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Measuring the Impact of Research on Well-being: A Survey of Indicators of Well-being

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Abstract

The main objective of this report is to conduct a survey and assessment of various indicators used by organizations, both in Canada and abroad, to measure attributes and the well-being of society at the economic, health, environmental, social, and cultural levels. The compilation includes a combination of quantitative and qualitative and objective and subjective indicators or measures. The report is divided into five major parts. The first part provides a brief overview of Canada's research effort. The second part, by far the longest section, surveys a large number of sets of indicators and composite measures that have been developed to quantify well-being in Canada, in the United States, in OECD countries, and at the international level. The third section develops a preliminary framework for measuring the impact of research on well-being. The fourth section discusses briefly the role of indicators in public policy initiatives to improve the well-being of Canadians. The fifth and final section outlines directions for further work. The report concludes that it is entirely feasible to assess the impact of research investments in Canada on various dimensions of well-being. But it is important to specify what particular research investments and what dimensions of well-being are of interest given the many types of research investments and well-being dimensions as well as the complex interrelationships between research and well-being.

Measuring the Impact of Research on Well-being: A Survey of Indicators of Well-being

Executive Summary

Canada makes significant research investments and these investments contribute to the well-being of the nation. To assess the impacts from research, and possibly align research investments based on these impacts on well-being, it would be useful to have an evaluation framework that links research investments to the various aspects of well-being of Canadians. A compilation of indicators is important for measuring the impacts of research investments in Canada.

The main objective of this report is hence to conduct a survey and assessment of various indicators used by organizations, both in Canada and abroad, to measure attributes and the well-being of society at the economic, health, environmental, social, and cultural levels. The compilation includes a combination of quantitative and qualitative and objective and subjective indicators or measures.

The report is divided into five major parts. The first part provides an overview of Canada's research effort. The second part, by far the longest section, surveys a large number of sets of indicators and composite measures that have been developed to quantify well-being in Canada, in the United States, in OECD countries, and at the international level. The third section develops a preliminary framework for measuring the impact of research on well-being. The fourth section discusses briefly the role of indicators in public policy initiatives to improve the well-being of Canadians, and the links between these indicators and research. The fifth and final section outlines directions for further work and concludes.

The main highlights from the section on Canada's research effort are:

- Canada has greatly increased its research effort in recent years, with the share of GDP devoted to research and development rising from 1.31 per cent in 1971 to 1.91 per cent in 2003;

- the business sector has been responsible for virtually all the increase in the R&D/GDP ratio; and

- from an international perspective, Canada has recently moved from sixth to fifth best performer among the G-7 countries in terms of its R&D/GDP share, surpassing the United Kingdom and Italy. In 2002, we ranked 14th of in a group of 39 OECD and newly industrialized nations.

Based on the survey of 38 sets of indicators or composite measures of well-being in the second section, a number of general observations on the current state of the art of well-being measure construction throughout the world can be made.

- A massive amount of work on the measurement of well-being, broadly defined to include concepts such as quality of life and social reporting, has been undertaken in developed countries by both governments and non-governmental organizations in recent years. The field of well-being measurement is currently experiencing a renaissance.

- The literature on measures of well-being includes both comprehensive sets of indicators as well as composite indexes. The key difference is that the latter go the final step and aggregate indicators into a single index or bottom line using a weighting scheme. Both types of measures require detailed data on a range of indicators and a strong case can be made that the real contribution or value added of a well-being measurement exercise lies in the data gathering and monitoring component. Composite indexes may capture headlines, but they cannot by their nature shed light on specific problems that only individual indicators can elucidate.

- Historically almost all indicators of well-being have been based on objective data. In recent years, the importance of subjective well-being, also called happiness or life satisfaction, has grown and a number of national indexes in this areas, such as the Australian Unity Well-Being Index, has been developed.

- The well-being measures surveyed show both commonalities and differences in terms of the indicators included. Certain basic indicators such as income, employment, poverty, health status, and pollution levels are found in almost every measure while certain others indicators appear in only one or a small number of measures.

- The role of government in the development of well-being measures has varied across regions. The vast majority of well-being measures created in OECD countries outside North America have been undertaken by governments. In contrast, most well-being measures developed in the United States have been undertaken outside of government by non-profit organizations or academics. Canada occupies an intermediate position with a relatively balanced number of government and non-government well-being measurement initiatives.

- The process by which specific indicators are chosen or selected from the much larger universe of indicators may be important for the legitimacy of the well-being measure. For example, a set of indicators selected by experts may have less resonance with the population than a set of indicators that emerged out of a citizen consultation process or even a set of indicators chosen through public opinion polling.

- Outcome indicators appear to be much more appropriate than input indicators in the measurement of well-being given that well-being itself is an outcome. Many well-being measures explicitly recognize this by only including outcome variables.

- The level of technical sophistication of measures of well-being surveyed varies greatly, from well articulated theoretical frameworks to little more than ad hoc compilations of indicators.

The following measures of well-being may be especially important and relevant in tracking the impact of research investments on well-being in Canada:

- the Newfoundland Community Accounts, GPI Alberta and the Conference Board of Canada Performance and Potential Indicators because of the very large number of well-being variables or indicators they include;

- CSLS Index of Economic Well-being because of its well-articulated framework for the measurement of economic well-being;

- the Quality of Life Indicators produced by the Treasury Board because they represent the official view of a central agency of the federal government on what it believes matters to Canadians;

- the environmental indicators highlighted by the National Roundtable on the Environment and the Economy because this exercise was commissioned by the Minister of Finance and because of the extensive stakeholder consultation process by which the indicators were developed;

- the Dutch and Swedish social reporting exercises because of the large number of variables included and long history of both projects;

- the Human Development Index (HDI) developed by the United Nations Development Program because it is probably the best know composite measure of well-being, has received extensive attention in Canada, and has a well-developed theoretical foundation to support the choice of indicators;

- the structural indicators of the European Union because they are used to shape public policies to attain certain objectives;

- the OECD social indicators because of their useful and policy-relevant state-pressure-response framework as well as carefully considered set of indicators; and

- the Atkinson report on EU social indicators because of the meticulous care that that has been given to the development of an appropriate set of indicators.

The third section lays out a basic framework for analyzing the relationship between research investments and well-being. The direction of causation runs from research investments to enhanced well-being through the uses made by societal actors of the increased knowledge generated by the research. This is a very general framework that can in principle capture the impacts of many different types of research investments used by different societal actors on a wide range of dimensions of well-being. This section also gives examples that illustrate the process whereby new knowledge generated has been used to enhance aspects of well-being. Perhaps the most direct link between research effort and well-being is in the field of medical research. A new drug (e.g. Viagara, Prozac) or medical procedure (e.g. cardiac bypass surgery) can directly improve the quality of life of the population, as measured by health indicators such as life expectancy, disability-free years, and infant mortality. Another example of the impact of research on well-being is the research undertaken by Nortel. New products arising from R&D generate revenues, allowing the company to compensate its employees, and pay taxes. Such research effort contributes directly to the economic well-being of Canadians through creation of well-paying jobs and indirectly through the services that governments supply from the tax revenues.

The fourth section examines the use of indicators for improving the well-being of Canadians through public policy. Research can play two roles in this regard. First, the choice of indicators can be greatly influenced by research findings. If, for example, research indicates that early childhood learning is important for later development, improvement in this stage of education can become a policy objective. Second, any strategy to attain these public policy objectives should draw on evidence-based research on the effectiveness of various programs and policies related to the attainment of these objectives accumulated both in Canada and in other countries.

The final section puts forward four steps that an initiative to track or measure the impact of research investments on well-being might include:

- define the broad domains of well-being that are of particular interest, as well as sub-domains within the broad domains. A set of criteria for the selection might be developed;

- choose concrete indicators that best capture or give statistical expression to the domains and sub-domains of interest;

- identify research investments that influence or determine the indicators chosen and specify the paths whereby these research investments and the knowledge created affect the indicators. It is particularly important to identify the societal actors who influence the well-being indicators of interest and the knowledge flows between the actors and the creators of new knowledge that have the potential to positively affect the well-being indicator; and

- quantify the impact of particular research investments on the indicators of interest. This last step is by far the hardest as it can be very difficult to disentangle empirically the role of the various factors that determine the state of an indicator.

The main conclusion of the report is that it is entirely feasible to assess the impact of research investments in Canada on various dimensions of well-being given the wealth of indicators that have been developed both in Canada and in other countries to measure well-being. But because of the many different types of research investments and dimensions of well-being as well as the complex relationships between research investment and well-being outcomes, it is important to specify what particular research investments and what dimensions of well-being are of interest before empirical work is undertaken to estimate the impact of these research investments on well-being.

Measuring the Impact of Research on Well-being: A Survey of Indicators of Well-being[1]

Canada makes significant research investments and these investments contribute to the well-being of the nation. To assess the impacts from research, and possibly align research investments based on these impacts on well-being, it would be useful to have an evaluation framework that links research investments to the various aspects of well-being of Canadians. A compilation of indicators is important for measuring the impacts of research investments in Canada.

The main objective of this report is hence to conduct a survey and assessment of various indicators used by organizations, both in Canada and abroad, to measure attributes and the well-being of society at the economic, health, environmental, social, and cultural levels. The compilation includes a combination of quantitative and qualitative and objective and subjective indicators or measures.

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I. Canada's Research Effort: An Overview

Before discussing indicators that potentially capture the impact of research investments on the well-being of Canadians, it is useful to briefly examine Canada's research effort. This section first looks at trends in total R&D spending, then discusses R&D spending by performing sector, field of research and a number of other characteristics, and finally provides an international perspective on Canada's R&D performance. The bottom line is that Canada's research effort has increased substantially in recent years. A key question motivating this report is whether this increase has translated into commensurate improvements in the well-being of Canadians. To answer

[1] This report was originally prepared for the Prime Minister's Advisory Council on Science and Technology (PMACST). The authors would like to thank the PMACST for financial support to undertake this research and for permission to publish this report. The views expressed in this paper are those of the authors and do not necessarily reflect the opinions of the PMACST. See Torjman and Minns (2005) for a sustainable development framework for science and technology research prepared for the PMACST.

this question, appropriate well-being indicators affected by research investments must be identified, and the impact of research on trends in these indicators specified.

A. Trends in Total R&D Spending in Canada

Statistics Canada produces statistics on expenditures on research and development (R&D) in Canada and these statistics capture, at least quantitatively, the lion's share of the country's research effort. These statistics include all expenditures on research, including salaries of researchers and research support personnel (around 90 per cent of the total), and capital equipment.[2] Expenditures are broken down by the type of organization undertaking the research (business, government, private non-profit organizations, and higher education). Sources of funding are also broken down by these four categories as well as the foreign sector.

In 2003, total research and development spending in Canada was $23.3 billion current dollars, representing 1.91 per cent of nominal GDP (Table 1).[3] Preliminary estimates for 2004, based on intentions, show R&D expenditures increasing 5.1 per cent to $24.5 billion. As nominal GDP growth is forecast to be around 6 per cent in 2004, the R&D/GDP ratio will be slightly lower than in 2003

As shown in Table 3 and Chart 1, Canada's R&D spending as a share of GDP has increased by nearly half (45.8 per cent) over the past three decades. This ratio rose 0.60 percentage points from 1.31 per cent in 1971, the earliest year for which complete data are available, to 1.91 per cent in 2003, the most recent year for which actual, albeit preliminary estimates are available.

The R&D/GDP ratio fell in the first half of 1970s to a low of 1.04 per cent in 1976. It then rebounded and has grown more or less steadily since then to 2001, reaching an historical peak of 2.05 per cent of GDP that year. The ratio fell significantly in 2002 because of the downturn in the high tech sector and again slightly in 2003, but appears to have more or less stabilized in 2004. In real terms (deflated by the GDP deflator), R&D expenditures grew by 4.4 per cent per year over 1971-2003, compared to 3.2 per cent for real GDP (Table 2).

B. Trends in R&D Spending by Performing Sector and Field of Research

In 1971, higher education, business enterprises and government were each responsible for about one third of Canada's R&D effort, each sector devoting 0.42-0.44

[2] Research effort of university teachers who undertake research without receiving research grants may not be included in R&D so from this perspective R&D statistics may underestimate total research investments. Research done by investigative journalists that creates new knowledge is also excluded.
[3] All tables and charts are found at the end of the document.

per cent of GDP to R&D (Tables 3 and 4). Over time there have been very divergent developments in the R&D performance of these three sectors (Chart 2). Between 1971 and 2003, R&D expenditures performed by business enterprises, measured as a share of GDP, increased by nearly two and one half times from 0.42 per cent to 1.01 per cent and now account for over half of total R&D spending (52.9 per cent in 2003). R&D spending by the higher education sector increased by about one half from 0.44 per cent of GDP in 1971 to 0.68 per cent in 2003 and still accounts for around one third of total R&D (35.6 per cent). In contrast to the upward trend in R&D spending by businesses and higher education, R&D spending by government fell by more than one half from 0.43 per cent of GDP in 1971 to 0.21 per cent in 2003, and now represents only 11.0 per cent of total R&D spending.[4]

Statistics Canada provides a breakdown of R&D spending between the natural sciences and engineering and the social sciences and humanities, but does not appear to provide any disaggregation within these general areas. Natural sciences and engineering account by far for the larger share of total R&D expenditures at around 90 per cent (Table 7 and Chart 3). Growth in R&D expenditure in natural sciences and engineering was much more rapid over the 1971-2003 period than that in social sciences and humanities (4.6 versus 2.7 per cent per year in real terms). Indeed, all the increase in the overall R&D/GDP ratio over the 1971-2003 period was accounted for by the increased share of R&D spending in natural sciences and engineering (Chart 4), up from 1.14 per cent to 1.77 per cent of GDP. R&D spending on social sciences and humanities fell from 0.16 cent in 1971 to 0.14 per cent in 2003, although up from a trough of 0.09 per cent in 1997.

The OECD's *Science and Technology Indicators* provides a breakdown of central government R&D funding by budget objective for OECD countries. Tables 8 and 9 provide these data for Canada for the 1981-2001 period, with R&D funding broken down into six categories: economic development, health and environment, space program, general university, defense, and non-oriented R&D. In 2001, the largest share of the federal government R&D funding of $5.4 billion U.S. dollars went to economic development (32.0 per cent), followed by general university (25.7 per cent), and health and environment (23.5 per cent). The remaining one fifth went to non-oriented R&D (7.2 per cent), space program (6.2 per cent), and defense (4.3 per cent). The major change in the federal government's research priority over the 1981-2001 period has been the increased share of funding going to R&D related to health and the environment.

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[4] The declining role of government as a performer of R&D has been paralleled by the sector's diminishing role as a funder of R&D. In 1971, government funding of R&D was equal to 0.68 per cent of GDP, but by 2003 it had fallen 0.22 percentage points to 0.46 per cent (Table 5). In terms of total R&D funding, the government share fell from 51.8 per cent in 1971 to 25.1 per cent in 2003 (Table 6). Government funding takes the form of contracting out of government research to other sectors and financial assistance to the higher education sector through the granting councils as well as government financial assistance for industrial R&D, through programs such as the Technology Partnerships Program. Tax incentives like the Scientific Research and Experimental Development (SR&ED) program are not considered part of government R&D funding.

R&D spending by business enterprises is very concentrated by industry. In 2003, the communications equipment industry was responsible for 17 per cent of total industrial R&D (Statistics Canada, 2003), followed by pharmaceutical and medicine (8 per cent), computer system design and related (8 per cent), aerospace products and parts (7 per cent), and semiconductor and other electronic components (7 per cent).

R&D spending is also concentrated by region, with a disproportionate share taking place in central Canada and this share growing over time (Table 10). In 2001 (the most recent year for which provincial data are currently available), Ontario accounted for 46.6 per cent of national R&D, Quebec 27.9 per cent, and the National Capital Region 4.2 per cent (these data are not included in either Ontario or Quebec figures). Central Canada thus accounted for nearly four fifths (78.7 per cent) of national R&D in 2001, up from 64.1 per cent in 1979. Ontario and Quebec in 2001 represented 62.3 per cent of the Canadian population and 61.8 per cent of real GDP.

A key characteristic that differentiates R&D spending in Canada from other industrial countries is the very large proportion of R&D that is undertaken by one firm.[5] In 2002, Nortel Networks Corporation spent $3.5 billion on R&D, 15.6 per cent of Canada's total R&D spending (Research Infosource Inc., 2003). The second largest R&D performer was Magna International Inc., which spent $574 million, one eighth the Nortel effort. The $1.5 billion fall in Nortel's R&D spending in 2002 from the 2001 level of $5.0 billion was responsible for the overall decline in Canada's R&D/GDP ratio that year.

C. Canada's R&D Performance in International Perspective

Canada's R&D performance has historically been regarded as poor relative to our major trading partners and consequently a matter of concern. Indeed, the federal government has made greater R&D spending one of its key economic objectives. In February 2002 the Government of Canada (2002:51) set as a target that by 2010 Canada "rank among the top five countries in the world in terms of R&D performance" and that the federal government should at least double its current investment in R&D by this time.

From an international perspective, Canada's research effort has actually improved significantly in recent years, in both absolute and relative terms. Canada has traditionally ranked sixth in terms of the R&D/GDP ratio among G-7 countries, only ahead of Italy (Table 11 and Chart 5). By 2002, the most recent year for which data are available for most countries, Canada had moved to fifth, having overtaken the United Kingdom.[6] The

[5] The only other industrial country with such a concentration of R&D in one firm may be Finland, where Nokia dominates.

[6] According to OECD estimates (OECD, 2004), Canada's ratio of R&D to GDP was 1.91 per cent in 2002. This is slightly below the ratio of 1.93 per cent reported in Table 3 for Canada in 2002 and is explained by an upward adjustment to Canadian nominal GDP estimates made by OECD officials to ensure comparability with estimates from other OECD countries.

OECD publishes R&D/GDP ratios for 39 countries. In 2002 (or the most recent year for which data are available), Canada ranked 14th. In addition to the four G-7 countries that outperformed Canada (Japan, United States, France, and Germany), Austria, Belgium, Korea, Switzerland, Singapore and four Nordic countries (Denmark, Finland, Iceland, Sweden) also did so.

II. A Survey of Indicators of Well-being

This part of the report, by far the longest, provides a survey of 38 indicators of well-being. The section surveys measures of economic, social/cultural/health, and environmental well-being that have been developed by both governmental and non-governmental organizations for Canada, for the United States, and for other OECD countries, as well as at the international level for all countries by international organizations and private researchers. The section also provides a synthesis of the well-being measures surveyed and discusses the relevance for potential future work on the evaluation of research impacts on well-being.

The empirical literature on the measurement of well-being, including both comprehensive and topical sets of indicators[7] and composite indexes[8] is voluminous, and a comprehensive review of this literature is well beyond the scope of this (or any) report.[9] To make such a review feasible, the domains of well-being must be limited and the geographical dimension at which well-being is measured circumscribed (hundreds of measures of well-being have been developed at the local level). The term "well-being" in this report is used in a general sense and encompasses work on the measurement of quality of life, social development, human development, sustainable development, sustainability, social reporting, social indicators, social accounts, social and economic performance and progress, among others. The underlying commonality is the focus on

[7] It is useful to make a distinction between a topical and comprehensive indicator system. According to USGAO (2004:5), the former involves a specific topic or issue such as health, education, and employment, while the latter pull together the most essential indicators on a range of topics or issues.

[8] In the well-being or quality of life indicators literature a major distinction is made between sets of indicators and composite indexes. Developers of composite indices like the Human Development Index weight different indicators to produce an index or bottom line. There are both advocates and critics of this approach, but this issue will not be addressed in this report. The key point is that developers of composite indexes must first develop an appropriate set of indicators or variables to which they apply weights. It is these sets of indicators that are relevant for this report.

[9] This survey updates and extends two earlier surveys of well-being measures conducted by the Centre for the Study of Living Standards (CSLS, 1999 and Sharpe, 2003). Other surveys of the literature on well-being measures are Michalos (2003), Donovan and Halpern (2002), and Gadrey and Jany-Catrice (2003). For an evaluation of 22 indexes of economic and social well-being, see Hagerty et al. (2001). The OECD has developed a website on the knowledge base of national and international experiences in indicators (www.oecd.org/oecdworldforum). It provides a structured list of roughly 200 relevant documents concerning a wide range of experiences on key indicators developed by private and governmental institutions of OECD member and non-member countries. This information is grouped by country and topic.

measuring in a summary or comprehensive manner outcomes or states of society. This means that work on topical indicators of well-being such as personal security or the well-being of children is not included.

The domains of well-being of interest to this report are economic and social/cultural including health, and to a lesser degree environmental. Little attention will be given the political, psychological, spiritual and religious dimensions of well-being.[10] The survey focuses on objective measures of well-being, but some work on the measurement of subjective well-being has been included. This document will largely focus on measures of well-being developed at the national level as most of the innovative work in the area of well-being measurement has been carried out at this level. However, some important measures of well-being that have been developed at the provincial/state level are included. The very large number of initiatives to measure well-being at the local or community level are generally not included.

Even with these restrictions, the literature is still massive and a selection must be made. Consequently, the report highlights what the authors believe are the most innovative initiatives from the point of view of methodology and choice of domains and variables, and the most important from the point of view of impact on public policy and private behaviour.

The survey of the measures of well-being describes the domains and variables included in the measure as well as the purpose for which the measure was developed and the framework or methodology employed. It does not attempt to provide a detailed evaluation of the measure, although a brief assessment is made. Trends in the measures of well-being are generally not presented. The purpose of the survey is to highlight the wide range of indicators that have been used to measure well-being to shed light on linkages between research and well-being.

A. Canada

This section examines 12 measures of well-being that have been developed and applied to Canada.[11] Six of the measures have been developed by governmental bodies

[10] To keep the size of this survey manageable, competitiveness and innovation indexes (e.g. World Economic Forum, 2003) are also not surveyed, although these measures often contain data on many useful variables. Economic freedom measures (e.g. Gwartney and Lawson, 2004 and O'Driscoll, Jr., Feulner, and O'Grady, 2003) are also omitted. Compendia of statistical information on well-being indicators (e.g. World Development Indicators published annually by the World Bank, 2003, the Economic Report of the President published annually by the U.S. Council of Economic Advisors) are also omitted, as are volumes that examine general trends in well-being (e.g. Jackson and Robinson (2000) on Canada, Gregg and Wadsworth (1999) on the United Kingdom, and Mishel, Bernstein and Boushey (2003) on the United States).

[11] Additional composite measures of well-being developed for Canada include the Fraser Institute's Index of Living Standards (Sarlo,1998). Additional sets of topical indicators include a set on personal security

and six by non-governmental organizations. All the measures developed by government are sets of indicators and only one aggregates to create a composite index bottom line. Three of the six measures developed by non-governmental organizations do produce a composite index. Six of the 12 measures have been developed primarily for Canada at the national level while six have been developed for a particular province or for municipalities.

1) Measures developed by governmental organizations

a) Treasury Board of Canada Quality of Life Indicators

The Treasury Board of Canada has released since 2001 an annual report entitled *Canada's Performance*. The most recent report, released in November 2004, focuses on the quality of life of Canadians using a set of 23 societal indicator groups that reflect a balance between social, economic and environmental interests. These indicators have been grouped according to six themes that public opinion research has identified as mattering strongly to Canadians, namely Canada's Place in the World; Canada's Economy; Society, Culture and Democracy; Aboriginal Peoples; the Health of Canadians; and the Canadian Environment.

Data are presented in disaggregated format, in some cases for different regions and groups, and international comparisons are provided where available. Linkages are made to the planning and performance information of federal departments and agencies that contribute to improvements in the six broad groups of indicators. The Treasury Board believes that by reporting on quality of life in this manner the document sets the context for assessing the performance of federal government programs and the effectiveness of government policies. The report also encourages government departments and agencies to clearly link their work to improvements in the quality of life of Canadians. According to the Treasury Board, Canada is one of only a few countries in the world to publish such a report on the quality of life of its citizens.

In the "Canada's Place in the World" domain the indicator groups are:

- "A Prosperous and Sovereign Canada in a Safe and Secure North America" (total trade and perceptions of security);
- "A Canada Committed to Multilateral Cooperation" (trust in international institutions);
- "A Canada Committed to Peace, Human Development and Human Security" (official development assistance); and
- "A World Where Canada has a Positive Influence and Profile" (indicator in development).

