental strategic outcomes. The PAAs show spending and measurable outcomes against each program activity. However the PAAs are different for each department, and thus it is difficult to make comparisons across departments. A complete discussion of this type of classification and its strengths and weaknesses can be found in a paper by Therrien (2006) for the OECD Blue Sky Conference.

As we will see, the key to a practical R&D classification system is one that will apply to all departments. Thus a workable system must be applicable to all departments – the system must accommodate both Health Canada and National Defence.

Comparisons with other nations

There are two broad drivers of developing classification systems of research and development expenditure. The first is that they aid in understanding the distribution of activities that are occurring, and for policy reasons should occur, in specific areas of departmental S&T efforts. The related purpose is that relevant classification systems provide guidance in the evaluation process of categories which are alike and which can therefore be compared against one another. Various countries have adopted classification systems that although aligned with Frascati differ in important aspects.

In each of the cases explored below (Australia, New Zealand, the UK and USA), additional classifications have been developed for particular solutions to governance within the country itself. In New Zealand, the system that has developed arose from particular circumstances in the 1980s when the public sector made up a large share of GDP and these initial rationales have continued to drive ever greater accountability. The research system in Australia is developing in a political climate where there is a concern for the *value* of research, combined with a government that leans towards market based reforms of the economy and government. Similar concerns appear to be evident in the UK with the reports by Martin *et al.* (1996) and Salter *et al*. (2000).

New Zealand

Background

In the 1980s New Zealand was facing difficult times. Government expenditure was 40 % of GDP and public sector debt was significant and rising. Bale and Dale comment:

> *"Its deficit was a high 9 percent of gross domestic product GDP, and public debt, at 60 percent of GDP, was rising. High underlying inflation and slow economic growth had reduced per capita income from one of the highest in the Organization for Economic Cooperation and Development to one of the lowest"* (1998:103).

The election of a new government in 1984 was the starting point for massive changes in the economic policies and structures of government within New Zealand. Of particular concern was government spending. There was a need to reduce government spending and the route that was chosen was to very deliberately have government choose priorities. Such large scale reforms were not implemented fully conceived and designed but took a number of years to settle down. In this section of the report we detail the research structures but these reflect wider machinery of government systems employed by New Zealand around other policy and administrative themes. The system described appears to have now stabilised with no recent major structural changes and it follows the principals outlined below.

R&D Policy and Funding Structures

Each year the government determines the research 'output classes' that it desires. In theory these can change year to year but in practice they remain relatively stable.

The *output classes* (see attachment) encompass a number of different goals. The output classes are not grouped within broader themes, but they can be analysed as covering:

- socio-economic goals (such as health and environmental research);
- infrastructure access (New Zealand's research internet network and access to the Australian synchrotron); and
- public service management (purchase agencies are funded for their administrative expenses separately to their funding for their research grants).

This breadth of goals for output classes reflects both their initial conceptual starting point (socio-economic and public service management) and the increasing complexity on knowledge management (the need to fund access to the Australian synchrotron). Although the government allocates funding to output classes it has established purchase agencies to pursue its goals for the output classes. The purchase agencies such as the Foundation for Research, Science and Technology (FRST) and the Health Research Council (HRC) operate in a similar fashion to their international counterpart research councils. They receive funds from, typically, a number of different output classes. However, a purchase agent such as the Health Research Council is not responsible for all funds *related* to health research. Another, important feature of the system, in line with the general principles of transparent accounting is that universities charge full cost overhead rates on research grants. This reduces the buying power of research grants in NZ.

The purchase agents are contracted by MoRST (Ministry of Research, Science and Technology) to administer the output class funds and are regularly evaluated against the goals of the output classes (see for example Garrett-Jones, Turpin and Wixted 2004).

Policy Research

The Ministry that oversees science and technology policy (MoRST), is itself treated like a purchase agent by the ministerial arm of government. It is funded to provide policy advice and administer the contracts with the other purchase agents. MoRST also has responsibility for the cross departmental research pool (see Ministry of Research, Science and Technology 2006a) and oversees the Crown Research Institutes are state owned, corporatised research organisations, which are somewhat similar to Government research conducted (CSIRO in Australia).

Table 4: The New Zealand Crown Research Institutes

Name	*Function*
AgResearch	*AgResearch Limited*
Crop & Food Research	*NZ Institute for Crop & Food Research*
ESR	*Institute of Environmental Science and Research Limited*
Scion	*New Zealand Forest Research Institute*
GNS	*Institute of Geological and Nuclear Sciences*
HortResearch	*Horticulture and Food Research Institute*
Industrial Research	*Industrial Research Limited*
Manaaki Whenua Landcare Research	*Landcare Research New Zealand Ltd*
NIWA	*National Institute of Water and Atmospheric Research*

Australia

Since being elected in 1996 the current Australian government has engaged in a large number of reviews (see Wood and Meek 2002) of policy related to research and development across the public sector. Apart from an underlying desire for a perception of *value for money*, primarily seemingly defined as benefit to the economy, there has been no obvious overarching policy direction to the changes to the system over the last 10 years.

Policy and Funding Structures

Although, Australia has a rather conventional system for funding research and development recent modifications have been aimed at increasing the level of indicator based evaluation. The Federal government is directly responsible for funding the universities, the major research councils (National Health and Medical Research Council and the Australian Research Council) and the federal research agencies. The latter category includes the:

- Commonwealth Scientific and Industrial Research Organisation (CSIRO);
- Australian Nuclear Science and Technology Organisation (ANSTO);
- Geoscience Australia (GA); and
- Australian Institute for Marine Science (AIMS)

The Cooperative Research Centres (CRCs) programme, another feature of the Australian system, is an innovative approach to concentrating research effort. An individual CRC may be comprised of partners from the public sector (federal research agencies), universities, the business sector or non-profits. The federal government provides funding for administrative costs. The CRC Association states that 'Data obtained from the Commonwealth's CRC Directory 2006, show that typically, each centre receives on average about $2.95 million in cash (ranging from $1.6 to $5.8 million) from the Government on establishment and for each year of its contract"[1]. CRCs are selected for a period of seven years based on proposals[2] in selection rounds held approximately every two years. A CRC can receive two rounds of funding but they must survive the same competitive selection process as other proposals.

Since the beginning of the 2000s the Australian Government has been pursuing a number of strategies for making Government organisations and R&D expenditure in particular, more accountable. It has gone through a number of phases as outlined below.

Output pricing reviews (circa 2000-2001)

In the early 2000s the Government designed a market proxy system for budgeting. Under a purchaser provider model of the interactions between the Bureaucracy of Government and the Executive Government (the Ministers of State), government organisations negotiate a price for delivering specified outcomes. This 'price' becomes the organisation's budget.