(Canadian Council on Social Development, 2002), and a set on female equity (Federal Provincial/Territorial Ministers Responsible for the Status of Women, 1997).

In the "Canada's Economy" domain the indicator groups are:

- "An Innovative and Knowledge-Based Economy" (innovation, educational attainment and literacy);
- "Income Security and Employment for Canadians" (the employment rate, real disposable income per capita and the low-income cut-off measure);
- "A Secure and Fair Marketplace" (barriers to entrepreneurship); and
- "Strong Regional Economic Growth" (real GDP per capita).

In the "Society, Culture and Democracy" domain the indicator groups are:

- "Diversity as a Fundamental Canadian Value" (attitudes towards diversity);
- "Safe Communities" (safety);
- "Caring Communities" (volunteerism);
- "Vibrant Canadian Culture and Heritage" (participation in culture and heritage activities);
- "Sustainable Cities and Communities" (indicator in development); and
- "An Informed and Engaged Canadian Public" (political participation).

In the "Aboriginal Peoples" domain the indicator groups are:

- "Full Aboriginal Participation in Life-Long Learning" (educational attainment of Aboriginal peoples);
- "Strong Aboriginal Economic Self-Reliance" (employment rate for Aboriginal peoples and median income for Aboriginal peoples);
- "Healthy Aboriginal Communities" (health status of Aboriginal peoples and housing of Aboriginal peoples); and
- "Effective Democracy and a Strengthened Aboriginal Relationship with Canada" (indicator in development).

In the "Health of Canadians" domain the indicator groups are:

- "A Healthy Population" (life expectancy, self-rated health, infant mortality and healthy lifestyles); and
- "A Strong Health Care System" (waiting times and patient satisfaction).

In the "Canadian Environment" domain the indicator groups are:

- "Canada's Environment is Protected and Restored from Pollution" (air quality and water quality);
- "The Risk of Climate Change is Minimized" (climate change); and
- "Canada has a Sustainable Approach to its Natural Resources and Healthy Ecosystems" (biodiversity and natural resources sustainability).

Out of the 32 individual indicators for which data are available, 12 were reported as showing increases over the most recent five to ten year period for which data are available, six were reported as showing decreases, and the remainder were judged to have shown no definitive trend.

The Treasury Board work is important because it represents the official view of a central agency of the Canadian government on where Canada is making progress in terms of quality of life and where we are falling behind. It is reassuring when governments acknowledge setbacks in quality of life as well as success. A second strength of the document is that it focuses on the contribution of federal government polices and programs to the quality of life of Canadians. The document does not however provide an analytical framework for the selection of domains and the variables in the domains for the quality of life indicators. The linkages between quality of life indicators and government actions are also vague and not developed, reducing the potential contribution of the document to an assessment of the impact of government policies on the quality of life of Canadians.

b) National Round Table on the Environment and the Economy

In 2003, the National Round Table on the Environment and the Economy (NRTEE), an independent advisory body of the federal government mandated to promote sustainable development,[12] published a report entitled *Environment and Sustainable Development Indicators for Canada*. The report was the culmination of the three year Environment and Sustainable Development Indicators (ESDI) initiative first announced in the 2000 federal budget by then-Finance Minister Paul Martin. The objective of the ESDI was to develop a small set of credible and understandable indicators to assess the possibility that current activities in Canada will threaten the activities of future generations.

This report recommended that six indicators of natural and human capital be further developed and reported by the government in order to supplement the standard national accounts data. It was felt by the ESDI task force that such reporting is necessary in monitoring sustainability because the type of capital estimates currently reported do not capture all of the assets necessary to maintain a healthy economy, environment and society. Out of the four types of capital – physical, natural, human and social – only estimates of physical capital are currently reported. The report is thus an attempt involving a large number of stakeholders to develop a framework for reporting estimates of natural and human capital as well (and states that indicators of social capital should eventually be reported also).

Of the six indicators recommended by NRTEE (2003), five are related to natural capital and the sixth to human capital. The indicators are:

[12] NTREE members are drawn from academia, business, labour, Aboriginal and environmental organizations and are appointed by the Prime Minister.

- an air quality trend indicator (as measured by the population-weighted exposure to ground-level ozone);
- a freshwater quality indicator (a national sample of the state of water quality);
- a greenhouse gas emissions indicator (the national total of annual emissions);
- a forest cover indicator (percentage of ground area covered by forest);
- an extent of wetlands indicator (percentage of ground area covered by wetlands); and
- the educational attainment of the working age population, measured as the proportion of the population between the ages of 25 and 64 that has attained upper-secondary and tertiary level education.

A further recommendation of the report is that Canada's system of national accounting be expanded to collect data on these indicators. This would improve the quality and consistency of the estimates available. Ultimately, the ESDI task force envisions a system of national accounts that provides extensive data on subsoil asset counts, biological and resource asset counts, land and terrestrial ecosystem asset counts, water and aquatic ecosystem asset counts, and atmospheric asset counts.

c) Natural Resources Canada's Atlas of Canada

Natural Resources Canada has constructed an electronic Atlas of Canada (www.atlas.gc.ca) that allows users to easily access socio-economic indicators reflecting quality of life at different levels of geographical disaggregation for the year 1996. The objective of the atlas is to disseminate to a broad audience knowledge about quality of life in Canada in four areas: the economic environment, the physical environment, the social environment, and overall quality of life.

The economic environment represents the external conditions under which people are engaged in, and benefit from, economic activity. It includes aspects of paid employment, economic status and finances. The indicators of the economic environment measure the ability of households to access goods and services important to quality of life. The following two domains and seven indicators are used to assess the quality of the economic environment:

<u>Household Finances</u>

- Average owner's major payments (inverse)
- Percentage of income from government transfer payments (inverse)
- Ratio of percentage of households in lowest income category to that of households in highest income category (inverse)
- Percentage incidence of low income families (inverse)

<u>Employment/Paid Work</u>

- Ratio of individuals working part year, part time to individuals working full year, full time (inverse)

- Unemployment rate (inverse)
- Average employment income (direct)

The social environment represents the external conditions under which people engage in social activity within their community. Seven domains and 14 indicators have been used to assess the social environment.

Leisure and Recreation

- Number of leisure-related commercial activities per thousand people (direct)
- Number of libraries per thousand people (direct)

Social Opportunity and Mobility

- Ratio of female median income to male median income (direct)
- Male participation rate in workforce (direct)
- Female participation rate in workforce (direct)

Participation in Democratic Processes

- Percentage of the population that participated in the 1997 federal elections (direct)

Social Stability

- Ratio of percentage of population living in owned housing to percentage of population living in rental housing (direct)
- Percentage of population living at the same address they lived at five years earlier (direct)
- Percentage of population living at a different address than the one they lived at five years earlier (inverse)

Education

- Ratio of percentage of population with trade/college or university education to percentage of population less than Grade 9 education (direct)

Access to Health Resources

- Number of physician specialists per thousand people (direct)
- Number of family physicians per thousand people (direct)

Health Status

- Incidence of low birth weight per thousand people (inverse)
- Incidence of breast cancer per thousand people (inverse)

The physical environment represents the external conditions under which we live. It includes aspects of housing, access to services, environmental quality and personal security. Four domains and eight indicators have been used to assess aspects of the quality of the physical environment.

Housing

- Percentage of population living in housing requiring major repairs (inverse)
- Average number of persons per room (inverse)
- Percentage of household incomes with owner's major payments (or gross rent) for shelter being greater than or equal to 30 per cent of household income (inverse)

Accessibility to Services

- Distance from centre of census subdivision to nearest hospital (inverse)

Environmental Quality

- Density of dwellings requiring major repairs (inverse)
- Air quality: measured as total pollutant particulate matter emissions (inverse)

Personal Security

- Incidence of personal crime (inverse)
- Incidence of property crime (inverse)

Overall quality of life is a composite assessment of the quality of the social, economic and physical environments and uses the domains and variables from these three environments. Eleven domains and 25 variables have been used to assess the external conditions of overall quality of life. All domains and variables are given equal weight.

The Atlas of Canada uses five classes to quantify and map the quality of the economic, social, and physical environments as well as the overall quality of life environment: low, fair, moderate, good and high. 'Moderate' quality of life can be seen as the average, whereas 'low' is well below the average and 'high' is well above average. A 'low' classification for a community implies that it scored low on all indicators of the social environment; conversely, a community with a 'high' classification more than likely scored above average on all indicators. The score for each community is calculated using a methodology called the standard score additive method. In this method, the data are standardized. The resulting values, called z-scores, are then added or subtracted, according to the direction of the indicator. The indicator direction is either inverse (–) or direct (+), where inverse indicates that a high value implies a lower quality of life; conversely, a high value for a direct relationship implies a higher quality of life.

The set of indicators used by the Atlas of Canada has been validated by various experts and represents a broad selection of indicators to compare quality of life between communities (or census subdivisions) on a national scale. It recognizes that regional variations in quality of life exist, and are probably not completely captured by these indicators. Nor do these indicators capture the internal diversity of the quality of life within communities. Nevertheless, it believes that by applying a consistent set of indicators and a common methodology, broad general patterns in quality of life can be identified among communities across Canada. Quality of life, as mapped here, is not a reflection of happiness or overall satisfaction with life but rather objective outcome indicators.

d) B.C. Statistics Regional Socio-economic Indicators

British Columbia (B.C.) Statistics released in 1999 a document entitled *British Columbia Regional Socio-Economic Indicators: Methodology* that put forth an index incorporating socio-economic indicators for 28 regions in the province. This study was updated in 2004. The B.C. Deputy Ministers' Committee on Social Policy commissioned this study, which develops indicators for the Regional Districts of British Columbia, which range in population from 2 million down to 1,500.

In the original study seven basic indicators were identified and developed, each with three or four variables. These indicators (with the weights given them in brackets) are economic hardship (0.25), impending change in economic hardship (0.05), crime (0.2), health (0.2), education (0.2), children (0.05), and youth (0.05).

- The economic hardship index is currently based on the proportion of the population aged 0-64 receiving social assistance for less than one year, the proportion of the population aged 0-64 receiving social assistance for over one year, and the proportion of the senior population receiving the Guaranteed Income Supplement. Additional hardship indicators that may be added include proportion of the population that is the working poor, income inequality measures, the proportion of the population receiving Employment Insurance (EI), per capita income, and per capita net taxes paid.

- The impending change in economic hardship is based on the annual percentage change in the number of social assistance recipients, the annual percentage change in the number of EI beneficiaries, and income dependency on forestry, fishing and mining.

- The crime index is based on the change in the overall crime code rate, the property crime rate, and the violent crime rate. Data on spousal assaults, drug offences, and young offenders may be added.

- The health index is based on three indicators: the potential years of life lost due to natural causes, the potential years of life lost due to accidental causes, and the

potential years of life lost due to suicide/homicide. Data on teen pregnancy, infant mortality, and incidence of smoking may be added.

- The education index is based on the proportion of the population aged 25-54 with completed post-secondary education, the high school completion rate, the pass rate for Grade 12 math, the pass rate for Grade 12 English, and career preparation enrolment. Data on average test scores may be added.

- The children at risk index is based on the proportion of the population under 19 living in families on social assistance, infant mortality, and average test scores for reading. Data may be added on young offenders, teen pregnancies, test scores for math, the proportion of the youth population in care, and the proportion of the population reporting child abuse.

- The youth at risk index is based on the proportion of the population aged 19-24 on social assistance, and the high school completion rate. Data may be added on the incidence of youth who smoke, the youth motor vehicle death rate, youth drug offence rate, youth net migration, and youth EI incidence rate.

All variables are given an index value between 0 and 100, with the best-off region given 0 and the worst off 100. The weights are then used to compute a composite index or index of regional stress given the values for the seven indexes.

e) Newfoundland Community Accounts

In order to provide information to policy makers and analysts about well-being of citizens, with the objective of making Newfoundlanders a self-reliant and prosperous people and Newfoundland a sustainable region, the Newfoundland government has developed a system of community accounts. This system contains data and indicators grouped into ten fields: social, health, demographic, environmental, resources/wealth, production, labour market, education, income, and dwelling accounts. Each of these accounts contains a broad and diverse selection of variables. There is also an overall well-being account. This account collects variables not included in the other accounts, rather than organizing or aggregating the variables from other accounts in some way. The indicators are available on-line (www.communityaccounts.ca) for various levels of geographic aggregations, from communities to the province as a whole. Map and graph functions also allow users to easily compare given variables across communities and economic regions.

f) Federation of Municipalities Quality of Life Reporting System

The Federation of Canadian Municipalities (FCM), an umbrella group of large Canadian municipalities, in cooperation with 20 large municipal governments, has developed a reporting system for monitoring the quality of life in major Canadian cities. The FCM Quality of Life Reporting System was born out of a desire to bring a community-based perspective to the development of public policy and to monitor the

consequences of changing demographics, as well as shifting responsibilities and fiscal arrangements.

While not a composite QOL index, the system provides much useful information on societal indicators. The FCM released its third QOL report in April 2004, following reports in 1999 and 2001. The reporting methodology and number of municipalities covered has changed across these three reports. The 2004 report presents QOL indicators in 11 domains: demographic and background information; affordable and appropriate housing; civic engagement; community and social infrastructure; education; employment; local economy; natural environment; personal and community health; personal financial security; and personal safety. The list of 72 variables used to capture trends in each QOL measure according to the most recent reporting system is given in Exhibit 1. The 20 Canadian municipalities covered account for 40 per cent of Canada's total population.[13]

The QOL monitoring system was originally based on consultations and community participation, and attempted to include both subjective/qualitative indicators and objective/quantitative indicators. It appears, however, that the more recent methodology focuses on objective indicators. The original criteria for selection of variables were the following: 1) meaningful at the community level; 2) annual availability at a national-consistent level; and 3) easily understood by the public.

[13] The 20 municipalities covered by the 2004 report were Calgary, Edmonton, municipality of Halifax, municipality of Halton, Hamilton, Kingston, London, municipality of Niagara, Ottawa, municipality of Peel, Quebec Metropolitan Community, Regina, Saskatoon, Greater Sudbury, Toronto, Vancouver, municipality of Waterloo, Windsor, Winnipeg, and the municipality of York.

Exhibit 1: Federation of Canadian Municipalities Quality of Life Reporting System Domains and Indicators

Demographic & Background Information (DBI)	Affordable, Appropriate Housing (AAH)	Civic Engagement (CE)	Community and Social Infrastructure (CSI)	Education (ED)	Employment (EM)	Local Economy (LE)	Natural Environment (NE)	Personal & Community Health (PCH)	Personal Financial Security (PFS)	Personal Safety (PS)
DBI1 Population Growth	AAH1 30+ Income on Shelter	CE1 Voter Turnout	CSI1 Social Housing Waiting Lists	ED1 Education Levels	EM1 Unemployment/ Employment Rates	LE1 Business Bankruptcies	NE1 Air Quality	PCH1 Low Birth Weight Babies	PFS1 Community Affordability	PS1 Young Offenders
DBI2 Household & Family Composition	AAH2 50%+ Income on Shelter	CE2 Women in Municipal Government	CSI2 Rent-Geared-to-Income Housing	ED2 Literacy Levels	EM2 Quality of Employment	LE2 Consumer Bankruptcies	NE2 Urban Transportation	PCH2 Teen Births	PFS2 Families Receiving EI/Social Assistance	PS2 Violent Crimes
DBI3 Average Income	AAH3 Core Housing Need	CE3 Newspaper Circulation	CSI3 Social Assistance Allowances	ED3 Adult Learning	EM3 Long Term Unemployment	LE3 Hourly Wages	NE3 Population Density	PCH3 Premature Mortality	PFS3 Economic Dependency Ratio	PS3 Property Crimes
DBI4 Renters & Owners	AAH4 Substandard Units	CE4 Volunteering	CSI4 Subsidized Child Care Spaces	ED4 Education Expenditures	EM4 Labour Force Replacement	LE4 Change in Family Income	NE4 Water Consumption	PCH4 Work Hours Lost	PFS4 Lone Parent Families	PS4 Injuries and Poisonings
DBI5 Population Mobility	AAH5 Changing Face of Homelessness	CE5 Charitable Donations	CSI5 Public Transit Costs	ED5 Classroom Size		LE5 Building Permits	NE5 Wastewater Treatment	PCH5 Suicides	PFS5 Incidence of Low Income Families	
DBI6 Foreign Born	AAH6 Vacancy Rates		CSI6 Social Service Professionals	ED6 Student/Teacher Ratio			NE6 Solid Waste	PCH6 Infant Mortality	PSF6 Children Living in Poverty	
DBI7 New Immigrant Groups	AAH7 Rental Housing Starts		CSI7 Private Health Care Expenditures	ED7 Post-Secondary Tuition			NE7 Ecological Footprint		PFS7 Income Gap	
DBI8 Language Spoken at Home	AAH8 Monthly Rent			ED8 Spending on Private Education			NE8 Recreational Water Quality			
DBI9 Visible Minorities										
DBI10 Aboriginal Population										

2) Measures developed by non-governmental organizations

a) CSLS Index of Economic Well-being (IEWB)

The Index of Economic Well-being (IEWB) has been developed by Lars Osberg from Dalhousie University and Andrew Sharpe of the Centre for the Study of Living Standards.[14] This index defines economic well-being as arising from the level of average consumption flows, aggregate accumulation of productive stocks, equality in the distribution of individual incomes and security in the anticipation of future incomes. Economic research has shown that individuals value both equality and security, and, of course, that they value income (consumption). Stocks of wealth are also important because individuals care about what is passed down to future generations. The weights attached to each of these components of economic well-being will vary depending on the values of different observers. The authors argue that public debate would be improved if there were explicit consideration of the aspects of economic well-being obscured by average income trends and if the weights attached to these aspects were explicitly open for discussion.

The four components or dimensions of economic well-being in the IEWB are effective per capita consumption flows; net societal accumulation of stocks of productive resources; poverty and inequality; and economic security from job loss and unemployment, illness, family breakup, and poverty in old age.

The following sub-components of consumption flows are expressed in constant dollars on a per capita basis, and consequently there is no need for explicit weighting as these dollar values represent implicit weights:

- marketed personal consumption flows, adjusted for the value of increased longevity, changes in family size which affect the economies of scale in household consumption, and regrettables or intermediate consumption goods (cost of commuting, household pollution abatement, auto accidents, and crime);
- government services;
- the value of leisure; and
- the value of unpaid work.

The sub-components of stocks of wealth, also expressed in constant dollars on a per capita basis with no need for explicit weighting as these dollar values represent implicit weights, include:

- the net capital physical stock, including housing stocks;

[14] For the methodological framework for the IEWB see Osberg (1985). For the estimates for Canada, see Osberg and Sharpe (1998 and 2001); for selected OECD countries, see Osberg and Sharpe (2002b and 2002c) for the United States, see Osberg and Sharpe (2002a and 2004), and on the relationship between the IEWB and the Human Development Index, see Osberg and Sharpe (2005b).

- the stock of research and development;
- value of natural resources stocks;
- the stock of human capital;
- the level of foreign indebtedness; and
- the net changes in the value to the environment of reduced CO2 emissions.

The following subcomponents of the inequality/poverty component of the index make use of a Rawlsian perspective that assigns greater importance to poverty than to overall inequality trends:

- income inequality, defined as the Gini coefficient for after-tax household income; and
- the intensity of poverty (incidence and depth), defined as the product of the poverty rate and the poverty gap. The poverty gap is the difference between the average income of those in poverty and the poverty line divided by the poverty line (the poverty line is defined as one half median adjusted household income).

The subcomponents of the insecurity component are weighted by the relative importance of the specific population at risk in the total population and are based on the change over time in the economic risks associated with the following:

- unemployment, where security from the risk of unemployment is determined by the employment/working age population ratio, the employment insurance coverage of the unemployed, and the benefits ratio;
- illness, where the risk of illness is modeled as the percentage of disposable income devoted to health costs;
- "widowhood" (or single female parenthood) where the risk of single parent poverty is determined by the divorce rate and poverty intensity of single parent families; and
- old age, where the risk of poverty in old age is a function of the poverty intensity of the elderly population.

Trends in the overall index are determined by the choice of variables that are included in the index, the trends in those variables, and the weights given to them. Since the four main dimensions of economic well-being are separately identified, it is easy to conduct sensitivity analyses of the impact on perceived overall trends of different weighting of these dimensions.

The composite Index of Economic Well-being developed by the Centre for the Study of Living Standards (CSLS) represents a simple yet cogent framework for organizing the variables that contribute to economic well-being. While the four components can be aggregated into an overall composite index of economic well-being, the real value added of this index is that trends in these components, and specific variables, can be separately tracked and assessed.

b) CPRN Quality of Life Indicators

The Canadian Policy Research Networks (CPRN), a not-for-profit think tank, in 2002 produced a set of Quality of Life indicators for Canada. The purpose was to go beyond simple economic indicators of well-being such as GDP and present indicators of what matters to Canadians. These indicators also allow the tracking of changes in the different aspects of quality of life over time. The CPRN (2002) produced what it calls a Citizens' Report Card of quality of life that assigns scores to the various indicators, showing change (better or worse) or absence of change. The indicators, which may be quantitative as well as qualitative, are organized under nine domains: Democratic Rights and Participation, Health, Education/Learning, Environment, Social Programs and Conditions, Community, Personal Well-being, Economy and Employment, and Government.

The target audience for the Quality of Life project is broad and includes citizens, policy makers, business and media. Those who prepared the report card are also of various backgrounds, including researchers, academics and citizens. Discussion of policy issues from both the point of view of citizens and experts was the aim of the project.

c) Conference Board of Canada Scorecard on Performance and Potential

Since 1999 the Conference Board of Canada has published a "scorecard" for Canada in its annual report entitled *Performance and Potential.* The most recent report, released in October 2004 and subtitled *How Can Canada Prosper in Tomorrow's World?* benchmarks Canada's socio-economic performance against 24 OECD countries for 110 variables in six categories: the economy (12 indicators), innovation (17), environment (24), education and skills (17), health (24), and society (16).

The Conference Board framework uses a combination of different methods. An overall index is created for each category to determine the top 12 out of 24 performers. The suite of individual indicators is then used to rank the top 12 countries in each of the six categories. This is done first with a relative method whereby countries are awarded a gold, silver or bronze ranking for each indicator. This ranking is done by taking the difference between a given indicator for the highest-scoring country and the same indicator for the lowest-scoring country and dividing this difference into thirds. Countries in the top third of this range are awarded a gold medal, in the second third a silver medal, and in the lowest third a bronze medal, for each individual indicator. The ranking for each of the six overall categories is determined in an ordinal fashion, by summing the medals awarded in each category (with gold medals receiving twice the weight as silver medals and bronze medals receiving a weight of zero).

Canada turned a solid performance, being in the top 12 of 24 countries in each of the six categories. Canada's strongest performance was in the innovation and the education and skills categories, ranking fourth; and its weakest performance was in the society category, ranking tenth. Canada ranked sixth out of 12 in the economy category,

but this marked a drop from third place according to the 2003 *Performance and Potential*. However, Canada's ranking was the same in health and higher in the other four categories in the 2004 report relative to the 2003 report. Out of the 110 indicators, Canada was awarded 33 gold medals, 39 silver medals and 38 bronze medals.

d) GPI Alberta

In April 2001, the Pembina Institute for Appropriate Development – an independent not-for-profit environmental policy research and education organization founded in 1985 in Alberta – published a report entitled *Alberta Sustainability Trends 2000*. The goal of this document was to present a set of Genuine Progress Indicators (GPI) for Alberta as an alternative to standard measures such as GDP per capita.

The selection of variables for the Alberta GPI was made through examining the values of Albertans and Canadians in general. This was done through the results of the Alberta Growth Summit and other public consultations. The Alberta GPI is organized into five accounts or themes important to Albertans, namely the time use account, social capital account, human health and wellness account, natural resource and environment account, and economic account. These five accounts can then be grouped into three broad domains, namely economic, personal-societal (containing the time use, social capital and human health and wellness accounts), and environmental. The overall Alberta GPI contains 51 variables, grouped into these three dimensions as shown in Exhibit 2.