> *"Every Australian Government agency is required to have specified outcomes and outputs. Relevant performance information must also be identified for the effectiveness in achieving outcomes, and the efficient delivery or management of outputs and administered items. Managing through outcomes and outputs helps agencies acquit their responsibilities to ministers and the government, which in turn is responsible to the Parliament and the wider community. Agencies, through their chief executives, are accountable for delivering the various policy results with which they have been charged. This requires a highly sophisticated management capacity, able to deal with the ambiguities and uncertainties that are inherent in public policy and its administration."*[3]

Organisations such as the Australian Nuclear Science and Technology Organisation, the Commonwealth Scientific and Industrial Research Organisation and Geoscience

[1] http://www.crca.asn.au/ accessed 5 March 2007.
[2] Cooperative Research Centres are based on research programs, are not limited to any particular field of research but the program is targeted at applied R&D. Manufacturing (eg. auto and composite materials), ICT (eg. Spatial information), mining and energy (eg. mineral exploration), agriculture and rural industries (eg. forestry), the environment (eg. weed management) and medical science and technology (aboriginal health) are all categories under which CRCs operate.
[3] http://www.finance.gov.au/budgetgroup/Commonwealth_Budget_-_Overview/structuring_outcomes___outputs.html

Australia all went through the process of formally valuing their research outputs. None of the research assessment and valuation documents are on the public record[4].

Extensive internet searching has turned up no recent references to this formal approach to organisational budgeting. It is possible that this approach has been discontinued. In the light of the new research quality framework (RQF – see below) currently being put forward, this is a logical conclusion for research activities at least.

Research priorities[5] (2003 onwards)

National priority setting for public research has been an objective of the current Government since it was first elected (see Stocker 1997). In 2002 it decided to develop a process for implementing priorities.

Australia undertakes world-class research in a range of areas and has excelled particularly in agricultural, environmental and medical sciences and in minerals related research. Priority setting is already well established at institution and funding agency levels, particularly in science, engineering and technology (SET). However, priorities are not set in the context of broad national objectives. Important questions are not addressed in a coordinated way by the research system:

- What do we want to achieve as a country?
- What are our strengths, opportunities and needs?
- What scale and scope of research effort is needed to address identified problems and solutions?
- How can our ability to exploit identified opportunities be enhanced by better collaboration between research agencies?

The government sees the setting of national research priorities as a means to complement and enhance existing priority setting processes within research agencies and funding bodies. The research needs of the nation in health, defence, environment, industry, or education need to be supported by a significant focusing of research effort (Department of Education, Science and Training 2002: 9).

In 2003 the Australian government formally adopted a series of national research priorities. The research priorities apply to both the research agencies and research councils. However, there is only limited data reporting, at present, against these categories[6].

The current Australian national research priorities (including sub-categories) are:

- Environmentally Sustainable Australia
    - Water – a critical resource

4 The personal experience of one of the authors (Wixted) is that the system was complex and depended on the calculation of an economic "value" of the research being performed

5 http://www.dest.gov.au/sectors/research_sector/policies_issues_reviews/key_issues/national_research_priorities/priority_goals/safeguarding_australia.htm

6 See http://www.arc.gov.au/ncgp/dp/dp06_selectionreport.htm

- Transforming existing industries
  - Overcoming soil loss, salinity and acidity
  - Reducing and capturing emissions in transport and energy generation
  - Sustainable use of Australia's biodiversity
  - Developing deep earth resources
  - Responding to climate change and variability

- Promoting and Maintaining Good Health
  - A healthy start to life
  - Ageing well, ageing productively
  - Preventive healthcare
  - Strengthening Australia's social and economic fabric

- Frontier Technologies for Building and Transforming Australian Industries
  - Breakthrough science
  - Frontier technologies
  - Advanced materials
  - Smart information use
  - Promoting an innovation culture and economy

- Safeguarding Australia
  - Critical infrastructure
  - Understanding our region and the world
  - Protecting Australia from invasive diseases and pests
  - Protecting Australia from terrorism and crime
  - Transformational defence technologies

Research Quality Framework (RQF) [2004 onwards]

The RQF is the latest policy to emerge from Australia. In 2004 the government announced:

> Two frameworks for publicly funded research are to be developed in consultation with universities and publicly funded research agencies: a Research Quality Framework to measure the quality of research conducted in universities and publicly funded research agencies, as well as its benefits to the wider community; and a Research Accessibility Framework to ensure that information about research and how to access it is available to researchers and the wider community[7].

The Government has earmarked $87m for implementing this system wide approach to evaluating the quality and impact of Australian research groups within the universities. Research groups will be classified according to their appropriate 4 digit Research Fields, Courses and Disciplines code (see below). The research centres will be nominated by

[7] http://backingaus.innovation.gov.au/2004/research/qual_pub_res.htm access 5 March 2007.

their universities in a rolling programme and evaluated on the basis of quantitative and qualitative data. The RQF will apply to the ***universities*** and be used to redistribute research block funds.

> '*The intent of the RQF is to more readily identify and reward the highest quality research being conducted in Australia's universities. The RQF will also recognize research that has significant broader impact on Australia. The RQF will provide the Australian Government with the basis for redistributing a significant proportion of university block funding to ensure that research areas of the highest quality and highest impact are rewarded'* (DEST 2006).

It should be noted that there is also currently a study of the wider research system being conducted by the Productivity Commission, an Australian Government research agency that reviews government programs and regulations. The aims of that study are:

- the economic impact of public support for science and innovation in Australia;
- the adequacy of arrangements to benchmark outcomes;
- identification of impediments to the effective functioning of Australia's innovation system;
- examination of the decision making principles and program design elements that influence the effectiveness and efficiency of Australia's innovation system and guide the allocation of funding together with the scope for improvements and the implications from changing the level and balance of current support; and
- the broader social and environmental impacts of public support for science and innovation.

The Productivity Commission has already criticised the RQF. 'While the proposed Research Quality Framework has some benefits, it also has considerable costs. The Commission suggests that a final decision about its implementation should be delayed pending the exploration of some other options'[8].

Australia's Statistical R&D Classification system

The Australian Bureau of Statistics abides by the Frascati framework, but has adopted a classification system that is far more detailed than comparable systems. The Australian Standard Research Classification (see ABS 1998) is more detailed in both the classification of what the OECD (2002) describes as fields of science and technology, which in Australia is unified with the classification of the university teaching course classification as well as the separate system for classifying socio-economic objectives.

University[9], business[10], and government[11] sectors are all surveyed against both the research fields and SEO systems. Detailed data against many of these classification

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[8] http://www.pc.gov.au/study/science/draftreport/keypoints.html accessed 5 March 2007

[9] See: http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/3FFCAB7F97F450A0CA2571B7007E4F78/$File/

categories is available (on a fee for service basis). A sample of the codes is attached in Appendix "A".

United Kingdom

R&D Classification in the United Kingdom

The UK Government[12] has determined that:

"*unlike the Frascati categories, which deal only with the classification of R&D, it is also useful to know* <u>*why*</u> *R&D is being funded by the public sector. In the UK this is known as the primary purpose* (pp)"

The *Primary Purpose* categories are:

- ppA, general support for research - all basic and applied R&D which advances knowledge for its own sake; support for postgraduate research studentships (PhDs);
- ppB, Government services - R&D relevant to any aspect of government service provision (all defence expenditures are included here)
- ppC, policy support - R&D which government funds to inform policy (excluding ppB and ppD) and for monitoring developments of significance for the welfare of the population;
- ppD, technology support - applied R&D that advances technology underpinning the UK economy (but excluding defence). The category includes strategic as well as applied research, and pre-competitive research under schemes such as LINK;
- ppE, technology transfer - activities that encourage the exploitation of knowledge in a different place to its origin; and
- ppF, taught course awards - includes awards for Masters degrees (but not for PhDs which are included in ppA). Restructuring and redundancy costs are no longer included here.