Exhibit 2: Variables in the Genuine Progress Index for Alberta

Economic	Personal-Societal	Environmental
• Economic growth • Economic diversity • Trade • Disposable income • Weekly wage rate • Personal expenditures • Transportation expenditures • Taxes • Savings rate • Household debt • Public infrastructure • Household infrastructure	• Poverty • Income distribution • Unemployment • Underemployment • Paid work time • Household work • Parenting and eldercare • Free time • Volunteerism • Commuting time • Life expectancy • Premature mortality • Infant mortality • Obesity • Suicide • Drug use (youth) • Auto crashes • Divorce (family breakdown) • Crime • Problem gambling • Voter participation • Educational attainment	• Oil and gas reserve life • Oilsands reserve life • Energy use intensity • Agricultural sustainability • Timber sustainability • Forest fragmentation • Parks and wilderness • Fish and wildlife • Wetlands • Peatlands • Water quality • Air quality-related emissions • Greenhouse gas emissions • Carbon budget deficit • Hazardous waste • Landfill waste • Ecological footprint

Each of these 51 indicators is discussed in a series of 28 reports plus a methodology report available from the website of the Pembina Institute (www.pembina.org). The summary report, *Alberta Sustainability Trends 2000*, presents the indicators in a number of ways for the 1961-1999 period. For the first type of presentation, each indicator is converted to index form by normalizing the time series according to the target value. For example, life expectancy is converted to an index with 1999=100, since 1999 saw the highest life expectancy over the period. The peatlands index is set to 25,000 square kilometers=100, since this is the area of peatlands judged to be optimal. Each of these indexes is then given equal weight, and the overall Alberta GPI is calculated as an average of the 51 underlying indexes. This overall GPI index is then compared over time with an index of real GDP. Each of the 51 indexes are also examined in a diagram for 1999 to illustrate which are furthest from their target values.

The second presentational method is a report card format, where each of the indicators is examined in turn and trends briefly summarized. For example, a graphic is used to indicate whether the variable increased or decreased over the entire period, and comments are made on each indicator in 1999 relative to its target value.

The final presentational method involves converting a large subset of the indicators into monetary terms and adding them to or subtracting them from GDP in order to arrive at "net beneficial output" or "net sustainable income".

The 51 indicators encompass both outcomes and inputs. Objectively measured indicators are the primary focus, although some subjective indicators, such as self-reported health status, are also discussed in the background reports.

e) GPI Atlantic

The Genuine Progress Index for Atlantic Canadian provinces has been developed by the GPI Atlantic organization based in Halifax. It consists of 22 individual indicators in five overall groups, as follows:

Time Use

- Economic Value of Civic and Voluntary Work
- Economic Value of Unpaid Housework and Child Care
- Work Hours
- Value of Leisure Time

Natural Capital

- Soils and Agriculture
- Forests
- Marine Environment/Fisheries
- Energy

Environmental Quality

- Greenhouse Gas Emissions
- Sustainable Transportation
- Ecological Footprint Analysis
- Air Quality
- Water Quality
- Solid Waste

Socioeconomic

- Income Distribution
- Debt, External Borrowing, and Capital Movements
- Valuations of Durability
- Composite Livelihood Security Index

Social Capital

- Population Health
- Educational Attainment
- Costs of Crime
- Human Freedom Index

These broadly defined indicators were chosen by the developers according to the values they believe all people hold in common – e.g. peaceful and safe communities, a clean environment, good health, time to relax, etc. In implementing the actual measurement of a given dimension or indicator, public consultations are made to determine which specific variables to include.

GPI Atlantic has produced one report on applying its Genuine Progress Index methodology for Nova Scotia. However, for the most part, the activities of GPI Atlantic focus on developing individual reports based on each of the 22 individual indicators. These reports focus on Canada as a whole, individual provinces, and even individual communities in some cases. There are no attempts at aggregating the indicators into an overall index, nor are any summative judgments made concerning trends in overall well-being.

f) Ontario Social Development Council Quality of Life Index

The Ontario Social Development Council developed in the second half of the 1990s a community-based Quality of Life Index (QLI) for Ontario (Shookner, 1998).[15] Based on an extensive review of literature on quality of life, it was found that:

[15] The index is no longer produced as the Ontario Social Development Council has closed.

- The overall level of health attained by Canadians is an important measure of the success of our society. Good health enables individuals to lead productive and fulfilling lives. For the country as a whole, a high level of health contributes to increased prosperity and overall social stability.

- Our overall high standard of health is not shared equally by all sectors in Canadian society. There are differences in health status by age, sex, level of income, education, and geographic area. The rich are healthier than the middle class, who are in turn healthier than the poor. The well-educated are healthier than the less educated, and the employed are healthier than the unemployed.

- Quality of life provides a conceptual framework, consistent with sustainable human development and determinants of health, for the interdependence of social, health, economic and environmental conditions in communities.

- A composite index including key indicators of social, health, economic and environmental conditions can contribute to progress toward improving our quality of life and becoming a more sustainable society.

- If the QLI is to have broad public credibility, it must be careful to include both positive and negative measures to provide a balanced perspective on quality of life.

- Communities must be involved in the selection and analysis of indicators.

- A quality of life/sustainability report should evaluate whether the indicator results are showing progress towards or away from desirable goals. It should also suggest how or whether the indicators could be improved, and may contain recommendations about the kinds of policies or programs that are needed to make progress towards the community's goals.

Using the findings from the literature review, the Ontario Social Development Council developed, with input from community groups, an index of Quality of Life for Ontario. The purpose of the QLI was to provide a tool for community development which could be used to monitor key indicators that encompass the social, health, environmental and economic dimensions of the quality of life. The following indicators were included in the Quality of Life Index:

Social Indicator: Children in care of Children's Aid Societies; social assistance recipients; public housing waiting lists;

Health Indicator: Low birth weight babies; elderly waiting for placement in long term care facilities; suicide rates;

Economic Indicator: Number of people unemployed; number of people working; bankruptcies; and

Environmental Indicator: Hours of poor air quality; environmental spills; tonnes diverted from landfill to blue boxes.

B. United States

This section examines measures of well-being that have been developed in the United States by both governments and non-governmental organizations. In terms of comprehensive sets of indicators or composite indexes, the federal government has done little.[16] State governments, and more importantly municipal governments, have been much more active. Non-governmental organizations and individual academics have been much more active and account for most of the comprehensive sets of well-being indicators and composite indexes produced.

1) Measures developed by governmental organizations

a) General Accounting Office Key Indicators Initiative

There has recently been a major exercise in the United States around the issue of a set of key national indicators to assess the nation's position and progress. The initiative has been spearheaded by the federal government's United States General Accounting Office (GAO), which in November 2004 released a detailed report entitled *Informing Our Nation: Improving How to Understand and Assess the USA's Position and Progress* (GAO, 2004).[17]

[16] However, the federal government has been very active in the development of topical indicators. For example, both the Federal Interagency Forum on Child and Family Statistics and the Federal Interagency Forum on Aging-Related Statistics seek to identify and remedy knowledge gaps in information about their respective populations. They report on many important aspects of children's and older Americans' lives for which regular indicators are lacking or are in development, such as homelessness; long-term poverty; mental health; disability; neighborhood environment; and the social, intellectual, and emotional skills of preschoolers. The Federal Interagency Forum on Child and Family Statistics updates all indicators annually on its Web site (http://www.childstats.gov) and publishes *America's Children in Brief: Key National Indicators of Well-Being*. This Forum chooses indicators that are easily understood by broad audiences; objectively based on substantial research connecting them to child well-being and using reliable data; balanced so that no single area of children's lives dominates the report; measured regularly so that they can be updated and show trends over time; and representative of large segments of the population, rather than one particular group. The Federal Interagency Forum on Aging-Related Statistics published in 2000 *Older Americans 2000: Key Indicators of Well-being*. For additional information on each forum, see GAO (2004).

[17] The GAO report reviewed 29 comprehensive indicator systems at the local, regional and state level as well at the national level outside the United States and the supranational level. Based on this review it chose to highlight in its report the Boston Indicators Initiative, Oregon Benchmarks, and the European Indicators System.

The motivation for the study was the "growing activity and interest in developing a system of key national indicators that would provide an independent, trusted, reliable, widely available and usable system of information that would facilitate fact-based assessments of the position and progress of the United States on both an absolute and relative basis." This interest emerged from three perspectives: the nation's complex challenges and decisions require more sophisticated information resources than now available; large investments have been made in indicators on a variety of topics that could be aggregated and disseminated in ways to better inform the public; and the United States, unlike other countries, does not have a national system that assembles key information on economic, environmental, and social and cultural issues. Consequently, Congressional leaders recognized that they could benefit from the experience of others who had already developed and implemented key indicator systems and asked the GAO to conduct a study on 1) the state of practice in these systems in the United States and around the world; 2) lessons learned and implications for the United States; and 3) observations, options, and next steps if further action is taken.

The study identified three general domains or dimensions of progress and position (basically well-being, but this term is not used in the report) that might be included in a comprehensive key indicator system: the economy, society and culture, and the environment. Under the economy, it identified the following components: consumers and employment, transportation and infrastructure, finance and money, business and markets, government, and the world economy. Under society and culture, it identified health and housing, communities and citizenship, education and innovation, security and safety, crime and justice, children, family and aging, democracy and governance, and values and culture. Under the environment, it identified the earth (ecosystems), land, water, life, air, and natural resources. In addition to the three basic domains, the report identified a number of cross-cutting themes: quality of life, sustainability, poverty, diversity, opportunity, mobility, and equity.

As part of its work, the GAO convened a forum on key national indicators in February 2003 (GAO, 2003). A consortium of organizations emerged from the forum with the objective of creating a comprehensive key indicators system for the United States. The consortium, which has grown to over 200 leaders from the government, business, research and non-profit sectors, has developed a project called the Key National Indicators Initiative (KNII). The National Academy houses a secretariat to incubate this effort and the goal of the project is to create a "State of the USA" website. See www.keyindicators.org.

The GAO report developed nine design features that it believes should be taken into account in the development of any comprehensive key indicator system. The design features are: 1) establish a clear purpose and define target audiences and their needs; 2) ensure independence and accountability; 3) create a broad-based governing structure and actively involve stakeholders; 4) secure stable and diversified funding sources; 5) design effective development and implementation processes; 6) identify and obtain needed indicators or data; 7) attract and retain staff with appropriate skills; 8) implement

marketing and communications strategies for target audiences; and 9) acquire and leverage information technologies.

The GAO report concludes that a national indicators system for the United States merits serious discussion and that a range of organization options (e.g. a public organization, a private organization, or a combination public-private organization) could serve as starting points for the system.

b) Oregon Benchmarks

One of the best-known community indicator projects is the Oregon Benchmarks.[18] The intent of the program was to measure progress toward a strategic vision and related goals for the state as a whole – known as Oregon Shines – and to provide a single source of comprehensive information on economic, environmental, and social and cultural conditions in Oregon. The Oregon Shines strategy was developed in the late 1980s, when the state was recovering from a serious recession, as a blueprint for the state's economic recovery, and the benchmarks system was created shortly thereafter to monitor the state's progress in achieving it.

The system is managed by the Oregon Progress Board, a unit of the state government that is chaired by the governor and consists of other appointed leaders inside and outside government. It also has a small government staff and is funded by state government appropriations. The Board developed, and continues to revise, the indicators based on extensive feedback sessions with other leaders and citizens.

The indicators are organized around three broad goals related to Oregon Shines: quality jobs; engaged, caring, and safe communities; and healthy, sustainable surroundings. Under these goals are 90 indicators regarding the economy, education, civic engagement, social support, public safety, community development, and the environment. There are numeric targets attached to each of the indicators. As an example of a particular goal and indicator, under the "safe, caring and engaged communities" goal, "students carrying weapons" is measured by the percentage of students (grades 9-12) who report carrying them – based on a statewide survey. In the case of Oregon, the number of students carrying weapons has declined in the past 10 years. However, if this indicator showed that the number of students carrying guns began to increase, it could result in leaders determining that corrective actions might be necessary to address the problem.

A report on the indicators has been published every two years since 1991, and its target audience is state government officials, other leaders throughout the state, and residents of the state. The Board promotes the results throughout the state so that state agencies will have clear benchmarks to aim for and others outside of government can

[18] This section draws from GAO (2004). The Oregon Progress Board website (www.econ.state.or.us/OPB) provides detailed information.

work to help the state achieve its indicator targets. In fact, since 2002 the indicator system has been part of the state government's performance measurement process and state agencies are required to specify how their programs and policies will lead to improvement in areas measured by the indicators. The Oregon Benchmarks system has evolved from exclusively monitoring and communicating on the level of progress toward achieving Oregon's statewide goals to also facilitating the state government's performance measurement system. However, many do want to see the Oregon Benchmarks lose the statewide visioning focus that originally motivated the creation of the benchmarks.

c) Social Well-being of Vermonters

Vermont's Agency of Human Services produces an annual report card on ten quality-of-life outcomes, and 2004 is the twelfth year for which such a report has been produced. These ten outcomes are as follows:

- Families, youth and individuals are engaged in their community's decisions and activities;
- Pregnant women and young children thrive;
- Children are ready for school;
- Children succeed in school;
- Children live in stable, supported families;
- Youth choose healthy behaviours;
- Youth successfully make the transition to adulthood;
- Adults lead healthy and productive lives;
- Elders and people with disabilities live with dignity and independence in settings they prefer; and
- Communities provide safety and support to families and individuals.

A number of indicators are presented under each of these outcomes in order to provide information on progress in each. Comparisons are made with a previous year of data, with the U.S. average, and with other states in most cases. No aggregation is attempted or overall observations made, either for the ten individual outcomes or quality of life in general. All indicators are objective, but include a mix of results and inputs. For example, under the pregnant women and children outcome, Vermont scores 46th out of 49 reporting states for having a high proportion of mothers who smoke during pregnancy (an input), and this is mentioned in the introduction as an area needing improvement; but at the same time Vermont has the tenth lowest rate of infant mortality among all states and the eighth lowest proportion of low birthweight infants (results).

2) Measures developed by non-governmental organizations

a) Measure of Economic Welfare (MEW)

William Nordhaus and James Tobin, two well-known Yale University economists, developed the Measure of Economic Welfare (MEW) in the early 1970s. The

MEW uses personal consumption expenditures as a starting point. Various additions, subtractions, and imputations are made to derive a measure of total consumption deemed to generate economic welfare. All aggregation is done in terms of prices.

The authors start with a premise that GDP is not a satisfactory measure of economic welfare. The correlation of MEW to GDP and Sustainable MEW to Net National Product (NNP) were examined to determine whether the trend of per capita GDP could satisfactorily serve as an indicator of economic welfare. From the outset, the authors are clear that MEW is a measure of economic and not social welfare.

Major deductions from consumption are private instrumental expenditures (i.e. personal outlays for commuting, banking and legal services as these are considered regrettable expenditures) and private spending on health and education. Added to consumption are imputations for the value of leisure based on the opportunity cost of work, and the value of non-market services such as unpaid housework, parenting, and volunteer work.

Nordhaus and Tobin also developed a sustainable MEW where the sustainability component is the net change in the net capital stock and the growth requirement, which is the annual change in the capital stock necessary to keep pace with changes in the size of the labor force and productivity. The MEW capital stock consists of the physical capital stock, land, net foreign assets, education capital, and health capital (accumulated health spending).

Nordhaus and Tobin estimated the MEW for the United States for the 1929-65 period and concluded that there was sufficient positive correlation between changes in GDP and MEW to conclude that GDP was a reasonable barometer of changes in economic welfare. Messinger and Tarasofsky (1997) found for Canada for the 1971-94 period that both the actual and sustainable MEW advanced at a slower rate than GDP, due to the slower growth in the imputed value of unpaid work and leisure.

b) Genuine Progress Indicator (GPI)

The Genuine Progress Indicator (GPI), probably the best known of the alternative indicators of economic well-being, was developed by the San Francisco-based think tank, Redefining Progress. It received massive public attention in an October 1995 article, “If GDP is up, why is America Down?” in the magazine *Atlantic Monthly.*

The GPI bears some similarity to the MEW, as both start with a measure of consumption from the national accounts and then proceed to make a large number of adjustments. The GPI has been falling in the United States since the early 1970s, largely because of the negative effect of resource depletion. The GPI can be broadly split into two blocks: a measure of current economic welfare and a measure of sustainable economic development.

Elements of current economic welfare consist of consumer spending, government spending, non-market production and leisure, and external factors. Sustainable economic development includes depletion of natural resources (non-renewable energy and farmland); net investment in produced business fixed assets; net foreign lending/borrowing; long term environmental damage ("greenhouse effect" and ozone depletion); and long term ecological damage resulting from the loss of wetlands and the harvesting of old growth forests.

The fundamental building block of the GPI is Consumer Expenditures on goods and services as recorded in the National Accounts. This represents approximately 60 percent of total GDP.

- Consumer spending is adjusted for changes in inequality in the distribution of personal income.

- Actual expenditures on consumer durable goods are replaced with an estimated value of services derived from the stock of consumer durable goods. This annual value of services is determined by the rate of depreciation of such goods and a rate of interest (the opportunity cost of income invested).

- Consumer spending is discounted for items that are deemed to be intermediate or defensive in nature, namely: cost of commuting – cost of traveling to and from work using either public transportation or private vehicle, as well as an estimate of time use while commuting; cost of crime and automobile accidents – costs associated with medical and legal expenses, expenditures related to lost or damaged property and spending on crime prevention (alarm systems, locks etc.); cost of family breakdown – expenses for legal fees, counseling and the establishment of separate residences, as well as an estimated cost of damage to the well-being of children; and cost of household pollution abatement – expenditures on air and water filters and devices to improve air and water quality in the home.

Government spending recorded in GDP is all regarded as intermediate (defensive) expenditures that are required to maintain rather than enhance quality of life. It is hence excluded from the GPI, with one small exception, namely an estimated value of the services to persons generated by the stock of streets and highways.

An estimated value of non-market production for unpaid housework, childcare and volunteer work is added to the current economic welfare components of GDP. The value of leisure is included in the sense that current economic welfare is discounted for leisure lost due to increased participation in the labour market, or more time spent on unpaid housework, childcare and volunteer work.

- Value of household work and parenting is determined by the number of unpaid hours spent on household tasks such as cooking, cleaning and child care multiplied by the average hourly earnings of household domestic workers.

- Value of volunteer work represents the estimated unpaid hours multiplied by the average real wage rate.

- Loss of leisure time is the value of lost leisure in relation to the year of greatest leisure over the estimated time period (1950-94). Hours lost are valued by the average real wage rate.

The current measure of economic welfare is reduced by costs associated with underemployment and pollution.

- Cost of underemployment represents the gap between full-time and involuntary part-time work, measured in hours and multiplied by the average real wage rate.

- Air pollution costs are based on damage to agricultural vegetation, materials damage, cleaning, acid rain damage (forests and aquatic), reduced urban property values, and aesthetics. Costs are adjusted annually by changes in indexes of air quality.

- Water pollution adversely affects recreation, aesthetic, ecological and property values as well as the quality of household and commercial water supplies. The estimated value of these effects is adjusted annually for changes in water quality and siltation.

- An estimated value of noise pollution was made by the World Health Organization. This value is adjusted annually by changes in noise pollution based on the rate of industrialization and motor vehicle traffic.

The cost of depletion of non-renewable natural resources is determined by substituting current production of non-renewable energy by a barrel equivalent of energy derived from ethanol produced from corn. The quantity of corn required to replace conventional production of non-renewable sources (mainly oil and gas) is multiplied by a price per bushel to obtain a value. The estimated price of corn is substantially higher than present values reflecting increased demand and no agricultural subsidies. The price is then assumed to rise by 3 per cent per annum due to increasing real production costs.

Loss of farmland in the GPI is regarded as a conversion from capital to current income thus negatively affecting sustainable development. The value of lost farmland represents the value of farm acreage lost to urbanization plus a discounting of existing farmland as a result of deterioration in the quality of soil.

Net capital investment (produced business fixed assets) is the difference between the change in the net stock of produced fixed capital (non-residential construction and machinery and equipment) and the amount of investment required to keep the net stock of capital per worker constant.

Net foreign lending/borrowing is the annual change in a country's net foreign investment position.

Costs of global warming (carbon dioxide emissions, "greenhouse effect") are linked to the current consumption of fossil fuels and nuclear power. The long-term cost is estimated by multiplying a per barrel equivalent by an arbitrary price (a tax) on current production of non-renewable energy to compensate future generations for the economic damage of global warming.

Cost of ozone depletion is linked to world production of chlorofluorocarbons (CFC's) and other ozone-depleting chemicals. The long-term costs to health and ecological effects are determined by multiplying cumulative world production of CFC's by an arbitrary price per kilogram.

Loss of wetland represents ecological damage valued as a product of the cumulative number of acres drained and an estimated cost per acre. Loss of forests represents ecological damage valued as a product of the cumulative number of acres of "old growth" forests cut and an estimated cost per acre.

c) Fordham Index of Social Health

Marc Miringoff and Marque-Luisa Miringoff (1999) of the Institute for Innovation in Social Policy of Fordham University have developed an index of social health that attempts to monitor social well-being in the United States by examining the progress on a number of social problems cumulatively over time. The Fordham Index of Social Health (ISH) composite index is said to track the nation's social performance.

A set of socio-economic indicators, covering 16 social issues dealing with health, mortality, inequality and access to services, was selected to cover all stages of life, with separate indicators for each age group. It is argued this approach is useful because age groups are universal, with everyone potentially passing through all age groups; age groups are conceptually integrated across components, creating a holistic framework; age groups highlight several important contemporary trends, such as deteriorating status of children and improved status of the elderly; and age groups are readily understood by the public.

Five of the indicators apply to all age groups – homicides, alcohol-related fatalities, food-stamp coverage, access to affordable housing, and the gap between the rich and poor. Three of the indicators apply to children – infant mortality, child abuse, and child poverty; to youth – teen suicides, drug abuse, and high school drop-outs; and to adults – unemployment, average weekly earnings, and health insurance coverage. Two indicators apply to the elderly – poverty of persons over 65 and out-of-pocket health costs for the elderly.

The index employs the construct of a Model Year to provide a standard of performance, combining the best achievements in all 16 areas. Annual performance is

measured against best past performance rather than an ideal standard. To standardize, each indicator is measured in comparison to its best and worst performance over the period, with the best performance scored at 10 and the worst a zero. All other observations are scored within the 0-10 scale.

The ISH in the United States reached its peak in 1973, then declined rapidly to 1982 and has since leveled off.

Brinks and Zeesman (1997) have estimated the ISH for Canada for the 1970-94 period, with minor changes to the index (the proportion of the population with no health insurance was dropped given universal health coverage in Canada and the food stamp indicator was replaced with the number of social assistance beneficiaries). It was found that the index increased in the 1970s, then fell sharply between 1980 and 1983, stabilized and fell again after1989 for two years and then stabilized.

d) Calvert-Henderson Quality of Life Indicators

In 2000, the Calvert Group, in collaboration with the futurist Hazel Henderson, released the Calvert-Henderson Quality of Life Indicators, billed as "the first national, comprehensive assessment of quality of life in the United States using the systems approach." The purpose of the exercise is to paint a broad picture of quality of life to complement current statistics and to identify statistical "blind spots" where new data collection is needed. The authors (Henderson, Lickerman, and Flynn, 2000) hope that the indicators will be used to educate the public, broaden the debate about quality of life, hold governments and business accountable, and clarify the multiple decisions individuals make in their work, education, leisure and civic commitments.

According to the authors, the Calvert-Henderson QOL Indicators "provide a methodology for organizing, synthesizing, and analyzing myriad statistics in ways that allow the bytes of data to be transformed into meaningful indicators to help citizens understand and influence complex socio-economic phenomena." They argue that the approach is unique in several ways.

- First, the approach was designed and implemented by a multi-disciplinary group of 15 researchers and practitioners with expertise in the indicators field.

- Second, the indicators unbundle central social, economic, and environmental issues into 12 distinctive domains of quality of life (education, employment, energy, environment, health, human rights, income, infrastructure, national security, public safety, recreation, and shelter), in contrast to "green GDP" approaches that collapse all elements into a single composite index.

- Third, all the indicators identify interfaces with other domains, allowing a systematic overview of society often concealed by aggregation of traditional indices.

- Fourth, a model is developed for each indicator that serves as a frame through which the underlying phenomena can be clearly organized, examined, and understood. The model outlines and prioritizes key concepts and relationships that are central to understanding each domain.

C. OECD countries

This section surveys a number of well-being measures that have been developed for particular OECD countries excluding Canada and the United States. In contrast to the United States where the federal government has not developed a comprehensive set of well-being indicators and certainly not a composite well-being index, central governments in other OECD countries have taken this step. On the other hand, again in contrast to the United States, there have been few non-governmental initiatives to construct sets of well-being indicators in OECD countries outside the United States and Canada.

1) Measures developed by governmental organizations

a) UK Indicators of Social Development

In December 1999 the UK government published a core set of 147 indicators of sustainable development to be used to monitor national progress. A updated version of the document was released in 2004. These indicators underpin the UK government document *A better quality of life*: *a strategy for sustainable development in the UK* (May 1999).[19] A strategy for sustainable development is intended to ensure that the government meets the needs of present citizens without compromising the ability of future generations to meet their own needs. The system of national indicators was designed with the intention that the United Kingdom would use the information to modify its policies and budgets to achieve the goals contained in the strategy, particularly in areas in which the United Kingdom is not making sufficient progress or is lagging behind other countries.

The UK strategy for sustainable development has four main aims. These are:

- social progress which recognizes the needs of everyone;
- effective protection of the environment;
- prudent use of natural resources; and
- maintenance of high and stable levels of economic growth and employment.

[19] The Department for Environment, Food, and Rural Affairs (DEFRA) manages the comprehensive sustainable development strategy, along with the indicator system, on a day-to-day basis, although DEFRA must closely coordinate with other ministries of the government that have jurisdiction over other areas in the strategy. The indicator system is funded entirely by the national government.

For the UK, priorities for the future are:

- more investment in people and equipment for a competitive economy;
- reducing the level of social exclusion;
- promoting a transport system which provides choice, and also minimizes environmental harm and reduces congestion;
- improving the larger towns and cities to make them better places to live and work;
- directing development and promoting agricultural practices to protect and enhance the countryside and wildlife;
- improving energy efficiency and tackling waste; and
- working with others to achieve sustainable development internationally.

The UK government has developed a way of measuring progress by a system of indicators. Headline indicators identify the key issues relating to quality of life at the national level and are published every year. The 15 headline indicators or quality of life barometer are intended to raise public awareness of sustainable development, to focus public attention on what sustainable development means, and to give a broad overview of progress. These 15 indicators cover the three pillars of sustainable development (with the indicators in brackets): Economic growth (output, investment, and employment),[20] Social progress (poverty and social exclusion, education, health, housing, and crime), and Environmental protection (climate change, air quality, road traffic, river water quality, wildlife, land use, and waste). In addition to the national headline indicators, regional and local indicators are published.

b) The Dutch Social and Cultural Planning Office's Living Conditions Index

Boelhouwer (2002) provides an overview of the activities of the Social and Cultural Planning Office of the Netherlands. These activities include the annual or bi-annual publication of two statistical reports on social indicators, namely the *Social and Cultural Report* and the *Social and Cultural Outlook*. These publications, as well as individual research reports, contain numerous indicators and analyses of these indicators. For example, the 1998 *Social and Cultural Report* included the following chapters or indicator dimensions: demographic developments, emancipation and values and norms in society; the multi-ethnic society; economy and the welfare state, work and social security; political diversity, public administration and participation; health and health care; housing; education; crime and justice; and leisure time, the media and culture.

[20] For example, one headline indicator measuring progress toward the goal of maintaining high and stable levels of economic growth and employment is the percentage of people of working age who are currently employed. If this indicator showed that the number of working-age individuals who are employed started to decline, it could raise questions and spur efforts to identify the root causes of the decline (which could range from cyclical conditions or demographic shifts to competitiveness issues). Then, the government or others could determine whether there was a need to design solutions to fit the nature of the problem. For example, they might consider enhancing job training programs or conclude that incentives to encourage businesses to increase hiring were needed to boost employment, or they might decide not to intervene.

However, Boelhouwer's larger focus is on the Office's Living Conditions Index. This index was initiated in 1974, with the following aims: "to depict social and cultural conditions as a single entity; to evaluate this entity in terms of positive and negative; to create a time series for observing changes; to monitor developments in the separate indicators over time; and to situate the description of social and cultural conditions in a broader context of background information" (94). In selecting methods and indicators to fulfill these aims, five criteria were employed:

- outcomes should be measured rather than inputs;
- indicators should be general rather than focused on a particular socio-economic or other group;
- objective characteristics should be measured rather than subjective perceptions;
- included indicators should have an unambiguous positive or negative effect on well-being; and
- measurement should be undertaken at the individual level so that well-being can be measure at the national level and for specific groups.

The index includes self-reported objective indicators in eight dimensions, namely housing, health, purchasing power/consumer durables, leisure activities, mobility, social participation, sport activity, and vacation. The individual indicators are aggregated into dimensions and a single index by way of statistical correlation analyses, where weights are chosen based on the degree of correlation with other variables.

The specific indicators included in the index change over time, due in part to policy relevance and technological and other advances since the survey and index were first implemented. Some included indicators, such as car ownership, have proven controversial, since the overall effect on living conditions is perhaps not clear; while some other indicators, such as safety, have not yet been satisfactorily included yet. Also, the statistical aggregation technique is not a particularly transparent procedure to the layperson. Nonetheless, the index is a strong tool for measuring living conditions in the Netherlands, since it is available on a more or less comparable basis for such a long time period. Also, the index is fairly unique internationally in that the underlying indicators are based on surveys of individuals specifically designed and undertaken for the purpose of the index, rather than being restricted to presently available aggregate data.

c) Swedish Social Indicator Program

Vogel (2002) discusses the practices of Statistics Sweden in terms of the reporting of social indicators. The Swedish system of social reporting is very similar to that of the Netherlands discussed above. A specialized survey system, the Surveys of Living Conditions, has been undertaken annually in Sweden since 1974. Some observations on this survey system and the overall Statistics Sweden approach are the following:

- Statistics Sweden has a long-term funding commitment from the Swedish government and a distinct public mandate for the collection and reporting of social statistics;

- The survey instrument is a combined cross-sectional and longitudinal design, allowing the benefits of panel analysis to be realized while mitigating the less desirable effects such as panel attrition and measurement error;
- The survey system is based on an eight-year cycle, which is desirable both because year-to-year changes are typically small in many variables and because it allows for the reporting of a wide array of variables for a large number of socio-economic groups collected through surveys over the entire cycle;
- Citizens of Nordic countries have a unique personal identification number for contact with the government, making the tracking of panel participants over time relatively simple;
- The survey system collects data on 125 social indicators within 13 domains (education, employment, working conditions, income, material living standards, housing, transport, leisure, social networks, participation, victimization, health, and social mobility), all of which are available for 120 population subgroups (gender, age, household type, employment status, trade-union affiliation, education, etc.) as far back as 1975;
- Only objective indicators are collected, as social reporting is aimed for the most part at public policy and it is deemed that subjective indicators are not as policy-relevant as objective indicators; and
- Variable selection, survey design and other aspects of the reporting system are undertaken by 10 advisory user boards comprising 100 members.

There are two main formats used for presenting this large number of indicators. The first is a standardized tabulation of the indicators in a given dimension for the 120 groups. The table for a given dimension shows, for every variable in that dimension, both current values based on the latest four years of data collection and trends since 1975.

The second presentational method is a statistical technique that measures inequality between two given groups in a number of individual material living conditions indicators and the average of all of these indicators (absence of overcrowded housing, high standard of housing space, dishwasher, car, second home, caravan, boat, video, freezer, and access to a daily newspaper). This summary inequality measure can be presented graphically for any group pairing, and indicates whether inequality between these two groups for a particular variable has fallen or increased since 1975. This method has proven especially useful in analyzing generational gaps in Sweden. Statistics Sweden sees much value in the reduction of information provided by this graphical presentation.

d) Measures of Australia's Progress

The Australian Bureau of Statistics (ABS) published *Measuring Australia's Progress* in 2002, and this was followed by *Measures of Australia's Progress* in 2004. This set of indicators was developed by the ABS in order to allow Australians to make a subjective assessment of life in Australia. It was developed through public consultations on aspects considered important by Australians, and with reference to international practices and prevailing policy priorities in Australia.

The process undertaken by the ABS in constructing this set of indicators started with the identification of progress with developments in three domains, namely economic, social and environmental. A number of headline dimensions were then chosen to represent progress in each of these domains. Each headline dimension was then associated with one or a small number of headline indicators plus several supplementary indicators. Supplementary dimensions with additional indicators were also chosen.

In deciding which indicators to include in each dimension, the ABS referred to two important criteria. First, indicators should reflect an outcome rather than an input. For example, expenditure on health is not included as an indicator in the health dimension, since it is the actual health status of the population that is of concern in terms of progress (e.g. life expectancy, which is included). Second, movements in a selected indicator should be unambiguously associated with improvement or deterioration. For example, the number of divorces is not included as an indicator in the social dimension because it is not possible to objectively state whether more divorces is good or bad in terms of progress. While increased divorces may be regarded by some as a sign of a deterioration in society, others might regard the increased dissolution of unhappy marriages as a positive development for the overall happiness of society. The availability of good-quality and timely data in time series and disaggregated by socio-economic and other groups was also considered important. In addition, only objective indicators were considered, to the exclusion of subjective indicators.

As a result of the selection process and criteria, *Measures of Australia's Progress* includes 15 headline dimensions and a further five supplementary dimensions. The headline dimensions and associated headline indicators are as follows:

- Health (life expectancy at birth);
- Education and training (population aged 25-64 with vocational or higher education qualifications);
- Work (unemployment rate);
- National income (real net national disposable income per capita);
- Financial hardship (real average weekly disposable income of households in the second and third income deciles, scaled for household size equivalence);
- National wealth (real national net worth per capita);
- Housing (no indicators developed);
- Productivity (multifactor productivity);
- Natural landscape (threatened birds and mammals, amount of land cleared annually, assets at risk or with a high potential to be at risk due to salinity, proportion of water management areas where use exceeded 70 per cent of sustainable yield);
- Human environment (fine particle concentrations, number of days health standards exceeded in selected cities);
- Oceans and estuaries (no headline indicators developed);
- International environmental concerns (net greenhouse gas emissions);
- Family, community and social cohesion (no headline indicators developed);
- Crime (victims of personal and household crimes); and

- Governance, democracy and citizenship (no headline indicators developed).

Several other supplementary indicators are also included along with these headline indicators. The supplementary dimensions, with their own additional indicators, are culture and leisure, inflation, competitiveness and openness, communication, and transportation.

The indicators are presented in a report card format, with commentary and discussion of the indicators, along with tables and graphs, for each dimension. Comparisons are made over time, amongst ethnic and other groups within Australia, and between Australia and other countries. While no aggregation into an overall index is attempted and no overall observations are made, the ABS states that this is because such summative judgments are ultimately subjective in nature and that statistical agencies are not in a position to make such subjective assessments. The ABS does, however, encourage users to apply their own values to the broad selection of indicators presented in coming to their own summative conclusions on Australia's progress.

e) Finland's Indicators for Sustainable Development

The development of indicators for sustainable development was initiated at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. It was recognized that methods needed to be developed to ensure that improvements to sustainable development in different sectors are at all times based on up-to-date, reliable, and usable information. To achieve this goal, the UN Commission on Sustainable Development started development of indicators in 1995. Finland took part in the testing of the UN indicators during 1996-99. Results showed that UN indicators were not all suitable as such for measuring sustainable development in Finland. For this reason it was deemed essential to develop indicators better adapted to Finnish conditions in addition to those chosen directly from the UN list.

Finland has since developed a comprehensive set of sustainable development indicators that include variables in the economic and social/cultural domains as well as the environmental domain. The variables in each domain are shown in Exhibit 3.[21]

The OECD's 'pressure-state-response' framework, described later in this report, was used in the development of Finland's indicators for sustainable development. Indicators on the 'pressures' (emissions, consumption, health risks) and the 'state' (concentrations, amounts) are widely available, but the community's response, i.e. indicators on measures taken, – the 'reactions' – are harder to define. For example, social service and health care expenditures do not necessarily lead to increased well-being.

[21] Details are posted at http://www.vyh.fi/eng/environ/sustdev/indicat/.

Exhibit 3: Variables in Finland's Indicators for Sustainable Development	
Ecological Issues	
1. Climate change	Greenhouse gas emissions Finland's mean temperature Ice break-up date of the river Tornio
2. Ozone layer depletion	Importation of ozone layer-depleting substances Stratospheric ozone above Finland
3. Acidification	Acidifying emissions Exceeding the critical sulphur load
4. Eutrophication	Nutrient discharges The nutrient balance Water quality Algae levels
5. Biodiversity	Numbers of threatened species Population trends in farmland and forest birds Numbers of grey seals Area of nature reserves Implementation of nature conservation programs
6. Toxic contamination	Emissions of volatile organic compounds Mercury emissions Pesticide sales PCB levels on Baltic herrings Dioxin levels in breast milk
Economic Issues	
7. Economic development	Gross Domestic Product Current account surplus State financial assets and liabilities Inflation
8. Environmental policy instruments	Environmentally-related taxes and fees Environmental protection expenditure Taxes per carbon dioxide content of fuels EMAS registrations and environmental certificates
9. Natural resources	Forest age structure Annual forest increment and drain Cultivated and fallow land Reindeer numbers Commercial fisheries Fish farm production
10. Community structure and transport	Urban land area and the urban population Urban population densities Average commuting distance Car numbers and use Trends in car and public transport use Air quality in cities

11. Production and consumption	Total energy consumption Energy use Total consumption of natural resources Water consumption Holiday air travel Household consumer spending Generation of waste Waste delivered at landfills Recovery of packaging materials
Social and Cultural Issues	
12. Demographic developments	Annual population changes Dependency ratio Life expectancy Internal migration
13. Lifestyles and illnesses	Daily smokers Obesity Alcohol and drug-related illnesses HIV infections Suicides
14. The workforce	Unemployment levels and rate of employment Long-term unemployment Occupational accidents Retirement age and disability pensions
15. Social problems and equality issues	Incidence of poverty Income level differences The homeless Women's earnings relative to men's Relocated children Violent crime
16. Education, research and participation	Education levels Research and development expenditure Young people neither studying nor working Voter turnout
17. Access to information	Newspaper circulations Library loans Internet users
18. Cultural heritage	Meadows and pastures Visits to museums Age structure of buildings
19. Ethnic minorities	Classes taught in Saame Immigrant unemployment rate
20. Development co-operation	Official development aid Development aid to regions near Finland

f) Italian Urban Ecosystem Report

Italy's best known set of indicators is the Urban Ecosystem report. It is an environmental report that ranks 103 Italian cities. It has been developed and carried out every year since 1994 by Legambiente (the most widespread environmental Italian NGO), Istituto Ambiente Italia (one of the principal independent Italian research centres) and the involved municipalities. The survey results are widely diffused in Italian newspapers and TV, both in national and local reports.

The selected indicators aim to evaluate urban sustainability rather than the environmental "urban quality." The project weaves together both environmental data and socio-economic variables (from per capita income through industrial intensity and cultural consumption). The Urban Ecosystem is used to evaluate local environmental policies, and to highlight the environmental pressures. The 18 environmental sustainability indicators[22] were selected through a balanced P-S-R (pressure-state-response) approach. For each indicator an appropriate sustainability target was defined and a specific performance scale determined. For some indicators (eg: public transport) small and big cities are evaluated differently, taking into account the "size factor". In the most recent survey different weights for indicators were also used, developed by a panel composed by local authorities and NGO experts.

This project has illustrated the importance of having indicators at the local scale to highlight failures and successes, identify trends and geographical differences, and to establish correlations between environmental performance and various urban "forms and models", such as metropolises, small to medium-sized cities, etc. This system of urban environmental indicators has been used as a tool in support of national policies in different areas.

g) New Zealand Social Report

The Social Report 2004 is the third in an annual series of publications by the New Zealand Ministry of Social Development. The "social monitoring framework" upon which the report is based was first developed in *The Social Report 2001*, and has been revised and updated since then. Government policy, families, communities, businesses and international factors all influence the particular aspects of well-being that are reported on.

The report states that its key aims are:

- to provide and monitor over time measures of well-being and quality of life that complement existing economic and environmental indicators;

[22] The 18 environmental indicators are air monitoring**,** NO2, CO, water consumption, nitrates, sewage treatment, production of urban solid waste, waste recycling, public transport, pedestrian areas, bike paths, circulating cars, household GWh, fuel consumption, tumour and respiratory death rate, ISO 14000 certified industries, and commitment to local Agenda 21.

- to allow for the assessment of how New Zealand compares with other countries on measures of well-being;
- to provide greater transparency in government and to contribute to better informed public debate; and
- to help identify key issues and areas where we need to take action, which can in turn help with planning and decision-making.

The report examines ten components of well-being, namely health, knowledge and skills, paid work, economic standard of living, civil and political rights, cultural identity, leisure and recreation, physical environment, safety, and social connectedness. A number of social indicators underlie each of these dimensions, and the total number of indicators examined is 43 (Exhibit 4). The criteria for inclusion of these variables are the following:

- relevant to the social outcome of interest – the indicator should be the most accurate statistic for measuring both the level and extent of change in the social outcome of interest, and it should adequately reflect what it is intended to measure;
- based on broad support – ideally there should be wide support for the indicators chosen so they won't be regularly changed;
- grounded in research – there should be sound evidence on key influences and factors affecting outcomes;
- able to be disaggregated – the data need to be broken down by age, sex, socioeconomic status, ethnicity, and region to allow the comparison of outcomes for different groups;
- consistent over time – the usefulness of indicators is related directly to the ability to track trends over time, so indicators should be temporally consistent;
- statistically sound – the measurement of indicators needs to be methodologically rigorous;
- timely – data need to be collected and reported regularly and frequently to ensure that indicators are reporting up-to-date information; and
- allows international comparisons – indicators need to reflect the social goals of New Zealanders but also need to be consistent with those used in international indicator programs so that comparisons are possible.

These indicators – including both objective and subjective measures – are presented in a report card format, with no attempt at aggregation, either of indicators into the ten components or of the ten components into an overall measure of well-being. Each indicator is discussed under its appropriate component heading, and comparisons are made across time, countries, and ethnic, gender and demographic groups. Nonetheless, the concluding section does attempt to make some overall observations. For example, 23 of the 43 indicators were available in a time series at the time of publication, and 16 of these showed an improvement in 2001-2003 compared to 1995-1997. For about two thirds of the 23 indicators for which internationally-comparable data are available, New Zealand exceeded the OECD median. These comparisons, as well as comparisons across gender and some ethnicities, are summarized in a useful circular diagram.

Exhibit 4: Indicators in the New Zealand Social Development Report

Health	1. Health expectancy 2. Life expectancy 3. Disability requiring assistance* 4. Suicide 5. Prevalence of cigarette smoking 6. Obesity* (new information on child obesity is provided)
Knowledge and Skills	7. Participation in early childhood education 8. School leavers with higher qualifications 9. Educational attainment of the adult population 10. Adult literacy skills in English* 11. Participation in tertiary education
Paid Work	12. Unemployment 13. Employment 14. Average hourly earnings▲ 15. Workplace injury claims* 16. Satisfaction with work/life balance
Economic Standard of Living	17. Market income per person 18. Income inequality* 19. Population with low incomes* 20. Population with low living standards* 21. Housing affordability* 22. Household crowding*
Civil and Political Rights	23. Voter turnout* 24. Representation of women in government* 25. Perceived discrimination 26. Absence of corruption▲
Cultural Identity	27. Local content on New Zealand television 28. Māori language speakers* 29. Language retention▲
Leisure and Recreation	30. Satisfaction with leisure▲ 31. Participation in sport and active leisure▲ 32. Experience of cultural activities*
Physical Environment	33. Air quality 34. Drinking water quality
Safety	35. Child abuse and neglect 36. Criminal victimisation* 37. Perceptions of safety* 38. Road casualties
Social Connectedness	39. Telephone and internet access in the home* 40. Regular contact with family/friends* 41. Trust in others▲ 42. Proportion of the population experiencing loneliness▲ 43. Contact between young people and their parents▲

h) Irish Central Statistics Office – Measuring Ireland's Progress

In a set of reports entitled *Measuring Ireland's Progress*, the Irish statistical agency reviews a number of sets of indicators and other work on social indicators and

proposes some key indicators of Ireland's progress in general. There are 108 indicators chosen, organized into 48 domain themes, themselves organized into ten broad domains. The domains and domain themes are as follows:

- Economy (gross domestic product, government debt, public balance, gross fixed capital formation, international transactions, international trade, exchange rates, interest rates, consumer price inflation, price levels);
- Innovation and Technology (science and technology graduates, R&D expenditure, patent applications, household internet access);
- Employment and Unemployment (employment rate, labour productivity, unemployment rate, jobless households, older workers);
- Social Cohesion (voter turnout, official development assistance, risk of poverty, gender pay gap);
- Education (education expenditure, pupil-teacher ratio, third-level education, literacy, early school leavers);
- Health (health care expenditure, life expectancy);
- Population (population distribution, migration, age of population, fertility, lone-parent families, persons aged 65 and over living alone);
- Housing (dwelling completions, owner-occupiers, mortgages);
- Crime (headline offences, homicide rate); and
- Environment (greenhouse gases, energy intensity of the economy, river water quality, urban air quality, acid rain precursors, waste management, transport).

The indicators – all based on objective data – are presented in table and chart form with brief descriptive comments for each domain theme. No aggregation is attempted, and no overall observations are made. For many of the indicators, comparisons are made with other European Union countries; but few comparisons are made with other countries or by region or socio-economic group within Ireland.

i) National Economic and Social Council of Ireland

Ireland's National Economic and Social Council (NESC) is a quasi-governmental body consisting of members from government, business, trade union, agricultural and farming, and community and volunteer organizations. The Programme for Prosperity and Fairness (PPF) directed the NESC to develop a framework to measure progress in economic, social and environmental development. In February 2002, the NESC published *National Progress Indicators for Sustainable Economic, Social and Environmental Development*, one of two reports fulfilling the PPF objectives.

The report identifies 30 indicators deemed important in monitoring progress in the three areas of development, and divides these into 18 "headline" indicators and 12 "background" indicators. The criteria for selecting the indicators were the following:

- Easily understandable – they should be simple, clear and relatively easy to interpret. This criterion is particularly important if the audience for the indicators includes non-specialists, such as the general public or media;

- Policy-relevant – they should relate not only to the three dimensions of sustainable development (economic, environmental and social) but should also be linked to the desired goals within each of these dimensions;
- Focused on priority issues – they should concentrate on identifying and monitoring priority issues so that the project remains manageable and relevant. In the first instance, indicators should be issue-driven rather than data-driven. This is not to subjugate the important measurability criterion referred to below, but to ensure that key issues and objectives are not excluded simply because of data problems;
- Analytically sound – they should be logically or scientifically defensible and representative of the information they are trying to summarize;
- Measurable – they should be feasible in terms of current or planned data availability, bearing in mind cost and resource requirements of data collection and processing; and
- Subject to ongoing assessment – they should be open to challenge, discussion and modification, to reflect changing objectives, the emergence of new issues and improvements in measurement techniques and data availability.

The NESC was also guided by concerns for making the indicators coherent to users. This meant that the indicators should be mutually supportive and as few as possible in number. Further, the NESC's objectives for Ireland in general underlie the choice of indicators:

- economic inclusion based on full employment;
- social inclusion, reflecting full participation in those activities considered the norm in society;
- successful and continuing adaptation to change as the dynamic expression of competitiveness;
- commitment to the utilization and development of the potential of the Information Society and the promotion of Research and Development;
- commitment to lifelong learning;
- sustainable and balanced development between regions and between urban and rural areas;
- commitment to the further development of the European Union and international solidarity; and
- an entrepreneurial culture.

The headline indicators and their rationale for inclusion in the context of these criteria are shown in Exhibit 5, and the background indicators and their rationale for inclusion in the context of these criteria are shown in Exhibit 6.