Frascati R&D relates to ppA-D, while ppE and ppF cover those non-R&D activities that are included in SET. It should be noted that these boundaries are determined by the Governments primary purpose in funding the activity and not the intentions of the researcher or the end result.

81110_2004%20(reissue).pdf (p23 – Business R&D by SEOs, p 24 business R&D by RFCD) [free download].

[10] See: http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/DB8B3AF164964D6CCA2571D50017A556/$File/81040_2004-05.pdf (p13 – university R&D by SEOs, p11 university R&D by RFCD) [free download].

[11] See: http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/F1859BB39A20B07DCA2571FE001420E6/$File/81090_2004-05.pdf (p12 – government R&D by SEOs, p13 government R&D by RFCD) [free download].

[12] See http://www.dti.gov.uk/science/science-funding/set-stats/page20113.html

This classification is then used for reporting data on government funding of R&D activity, but it is used in conjunction not as a replacement for the standard internationally comparable statistics.

Commentary

It is not clear what the rational for this reporting system for R&D is derived from as there is no evidence on the internet and researchers[13] in the science and technology policy field were not aware of its development. The *PP* model of R&D classification seems to bear an, albeit distorted, relationship to the list of benefits of publicly funded R&D reported by Martin *et al.* 1996, Salter *et al.* (2000) and Salter and Martin (2001) – see Table 6. These papers identified a number of key impacts of public sector R&D expenditure.

Table 5: The SPRU framework for the benefits of public R&D

Salter et al. (2000)	Salter and Martin (2001)
1. increasing the stock of useful knowledge	1. increasing the stock of useful knowledge
2. training skilled graduates	2. training skilled graduates
3. creating new scientific instrumentation and methodologies	3. creating new scientific instrumentation and methodologies
4. forming networks and stimulating social interaction	4. forming networks and stimulating social interaction
5. increasing the capacity for scientific and technological problem-solving	5. increasing the capacity for scientific and technological problem-solving
6. creating new firms	6. creating new firms.
7. provision of social knowledge	

Sources: Salter *et al.* (2000) and Salter and Martin (2001).

A classification based on these concepts would be based in good theory, but a number of them, such as funding for increasing the *capacity for problem solving* would be difficult to implement. However, instead the UK has adopted a system that conflates a number of these objectives into its primary purpose classification. PPA covers most of the goals of increasing useful knowledge and social knowledge, PPF might be considered to cover – training skilled graduates (but not PhDs), but there is no direct correspondence between PPD and PPE. Similarly the PPs for government policy and services were not considered within the SPRU system.

A key problem with the UK classification is typified in the example of the first *PP*. Defined as 'general support for research - all basic and applied R&D which advances knowledge for its own sake; support for postgraduate research studentships' the classification covers a huge variety of R&D projects.

The following table helps to illustrate the problem:

[13] Correspondence with Ben Martin of SPRU.

Table 6: Net UK Gov't R&D expenditure by primary purpose 2003-04

£ million **Science Budget**	**General support** **ppA**	**Gov't services** **ppB**	**Policy support** **ppC**	**Tech support** **ppD**	**TOTAL R&D**
Office of Science and Technology OST - DTI	387.5	-	-	-	**387.5**
Biotechnology and Biological Sciences Research Council (BBSRC)	262.6	-	-	4.1	**266.7**
Economic and Social Research Council (ESRC)	83.4	-	-	-	**83.4**
Medical Research Council	332.2	26.9	0.8	0.8	**360.7**
Natural Environment Research Council	180.2	19.0	49.9	28.4	**277.6**
Engineering and Physical Sciences Research Council	392.5	-	-	12.9	**405.4**
Particle Physics and Astronomy Research Council	244.8	-	-	27.2	**272.0**
Central Laboratory of the Research Councils	-	61.8	-	-	**61.8**
Total Science Budget	*1,883.2*	*107.7*	*50.8*	*73.4*	***2,115.1***
Civil Departments					
Department for Environment Food and Rural Affairs	16.9	6.0	128.8	29.2	**181.0**
Department for Education and Skills	-	17.0	33.8	1.2	**52.0**
Office of the Deputy Prime Minister	0.3	3.2	26.9	0.0	**30.4**
Department for Transport	0.1	10.6	41.0	7.1	**58.8**
Department of Health	2.8	557.6	31.4	1.1	**593.0**
National health Service	-	532.7	0.0	0.0	**532.7**
Department for Work and Pensions	-	12.1	6.4	0.0	**18.4**
HSC	-	-	14.1	0.0	**14.1**
Home Office	-	42.2	5.7	0.0	**48.0**
Department for Culture Media and Sport	6.2	0.8	7.4	0.8	**15.2**
Department for International Development	-	214.9	0.0	0.0	**214.9**
Department of Trade and Industry (ex OST)	-	-	15.7	455.0	**470.8**
Northern Ireland departments	-	1.6	19.1	0.0	**20.6**
SE	17.5	52.2	20.5	38.3	**128.5**
NAW	4.5	18.1	8.5	0.0	**31.1**

Financial Services Authority	-	-	22.1	0.0	**22.1**
Other departments	1.3	13.3	11.4	4.2	**30.2**
Total civil *Departments*	**49.7**	**949.5**	**392.9**	**537.0**	**1,929.2**
Total civil *R&D*	**3,597.5**	**1,057.3**	**443.7**	**610.4**	**5,708.9**
Ministry of Defence	**-**	**2,676.6**	**0.0**	**0.0**	**2,676.6**
Total Government	**3,597.5**	**3,733.9**	**443.7**	**610.4**	**8,385.5**

Note: 1. For the purpose of this analysis Research Councils expenditure for Pensions/Other costs have been excluded.
Source: http://www.dti.gov.uk/files/file22025.xls

Table 6 reveals that if using the PP system PPA includes the bulk (89%) of UK Government expenditure on R&D through the science budget. When including Departmental research (but firstly excluding the Ministry of Defence) PPA still accounts for 63 per cent of expenditure. Finally, all ministry of defence R&D expenditure is classified as Government services. It would seem odd that none of this later research was for increasing knowledge or developing technology. Thus, it would appear that although the PP system may have some merit it is not being implemented in a way that appears to actually assist decision making.

Another important feature of the PP classification is that it is based on differentiating between PPB (services) and PPC (policy support). As many government activities are related to services, then policy support will often actually be related to provision of Government's core roles (regulation, service delivery). It many cases it would be difficult to distinguish between these categories. Clearly, a better approach is required.

United States

National Research and Development Reporting

The National Science Foundation (NSF) is the lead agency for compiling data on R&D expenditure in the USA by government, universities and industry. As well as reported by traditional SEO and Research fields, the NSF has adopted what it calls the *budget function* approach.

The budget functions are:

- National defense
- Non-defense
- Health
- Space research and technology
- General science
- Natural resources and environment
- Agriculture
- Transportation
- Energy

- Other functions (Other functions include administration of justice; commerce and housing credit; community and regional development; education, training, employment, and social services; income security; international affairs; and veterans benefits and services)

As can be seen in the following figure, copied from NSF 2006, there is little difference between these ‘functions’ and departmental reporting.

Fig 3: Agency and Budget Crosswalk

Agency	Administration of justice (750)	Agriculture (350)	Commerce and housing credit (370)	Community and regional development (450)	Education, training, employment, and social services (500)	Energy (270)	General science and basic research (251)	Health (556)	Income security (600)	International affairs (150)	National defense (050)	Natural resources and environment (300)	Space research and technology (252)	Transportation (400)	Veterans benefits and services (700)
Agency for International Development										●					
Army Corps of Engineers (Civil)												●			
Department of Agriculture		●										●			
Department of Commerce			●									●			
Department of Defense (Military)											●				
Department of Education					●										
Department of Energy						●	●				●				
Department of Health and Human Services					●			●							
Department of Homeland Security	●										●			●	
Department of Housing and Urban Development				●											
Department of Justice	●														
Department of Labor					●			●							
Department of the Interior												●			
Department of Transportation														●	
Department of Veterans Affairs															●
Environmental Protection Agency												●			
National Aeronautics and Space Administration													●	●	
National Science Foundation							●								
Nuclear Regulatory Commission						●									
Smithsonian Institution					●										
Social Security Administration									●						
Tennessee Valley Authority						●									

● = R&D function funded by specified agency.

For many organisations their entire R&D budget fits with just one functional category. In a few cases they are divided in two. In two cases they agency budgets are divided between three functional categories.

Although, conceptually a functional concept might have some merit the richness of the information it can provide is dependent on the categories developed. If they are too similar to the departmental organisational structure it provides little that is useful.

Agency Reporting

Within the US system, different organisations take different approaches to reporting their R&D budgets depending upon their constituencies.

For example, the National Institutes of Health, which has a budget of USD $28 billion, reports by diseases and conditions[14], its institutes[15] as well as other formats. As another example, the Department of Energy provides very detailed reports on the expenditure by Departmental organisational programs[16].

Lessons from the US system

The US system of R&D is vast, with government spending for 2008 proposed at USD$136.9B (NSF 2006), compared to Canada's government expenditure of CAD$5.2B in 2006. Further, over $100B of the US expenditure occurs within just two line items; defence and health. Although the NIH does attempt to provide detailed reporting of expenditures, the degree to which its large budget can be broken down into useful categories is limited. On the other hand, military expenditures, given their nature are not likely to be reported in any meaningful approach.

Finally, the US system of government differs markedly from the parliamentary democracies of the UK, Australia, New Zealand and Canada. In the latter form of government there is an expectation of political debate over the quantum of expenditures for various programs that is ongoing, a form of accountability that takes a different form in the US where representatives of Congress are somewhat more individual in their activities. In addition, the executive branch of government (the President) has far more influence over expenditures than in parliamentary democracies. In addition, there are clearly factors relating to magnitude, it is clear from empirical research (eg. Holbrook, 1991) that an economy that is an order of magnitude larger than Canada behaves in different ways , including investment in R&D.

Challenges in the design of R&D classification systems

We have shown in this brief account of the research funding systems of New Zealand, Australia, United Kingdom and the USA that each of these countries has been developing a policy related classification of R&D. In the first two examples some of the rationale for the policy orientation of R&D classification has been explicitly linked to evaluation and the justification for expenditure. In the UK case, evaluation is probably related, if implicitly, to the development of the PP system. The USA being such a massive and diverse system has no overarching structures, although there attempts to increase the level of understanding of the federal budget for science.

[14] http://www.nih.gov/news/fundingresearchareas.htm
[15] http://officeofbudget.od.nih.gov/UI/SpendingHistory.htm
[16] See http://www.energy.gov/about/budget.htm

However, the decision to link R&D classification with both policy rationales and evaluation systems with explicit indicators presents some important challenges. R&D cannot be easily evaluated, as Therrien (2006) acknowledges. The prominent reasons are:

- the indirect nature of research impacts;
- the incrementality of research results from the world-wide knowledge base;
- the timeframe to assess the impact; and
- the variety of missions pursued by governments.

The experience of other countries documented above reveals there is no "off-the-shelf" solution to the problem of a policy relevant R&D classification. Further, our research also reveals, implicitly at least, that classification of research activities is a problem common to a number of advanced countries. These reporting systems are intimately linked to the overall structure of their administrative systems. New Zealand has developed its particular classification system to suit the needs of its governance system which itself is highly towards transparent evaluation. This system may only work well in a small, open, economy.

Australia is moving towards more quantitative evaluation of research, but is doing so within the confines of more traditional bureaucratic structures. However it has national research priorities to steer the overall research effort. The UK system is based on a concept of "primary purpose" but lack a detailed analytical or logical structure. The system used by the National Science Foundation in the US is a functional splitting of expenditures that is only slightly more detailed than the departmental budgets themselves.

However, important as these limitations are, they are not the only ones. A more fundamental restraint is the data availability itself. Research for the Australian Nuclear Science and Technology Organisation (Wixted 2001), the Australian National Health and Medical Research Council[17] (Turpin, Wixted and Garrett-Jones 2003) and the New Zealand Ministry of Science and Technology (Garrett-Jones, Turpin and Wixted 2004)[18] reveals that collating relevant comprehensive data against output class criteria and indicators is time consuming and difficult. Even for the simplest category such as health R&D expenditure, the report by Garrett-Jones, Turpin and Wixted (2004) reveals that funding formulas and differing structures make cross country comparison very difficult.

Most, importantly, none of the countries have attempted to develop an approach that is based in a theory of innovation in government. Classification schemes as categories of the mind either implicitly or explicitly reflect the worldviews of their creators. This can be demonstrated with the example of health statistics. The R&D classification of medical related activities tend to be based in a concept of knowledge fields which in turn are based in a primary methodology (chemistry) or the topic of study (living organisms – biology). Yet, managers of health systems are interested in the prevalence and concentration of particular diseases, thus epidemiology data is collected by condition.

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[17] Partly reported here http://www.nhmrc.gov.au/publications/_files/pmf2003.pdf NHMRC (2003).

[18] An evaluation of the performance and strategy of the New Zealand Health Research Council (can be downloaded here http://www.morst.govt.nz/publications/a-z/health-research-evaluation/)

Finally, none of the non-statistical agency R&D classification systems reviewed during this project seem applicable or advisable for Canada. Another approach is necessary.

A theoretical framework for federal R&D expenditures

A theoretical grounding

R&D is a component of innovation. In his discussion of innovation as a social process, Everett Rogers (2003) drew the distinction between inventors and innovators. Inventors generate the new ideas, but it is innovators who communicate the new ideas to society as a whole and promote their acceptance. In this model, the inventors are those who perform the R&D; R&D is the act that initiates innovation within the society as a whole.