Exhibit 5: Headline Indicators used by the National Economic and Social Council of Ireland

Elements of NESC Vision	Headline Indicators	Sustainability Dimension
1. Successful Adaptation to Change	H1.1 Labour Productivity	• Economic Sustainability
	H1.2 Per Capita GNP/Annual GDP Growth Rates	• Economic Sustainability
2. Utilisation and Development of the Information Society	H2.1 Gross Domestic Expenditure on R&D as a Proportion of GDP (GERD)	• Economic Sustainability
	H2.2 Proportion of Households with Access to a PC/Internet	• Economic and Social Sustainability
3. Economic Inclusion	H3.1 Employment Rate	• Economic and Social Sustainability
	H3.2 Unemployment Rate	• Economic and Social Sustainability
	H3.3 Labour Force Participation Rate	• Economic and Social Sustainability
4. Social Inclusion	H4.1 Percentage of Households Living in Consistent Poverty	• Economic and Social Sustainability
	H4.2 Households and Persons Experiencing Relative Income Poverty	• Economic and Social Sustainability
	H4.3 Retention Rates to the end of Upper Secondary School	• Economic and Social Sustainability
	H4.4 Disability-Adjusted Life Expectancy at Birth and 60 Years	• Economic and Social Sustainability
	H4.5 Housing Stock and Completions Local Authority and Private	• Economic and Social Sustainability
5. Lifelong Learning	H5.1 Participation in Adult and Continuing Education and Training	• Economic and Social Sustainability
6. Balanced Regional Development	H6.1 Employment Growth Rates by Region	• Economic and Social Sustainability
7. Commitment to EU/International Organisations	H7.1 Total ODA as a percentage of GNP	• Economic and Social Sustainability
8. Maintaining and Managing the Environment	H8.1 Greenhouse Gas Emissions	• Economic, Environmental and Social Sustainability
	H8.2 River Water Quality	• Economic, Environmental and Social Sustainability
	H8.3 Disposal and Recovery of Municipal Waste	• Economic, Environmental and Social Sustainability

Exhibit 6: Background Indicators used by the National Economic and Social Council of Ireland

Elements of NESC Vision	Background Indicators	Sustainability Dimension
1. Successful Adaptation to Change	B1.1 Business Investment in R&D	• Economic Sustainability
2. Utilisation and Development of the Information Society	B2.1 IT Graduates as a Percentage of all Graduates	• Economic Sustainability
	B2.2 Government Appropriations and Outlays on R&D as a Proportion of GDP (Gbaord)	• Economic and Social Sustainability
	B2.3 Internet Hosts per 1,000 population	• Economic and Social Sustainability
3. Economic Inclusion	B3.1 Number of Childcare Places per 1,000 Children Aged Under 5 Years (pre-school) and 6 to 15 Years (after-school).	• Social and Economic Sustainability
4. Social Inclusion	B4.1 Income Inequality Measure	• Social and Economic Sustainability
	B4.2 Number and Proportion of Public In-Patients Waiting 6 Months or More (Children) and 12 Months or More (Adults) for Targeted Specialities	• Social and Economic Sustainability
5. Balanced Regional Development	B5.1 Percentage FDI by Region	• Economic Sustainability
	B5.2 Gross Value Added by Region	• Economic Sustainability
	B5.3 Per Capita Expenditure on Infrastructure	• Economic, Social and Environmental Sustainability
6. Maintaining and Managing the Environment	B6.1 Vehicle Numbers: Cars per 1,000 Capita	• Environmental, Economic and Social Sustainability
	B6.2 Household and Commercial Waste Arising	• Environmental and Economic Sustainability

As this report is focused primarily on the framework, the indicators themselves are not presented in great detail. No aggregation into dimensions or an overall indicator is done. Data by gender, age and socio-economic groups are given where available, and international comparisons are also attempted in many cases. A summary table organizes all the headline indicators into those experiencing positive, little/no and negative change over the 1990s.

Another report by the NESC, entitled *Benchmarking the Program for Prosperity and Fairness*, develops a separate set of headline and background indicators for monitoring the progress of government policy on a number of stated objectives such as social inclusion and improved workplaces. Both reports include objective indicators only.

2) Measures developed by non-governmental organizations

a) The German System of Social Indicators

The Centre for Survey Research and Methodology (ZUMA) in Mannheim, Germany, under the leadership of Dr. Heinz-Herbert Noll, has developed an extensive system of social indicators for Germany.[23] The aim of the German System of Social Indicators is to provide an observational grid and suitable data that allow one to monitor the status quo as well as the development of citizens' objective living conditions and their subjective quality of life. In order to attain this objective, the time series data of the indicator system describe welfare development and social change in 14 life and political domains (population, socioeconomic status and subjective class identification, labour market and working conditions, income and income distribution, consumption and supply, transportation, housing, health, education, participation, the environment, public safety and crime, leisure and media consumption, and global welfare).

The almost 400 indicators (83 in the condensed version) and over 3000 time series currently included in the German System of Social Indicators provide empirical information on changes in the living conditions of the population and on shifts in the social structure of the Federal Republic of Germany. The period of observation stretches from the beginning of the 1950s until the early 2000s.

While it is not claimed that the system of social indicators includes all facts and conditions that are relevant to individual welfare, it is assumed that the life domains selected are central to individual well-being as well as of socio-political interest. Furthermore, it should be supposed that the indicators chosen relate to actual goals of individual welfare, that they are representative for those of the population and that there is a wide consensus in politics and in society at large.

[23] The website is http://www.gesis.org/en/social_monitoring/social_indicators/Data/System/keyindic.htm. This section draws on the website description of the indicators.

Thus the System of Social Indicators offers a database that by comparing the real state of affairs to a previous or desired one, allows an assessment of the population's current living conditions and their development over time. As a result it makes it possible to interpret the observed trends as an improvement or deterioration of the original status quo, i.e. as social progress or setback.

The System of Social Indicators is based on the Socio- Political Decision- and Indicators-System for the Federal Republic of Germany (SPES Indicator System) developed in the 1970s. This system is continuously updated and expanded. These changes not only comprise the addition of new domains, including the environment, public safety and crime, leisure and media consumption and global welfare, but also further fundamental modifications and developments. In this context the systematic inclusion of components to measure subjective well-being and of indicators for the perceived quality of life are especially noteworthy.

b) New Economics Foundation's Well-being Manifesto

The New Economics Foundation (NEF) – a charity based in London, United Kingdom and founded in 1986 by The Other Economic Summit – published in 2004 a document entitled *A Well-being Manifesto for a Flourishing Society*. The first of their policy recommendations is that governments should "measure what matters." Although its more specific recommendations in this direction are quite general in nature, NEF has begun to develop a set of indicators following these recommendations in partnership with the Nottingham City Council.

The main recommendation put forward by NEF is that governments should maintain a set of national well-being accounts. Such accounts would comprise individual well-being indicators – subjective life satisfaction, personal development – and other indicators such as engagement, meaningfulness and trust. Measures of ill-being should also be included, such as stress and depression. Indicators of social and ecological well-being should be included in addition to these individual indicators. These recommendations tend to have a clear focus on subjective perceptions of well-being. No recommendations are made concerning aggregation into an overall indicator of well-being. It is recommended that the data required for such accounts be collected at the local or community level, meaning that the well-being accounts could be developed for communities and regions as well as at the national level.

c) Australian Unity Wellbeing Index

Cummins et al. (2003) have developed the Australian Centre for Quality of Life (ACQOL) Australian Unity Wellbeing Index in partnership with the Australian Unity financial services group. The goal of this index is to use only subjective measures in monitoring quality of life. However, the developers find that the most common measure of subjective well-being – survey responses to the question "how satisfied are you with your life in general on the following scale" – is largely invariant across the most developed countries and over time, limiting its usefulness for cross-country and time

series comparisons. It is posited that such invariance is related to a psychological effect that is present when survey respondents answer such questions.

The Australian Unity Wellbeing Index attempts to overcome these limitations by collecting and presenting a number of subjective indicators at a more specific level that relate to both the personal and national situations. These more specific subjective perceptions are presented separately and with results for the more general questions. However, the results for the specific indicators do not typically average to the results for the general indicators. This is in part because the psychological effect that limits the variability of the general results is not active to as great an extent in responses to the more specific questions. The indicators in the personal and national dimensions, along with their results for 2001 in Australia, are shown below. The domains within each dimension were chosen by the developers based on their perceived importance, although the developers state that the specific domains included can be revised as evidence on the importance of other factors becomes available.

Personal Wellbeing	
Life as a whole	75.48
Personal Life domains	
1. Standard of living	75.78
2. Health	73.97
3. Achieve in life	73.48
4. Personal relationships	78.44
5. How safe you feel	75.40
6. Community connectedness	68.98
7. Future security	69.29
Personal wellbeing index	73.48
National Wellbeing	
Life in Australia	69.79
National life domains	
1. Economic situation	53.80
2. State of the environment	58.17
3. Social conditions	59.44
National wellbeing index	57.14

The “life as a whole” and “life in Australia” results are for the general questions of life satisfaction. The “personal wellbeing index” and “national wellbeing index” results are the simple averages of the results for the specific domains within each dimension.

The developers examine the statistical merits of their data in a number of ways. They conclude first of all that the data are sound, and secondly that the more specific indicators are useful for monitoring quality of life because they exhibit more variability than the general indicators (and are so less affected by the psychological effect that limits the usefulness of the general results). Furthermore, they state that such subjective

indicators of quality of life are becoming more reliable and so should be given more attention by governments interested in monitoring quality of life.

D. International

This section surveys measures of well-being, including sets of indicators and composite indexes, developed for sets of countries rather than for one particular country. Both measures developed by international organizations and by independent research and research organizations are included.

1) Measures developed by international organizations

a) European Structural Indicators[24]

The Lisbon Strategy of 2000 (and modified in 2001) put forward to renew the European Union (EU) a 10-year blueprint to promote sustainable economic growth, social cohesion, and environmental protection that member countries agreed to work toward by implementing related policies within their own borders. The impetus for creating the European Structural Indicators system was the need to track the progress of member countries in achieving the ambitious goals of the Lisbon Strategy and identifying areas that need improvement. The system is managed by the European Commission (EC), the EU's executive apparatus. A European Council, which consists of representatives of member countries, makes decisions about the general direction of the system and which indicators to include.

The indicators are organized into five key areas: employment, innovation and research, economic reform, social cohesion, and the environment. Indicators are presented at the national level to facilitate comparisons among member countries. Data for the indicators are obtained from countries and coordinated by Eurostat, the EC's statistical agency. The EC is required to report each year to the Council on progress in meeting the Lisbon Strategy. The progress report based on the structural indicators (and accompanying analyses) has been published every year since 2001.

In response to changing circumstances, this indicator system was recently redesigned to improve its utility in monitoring and reporting on progress toward the Lisbon Strategy's goals and to encourage leaders of member countries to take action to meet those goals. Leaders from member countries agreed that the system needed to focus attention on a limited number of what were considered the most important indicators. However, the number of indicators kept increasing, and some changed from year to year, making it difficult to focus on a few important challenges or monitor progress. As a result, the EC reduced the number of indicators that appeared in its 2004 report to 14 headline indicators, and EC officials guaranteed that the indicators that will be reported

[24] This section draws on GAO (2004).

to member country leaders annually will not change for at least 3 years. The 14 headline indicators are:

- Business investment;
- GDP per capita;
- At risk of poverty rate;
- Long-term unemployment rate;
- Dispersion of regional employment rates;
- Greenhouse gas emissions;
- Energy intensity of the economy;
- Volume of freight transport;
- Labour productivity;
- Employment rate;
- Employment rate of older workers;
- Educational attainment (20-24);
- Research and development expenditure; and
- Comparative price levels.

To develop and revise its indicators, the EU uses the following criteria: mutual consistency; policy relevance (linked to policy goals already established); ease of understanding by the target audience; timely availability; availability for all or nearly all member countries; comparability among these countries as well as to external parties such as the United States; availability from reliable, official sources; and ease of collection and not unduly burdensomeness on member countries.

b) EU Social Indicators: The Atkinson Report

During its EU presidency in the second half of 2001, the government of Belgium decided to make the establishment of common European social indicators a priority. The Belgian government insisted that agreement be found on a multidimensional set of indicators to quantify the multidimensional nature of social exclusion.

For the EU, " … the social indicators themselves reflect our sense of democracy through a dialogue with socially excluded groups about the frameworks to be used, and through explicit measurement of poor people's own experience of participation, freedom, and social inclusion… The ultimate effectiveness of social indicators depends on there being the political will to exploit them fully and put into effect the necessary policies" (Atkinson et al., 2002:x-xi).

A committee of experts was asked to produce a report by the end of 2001 that recommended a common set of indicators for all EU members (Atkinson et al, 2002), although it was recognized that members could complement the EU indicators with country-specific indicators. The purpose of the establishment of common indicators was not a naming and shaming exercise, that is, not a vehicle for defining a pecking order among EU members. The report prepared, entitled *Indicators for Social Inclusion in Europe*, is known as the Atkinson report (Atkinson et al., 2002) after well-known

economist Tony Atkinson of the London School of Economics, one of the committee members.

The Atkinson report represents the most sophisticated work on social indicator construction available. As noted, the report is not concerned with social indicators in general, but with social indicators as performance measures that play a political role in the development of the EU agenda of social inclusion. Consequently, it is not enough that indicators capture social conditions. They must have a clear normative connotation. This means they cannot be constructed in an ad hoc manner based on underlying principles, be they implicit or explicit. The laying out of these principles fosters public debate among the social actors.

The report proposes six principles that apply to single indicators and three principles that apply to a portfolio of indicators (Atkinson et al., 2002:21-26). The six principles for single indicators are outlined below.

- *An indicator should identify the essence of the problem and have a clear and accepted normative interpretation.* This means that the indicator must be recognized as meaningful by users of all kinds and must appear "reasonable" to the general public. There should be general agreement that a movement in a particular direction represents an improvement. The indicator should be in a form that allows national targets to be set and performance to be assessed.

- *An indicator should be robust and statistically validated.* This means that the indicator should be measurable in a way that commands general support. Data employed should be regarded as statistically reliable and should avoid arbitrary judgments.

- *An indicator should be responsive to effective policy intervention but not subject to manipulation.* This means that indicators must reflect the successful intervention of policy, but at the same time it must not be possible for governments to improve their score by artificial policy changes.

- *An indicator should be measurable in a sufficiently comparable way across member states, and comparable as far as is practical with the standards applied internationally by the UN and the OECD.* This means that indicators that are over-sensitive to structural differences across countries or raise specific problems of interpretation for particular countries should be avoided.

- *An indicator should be timely and susceptible to revision.*

- *The measurement of an indicator should not impose too large a burden on member states, on enterprises, or on EU citizens.*

The three principles applying to a portfolio of indicators follow.

- *The portfolio of indicators should be balanced across different dimensions.* There are costs in terms of lost transparency from having too extensive a range of indicators. A selection is needed and this selection must ensure that all main areas of concern are covered in a manner that reflects a balanced representation of Europe's social concerns.

- *The indicators should be mutually consistent and the weight of single indicators in the portfolio should be proportionate.* This latter term means it is much easier to interpret a set of indicators when the individual components have degrees of importance that are not grossly different.

- *The portfolio of indicators should be as transparent and accessible as possible to EU citizens.*

The Atkinson report provides a detailed discussion of the properties of indicators and makes a number of recommendations and observations, including the following.

- The fundamental concern when measuring social inclusion as part of the EU monitoring process is with the position of individual citizens, and in general, statistics should be presented in terms of counting individuals.

- Equality of treatment between women and men is a prominent part of the EU agenda. This means that a gender equality perspective should be integrated into all policy areas, a process known as "gender mainstreaming." Consequently, all indicators must be broken down by gender.

- In relation to the debate over relative versus absolute indicators, the report argues that a more valid contrast is between measures designed to move over time in line with the general standard of living and those that are up-rated only by the increase in prices and are intended to represent a fixed level of purchasing power.

- Sole reliance on objective indicators may reduce the legitimacy of the indicators exercise. Subjective indicators should be considered when the standard or target is set on the basis of citizen's responses to survey questions and when it is desirable to include subjective evaluations by the population of their own situation.

- Indicators can focus on both changes and levels. The case for focusing on changes is strongest when indicators cannot be compared across countries, but the errors are constant over time, and when a country wishes to emphasize progress toward closing a gap, as opposed to its inferior level performance.

- The construction of social indicators is necessarily a compromise between the theoretical definition and the empirically possible. This makes the further development of the European Statistical System a major priority. A systematic validation procedure should be associated with each indicator, assessing its reliability in the light of all available sources.

In terms of recommendations on the actual indicators, the Atkinson report proposed a three-tier structure of indicators. Level 1 consists of a small number (around 10) of lead indicators for the main fields to be covered. Level 2 indicators, which would not be limited in number, support the lead indicators and describe other dimensions of the challenge. Both Level 1 and 2 indicators would be commonly agreed upon and defined by all member states. Level 3 indicators would be decided upon by individual member states to highlight national specificities.

The report argues that this three-tier structure has a number of advantages. It allows the principle of balance across different dimensions to be satisfied without restricting the scope of individual fields. A list of ten lead indicators would be relatively easy to understand by the public.

The report stresses that indicators should be presented in the form of a level of performance and not as a ranking. This is because the aim of policy is to improve performance and bring all countries to a high level. If all countries perform badly, a ranking would give no indication of the need for action.

A key consideration is whether the lead indicators should be added up to provide a total score for each country. Such an aggregate performance measure can serve the twin functions of summarizing the overall picture and communications. The major challenge is the difficulty in EU countries reaching agreement on weights. Two different forms of aggregation can be distinguished. The first combines aggregates. The second combines different elements of deprivation at the individual level (which are then summed over the individuals to form an aggregate index for the country).

The Level 1 or lead indicators for social inclusion recommended by the Atkinson report are outlined below:

- risk of financial poverty as measured by 50 and 60 per cent of national median income using the OECD modified equivalence scale;

- income inequality as measured by the quintile share ratio;

- proportion of those aged 18-24 who have only lower secondary education and are not in education or training leading to a qualification at least equivalent;

- overall and long-term unemployment rates measured on an ILO basis;

- proportion of the population living in jobless households;

- proportion failing to reach 65, or the ratio of those in bottom and top income quintiles who classify their health as bad or very bad on the WHO definition; and

- proportion of people living in households that lack specified housing amenities or have specified housing faults.

The Level 2 indicators are:

- proportion of persons in households below 40 per cent and 70 per cent median income, and proportion below 60 per cent of median fixed in real terms on a specific date;

- value of 60 per cent of median threshold in purchasing power terms for one and four person households;

- proportion of the population living in households that are persistently at risk of financial poverty;

- mean and median equivalized poverty gap for the 60 per cent median;

- income inequality as measured by the decile ratio and Gini coefficient;

- proportion of the population aged 18-59 (64) with only lower secondary education or less;

- proportion of discouraged workers, proportion non-employed, and proportion of involuntary part-time work (as a percentage of the total population aged 18-64 excluding those in full-time education);

- proportion of people living in jobless households with income below 60 per cent of the median;

- proportion of employees living in households at risk of poverty (60 percent median);

- proportion of employees who are low paid;

- proportion of people unable to obtain medical treatment for financial reasons or on account of waiting lists;

- proportion of people living in households that are in arrears on rent or mortgage payments; and

- proportion of people living in households unable in an emergency to raise a specified sum.

The report points out however that the choice of indicators should not be regarded as fixed for three reasons. First, as experience is gained, the definition and implementation of indicators can be refined. Second, the social and economic situation is constantly changing, generating new issues and challenges. Third, discussion of indicators needs to be broadened responding to the views of social partners, non-governmental organizations, and those experiencing social exclusion.

The European Community social indicators project on social inclusion is undoubtedly the most important social indicators project that has ever taken place. This is so for several reasons. First, the project has been initiated at the highest political level and will play a crucial role in the implementation of the EU social agenda. The EU appears to take indicators very seriously. Second, the EU has allocated significant resources to social indicator development. Third, many of the world's leading indicator experts are involved in the project. Fourth, the project has produced a very sophisticated framework for indicator development, as has been outlined in this report.

The strength of the EU social indicators project is that it represents the state of the art in terms of indicator development, particularly for OECD countries. All serious students of indicators should read the report on social indicators. A weakness from the point of view of a Canadian perspective is that the EU project focuses exclusively on social inclusion, a concept and issue that is not explicitly on the political agenda in Canada (although aspects of social inclusion such as poverty certainly are). Nevertheless, there is much to learn from the EU indicators work.

A second weakness of the EU social indicators project, given its objective to motivate the development of public policies to increase social inclusion in EU countries and to monitor the impact of policies on social inclusion, is that "macro" changes affect the indicators. This makes it very difficult to separate the effect of macro changes from policy-induced changes, particularly for income-based indicators. Positive effects of policy initiatives may be mitigated by other independent changes in the economy or society. Simulation models are needed to disentangle the effect of the two forces, but these simulations may not capture behavioural effects. A recent simulation of the impact of macro changes on EU indicators for social inclusion (Feres et al., 2003) found that the response of the different indicators to these changes varied significantly across indicators and the response for a given indicator to a change varied considerably across countries. Thus the interpretation in the movement of the EU social indicators, that is the causal relationships, is difficult. This criticism is of course true for all indicators.

c) Human Development Index (HDI)

Probably the best-known composite index of social and economic well-being is the Human Development Index (HDI), developed by the United Nations Development Programme (UNDP). The index was first published in 1990. This index is particularly well known in Canada, as the federal government has publicized its finding that Canada ranked number one consistently in the 1990s. The most recent release of the index in July

of 2004, ranked Canada fourth, up from eighth in 2003, but down from third in 2002. The HDI receives much media attention in Canada. Because of frequent changes in methodology, the index is used more for cross-national comparisons than for tracking trends in human development over time within one country.

The HDI is based on three indicators: longevity, as measured by life expectancy at birth; educational attainment, as measured by a combination of adult literacy (two-thirds weight) and the combined first-, second- and third-level gross enrolment ratio (one-third weight); and standard of living, as measured by real GDP per capita in Purchasing Power Parity (PPP) terms.

For the construction of the index, fixed minimum and maximum values have been established for each of these indicators.

- Life expectancy at birth: 25 years and 85 years
- Adult literacy: 0% and 100%
- Combined gross enrolment ratio: 0% and 100%
- Real GDP per capita: $100 and $40,000 (U.S. dollars in PPP terms).

The UNDP also has developed a gender-related development index (GDI). The difference with the HDI is that the GDI adjusts the average achievement of each country in life expectancy, educational attainment, and income in accordance with the disparity in achievement between men and women. A weighting formula is used that expresses a moderate aversion to inequality.

The UNDP has also developed a gender empowerment measure (GEM) to measure the relative empowerment of women and men in political and economic spheres of activity. It is based on the gender shares in the areas of parliamentary representation, administrative and managerial positions, professional and technical positions, and earned income.

Finally, the UNDP has developed a Human Poverty Index (HPI). For developing countries, the HPI-1 concentrates on deprivations in three essential dimensions of human life already reflected in the HDI – longevity, knowledge and a decent standard of living. The first deprivation relates to survival (the vulnerability to death at a relatively early age). The second relates to knowledge (being excluded from the world of reading and communication). The third relates to a decent standard of living in terms of overall economic provisioning. The deprivation in longevity is represented by the proportion of the population not expected to survive to age 40. The deprivation of knowledge is represented by the proportion of the population that is illiterate. The deprivation of a decent standard of living is represented by three variables – the proportion of the population without access to safe water, the proportion without access to health services, and the proportion of moderately and severely underweight children under five.

For industrial countries, the HPI-2 concentrates on deprivations in four dimensions of human life quite similar to those in the HDI – longevity, knowledge, a

decent standard of living, and social inclusion. The deprivation in longevity is represented by the proportion of the population not expected to survive to age 60, the deprivation of knowledge by the proportion of the people that is not functionally literate as defined by the OECD, the deprivation in a decent standard of living is represented by the proportion of the population living below the poverty line set at 50 per cent of median disposable personal income, and the deprivation of social inclusion is measured by the long-term (12 months or more) unemployment rate.

Many commentators in Canada, including representatives of the right and left, are critical of the HDI, and in particular the uses made of it in this country. This critique may in part be motivated by the fear that the index's good news message may mitigate pressures for the adoption of the policies they are recommending (e.g. tax cuts, increased social spending, etc.).