The economic view, which draws heavily on the work of Josef Schumpeter (1961), suggests that there are at least five different types of innovation: typically new products, new processes, new forms of organization, new sources of inputs, and development of new markets. This approach suggests at least some elements for a framework within a larger view of the roles of government programs.

Government as an innovator

Policy makers in governments and the private sector alike have recognized that innovation is a necessary element for growth and indeed, survival of a society in the global economy. The ability of organizations to learn and to adapt to rapidly changing circumstances is a key determinant of their viability and likelihood of continued success. All governments, and, in this case the Government of Canada is as much an innovator as any large organization. It is constantly searching for new resources, new ways of organizing itself, and new client groups in order to meet its mandate. These ends are accomplished through new outputs (products and services); the government follows the Schumpetrian model as much as any private sector organization.

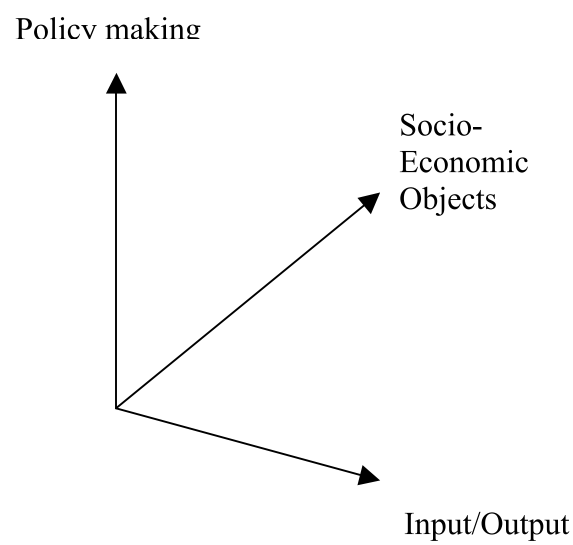
In many respects, government is a highly-regulated service industry. As with any service industry, it can improve its levels of service, which is a social benefit. But it can also improve its productivity - an economic good. Public service managers innovate both to improve efficiency and to increase client satisfaction. For service industries, the degree of regulation is a key factor. In its surveys, Statistics Canada has looked at technological innovation in both regulated and unregulated service industries. They have used the computer services industry as a model of a service provided essentially without regulation in a free market, and the banking and financial sector as an example of a heavily regulated service sector.

Over the past two decades the public sector in Canada has undergone significant change in all aspects of its activities. There has often been a perception that public sector organizations are incapable of innovation, or, at best, they are late adopters of innovations that have been proven in the private sector at home or abroad. As Kernaghan, Marson and Borins (2000) have discussed in *The New Public Organization*, innovation in the public sector takes many forms including technological innovation. Policy-makers must consider how to apply new technologies to deliver government services, the role of technological innovation in governance, and the evolving role of government as a service organization to its clients, the citizens of the nation.

Often, public sector innovations are simply adaptations of existing technologies from other sectors, but governments can, and do, develop innovations that are new to the country or even new to the world. Which comes first - technological innovation or organizational innovation? In another (orthogonal) dimension there is also the question - which comes first - technological innovations or policy and program developments that require new technologies. Also, governments frequently innovate with new forms of organization. Sometimes it is a chicken and egg situation: a new technology, such as the Internet, results in new products or services, which in turn lead to new forms of organization which then lead to the adoption of newer technology, and so on.

Thus governments, and particularly the federal government, carry out research to support their innovative activities. The problem is that there are a number of orthogonal dimensions in which they operate. The key in analyzing R&D expenditures is to establish a framework in the appropriate dimension. For example:

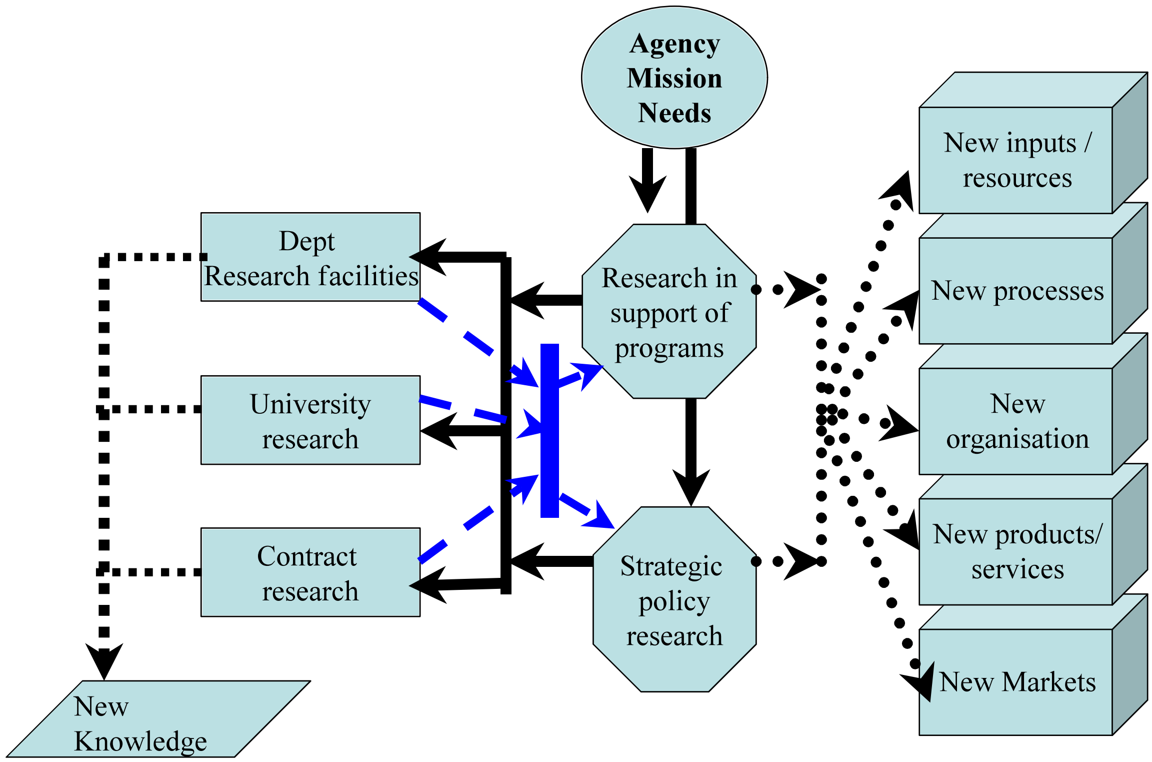
Figure 4 : Research functional classifications



The Government Innovation System

Before building a classification of R&D expenditures it is useful to have a conceptual model of innovation within government. As argued above governments are innovators, and innovate in a number of ways that have analogues with those pathways in the private sector. Thus it is worth thinking in terms of an innovation system for federal research programs. The Government of Canada has a large number of "primary purposes" for its programs, which are articulated through the PAAs. This value chain maps government "primary purposes" on to a Schumpetarian framework, but attempts to generalize them so that they are not department-specific PAAs. Taking what we know of the needs for policy-makers, the benefits of public R&D and the existence of systems of innovation within government, we can generate a model of governmental research programs:

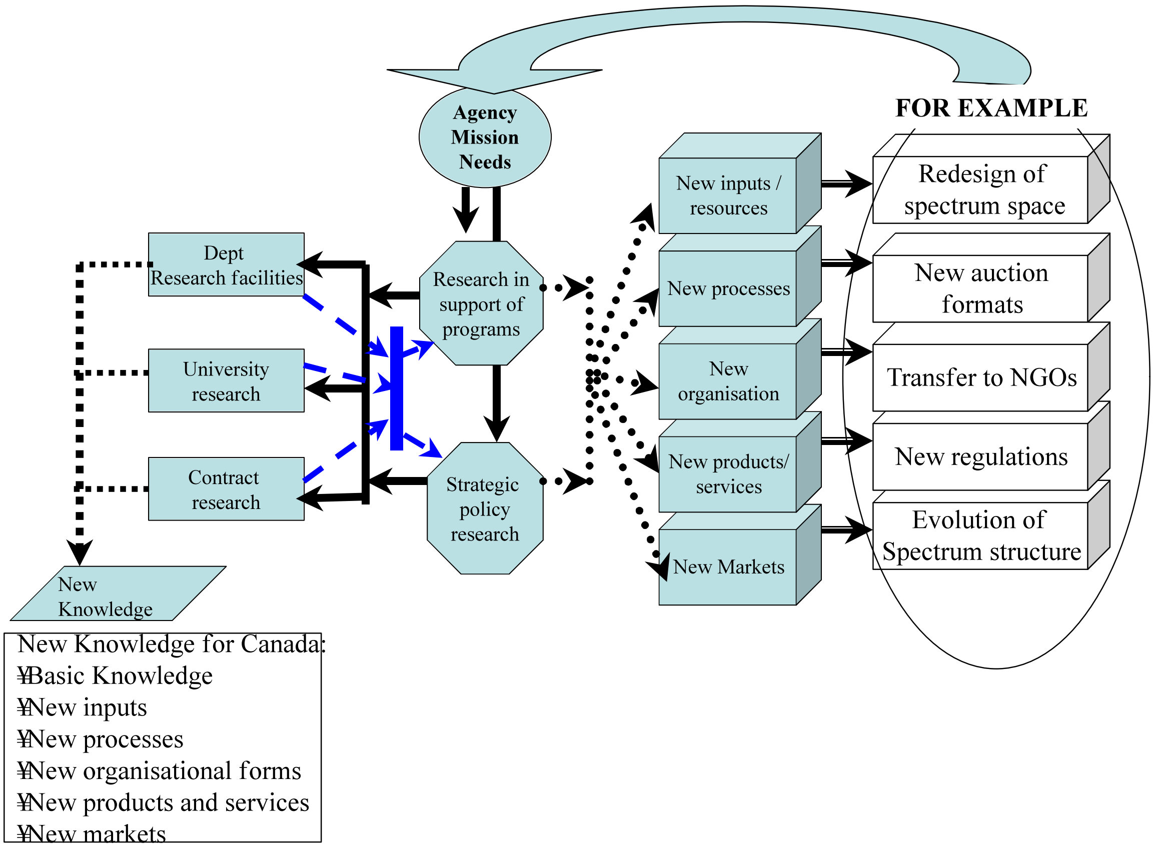
Figure 5 : A generalized model of government research programs



The model is based Schumpeter's description of innovation. Inputs (new resources, in this case new knowledge) and outputs (new markets and/or new "products" – which in government usually means new services) are straightforward. The processing of new knowledge encompasses new methods of organization and new internal processes. The training of HQP, not shown on this diagram, is common to all of these departmental research functions. The heavy lines represent the flow of research funding.

This is a generalized view. Taking, for example, the Industry Canada Spectrum Management system, a hypothetical model of its research activities might be:

Figure 6 : Research activities in the Spectrum Management Program (hypothetical)



Each of the linkages and interfaces generate a number of quantifiable activities. In theory, at least, some of these could be PAAs for Spectrum Management. In order to understand the benefits of the Spectrum Management research program, it would be desirable to classify the activities in each of the components in the model.

<u>Proposal for an alternative classification system</u>

The challenge is to develop a system that allows the categorization of departmental research projects. The model described above needs to be subdivided to give greater detail to the framework for classifying R&D expenditures. The various inputs associated with each project could then be assigned to a specific element within a classification system that could apply to any department, regardless of mission or degree of legal separation from the Minister responsible.

PAAs can be roughly divided into “advancement of knowledge”, (basic research, which for the most part is carried out in universities), “peace, order and good government”, (which focuses on government operations) and “economic and social development”. Note that this is somewhat similar to the construct of principal purposes developed by the UK.

A possible framework derived from the research activity model might look as follows:

Table 9: A research activity taxonomy

Overall purpose of research	**Objective**	**Examples**
A. Advancement of Knowledge	1. Research for public dissemination	Support for basic research in universities
B. Peace, order and good government (government operations)	1. Research on new programs	Intramural or extramural research in support of new operations
	2. Research on new methods of program delivery	Intramural or extramural research in support of existing operations
	3. Research on new methods of program management	Intramural or extramural research in support of delivery of existing programs
	4. Research into new inputs to existing programs	Intramural or extramural research in support of sustainability of existing programs
	5. Research on new areas of government operations	Intramural or extramural research on threats to, or opportunities for, existing government operations
	6. Policy research	Intramural or extramural research in support of new policy initiatives
	7. Development of research HQP (for objectives specific to government operations)	Research fellowships at departmental laboratories
C. Economic development	1. Research resulting in technology transfer to the economy	Intramural research in support of industry on new technologies
	2. Research resulting in improvements to existing technologies	Intramural or extramural research in support of increased productivity
	3. Research into new forms of managing an economic activity	Intramural or extramural research into new regulations, new testing and standards

	4. Research on new resources or inputs to the economy	Intramural or extramural research in industry on new products or processes
	5. Research resulting in new opportunities for the economy	Intramural or extramural research in support of market development
	6. Development of research HQP (for economic objectives)	Research scholarships at universities or in industry
D. Social development	1. Research on new social programs	Intramural or extramural research in support of identification of new programs
	2. Research on delivery existing social programs	Intramural or extramural research in support of new methods of program delivery
	3. Research into new forms of management of social programs	Intramural or extramural research in support of new laws and regulations
	4. Research into new sources of information about society	Intramural or extramural research in support of data collection
	5. Research in support of identification of new client groups	Intramural or extramural research on the structure of society
	6. Development of research HQP (for social objectives and basic research)	Research scholarships at universities

Many of the examples cover both intramural and/or extramural research. Both are part of the classification; they could be further subdivided, but "intramural" and "extramural" are methods of delivery, not purposes in themselves.

As an example, the research activities of the Communications Research Centre of Industry Canada might fall into:

A 1 : research for public dissemination
B 2 : research on new programs
C 1 : research resulting in technology transfer to the economy
C 2 : research resulting in improvements to existing technologies
C 5 : sesearch resulting in new opportunities for the economy

and possibly others, including, B 7. development of research HQP for departmental operations.

The Communications Research Centre program activity structure covers a number of PAAs (see Therrien, 2006, Appendix B, p 39), but these describe program activities, not the purposes of the various research activities. The two systems could be described as "orthogonal".

The role of Highly Qualified Personnel (HQP)

Salter and Martin (2001) in their summary of research on the economic benefits of publicly funded basic research have pointed out that it is very difficult to produce a simple economic model that describes the flow of resources from input to output. They note that there are real economic benefits arising from publicly funded basic research but they are difficult to quantify. However they also point out that some of the clearest benefits come through the consequent investment in human skills. Publicly funded research is a source of skills, of training in problem solving capabilities and an entry point into the world's stock of knowledge. It provides opportunities for researchers to exploit new technological opportunities and to interact, building networks and new economic opportunities.

The focus of many of the national R&D classification systems discussed above, has been on expenditures. There are also inputs of human capital, which can be measured as full-time equivalent person-years, both inside the government and externally. Thus the same system can be used to illustrate among the levels of investment of human capital by the government in its R&D programs. Since R&D is a knowledge-intensive process, it can be argued that the effective and efficient application of human capital is perhaps of even greater importance than the distribution of financial resources.

But it is not only the application of existing human capital that is relevant. Again, as a result of R&D being a knowledge-intensive process the training of new human capital is equally important. Thus all of the purposes, objectives and sub-objectives should capture the level of training HQP as much as they should display the allocation of existing human resources. When quantitative indicators are developed, measures of HQP training, as well simple measures of HQP involved in the program need to be included.

In the model used above, we differentiate between HQP training for internal purposes and HQP development for overall economic and social development in Canada. The development of research HQP is usually thought of as support for post-graduate training, but research HQP requires skills at a number of levels. HQP development should clearly include the training of technicians, technologists and research administrators.

A research agenda

The above framework is a proposal. It is clear that a great deal more needs to be known about the structure of research programs in the federal government. Table 5 shows some of the linkages, but it is by no means certain that this structure is correct, or if there are substantive omissions.

In order to understand the nature of the federal government's research enterprise, it is necessary first to develop a complete model of this activity. This would likely involve a number of case studies, to determine the linkages between the inputs, knowledge processing and output elements of the process. This is not simply a matter of developing addition suites of indicators, but rather, first, understanding how the processes work, and what the true inputs and outputs really are.

There would have to be several case studies. In broad terms there are a number of different types of federal R&D performers:

a) line departments, whose missions include some inputs for of technological development
b) line departments whose missions require some inputs from the social sciences
c) policy departments , agencies and secretariats
d) arm's length agencies who deliver specific outputs on behalf of the federal government
e) granting agencies, who mandate is to support knowledge development outside the federal government
f) technology development agencies, whose mandate is to support knowledge development outside the federal government

Ideally the project would start with an elaboration of a model, such as the one above, and then proceed to testing the model against the different types of federal research performers. Once a clear, verifiable, model is established, data collection could then proceed with a view to quantifying the relationships.

From Industry Canada's point of view, the actual steps and time line might be:

1. A first workshop with invited participants from departments and agencies from within the Industry Canada portfolio, and selected academic experts, to develop a model for testing (three months, including preparation and write-up)
2. Minimum six case studies, carried out conjunction with the departments and agencies concerned (four to six months, if the studies are concurrent)
3. A second workshop, with the same participants as the first workshop, to review the results of the case studies (two months, including preparation and write-up)
4. A formal conference to introduce the findings of the workshops to all science-based departments and agencies (four months, including preparation and write-up)
5. Integration of new data collection into the Statistics Canada cycle of R&D expenditure data collection (up to a year, depending on timing)

The project would likely consume at least 30 person-months, of which at least half would be contracted (not necessarily a single individual) and half from Industry Canada.

Conclusions

The preparation of a framework to understand the purpose and effectiveness of federal research programs is complex and difficult. Several nations have tried over the past few years, each without noticeable success. Part of the problem lies with the temptation to use a research classification system as part of an evaluation process. Inputs and outputs are certainly tied to each research project, but they do not provide precise information about the purpose of the research. Similarly classification by SEOs does not describe the true purpose of research. Policy research is a case in point: policy research is carried out in just about every SEO classification, yet each SEO encompasses a great deal more research than just policy research. As for input/output analysis, while the inputs may be fairly well defined, the outputs may be several, ranging over a long time span, from immediate policy advice to the final consequences of programs initiated as a result of that policy advice. Evaluation on the basis of comparing inputs to outputs, in this instance would be very difficult.

Thus a new paradigm is needed. This paper proposes such a paradigm, based on an economic understanding of the innovation process, of which research is a part. The paradigm needs testing, first with a small group of experts and then with a larger group of stakeholders.

The overall intent is not to establish the economic rate of return on research , a topic that has been tackled many times, with varying degrees of success, but to develop a management information system that will allow public service managers to make informed decisions about the allocation of scarce resources to research, in competition with other priorities, and to decide on priorities within the research envelope.

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Appendix A: R&D Classification System - Australia

The Australian Standard Research Classification (ABS 1998) is more detailed in both the classification of research fields (also unified with university teaching course codes) and socio-economic objectives than the traditional Frascati categories

The division categories (noting there are also divisional and subject codes) are:

210000 Science - General
220000 Social Sciences, Humanities and Arts - General
230000 Mathematical Sciences
240000 Physical Sciences
250000 Chemical Sciences
260000 Earth Sciences
270000 Biological Sciences
280000 Information, Computing and Communication Sciences
290000 Engineering and Technology
300000 Agricultural, Veterinary and Environmental Sciences
310000 Architecture, Urban Environment and Building
320000 Medical and Health Sciences
330000 Education
340000 Economics
350000 Commerce, Management, Tourism and Services
360000 Policy and Political Science
370000 Studies in Human Society
380000 Behavioural and Cognitive Sciences
390000 Law, Justice and Law Enforcement
400000 Journalism, Librarianship and Curatorial Studies
410000 The Arts
420000 Language and Culture
430000 History and Archaeology
440000 Philosophy and Religion

The SEO Division and sub-division categories (noting there are also group and class codes) are:

Division 1 Defence
- Subdivision 610000 Defence

Division 2 Economic Development
- Subdivision 620000 Plant Production and Plant Primary Products
- Subdivision 630000 Animal Production and Animal Primary Products
- Subdivision 640000 Mineral Resources (excluding Energy)
- Subdivision 650000 Energy Resources
- Subdivision 660000 Energy Supply
- Subdivision 670000 Manufacturing
- Subdivision 680000 Construction

Subdivision 690000 Transport
Subdivision 700000 Information and Communication Services
Subdivision 710000 Commercial Services and Tourism
Subdivision 720000 Economic Framework

Division 3 Society

Subdivision 730000 Health
Subdivision 740000 Education and Training
Subdivision 750000 Social Development and Community Services

Division 4 Environment

Subdivision 760000 Environmental Policy Frameworks and Other Aspects
Subdivision 770000 Environmental Management

Division 5 Non-Oriented Research

Subdivision 780000 Non-Oriented Research

Appendix B: Statistical reporting of R&D in New Zealand

National reports on R&D expenditures in New Zealand by government, universities and industry largely follow the format of similar reports for other countries (MoRST 2006b). Research fields and Socio-Economic objective are both adopted. The CRIs report by their topic.