If the EU social indicators project represents the gold standard for social indicators, the Human Development Index (HDI) produced by the United Nations Development Programme represents the gold standard for composite indicators. This is the case for a number of reasons. First, the HDI is by far the best-known composite indicator in the world, reflecting the fact it has been around since 1990 and that it is produced by a high-profile UN agency. Second, the HDI uses a simple framework for identifying what constitutes human development, namely income, health and education, which is intuitive and easy to understand. Third, despite the apparent simplicity, there is much technical sophistication behind the HDI. Nobel prize winning economist A.K. Sen contributed significantly to the conceptual development of the index.

Despite Canada's stellar rankings on the HDI in the 1990s, the index has limited relevance to Canada in its current form. This is because the index is for all countries and the wide range in variables between the developing and developed countries means that it is difficult to differentiate performance among the developed countries. In addition, the HDI includes only a very small number of variables (five), although they are admittedly well-chosen and important ones. It can be argued that the HDI consequently fails to capture many dimensions of economic and social well-being, although the developers of the HDI argue that the variables do capture all important dimensions of human development.

Nevertheless, the methodologies used by the HDI and its associated composite indexes, especially the Human Poverty Index for developed countries, remain a great strength and continue to have considerable relevance for indicator development in this country. All students of indicators and indexes of economic and social well-being need to have a solid understanding of this pioneering and innovative index.

d) OECD Social Indicators

The OECD has been a pioneer in the social indicators field since the 1970s and continues to play a leading role in the development of social indicators for member countries including Canada. Indeed, it recently updated its work on social indicators with

the publication *Society at a Glance* (OECD, 2001b). The OECD's motivation for developing social indicators is two-fold. First, to identify what have been the major social developments in OECD countries. Second, and more challenging, to ascertain which societal responses are effective in altering social outcomes. The OECD argues that social indicators can be used to assess whether and how the broad thrust of policy is addressing important social issues, but cannot be used to evaluate whether a particular social program is effective.

The OECD recognizes that the structure of the indicators it presents falls well short of being a full-scale framework for the collection of social statistics, but feels it is nevertheless more than a one or two dimensional listing of social indicators. The underlying structure of the indicators draws upon the pressures-state-response (PSR) framework developed by the OECD Environmental Directorate (OECD, 2000). Under this framework, human activities exert *pressures* on the environment and affect its quality and quantity of natural resources (*state*). Society responds to these changes through policies and changes in awareness and behaviour (*response*). The attraction of this framework is that it focuses on broad indicators of what government and society do (response indicators) and what they are trying to influence (state and pressure indicators).

The OECD social indicators publication follows a similar approach of dividing indicators into three categories of social context, social status and societal response. Social context variables are not usually directly the target of policy, or if they are policy objectives, only in the longer term (e.g. the proportion of the population 65 and over). These variables are neutral in terms of whether a particular outcome is good or bad. Social status variables are descriptions of social situations of highest current priority for polity action (e.g. poverty rates). Societal response variables illustrate what society is doing to affect social status variables.

The context indicators include national income, fertility rates, old-age dependency ratios, foreigners and the foreign-born population, refugees and asylum-seekers, divorce rates, and lone-parent families.

The OECD has grouped status and response social indicators into very broad policy fields based on four underlying objectives of social policy. The four fields or objectives are enhanced self-sufficiency, greater equity of outcome, improved health status, and social cohesion. The variables in each policy field are outlined below.

- The self-sufficiency indicators for social status are employment, unemployment, jobless youth, jobless households, working mothers, retirement ages; and for societal responses are activation policies, spending on education, early childhood education and care, educational attainment, literacy, replacement rates and tax wedges.

- The equity indicators for social status are relative poverty, income inequality, low paid employment, and the gender wage gap; and for societal response are

minimum wages, public social expenditures, private social expenditures, net social expenditure, and benefit recipiency.

- The health indicators for social status are life expectancy, infant mortality, potential years of life lost, disability-free life expectancy, and accidents; and for societal response are older people in institutions, health care expenditures, responsibility for financing health care, and health infrastructure.

- The social cohesion indicators for social status are strikes, drug use and related deaths, suicide, crime, group membership, and voting; and for societal response the indicator is prisoners.

The PSR framework has been widely adopted by indicator developers, including the Italian Urban Ecosystem indicators project and Finland's Indicators for Sustainable Development, which are both described earlier in this report.

The overall assessment of the OECD social indicators is very positive. The strength of the OECD framework is that it focuses on the linkages between the different social variables. These indicators were developed to assess social conditions and social policies for developed countries, and therefore are very appropriate for use in Canada.

One weakness of the approach may be that the distinction between context and status indicators may appear at times arbitrary. For example, the OECD notes that the context variables may be policy variables, but only in the long run while status variables are policy variables at all times. But the definition of the long run may vary across countries so a variable, such as the fertility rate, may be a context variable in certain countries, but a status variable in other countries. Another problem with the definition of context variables is that they are considered neutral in terms of whether a particular outcome is good or bad. Again this can be problematic as the outcome of a context variable may not be neutral for particular periods or for certain countries, while being neutral for other periods and countries.

2) Other measures developed for international comparisons

a) Prescott-Allen's Indexes of the Wellbeing of Nations

Robert Prescott-Allen (2001), a principal of PADATA, a consultancy on nature and culture based in Victoria, British Columbia, has written a book entitled *The Wellbeing of Nations*. The book builds on his earlier work on the Barometer of Sustainability and his Well-being Assessment method. His framework attempts to integrate indicators of sustainable development with indicators of economic and social well-being.

The Well-being Assessment is a method of assessing sustainability that gives people and the ecosystem equal weight. It provides a systematic and transparent way of:

- deciding the main features of human and ecosystem well-being to be measured;

- choosing the most representative indicators of those features; and

- combining the indicators into four indexes: a Human Well-being Index (HWI), Ecosystem Well-being Index (EWI), Well-being Index (WI), and Well-being/Stress Index (WSI) – the ratio of human well-being to ecosystem stress. Together, these four indexes provide a measurement of sustainable development.

These four indexes are used in *The Well-being of Nations* to measure the sustainability of 180 countries:

- The Human Well-being Index (HWI) distills 36 indicators of socioeconomic conditions. The HWI is a more realistic measure of socioeconomic conditions than narrow monetary indicators such as the Gross Domestic Product. It also covers more aspects of human well-being than the United Nations Development Programme's Human Development Index.

- The Ecosystem Well-being Index (EWI) synthesizes 51 indicators of the state of the environment. The EWI is an equally broad measure of the state of the environment, which, according to the developer, treats national environmental conditions more fully and more systematically than other global indices, such as the Environmental Sustainability Index.

- The Well-being/Stress Index (WSI) measures how much harm each country does to the environment for the level of development it achieves. The WSI, and the WI below, measure people and the ecosystem together to compare their status, show the impact of one on the other, and highlight improvements in both.

- The Well-being Index (WI) combines the HWI and EWI on the Barometer of Sustainability, a graphic scale that shows how far each country is from the goal of high levels of human and ecosystem well-being.

Well-being Assessment differs from other methods of assessing sustainability in two ways: it has a dual focus on human and ecosystem well-being, and it uses a Barometer of Sustainability – a graphic performance scale – to sum up a comprehensive set of indicators into the HWI, EWI, WI, and WSI. The Well-being Assessment method was developed and tested with the support of IUCN – The World Conservation Union and the International Development Research Centre.

b) Diener Quality of Life Index

Ed Diener (1995), a psychologist at the University of Illinois at Urbana-Champaign, has developed an index of the quality of life (QOL) based on a universal set of values. He constructs two indexes, one called the Basic QOL Index, which is particularly relevant for developing countries and the Advanced QOL Index for

developed countries. He estimates both indexes for 77 countries and also calculates a combined index, which brings together the basic and advanced indexes. The Basic QOL Index includes seven variables: purchasing power, homicide rate, fulfillment of basic needs, suicide rate, literacy rate, gross human rights violations, and deforestation. The Advanced QOL Index also includes seven variables: physicians per capita, savings rate, per capita income, subjective well-being, college enrollment rate, income inequality, and environmental treaties signed. According to Diener, combining the two indices produces a reliable measure of QOL that systematically covers diverse human values.

Diener makes use of a set of 45 universal values across all cultures reflecting three universal requirements of human existence: meeting biological needs, coordinating social interaction, and the survival and welfare needs of groups. The 45 values are in turn organized into seven sets of similar values. The sets of values and the variables used to capture each value in the basic index for developing countries and the advanced index for developed countries are given in Exhibit 7.

Exhibit 7: Variable by Value Region for the Basic and Advanced QOL Index

Value Region	Basic Index	Advanced Index
Mastery	basic physical need fulfillment	physicians per capita
Affective autonomy	suicide rate	subjective well-being
Intellectual autonomy	literacy rate	university attendance
Egalitarian commitment	gross human rights violations	income inequality
Harmony	deforestation	environmental treaties
Conservatism	homicide rate	savings rate
Hierarchy	purchasing power parity	per capita income

c) Index of Social Progress

Richard J. Estes (1997) from the University of Pennsylvania has developed an Index of Social Progress (ISP) for the purpose of identifying significant changes in "adequacy of social provision" and to assess the progress in providing more adequately for the basic social and material needs of the world's population. The ISP consists of 46 social indicators that have been subdivided into 10 sub-indexes: education, health status, status of women, defence effort, economic performance, demography, geography, political participation, cultural diversity, and welfare effort. All 46 indicators are known to be valid indicators of social development.

The weights used to construct the index are derived through a two-stage varimax factor analysis in which each indicator and sub-index is analyzed for its relative contribution toward explaining the variance associated with changes in social progress over time. Standardized sub-index scores are then multiplied by the factor loadings to

create weighted sub-index scores and the Composite Weighted Index of Social Progress (WISP) scores are obtained through a summation of the weighted sub-index scores.

Estes argues that the WISP is a more comprehensive, valid, reliable instrument for assessing changes in social development over time than other indices on national and international progress like GDP and the HDI. Estes (1997) has provided estimates for 124 countries for 1970, 1980, and 1990.

Exhibit 8: Index of Social Progress, Indicators by Sub Index
I. Educational Sub Index (N=6)
Percent Age Group Enrolled, Primary Level (+) Percent Grade 1 Enrollment Completing Primary School (+) Percent Age Group Enrolled, Secondary Level (+) Percent Age Group Enrolled, Tertiary Level (+) Percent Adult Illiteracy (-) Percent GNP in Education (+)
II. Health Status Sub Index (N=7)
Life Expectation at 1 Year (+) Rate Infant Mortality Per 1000 Liveborn (-) Under 5 Years of Age Child Mortality Rate (-) Population in Thousands per Physician (-) Per Capita Daily Calorie Supply as % of Requirement (+) Percent Children Fully Immunized at Age 1, DPT (+) Percent Children Fully Immunized at Age 1, Measles (+)
III. Women Status Sub Index (N=6)
Female Life Expectation at Birth (+) Female Adult Literacy Rate (+) Percent Married Women Using Contraception (+) Maternal Mortality Rate per 10000 Live Births (-) Female Primary School Enrollment as percent of Males (+) Female Secondary School Enrollment as percent of Males (+)
IV. Defense Effort Sub Index (N=1
Military Expenditures as Percent of GDP (-)
V. Economic Sub Index (N=6)
Per Capita Gross National Product in dollars (+) Real Gross Domestic Product per Head (+) GNP per Capita Annual Growth Rate (+) Average Annual Rate of Inflation (-) Per Capita Food Production Index (+) External Public Debt as Percent of GDP (-)

VI. Demography Sub Index (N=6)
Total Population Millions (-) Crude Birth Rate Per 1000 Population (-) Rate of Population Increase (-) Percent of Population under 15 Years (-) Percent of Population over 60 Years (+)
VII. Geographical Sub Index (N=3)
Percent Arable Land Mass (+) Natural Disaster Vulnerability Index (-) Average Annual Deaths From Natural Disasters Per Million Population (-)
VIII. Political Participation Sub Index (N=3)
Violations of Political Rights Index (-) Violations of Civil Liberties Index (-) Composite Human Suffering Index (-)
IX. Cultural Diversity Sub Index (N=5)
Largest Percent Sharing Same Mother Tongue (+) Largest Percent Sharing Same Basic Religious Beliefs (+) Largest Percent Sharing Same or Similar Racial/Ethnic Origins (+)
X. Welfare Effort Sub Index (N=5)
Years Since First Law-Old Age, Invalidity, Death (+) Years Since First Law-Sickness & Maternity (+) Years Since First Law-Work Injury (+) Years Since First Law-Unemployment (+) Years Since First Law-Family Allowances (+)

Source: Estes (1997)

d) The Global Footprint Network – National Footprint and Biocapacity Accounts

The Global Footprint Network publishes estimates of the "Ecological Footprint" and "Ecological Overshoot" for the world as a whole, broad regions and countries, for the period of 1961 onwards. The 2004 release includes data up to 2001. The Ecological Footprint is a calculation of overall resources used and waste produced by humans. Ecological Overshoot compares the Ecological Footprint to the resources available now and in the future from the earth's ecosystem, and is an estimate of sustainability. It indicates the proportion of current consumption of natural resources in a given year that the earth can reproduce in one year. In 2001, for example, it is estimated that humans consumed 120 per cent of the reproducible resources of the earth. This implies that the stock of natural resources would have been less in 2002 than it was in 2001.

The National Footprint and Biocapacity Accounts (NFBA), which are made up of the Ecological Footprint and Overshoot, are essentially a set of indicators that have been

presented in a unified framework and expressed in the same units. It is hence a relatively straightforward procedure to aggregate each indicator into a single overall assessment, namely Ecological Overshoot. The conversion of different forms of resource use into a common unit is done through observing the equivalent amount of biologically productive land area required for the given amount of use of that particular resource.

A weakness of this approach is that the aggregation of all of the underlying variables associated with resource use is not transparent. However, an "academic edition" of the detailed data for the world as a whole is available for no charge, and this shows the conversion factors and aggregation from resource use data to the overall footprint and overshoot. Also, publications such as *The Living Planet Report* give extensive data on the overall footprint and the footprints associated with particular resource uses for every country. Further information on the methodology of the NFBA can be found in Wackernagel et al. (2004) and on the website of the Global Footprint Network (www.footprintnetwork.org).

E. Synthesis of Well-being Measures and Relevance for Potential Future Work on the Evaluation of Research Impacts on Well-being

The above section surveyed 38 sets of indicators or composite indexes designed to capture well-being outcomes in the economic, social/cultural/health, and environmental domains in Canada, the United States and nine other OECD countries as well as measures developed for large numbers of countries. This section contains a number of observations on the major characteristics of the measures surveyed and the general state of well-being measurement throughout the world, and comments on the relevance of the measures for potential future work that tries to develop measures of well-being to track the impact of research investments in Canada.

1) General observations on measures of well-being

Based on the survey, a number of general observations on the current state of the art of well-being measure construction throughout the world can be made.

- A massive amount of work on the measurement of well-being, broadly defined to include concepts such as quality of life and social reporting, has been undertaken in developed countries by both governments and non-governmental organizations in recent years. The 38 measures surveyed in this paper were chosen for their importance and innovativeness, and represent only a small sub-set of the hundreds of measures of well-being. The field of well-being measurement is currently experiencing a renaissance.

- The literature on measures of well-being includes both comprehensive sets of indicators as well as composite indexes. The key difference is that the latter go the final step and aggregate indicators into a single index or bottom line using a weighting scheme. Both types of measures require detailed data on a range of

indicators and a strong case can be made that the real contribution or value added of a well-being measurement exercise lies in the data gathering and monitoring component. Composite indexes may capture headlines, but they cannot by their nature shed light on specific problems that only individual indicators can elucidate.

- Historically almost all indicators of well-being have been based on objective data. In recent years, the importance of subjective well-being, also called happiness or life satisfaction, has grown and a number of national indexes in this areas, such as the Australian Unity Well-Being Index, have been developed. While it is widely recognized that public policy has a very important role to play in improving objective measures of well-being, the role of public policy on happiness is much more controversial. Some argue that public policy can and should influence certain variables that increase happiness while others believe that happiness is too general and mundane a concept to be the focus of public policy, pointing out for example that 86 per cent of Canadians reported in 2002 that they already consider themselves satisfied or very satisfied with their lives (Vanier Institute of the Family, 2004).

- The well-being measures surveyed show both commonalities and differences in terms of the indicators included. Certain basic indicators such as income, employment, poverty, health status, and pollution levels are found in almost every measure while certain others indicators appear in only one or a small number of measures.

- The role of government in the development of well-being measures has varied across regions. The vast majority of well-being measures created in OECD countries outside North America have been undertaken by governments. In contrast, most well-being measures developed in the United States have been undertaken outside of government by non-profit organizations or academics. Canada occupies an intermediate position with a relatively balanced number of government and non-government well-being measurement initiatives.

- The process by which specific indicators are chosen or selected from the much larger universe of indicators may be important for the legitimacy of the well-being measure. For example, a set of indicators selected by experts may have less resonance with the population than a set of indicators that emerged out of a citizen consultation process or even a set of indicators chosen through public opinion polling.

- Outcome indicators appear to be much more appropriate than input indicators in the measurement of well-being given that well-being itself is an outcome. Many well-being measures explicitly recognize this by only including outcome variables.

- The level of technical sophistication of the measures of well-being surveyed varies greatly, from well articulated theoretical frameworks to little more than ad hoc compilations of indicators.

2) Relevancy of the survey of measures of well-being for evaluating research impacts on well-being

Based on the survey of measures of well-being, it is possible to identify measures of well-being that could potentially be useful in tracking the impact of research investments on well-being in Canada. The findings of this survey of a large number of measures of well-being show the great breadth and depth of the material available on indicators of well-being. The report enumerates hundreds of potential indicators of well-being in the economic, social/cultural, and environmental domains that the such an exercise could potentially consider.

The well-being measures developed for Canada are of obvious relevance for evaluating the impact of research on well-being in Canada. In terms of the types of indicators available to assess well-being, the Newfoundland Community Accounts are especially useful because of the very large number of well-being variables or indicators included in the accounts. The GPI Alberta and the Conference Board of Canada Performance and Potential Indicators also include a large number of indicators. From a conceptual perspective, the CSLS Index of Economic Well-being provides a well-articulated framework for the measurement of economic well-being. The Quality of Life Indicators produced by the Treasury Board are important because they represent the official view of a central agency of the federal government on what it believes matters to Canadians. The environmental indicators highlighted by the National Roundtable on the Environment and the Economy are also important both because this exercise was commissioned by the Minister of Finance and because of the extensive stakeholder consultation process by which the indicators were developed.

In terms of measures of well-being developed in other countries, the Dutch and Swedish social reporting exercises are of particular relevance both because of the large number of variables included and because of their long history, with both projects dating back to the 1970s.

All three measures of well-being developed by international organizations are very relevant for evaluating the impact of research on well-being in Canada. The Human Development Index (HDI) developed by the United Nations Development Program is extremely important for several reasons. First, it is probably the best know composite measure of well-being. Second, it has received extensive attention in Canada, by the general public, the media, political leaders, and the bureaucracy. Third, a well-developed theoretical and philosophical foundation has been applied to support the choice of indicators. The structural indicators of the European Union are also important because they are used to shape public policies to attain certain objectives and consequently one hopes have been well thought out and articulated. The OECD social indicators should

also be of interest because of their useful and policy-relevant state-pressure-response framework as well as the careful consideration exercised in choosing the indicators.

Finally, among the measures of well-being developed internationally by bodies other than international organizations, the Atkinson report on EU social indicators is an extremely valuable resource because of the meticulous care that that has been given to the development of an appropriate set of indicators.

III. A Framework for Measuring the Impact of Research on Well-being

This section of the report develops a general framework for assessing the impact of research investments on the well-being of Canadians. It first outlines the framework and then provides a number of examples of the impact of research on well-being that illustrate the framework.

A. The Framework

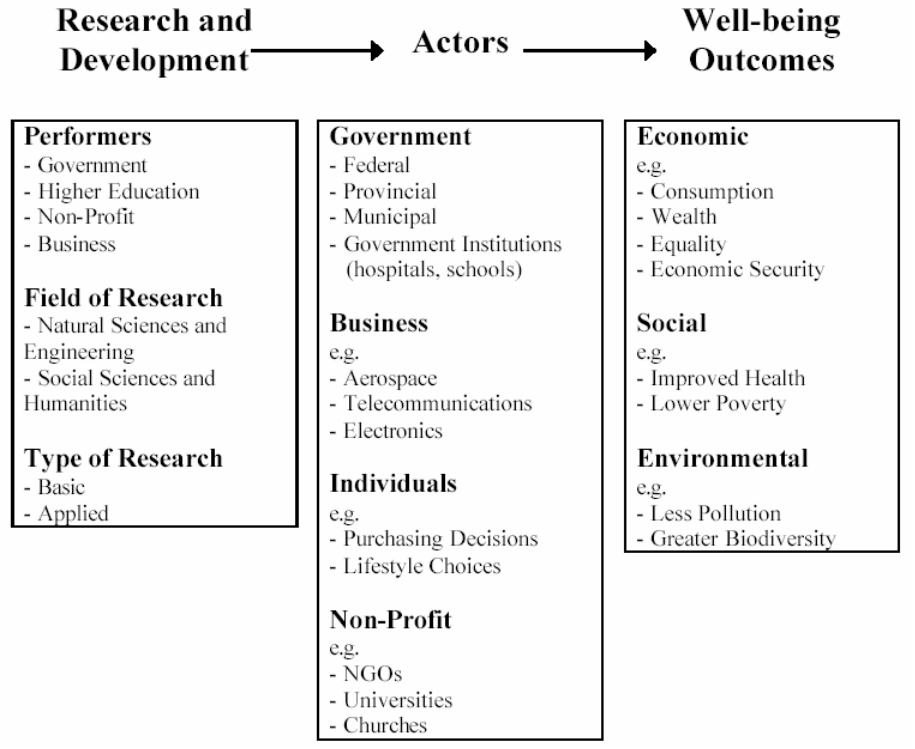
Exhibit 9 lays out a basic framework for analyzing the relationship between research investments and well-being. The direction of causation runs from research investments to enhanced well-being through the uses made by societal actors of the increased knowledge generated by the research. This is a very general framework that can in principle capture the impacts of many different types of research investments used by different societal actors on a wide range of dimensions of well-being.

Research investments can be classified according to a number of criteria: foreign versus domestic; sector of R&D performance; field of research; and basic versus applied research. A first basic distinction can be made between research investments made in Canada and those made abroad, but used by Canadians. Canada accounts for a very small proportion of the world's R&D expenditures, certainly less than 2 per cent of OECD R&D expenditure in 2002 (OECD countries account for the vast majority of world R&D spending), but Canadians make use of the new knowledge created outside the country. However, the focus of this report is on the impact of research investments in Canada on well-being, although it is recognized that research undertaken outside the county also greatly affects our well-being and that the framework developed applies to foreign research as well as domestic research.

R&D expenditures are classified by the sector of the performer, defined to include business, government, higher education, and the non-profit sector (these latter two sectors are often combined). Less relevant from the point of view of the impact of research on well-being is the sector of research funding, which includes the same four sectors plus international sources. Data on the relative importance of the four R&D performing sectors in Canada and trends over time were given earlier in the report.

R&D expenditures can also be classified into field or area of research or study. As noted earlier, official Statistics Canada data for all performers are only available for two categories: natural sciences and engineering; and social sciences and humanities, with the latter less than one tenth the size of the former. R&D expenditures can be broken down by industry and R&D expenditure by the federal government can be broken down by budget objective.

Exhibit 9: Framework for Analyzing the Effect of Research on Well-being



A final dimension of research is its basic or applied nature. Basic research advances the theoretical understanding of the field and generally has no immediate application, although its long-run impact may be massive. In contrast, applied research has an immediate application to society. The basic/applied distinction applies to all fields of research. For example, both basic and applied research are undertaken in the social sciences. The former develops theoretical models of the way societal actors behave while the latter applies these models to understand current and historical developments. Policy research is a form of applied research done to influence public policy.

Research findings are used by various societal actors to enhance well-being. At least four types of actors can be identified: firms, governments, individuals, and non-profit organizations. (A fifth actor may be communities, but this actor really consists of the other four actors, possibly acting together). Firms use industrial R&D either performed in house or contracted out to other firms or the higher education sector to improve production processes and develop new products. Governments use new

knowledge developed by the higher education sector and the non-profit sector (e.g. think tanks) or within government to improve public policy and attain more effectively their political objectives. Individuals and non-profit organizations also can use new knowledge in ways that benefit themselves.