The reporting of government expenditures on R&D in the budget process is by output classes. Data on the funding of purchase agencies is, surprisingly, not reported at the Ministry level. Reports of the individual agencies must be mined to piece together their data.

Output classes 2006

(source: New Zealand Ministry for Research Science and Technology 2006)

Advanced Network

To fund the establishment and operation of a high-speed research and education data network connecting education and science institutions throughout New Zealand with each other and internationally. **Agent: REANNZ. 2006/2007 investment: $10.360m**

Advanced Network Capability Building

To develop capability within the Advanced Network user group (Tertiary Education Institutes and CRIs) to make effective use of the Advanced Network. **Agent: REANNZ. 2006/2007 investment: $1.221m**

Advanced Network CRI Tariffs

For payment of Advanced Network tariffs incurred by some CRIs. These CRIs fund the Crown by way of special dividend. **Agent: REANNZ. 2006/2007 investment: $0.968m**

Advice on shaping the science system

To fund MoRST to negotiate, manage and monitor contracts, and pay expenses on behalf of the Government. It also funds MoRST to define, design and deliver policy advice to the Government on research and innovation. This includes a strategic oversight of the whole RS&T system and evaluating its effectiveness in achieving outcomes, as well as technical advice on science-related issues and emerging technologies, coordinating the implementation of the Biotechnology Strategy, commercialisation of RS&T, and international RS&T linkages. **Agent: MoRST. 2006/2007 investment: $13.406m**

Australian Synchrotron

For New Zealand's contribution to the establishment and operation of a synchrotron located in Victoria, Australia. **2006/2007 investment: $1.166m**

Convention Du Metre

For payment of New Zealand's annual subscription to the Convention du Metre.
Agent: MoRST. 2006/2007 investment: $0.095m

CRI Capability Fund

To retain and develop research in CRIs. **Agent: MoRST. 2006/2007 investment: $46.612m**

Development of International Linkages

To promote and support New Zealand RS&T internationally by accessing and utilising the best global ideas and encouraging New Zealanders to use international linkages to enhance our knowledge-base and innovative capacity. **Agents: MoRST, RSNZ. 2006/2007 investment: $2.527m**

Environmental Research

For increasing the knowledge of the environment, and the factors that affect it, in order to enhance the understanding and management of our environment. **Agent: FRST. 2006/2007 investment: $90.226m**

Equity Investment Fund

Provides for the Government to make equity investments into CRIs that have the capability to develop commercial prospects from publicly funded research. **Agent: MoRST. 2006/2007 investment: $5.00m**

Health Research

For supporting public good research that has the greatest potential to improve the health status of New Zealanders. **Agent: HRC. 2006/2007 investment: $58.955m**

International Investment Opportunities Fund

To support research providers and research funders to participate in international, research collaborations and to recruit highly experienced researchers from overseas. **Agents: MoRST, FRST, HRC, RSNZ. 2006/2007 investment: $9.600m**

Māori Knowledge and Development Research

For building capacity and capability in research which contributes to unlocking the innovation potential of Māori knowledge, resources and people. **Agents: FRST, HRC. 2006/2007 investment: $4.867m**

Marsden Fund

For excellent research exploring the frontiers of new knowledge. **Agent: RSNZ. 2006/2007 investment: $33.878m**

National Measurement Standards

For providing a set of internationally accepted standards for New Zealand products, processes and services. **Agent: IRL. 2006/2007 investment: $5.504m**

New Economy Research Fund

For research capability and knowledge development in areas of science and technology where new industries and enterprises are emerging. **Agent: FRST. 2006/2007 investment: $61.586m**

Pre-Seed Accelerator Fund

To assist an innovative process or product from the conceptual stage to the point where there is a demonstrably marketable product or process. **Agent: FRST. 2006/2007 investment: $8.267m**

Promoting an Innovation Culture

To develop relationships that strengthen and encourage a culture of innovation. **Agents: MoRST, RSNZ. 2006/2007 investment: $4.592m**

Research Contract Management

To fund FRST, HRC and the RSNZ to invest in portfolios of research on behalf of the Government. **Agents: FRST, HRC, RSNZ, Fulbright NZ. 2006/2007 investment: $20.467m**

Research for Industry

For increasing the global competitiveness of our food and fibre, manufacturing and service industries and in national infrastructure such as energy and our built environment. **Agent: FRST. 2006/2007 investment: $190.663m**

Social Research

For supporting public good research that improves social wellbeing. **Agent: FRST. 2006/2007 investment: $5.860m**

Supporting Promising Individuals

For awards and fellowships to retain, attract and support people who sustain the innovation system. **Agents: FRST, HRC, RSNZ, MoRST, Fulbright NZ. 2006/2007 investment: $18.291m**

Technology New Zealand

For increasing both the flow of technology from researchers to firms and the ability of firms to take up new technology. **Agent: FRST. 2006/2007 investment: $47.908m**

Technology Partnership Programme

To provide a mechanism for New Zealand firms and organisations with technical and research capability to access information about internationalmarkets and expertise. **Agent: FRST. 2006/2007 investment: $1.940m**

New Zealand: Reporting by Purchase Agents

Purchase Agents		Organisation Budget 2006 (NZ$)
FRST Foundation for Research, Science and Technology	The largest of the public sector investment agents for research, science and technology (RS&T). 2006/07 investment funding of $419.617 million amounts to about 65% of the investment in research and development (R&D) This represents about 30% of the total New Zealand investment in R&D (ie, public plus private sector). Funding for operations for 2006/07 is $14.6 million (GST exclusive).	$435.217m
HRC Health Research Council	The Health Research Council of New Zealand (HRC) is the Government's principal funding and investment agency for health research. As a Crown entity the HRC is responsible to both the Minister of Health and the Minister of Research, Science and Technology. Consequently, the goals and strategic priorities for the HRC align with those for both Vote Health and Vote Research Science and Technology.	$69.08M
IRL Industrial Research Limited	For providing a set of internationally accepted standards for New Zealand products, processes and services.	$5.504m
REANNZ Research and Education Advanced Network New Zealand	REANNZ (Research and Education Advanced Network New Zealand Ltd) is the Crown-owned company set up to establish, own and operate a high-speed telecommunications network for the research and education sectors.	$12.549m
RSNZ Royal Society of New Zealand.	The Royal Society of New Zealand is an independent, national academy of sciences, a federation of some 60 scientific and technological societies, and individual members. We administer several funds for science and technology, publish eight journals, offer science advice to government, and foster international scientific contact and co-operation.	$33.878m

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