The ability of societal actors to acquire and make use of new and existing knowledge depends on many factors and is a very important topic for a report in its own right.[25] The ability of societal actors to acquire new knowledge from research depends on information and knowledge flows[26] between those who undertake research investment to create new knowledge and commercialize research findings and those who could potentially use this new knowledge. Incentives play a key role in ensuring that these knowledge flows take place. There can also be considerable lags in the diffusion of new knowledge from creator to user. The ability of societal actors to actually make use of knowledge once acquired depends on the absorptive capacity of the actors, which is determined by many factors, including financing opportunities, technical skills, managerial skills, entrepreneurship, and governance structures.

The use of the new knowledge created by R&D by the four actors mentioned above can affect different dimensions and indicators of well-being.[27] The report earlier reviewed 40 measures of well-being (either indexes or sets of indicators) that included many domains, and innumerable indicators within each domain. This focus was on the economic, social, and environmental domains, including both objective and subjective indicators.

B. Examples of the Impact of Research on Well-being

There are many examples that illustrate the process whereby new knowledge generated has been used to enhance aspects of well-being. Perhaps the most direct link between research effort and well-being is in the field of medical research. A new drug (e.g. Viagara, Prozac) or medical procedure (e.g. cardiac bypass surgery) can directly improve the quality of life of the population, as measured by health indicators such as life expectancy, disability-free years, and infant mortality.

The lion's share of Canada's research effort is by business enterprises to develop new processes and products. An example would be the research undertaken by Nortel, by far the largest R&D performer in Canada, which develops new communications equipment for world markets. These products generate income for Nortel, allowing the

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[25] On this issue of knowledge acquisition and transfer, see the volumes edited by de la Mothe and Paquet (2000) and de la Mothe and Foray (2001). See Bordt (2001) on knowledge flows from public institutions to firms.

[26] On the importance of information for economics and for economic and social development in general, see the lecture by Joseph Stiglitz, a pioneer in the field of information economics, given at the occasion of his receipt of the Nobel prize in economics in December 2001 (Stiglitz, 2002).

[27] See McDaniel (2000) for an interesting discussion of how to capture or "unpack" the elusive social impacts of technology.

company to compensate its employees, and pay taxes. Such research effort contributes directly to the economic well-being of Canadians through creation of well-paying jobs and indirectly through the services that governments can supply using the tax revenues.

Economic well-being depends on income and income in turn depend directly on productivity improvements. A recent study by John Baldwin and Wulong Gu of Statistics Canada (Baldwin and Gu, 2004) has demonstrated that manufacturing firms in Canada that undertake R&D spending do enjoy, with a lag, stronger productivity growth relative to firms that do not engage in R&D.

The size of economically available natural resources also directly affects income and economic well-being. Hence the discovery of additional resources can enhance economic well-being. Research investments can in turn foster this discovery. A recent article in the Globe and Mail (Bethour and Ebner, 2004) illustrates this process. It documents how advances in three-dimensional seismic technology now allow petroleum firms to penetrate limestone barriers previous impervious to sound waves, allowing the pinpointing of massive pools of natural gas.

Societal well-being depends on effective public policy and such policy requires evidence-based research on that works and does not work. In the opening speech at a recent conference on social policy organized by the federal government's Policy Research Initiative, Michael Wernick, Deputy Secretary to the Cabinet, Plans and Consultations at the Privy Council Office identified four examples of recent policy research that have lead to changes in public policy and affected the well-being of Canadians.

- Research on the problems associated with high incidence of repeat use of unemployment insurance lead to a major overall hall of UI in 1996.

- Research pointing to the poor labour market performance of recent immigrants often associated with the lack of recognition of their credentials has lead government to take measures to have these credentials accepted more easily.

- Research showing that training and R&D spending have significant positive impacts on firm performance have convinced governments of the importance of these two factors and of the key role for public policy to foster both training and R&D spending.

- Research highlighting the importance of early childhood education for the full development of the individual has lead to the recent expansion of government programs in this area.

IV. The Use of Indicators for Public Policy Initiatives to Improve the Well-being of Canadians

"It you cannot measure it, you cannot manage it"
Conventional wisdom among Canadian public servants

In recent years, public policy development in Canada has been greatly influenced by the use of indicators. The purpose of this section is to provide evidence of this trend, to discuss how the indicators have been used, and to comment on whether the use of indicators has resulted in better public policy. The section discusses what have been the most important indicators in the economic, social and environmental domains of well-being that have been used for policy purposes in Canada at the federal level. The discussion focuses on specific single indicators, not composite indexes such as the Human Development Index.

A. Economic Indicators

The attainment of very specific economic targets or indicators have dominated the economic policy debate in Canada for well over a decade and the federal government has invested enormous political capital and credibility in the attainment of these targets. This is a recent development. In the 1960s, the Economic Council of Canada put forward five economic goals for the country that were to be the objective of economic policy: low inflation, full employment, strong economic growth, a balance on the current account, and equitable income distribution. But these objectives never motivated public policy to the degree the economic targets have affected policy in the 1990s.

The first economic indicator that assumed the role of economic target was the rate of inflation. In 1991, the Department of Finance and the Bank of Canada announced that henceforth target bands (1 to 3 per cent) would be set for the core inflation rate (the Consumer Price Index excluding the volatile food and energy components). Monetary policy was to be conducted in light of the attainment of this objective, even if the short to medium term result was stagnant economic growth and high unemployment. This was indeed the result during the first half of the 1990s, although the inflation target was achieved. The credibility of the Bank of Canada has rested on the attainment of inflation within this band.

The second economic indicator that was the explicit target of economic policy was the federal budget deficit. In the 1995 federal budget, Finance Minister (and now Prime Minister) Paul Martin committed the government to the elimination of the deficit within five years in his famous "come hell or high water" speech. This objective was in fact attained in three years through deep cuts to program spending (and a robust economy).

Another economic indicator that is currently the target of economic policy is the debt/GDP ratio. In the October 2004 Speech from the Throne, the federal government

announced that it intends to reduce the debt/GDP ratio to 25 per cent within ten years from its current level of around 48 per cent despite any evidence that 25 per cent represent an optimal debt/GDP ratio.

In addition to the macroeconomic indicators outlined above, the federal government in its Innovation Strategy announced in 2002 has also targeted research and development spending. It intends to double the government R&D/GDP ratio within five years. It also has focused on business R&D and has developed and implemented policies to boost this variable.

A final economic indicator that is the focus of great attention by Canadian government policy makers is our productivity gap of around 20 percentage points with the United States, as this gap is the cause of the Canada-U.S. income gap. Economic policies in many areas, including tax policy, have been developed with the objective of closing this gap, although they have largely been unsuccessful as the productivity gap has increased, not decreased in recent years.

B. Social Indicators

The use of social indicators for public policy purposes in Canada has not been as intense as the use of economic indicators, but there still are a number of important examples. Probably the two most important are child poverty and hospital waiting lists. In 1989, the House of Commons unanimously passed a resolution calling for the elimination of child poverty in Canada by 2000. Unlike inflation and deficit indicators outlined above, the federal government did not put its credibility on the line regarding this objective and consequently came nowhere close to attaining it. However, certain anti-child poverty policies such as the National Child Benefit Supplement (NCBS) were developed with the goal of reducing child poverty, and at least the NCBS was mildly effective. A case can be made that the widely accepted and popular public objective of the quantifiable indicator of the elimination of child poverty was used by child advocacy groups to goad the government into action. Without the rhetoric of the elimination of child poverty as a goal, the government would have had less incentive to act.

A second social indicator that has had a considerable effect on public policy in Canada is the ratio of female to male earnings for full time, full year workers. In the 1970s this ratio was around 60 per cent. Many believed it reflected occupational segregation of women in low paying jobs as well as outright labour market discrimination against women. A number of measures were enacted to reduce the female wage gap such as employment equity and pay equity legislation. Women have also been encouraged to enter non-traditional occupations. The result has been that the female/male earnings ratio has increased significantly.

A third social indicator that has been the focus of social policy is the high school drop-out rate, which used to be around 30 per cent in Canada. The negative effect of this situation were increasingly recognized, both in terms of the poor labour market outcomes

of the non-completers and in the lack of well trained workers for employers. Public policy has vigorously tackled this issue and the drop-out rate has fallen considerably to around 12 per cent.

A very recent example of a social indicator having a major influence on public policy development is hospital waiting times, an important issue in a country with a universal health care system where access to scarce medical equipment and health practitioners is on a priority basis, not to the one willing to pay the highest price. The Fraser Institute, a conservative think tank, has been publishing waiting times for different types of medical procedures for over ten years. But it was only in 2004 that the issue of waiting time took on major public prominence when it has made an issue in the federal election. Once reelected, the Martin government acted on its campaign promise to greatly reduce waiting time and has allocated billions to provincial governments (the level of government directly responsible for health care in Canada) for the attainment of this objective. Now trends in waiting times are being monitored extremely closely throughout Canada.

C. Environmental Indicators

In the 2000 federal budget, the Minister of Finance Paul Martin asked the National Roundtable on the Environment and the Economy to develop in consultation with indicator experts a set of environmental indicators that he could use in future budget speeches to assess the performance of Canada in the environmental area. In 2003, the Roundtable released a report that put forward a small number of environmental indicators (air quality, water quality, wetlands, greenhouse gas emissions) for close monitoring by the federal government. The federal government has indicated that it will follow developments in these indicators closely, and take policy where necessary to ensure that there is no deterioration. Greenhouse gas emission is of course an environmental indicator of great importance because of Canada's ratification of the Kyoto Protocol.

D. Lessons from the Greater Use of Indicators for Public Policy

The use of indicators for public policy in Canada is a positive development for several reasons, as outlined below.

- First, when an indicator is accepted by the public as a laudable objective, the attainment of this indicator can be used to goad the government into action.

- Second, government commitment to a specific indicator allows the public to exactly know where the government stands and to reward or punish the government if the target for the indicator is made or missed.

- Third, a government's desire to articulate a set of indicators can foster intense and productive public debate about what kind of economy and society the population wants. Such debate is very healthy for democracy.

Indicators are politically neutral. They can be used for both progressive and non-progressive purposes, although what constitutes progress is often in the eye of the beholder.

The use of indicators for public policy of course requires that the indicators be well specified, meaningful, and based on reliable data both over time and across space. In general, the more specific and well-defined the indicator, the more useful it is. For this reason, composite indicators are much less useful for policy development than single indicators, although composite indicators may contain components that are very relevant.

Research can play two roles in the use of indicators for public policy initiatives to improve the well-being of Canadians. First, the choice of indicators can be greatly influenced by research findings. If, for example, research indicates that early childhood learning is important for later development, improvement in this stage of education can become a policy objective. Second, any strategy to attain these public policy objectives should draw on evidence-based research on the effectiveness of various programs and policies related to the attainment of these objectives accumulated both in Canada and in other countries.

The Government of Canada, like a number of other countries and political groupings (e.g. the European Community) has made much greater use of economic, social and environmental indicators in recent years both as a stimulus for policy development and to assess the effectiveness of public policy. This is in general a positive development. But the real issue is not just the use of indicators, but the choice of what indicators are to be used as targets or objectives for public policy. The use of quantitative indicators enriches the conduct of public policy, but in itself it does not make for better public policy and improved well-being. If the indicators are poorly chosen, even if the targets set for them are attained, citizens will not be better off.

V. Directions for Further Work and Conclusion

A. Steps for Better Understanding the Impact of Research on Well-being

Because there are many types of research undertaken by different types of organizations and for different purposes, and because there are so many different dimensions of well-being, it is very difficult, if not impossible, to develop a definitive framework capable of capturing all the impacts of research investments on well-being.

Nevertheless, an initiative to track or measure the impact of research investments on well-being might include the following four steps.

- Define the broad domains of well-being (e.g. social, economic, environmental, etc.) that are of particular interest, as well as sub-domains within the broad domains (e.g. within the social domain, health, child well-being, and education sub-domains might be of interest). A set of criteria for the selection of domains and sub-domains might be developed.

- Choose concrete indicators that best capture or give statistical expression to the domains or sub-domains of interest. The many indicators that have been highlighted in the measures of well-being surveyed by this report might be a point of departure for the identification of indicators considered of particular relevance.

- Identify research investments that influence or determine the indicators chosen and specify the paths whereby these research investments and the knowledge created affect the indicators. It is particularly important to identify the societal actors who influence the well-being indicators of interest and the knowledge flows between the actors and the creators of new knowledge that have the potential to positively affect the well-being indicator.

- Quantify the impact of particular research investments on the indicators of interest. This last step is by far the hardest. It can be very difficult just to disentangle empirically the role of the various factors that determine the state of an indicator. Quantifying the role of research and knowledge creation is likely even less manageable than quantifying the role of other determinants of well-being because of the factors that mediate the impact of research investments on well-being indicators. An additional problem is that causation is often two-way, not unidirectional between research investments and well-being indicators. Increased income generated by research investments in turn funds more research.

B. Conclusion

Given Canada's significant research investments, it would be useful to have an evaluation framework that links research investments to the various aspects of well-being of Canadians, as represented by a wide range of indicators. The main objective of this report hence has been to conduct a survey and assessment of various indicators used by organizations, both in Canada and abroad, to measure attributes and the well-being of society at the economic, health, environmental, social, and cultural levels.

The main conclusion of the report is that it is entirely feasible to assess the impact of research investments in Canada on various dimensions of well-being given the wealth of indicators that have been developed both in Canada and in other countries to measure well-being. But because of the many different types of research investments and dimensions of well-being as well as the complex relationships between research

investment and well-being outcomes, it is important to specify what particular research investments and what dimensions of well-being are of interest before empirical work is undertaken to estimate the impact of these research investments on well-being.

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List of Tables and Charts

Tables

Charts

Table 1: General Expenditures on Research and Development in Canada, by Performer, All Funders and Total (Natural Sciences, Engineering, Social Sciences and Humanities) Expenditures, 1971-2003

(millions of current dollars)

		Government Sector							
	Total	Total	Federal	Provincial (except PROs)	PROs	Business Enterprise Sector	Higher Education Sector	Private Non-Profit Sector	Nominal GDP
1971	1,285	426	383	34	9	413	436	10	98,429
1972	1,372	464	414	39	11	462	434	12	109,913
1973	1,470	505	450	41	14	503	449	13	128,956
1974	1,689	576	508	52	16	613	485	15	154,038
1975	1,901	617	545	53	19	700	568	16	173,621
1976	2,071	675	593	59	23	755	624	17	199,994
1977	2,322	731	638	66	27	857	713	21	220,973
1978	2,609	809	711	70	28	1,006	769	25	244,877
1979	3,044	830	717	80	33	1,266	921	27	279,577
1980	3,575	919	779	97	43	1,571	1,055	30	314,390
1981	4,415	1,078	916	109	53	2,124	1,177	36	360,471
1982	5,198	1,297	1,103	138	56	2,489	1,373	39	379,859
1983	5,517	1,420	1,219	141	60	2,602	1,452	43	411,386
1984	6,273	1,595	1,389	139	67	3,022	1,604	52	449,582
1985	6,985	1,569	1,356	134	79	3,635	1,722	59	485,714
1986	7,546	1,624	1,407	149	68	4,022	1,839	61	512,541
1987	7,950	1,611	1,383	151	77	4,341	1,934	64	558,949
1988	9,045	1,671	1,429	162	80	4,623	2,669	82	613,094
1989	9,517	1,805	1,533	188	84	4,779	2,844	89	657,728
1990	10,260	1,956	1,654	206	96	5,169	3,033	102	679,921
1991	10,767	2,013	1,685	238	90	5,355	3,289	110	685,367
1992	11,338	2,009	1,716	208	85	5,742	3,519	68	700,480
1993	12,184	2,026	1,757	192	77	6,424	3,660	74	727,184
1994	13,342	2,014	1,754	197	63	7,567	3,675	86	770,873
1995	13,754	1,981	1,727	186	68	7,991	3,691	91	810,426
1996	13,816	2,034	1,792	163	79	7,996	3,697	89	836,864
1997	14,636	1,934	1,720	156	58	8,741	3,879	82	882,733
1998	16,089	1,959	1,743	155	61	9,683	4,370	77	914,973
1999	17,638	2,092	1,859	173	60	10,401	5,082	63	982,441
2000	20,531	2,335	2,080	189	66	12,346	5,793	57	1,076,577
2001	22,733	2,410	2,103	284	23	13,847	6,424	52	1,108,200
2002	22,370	2,505	2,190	289	26	12,383	7,429	53	1,157,968
2003	23,293	2,561	2,239	296	26	12,343	8,321	68	1,218,772
2004	24,487	2,564	2,234	304	26	12,534	9,319	70	1,294,336
compound average annual growth rates									
1971-2003	9.48	5.77	5.67	7.00	3.37	11.20	9.65	6.17	8.18
1971-1981	13.14	9.73	9.11	12.36	19.40	17.79	10.44	13.67	13.86
1981-2003	7.85	4.01	4.15	4.65	-3.19	8.33	9.30	2.93	5.69
1981-1989	10.08	6.66	6.65	7.05	5.93	10.67	11.66	11.98	7.81
1989-2003	6.60	2.53	2.74	3.30	-8.04	7.01	7.97	-1.90	4.50
1989-1996	5.47	1.72	2.26	-2.02	-0.87	7.63	3.82	0.00	3.50
1996-2003	7.75	3.35	3.23	8.90	-14.68	6.40	12.29	-3.77	5.52

Source: CANSIM series v13682131, v617571, v617480, v617505, v617526, v617624, v617679, v617750, December 14, 2004. Data for 1998-2004 are taken from Statistics Canada Working Paper, Catalogue no. 88F0006XIE — No. 020, December 2004.

For R&D, data for 1971-2002 are actual expenditures, data for 2003 are preliminary estimates of expenditures, and data for 2004 are expenditure intentions. GDP for 2004 based on projections published in Annex 2 of the November 2004 *Economic and Fiscal Update* of Finance Canada.

PRO - Provincial Research Organization.

Table 2: Real General Expenditures on Research and Development in Canada, by Performer, All Funders and Total (Natural Sciences, Engineering, Social Sciences and Humanities) Expenditures, 1971-2003

(millions of chained 1997 dollars)

		Government Sector							
	Total	Total	Federal	Provincial (except PROs)	PROs	Business Enterprise Sector	Higher Education Sector	Private Non-Profit Sector	Real GDP
1971	5,299	1,757	1,579	140	37	1,703	1,798	41	405,860
1972	5,342	1,807	1,612	152	43	1,799	1,690	47	427,962
1973	5,218	1,793	1,597	146	50	1,786	1,594	46	457,766
1974	5,205	1,775	1,565	160	49	1,889	1,495	46	474,663
1975	5,292	1,718	1,517	148	53	1,949	1,581	45	483,316
1976	5,265	1,716	1,508	150	58	1,919	1,586	43	508,445
1977	5,528	1,740	1,519	157	64	2,040	1,697	50	526,028
1978	5,826	1,807	1,588	156	63	2,246	1,717	56	546,825
1979	6,180	1,685	1,456	162	67	2,570	1,870	55	567,631
1980	6,594	1,695	1,437	179	79	2,898	1,946	55	579,907
1981	7,352	1,795	1,525	182	88	3,537	1,960	60	600,253
1982	7,979	1,991	1,693	212	86	3,821	2,108	60	583,089
1983	8,032	2,067	1,775	205	87	3,788	2,114	63	598,941
1984	8,843	2,248	1,958	196	94	4,260	2,261	73	633,756
1985	9,550	2,145	1,854	183	108	4,970	2,354	81	664,059
1986	10,014	2,155	1,867	198	90	5,337	2,440	81	680,144
1987	10,085	2,044	1,754	192	98	5,507	2,453	81	709,058
1988	10,981	2,029	1,735	197	97	5,613	3,240	100	744,333
1989	11,052	2,096	1,780	218	98	5,550	3,303	103	763,837
1990	11,549	2,202	1,862	232	108	5,818	3,414	115	765,311
1991	11,771	2,201	1,842	260	98	5,854	3,596	120	749,294
1992	12,234	2,168	1,852	224	92	6,196	3,797	73	755,848
1993	12,960	2,155	1,869	204	82	6,833	3,893	79	773,528
1994	14,031	2,118	1,845	207	66	7,958	3,865	90	810,695
1995	14,145	2,037	1,776	191	70	8,218	3,796	94	833,456
1996	13,983	2,059	1,814	165	80	8,092	3,742	90	846,952
1997	14,636	1,934	1,720	156	58	8,741	3,879	82	882,733
1998	16,158	1,967	1,750	156	61	9,725	4,389	77	918,910
1999	17,410	2,065	1,835	171	59	10,267	5,016	62	969,750
2000	19,461	2,213	1,972	179	63	11,703	5,491	54	1,020,488
2001	21,310	2,259	1,971	266	22	12,980	6,022	49	1,038,845
2002	20,760	2,325	2,032	268	24	11,492	6,894	49	1,074,621
2003	20,953	2,304	2,014	266	23	11,103	7,485	61	1,096,359
2004	21,364	2,237	1,949	265	23	10,935	8,130	61	1,129,250
compound average annual growth rates									
1971-2003	4.39	0.85	0.76	2.02	-1.43	6.03	4.56	1.24	3.15
1971-1981	3.33	0.22	-0.35	2.62	9.05	7.58	0.87	3.81	3.99
1981-2003	4.88	1.14	1.27	1.76	-5.86	5.34	6.28	0.09	2.78
1981-1989	5.23	1.96	1.95	2.34	1.26	5.79	6.74	7.05	3.06
1989-2003	4.67	0.68	0.89	1.43	-9.70	5.08	6.02	-3.68	2.62
1989-1996	3.42	-0.26	0.26	-3.92	-2.80	5.54	1.80	-1.95	1.49
1996-2003	5.95	1.62	1.51	7.08	-16.10	4.62	10.41	-5.38	3.76

Source: Table 1, deflated by the chained expenditure-based GDP deflator, calculated from CANSIM series v646937 and v3860085, December 14, 2004. GDP for 2004 based on projections published in Annex 2 of the November 2004 *Economic and Fiscal Update* of Finance Canada.

PRO - Provincial Research Organization.

Table 3: Intensity of Expenditures on Research and Development in Canada, by Performer, All Funders and Total (Natural Sciences, Engineering, Social Sciences and Humanities) Expenditures, 1971-2003

(current R&D expenditures as a proportion of current dollar total GDP)

		Government Sector						
	Total	Total	Federal	Provincial (except PROs)	PROs	Business Enterprise Sector	Higher Education Sector	Private Non-Profit Sector
1971	1.31	0.43	0.39	0.03	0.01	0.42	0.44	0.01
1972	1.25	0.42	0.38	0.04	0.01	0.42	0.39	0.01
1973	1.14	0.39	0.35	0.03	0.01	0.39	0.35	0.01
1974	1.10	0.37	0.33	0.03	0.01	0.40	0.31	0.01
1975	1.09	0.36	0.31	0.03	0.01	0.40	0.33	0.01
1976	1.04	0.34	0.30	0.03	0.01	0.38	0.31	0.01
1977	1.05	0.33	0.29	0.03	0.01	0.39	0.32	0.01
1978	1.07	0.33	0.29	0.03	0.01	0.41	0.31	0.01
1979	1.09	0.30	0.26	0.03	0.01	0.45	0.33	0.01
1980	1.14	0.29	0.25	0.03	0.01	0.50	0.34	0.01
1981	1.22	0.30	0.25	0.03	0.01	0.59	0.33	0.01
1982	1.37	0.34	0.29	0.04	0.01	0.66	0.36	0.01
1983	1.34	0.35	0.30	0.03	0.01	0.63	0.35	0.01
1984	1.40	0.35	0.31	0.03	0.01	0.67	0.36	0.01
1985	1.44	0.32	0.28	0.03	0.02	0.75	0.35	0.01
1986	1.47	0.32	0.27	0.03	0.01	0.78	0.36	0.01
1987	1.42	0.29	0.25	0.03	0.01	0.78	0.35	0.01
1988	1.48	0.27	0.23	0.03	0.01	0.75	0.44	0.01
1989	1.45	0.27	0.23	0.03	0.01	0.73	0.43	0.01
1990	1.51	0.29	0.24	0.03	0.01	0.76	0.45	0.02
1991	1.57	0.29	0.25	0.03	0.01	0.78	0.48	0.02
1992	1.62	0.29	0.24	0.03	0.01	0.82	0.50	0.01
1993	1.68	0.28	0.24	0.03	0.01	0.88	0.50	0.01
1994	1.73	0.26	0.23	0.03	0.01	0.98	0.48	0.01
1995	1.70	0.24	0.21	0.02	0.01	0.99	0.46	0.01
1996	1.65	0.24	0.21	0.02	0.01	0.96	0.44	0.01
1997	1.66	0.22	0.19	0.02	0.01	0.99	0.44	0.01
1998	1.76	0.21	0.19	0.02	0.01	1.06	0.48	0.01
1999	1.80	0.21	0.19	0.02	0.01	1.06	0.52	0.01
2000	1.91	0.22	0.19	0.02	0.01	1.15	0.54	0.01
2001	2.05	0.22	0.19	0.03	0.00	1.25	0.58	0.00
2002	1.93	0.22	0.19	0.02	0.00	1.07	0.64	0.00
2003	1.91	0.21	0.18	0.02	0.00	1.01	0.68	0.01
2004	1.89	0.20	0.17	0.02	0.00	0.97	0.72	0.01
compound average annual growth rates								
1971-2003	1.20	-2.23	-2.32	-1.09	-4.45	2.79	1.36	-1.86
1971-1981	-0.64	-3.63	-4.17	-1.32	4.86	3.45	-3.00	-0.17
1981-2003	2.04	-1.59	-1.46	-0.99	-8.40	2.49	3.41	-2.61
1981-1989	2.11	-1.07	-1.07	-0.70	-1.75	2.65	3.57	3.87
1989-2003	2.01	-1.89	-1.69	-1.16	-12.00	2.40	3.32	-6.13
1989-1996	1.90	-1.72	-1.20	-5.33	-4.23	3.99	0.31	-3.38
1996-2003	2.11	-2.06	-2.17	3.20	-19.14	0.84	6.42	-8.80

Source: Table 1, divided by current dollar expenditure-based GDP, from CANSIM series v646937, December 14, 2004. GDP for 2004 based on projections published in Annex 2 of the November 2004 *Economic and Fiscal Update* of Finance Canada.
PRO - Provincial Research Organization.

Table 4: Expenditures on Research and Development in Canada, by Performer, All Funders and Total (Natural Sciences, Engineering, Social Sciences and Humanities) Expenditures, 1971-2003

(R&D expenditures by funder as a proportion of total R&D expenditure)

%		Government Sector						
	Total	Total	Federal	Provincial (except PROs)	PROs	Business Enterprise Sector	Higher Education Sector	Private Non-Profit Sector
1971	100.00	33.15	29.81	2.65	0.70	32.14	33.93	0.78
1972	100.00	33.82	30.17	2.84	0.80	33.67	31.63	0.87
1973	100.00	34.35	30.61	2.79	0.95	34.22	30.54	0.88
1974	100.00	34.10	30.08	3.08	0.95	36.29	28.72	0.89
1975	100.00	32.46	28.67	2.79	1.00	36.82	29.88	0.84
1976	100.00	32.59	28.63	2.85	1.11	36.46	30.13	0.82
1977	100.00	31.48	27.48	2.84	1.16	36.91	30.71	0.90
1978	100.00	31.01	27.25	2.68	1.07	38.56	29.47	0.96
1979	100.00	27.27	23.55	2.63	1.08	41.59	30.26	0.89
1980	100.00	25.71	21.79	2.71	1.20	43.94	29.51	0.84
1981	100.00	24.42	20.75	2.47	1.20	48.11	26.66	0.82
1982	100.00	24.95	21.22	2.65	1.08	47.88	26.41	0.75
1983	100.00	25.74	22.10	2.56	1.09	47.16	26.32	0.78
1984	100.00	25.43	22.14	2.22	1.07	48.17	25.57	0.83
1985	100.00	22.46	19.41	1.92	1.13	52.04	24.65	0.84
1986	100.00	21.52	18.65	1.97	0.90	53.30	24.37	0.81
1987	100.00	20.26	17.40	1.90	0.97	54.60	24.33	0.81
1988	100.00	18.47	15.80	1.79	0.88	51.11	29.51	0.91
1989	100.00	18.97	16.11	1.98	0.88	50.22	29.88	0.94
1990	100.00	19.06	16.12	2.01	0.94	50.38	29.56	0.99
1991	100.00	18.70	15.65	2.21	0.84	49.74	30.55	1.02
1992	100.00	17.72	15.13	1.83	0.75	50.64	31.04	0.60
1993	100.00	16.63	14.42	1.58	0.63	52.72	30.04	0.61
1994	100.00	15.10	13.15	1.48	0.47	56.72	27.54	0.64
1995	100.00	14.40	12.56	1.35	0.49	58.10	26.84	0.66
1996	100.00	14.72	12.97	1.18	0.57	57.87	26.76	0.64
1997	100.00	13.21	11.75	1.07	0.40	59.72	26.50	0.56
1998	100.00	12.18	10.83	0.96	0.38	60.18	27.16	0.48
1999	100.00	11.86	10.54	0.98	0.34	58.97	28.81	0.36
2000	100.00	11.37	10.13	0.92	0.32	60.13	28.22	0.28
2001	100.00	10.60	9.25	1.25	0.10	60.91	28.26	0.23
2002	100.00	11.20	9.79	1.29	0.12	55.36	33.21	0.24
2003	100.00	10.99	9.61	1.27	0.11	52.99	35.72	0.29
2004	100.00	10.47	9.12	1.24	0.11	51.19	38.06	0.29
compound average annual growth rates								
1971-2003	0.00	-3.39	-3.47	-2.27	-5.58	1.57	0.16	-3.02
1971-1981	0.00	-3.01	-3.56	-0.69	5.54	4.12	-2.38	0.47
1981-2003	0.00	-3.56	-3.44	-2.97	-10.23	0.44	1.34	-4.56
1981-1989	0.00	-3.11	-3.11	-2.75	-3.77	0.54	1.44	1.73
1989-2003	0.00	-3.82	-3.62	-3.10	-13.73	0.38	1.28	-7.98
1989-1996	0.00	-3.55	-3.05	-7.10	-6.01	2.05	-1.57	-5.19
1996-2003	0.00	-4.08	-4.19	1.07	-20.81	-1.25	4.21	-10.69

Source: Calculated from Table 1.

PRO - Provincial Research Organization.

Table 5: Intensity of Expenditures on Research and Development in Canada, by Funder, All Performers and Total (Natural Sciences, Engineering, Social Sciences and Humanities) Expenditures, 1971-2003

(R&D expenditures as a proportion of total GDP)

		Government Sector						
	Foreign Sector	Total	Federal	Provincial (except PROs)	PROs	Business Enterprise Sector	Higher Education Sector	Private Non-Profit Sector
1971	0.03	0.68	0.60	0.08	0.00	0.34	0.23	0.04
1972	0.03	0.65	0.57	0.08	0.00	0.34	0.19	0.04
1973	0.02	0.60	0.52	0.08	0.00	0.32	0.16	0.04
1974	0.02	0.56	0.48	0.07	0.00	0.33	0.15	0.03
1975	0.03	0.53	0.46	0.07	0.00	0.34	0.17	0.03
1976	0.03	0.50	0.43	0.07	0.00	0.31	0.17	0.03
1977	0.03	0.50	0.42	0.08	0.00	0.32	0.17	0.03
1978	0.03	0.50	0.42	0.08	0.00	0.34	0.16	0.04
1979	0.03	0.46	0.38	0.07	0.00	0.39	0.18	0.03
1980	0.03	0.46	0.38	0.08	0.00	0.44	0.18	0.03
1981	0.05	0.49	0.41	0.08	0.00	0.50	0.16	0.03
1982	0.07	0.57	0.47	0.10	0.00	0.52	0.19	0.03
1983	0.11	0.57	0.48	0.09	0.00	0.46	0.17	0.03
1984	0.12	0.59	0.50	0.09	0.00	0.49	0.17	0.03
1985	0.11	0.56	0.47	0.09	0.00	0.57	0.17	0.03
1986	0.11	0.55	0.46	0.09	0.00	0.60	0.18	0.03
1987	0.13	0.52	0.43	0.09	0.00	0.58	0.16	0.03
1988	0.14	0.50	0.41	0.09	0.00	0.56	0.24	0.03
1989	0.13	0.49	0.40	0.09	0.00	0.55	0.24	0.03
1990	0.14	0.51	0.42	0.09	0.00	0.58	0.24	0.03
1991	0.15	0.53	0.43	0.10	0.00	0.60	0.25	0.04
1992	0.15	0.54	0.44	0.09	0.00	0.63	0.27	0.03
1993	0.16	0.53	0.43	0.09	0.00	0.69	0.26	0.04
1994	0.19	0.49	0.40	0.09	0.00	0.76	0.25	0.04
1995	0.20	0.45	0.37	0.08	0.00	0.78	0.24	0.04
1996	0.20	0.41	0.34	0.08	0.00	0.76	0.23	0.04
1997	0.20	0.39	0.32	0.07	0.00	0.80	0.22	0.04
1998	0.28	0.38	0.31	0.07	0.00	0.80	0.26	0.04
1999	0.28	0.41	0.33	0.08	0.00	0.81	0.27	0.04
2000	0.33	0.41	0.33	0.08	0.00	0.83	0.27	0.04
2001	0.26	0.46	0.36	0.10	0.00	0.96	0.27	0.05
2002	0.22	0.47	0.37	0.10	0.00	0.85	0.28	0.05
2003	0.22	0.46	0.36	0.10	0.00	0.82	0.30	0.05
compound average annual growth rates								
1971-2003	6.91	-1.18	-1.59	0.91		2.81	0.79	0.97
1971-1981	6.32	-3.11	-3.74	0.62		4.03	-3.61	-3.55
1981-2003	7.19	-0.30	-0.59	1.04		2.26	2.86	3.09
1981-1989	13.41	0.02	-0.20	1.30	-27.27	1.31	5.23	2.16
1989-2003	3.78	-0.48	-0.82	0.89		2.81	1.53	3.63
1989-1996	4.87	-1.56	-1.61	-1.26		4.84	-0.24	1.61
1996-2003	0.75	1.65	0.92	4.61		0.95	3.80	2.99

Source: Table 6, divided by current dollar expenditure-based GDP, from CANSIM series v646937, December 14, 2004.

PRO - Provincial Research Organization.

Table 6: Expenditures on Research and Development in Canada, by Funder, All Performers and Total (Natural Sciences, Engineering, Social Sciences and Humanities) Expenditures, 1971-2003

(R&D expenditures by funder as a proportion of total R&D expenditure)

		Government Sector						
	Foreign Sector	Total	Federal	Provincial (except PROs)	PROs	Business Enterprise Sector	Higher Education Sector	Private Non-Profit Sector
1971	1.95	51.75	45.84	5.91	0.00	25.76	17.59	2.96
1972	2.11	52.19	45.55	6.63	0.00	27.19	15.45	3.06
1973	2.18	52.52	45.78	6.73	0.00	27.82	14.29	3.20
1974	2.07	50.86	44.05	6.75	0.06	30.25	13.68	3.14
1975	2.58	48.34	41.71	6.47	0.16	30.62	15.47	3.00
1976	2.41	48.48	41.28	7.15	0.05	30.18	16.03	2.90
1977	2.76	47.67	40.31	7.32	0.04	30.23	16.49	2.84
1978	2.87	46.65	39.40	7.17	0.08	32.16	14.95	3.37
1979	2.69	41.89	34.95	6.83	0.10	36.27	16.66	2.50
1980	2.83	40.39	33.43	6.88	0.08	38.94	15.61	2.24
1981	3.83	40.23	33.36	6.70	0.16	40.77	12.98	2.20
1982	5.35	41.30	34.15	7.12	0.04	37.92	13.60	1.83
1983	8.07	42.83	35.83	6.98	0.02	34.66	12.42	2.03
1984	8.46	42.64	36.11	6.49	0.05	34.99	11.97	1.93
1985	7.59	38.88	32.68	6.10	0.10	39.54	12.04	1.95
1986	7.45	37.61	31.38	6.22	0.01	40.95	12.11	1.88
1987	9.40	36.42	30.33	6.06	0.03	40.59	11.43	2.16
1988	9.53	34.01	28.02	5.96	0.03	37.77	16.38	2.31
1989	8.87	34.11	27.80	6.29	0.01	38.30	16.52	2.21
1990	9.25	34.11	27.87	6.24	0.01	38.60	15.77	2.27
1991	9.41	33.83	27.36	6.45	0.01	38.20	16.09	2.48
1992	9.25	33.10	27.42	5.67	0.01	39.20	16.47	1.98
1993	9.60	31.36	25.90	5.46	0.00	41.24	15.53	2.27
1994	11.23	28.17	23.20	4.97	0.00	44.03	14.35	2.23
1995	11.56	26.47	21.73	4.74	0.00	45.72	14.00	2.25
1996	12.41	24.92	20.37	4.55	0.00	46.29	13.79	2.59
1997	12.26	23.72	19.23	4.49	0.01	48.05	13.47	2.51
1998	15.88	21.58	17.60	3.97	0.00	45.68	14.55	2.31
1999	15.33	22.61	18.24	4.35	0.02	44.88	15.02	2.16
2000	17.71	21.80	17.49	4.31	0.00	44.10	14.20	2.19
2001	12.87	23.00	18.07	4.92	0.00	48.25	13.47	2.41
2002	12.00	24.92	19.54	5.39	0.00	45.30	15.09	2.69
2003	11.71	25.05	19.46	5.59	0.00	44.33	16.05	2.86
compound average annual growth rates								
1971-2003	5.77	-2.24	-2.64	-0.17		1.71	-0.29	-0.11
1971-1981	7.00	-2.49	-3.13	1.26		4.70	-2.99	-2.93
1981-2003	5.22	-2.13	-2.42	-0.82		0.38	0.97	1.20
1981-1989	11.07	-2.04	-2.25	-0.79	-28.77	-0.78	3.06	0.05
1989-2003	2.01	-2.18	-2.52	-0.84		1.05	-0.21	1.86
1989-1996	2.80	-3.52	-3.56	-3.22		2.77	-2.22	-0.40
1996-2003	-0.82	0.07	-0.65	2.99		-0.62	2.19	1.40

Source: CANSIM series v13682131, v13682133, v13682135, v13682137, v13682139, v13682141, v13682143, v13682145, v13682147, December 14, 2004.

PRO - Provincial Research Organization.

Table 7: General Expenditures on Research and Development in Canada, by Type of Expenditure, All Performers and All Funders, 1971-2003

	(millions of current dollars)			(millions of 1997 chained dollars)			(% of nominal GDP)		
	Total	Natural Sciences and Engineering	Social Sciences and Humanities	Total	Natural Sciences and Engineering	Social Sciences and Humanities	Total	Natural Sciences and Engineering	Social Sciences and Humanities
1971	1,285	1,124	161	5,299	4,635	664	1.31	1.14	0.16
1972	1,372	1,210	162	5,342	4,711	631	1.25	1.10	0.15
1973	1,470	1,304	166	5,218	4,629	589	1.14	1.01	0.13
1974	1,689	1,497	192	5,205	4,613	592	1.10	0.97	0.12
1975	1,901	1,676	225	5,292	4,666	626	1.09	0.97	0.13
1976	2,071	1,822	249	5,265	4,632	633	1.04	0.91	0.12
1977	2,322	2,040	282	5,528	4,856	671	1.05	0.92	0.13
1978	2,609	2,319	290	5,826	5,178	648	1.07	0.95	0.12
1979	3,044	2,728	316	6,180	5,539	642	1.09	0.98	0.11
1980	3,575	3,216	359	6,594	5,932	662	1.14	1.02	0.11
1981	4,415	4,020	395	7,352	6,694	658	1.22	1.12	0.11
1982	5,198	4,728	470	7,979	7,258	721	1.37	1.24	0.12
1983	5,517	5,023	494	8,032	7,313	719	1.34	1.22	0.12
1984	6,273	5,756	517	8,843	8,114	729	1.40	1.28	0.11
1985	6,985	6,433	552	9,550	8,795	755	1.44	1.32	0.11
1986	7,546	6,964	582	10,014	9,241	772	1.47	1.36	0.11
1987	7,950	7,338	612	10,085	9,309	776	1.42	1.31	0.11
1988	9,045	8,358	687	10,981	10,147	834	1.48	1.36	0.11
1989	9,517	8,803	714	11,052	10,223	829	1.45	1.34	0.11
1990	10,260	9,514	746	11,549	10,709	840	1.51	1.40	0.11
1991	10,767	9,974	793	11,771	10,904	867	1.57	1.46	0.12
1992	11,338	10,512	826	12,234	11,343	891	1.62	1.50	0.12
1993	12,184	11,363	821	12,960	12,087	873	1.68	1.56	0.11
1994	13,342	12,527	815	14,031	13,174	857	1.73	1.63	0.11
1995	13,754	12,944	810	14,145	13,312	833	1.70	1.60	0.10
1996	13,816	13,018	798	13,983	13,175	808	1.65	1.56	0.10
1997	14,636	13,810	826	14,636	13,810	826	1.66	1.56	0.09
1998	16,089	15,084	1,005	16,158	15,149	1,009	1.76	1.65	0.11
1999	17,638	16,469	1,169	17,410	16,256	1,154	1.80	1.68	0.12
2000	20,531	19,223	1,308	19,461	18,221	1,240	1.91	1.79	0.12
2001	22,733	21,344	1,389	21,310	20,008	1,302	2.05	1.93	0.13
2002	22,370	20,813	1,557	20,760	19,315	1,445	1.93	1.80	0.13
2003	23,293	21,557	1,736	20,953	19,392	1,562	1.91	1.77	0.14
2004	24,487	22,556	1,931	21,364	19,679	1,685	1.89	1.74	0.15
compound average annual growth rates									
1971-2003	9.48	9.67	7.71	4.39	4.57	2.71	1.20	1.38	-0.43
1971-1981	13.14	13.59	9.39	3.33	3.74	-0.09	-0.64	-0.24	-3.93
1981-2003	7.85	7.93	6.96	4.88	4.95	4.01	2.04	2.12	1.20
1981-1989	10.08	10.29	7.68	5.23	5.44	2.94	2.11	2.31	-0.12
1989-2003	6.60	6.61	6.55	4.67	4.68	4.63	2.01	2.01	1.96
1989-1996	5.47	5.75	1.60	3.68	3.95	-0.02	2.02	2.29	-1.62
1996-2003	7.75	7.47	11.74	5.95	5.68	9.88	2.11	1.85	5.90

Source: CANSIM series v13682130 and v13682131,
December 14, 2004. Data for 1998-2004 are taken from Statistics Canada
Working Paper, Catalogue no. 88F0006XIE — No. 020, December 2004.
For R&D, data for 1971-2002 are actual expenditures, data for 2003 are preliminary estimates of expenditures,
and data for 2004 are expenditure intentions. GDP for 2004 based on projections published in
Annex 2 of the November 2004 *Economic and Fiscal Update* of Finance Canada.
Real R&D calculated by deflating nominal R&D by the GDP deflator. Nominal and real GDP
from CANSIM series v646937 and v3860085, December 14, 2004.
PRO - Provincial Research Organization.

Table 8: Federal Government Research and Development Funding by Budget Objective in Canada, 1981-2001 (millions of current U.S. dollars at Purchasing Power Parity)

	Total Federal Govern-ment R&D	Economic Develop-ment R&D	Health and Environ-ment R&D	Space Program	"Non-Oriented" R&D	General University	Defence R&D
1981	1,801.2	682.9	288.5		334.6	397.0	99.1
1982	2,055.8	732.5	328.7		406.3	469.7	119.2
1983	2,243.7	822.1	371.9		470.8	448.6	130.1
1984	2,476.9	901.3	446.5		523.5	448.2	158.5
1985	2,534.7	930.2	450.6		483.7	497.0	172.4
1986	2,633.9	929.2	491.8		490.9	540.3	181.7
1987	2,526.0	956.1	382.8	46.0	359.4	528.9	197.0
1988	2,671.3	986.9	435.9	69.6	381.5	519.1	221.7
1989	3,238.9	1,029.9	471.8	106.2	409.1	943.5	217.0
1990	3,414.3	1,083.6	509.9	101.3	471.6	964.7	218.5
1991	3,706.5	1,251.3	512.1	266.5	464.7	1,024.1	189.0
1992	3,900.0	1,269.5	537.5	291.8	486.4	1,109.8	206.7
1993	3,983.1	1,339.1	569.8	310.7	482.4	1,089.8	191.2
1994	4,021.0	1,374.1	599.6	266.4	493.2	1,094.5	193.0
1995	3,815.0	1,219.9	766.6	270.6	225.4	1,061.9	179.3
1996	3,632.1	1,198.9	729.4	244.2	207.1	997.6	174.3
1997	3,653.8	1,214.1	711.5	219.8	238.0	1,000.9	208.3
1998	4,105.4	1,233.1	849.9	317.5	238.4	1,189.3	217.6
1999	4,439.0	1,286.5	944.7	295.6	340.9	1,277.3	239.7
2000	4,645.5	1,385.2	1,073.6	308.4	278.7	1,325.1	223.0
2001	5,403.4	1,729.5	1,270.8	334.2	390.2	1,387.8	232.3
compound average annual growth rates							
1981-2001	5.65	4.76	7.70		0.77	6.46	4.35
1981-1989	7.61	5.27	6.34		2.54	11.43	10.30
1989-2001	4.36	4.41	8.61	10.02	-0.39	3.27	0.57
1989-1996	1.65	2.19	6.42	12.63	-9.27	0.80	-3.08
1996-2001	8.27	7.60	11.74	6.48	13.51	6.83	5.91

Source: OECD, *Main Science and Technology Indicators* , December 2004.
Note: Various comparability and data issues exist, as discussed in the MSTI documentation.
Defence R&D calculated as the percentage of defence R&D in total government R&D mutiplied by total government R&D. Data do not round exactly to total due to rounding.
Non-oriented R&D refers to spending on research for general knowledge.

Table 9: Federal Government Research and Development Funding by Budget Objective in Canada, 1981-2001 (as a per cent of total federal government R&D funding)

	Total Federal Govern-ment R&D	Economic Develop-ment R&D	Health and Environ-ment R&D	Space Program	"Non-Oriented" R&D	General University	Defence R&D
1981	100.0	37.9	16.0		18.6	22.0	5.5
1982	100.0	35.6	16.0		19.8	22.8	5.8
1983	100.0	36.6	16.6		21.0	20.0	5.8
1984	100.0	36.4	18.0		21.1	18.1	6.4
1985	100.0	36.7	17.8		19.1	19.6	6.8
1986	100.0	35.3	18.7		18.6	20.5	6.9
1987	100.0	37.9	15.2	1.8	14.2	20.9	7.8
1988	100.0	36.9	16.3	2.6	14.3	19.4	8.3
1989	100.0	31.8	14.6	3.3	12.6	29.1	6.7
1990	100.0	31.7	14.9	3.0	13.8	28.3	6.4
1991	100.0	33.8	13.8	7.2	12.5	27.6	5.1
1992	100.0	32.6	13.8	7.5	12.5	28.5	5.3
1993	100.0	33.6	14.3	7.8	12.1	27.4	4.8
1994	100.0	34.2	14.9	6.6	12.3	27.2	4.8
1995	100.0	32.0	20.1	7.1	5.9	27.8	4.7
1996	100.0	33.0	20.1	6.7	5.7	27.5	4.8
1997	100.0	33.2	19.5	6.0	6.5	27.4	5.7
1998	100.0	30.0	20.7	7.7	5.8	29.0	5.3
1999	100.0	29.0	21.3	6.7	7.7	28.8	5.4
2000	100.0	29.8	23.1	6.6	6.0	28.5	4.8
2001	100.0	32.0	23.5	6.2	7.2	25.7	4.3
compound average annual growth rates							
1981-2001	0.00	-0.84	1.94		-4.61	0.77	-1.22
1981-1989	0.00	-2.17	-1.18		-4.71	3.55	2.50
1989-2001	0.00	0.05	4.07	5.43	-4.55	-1.04	-3.63
1989-1996	0.00	0.54	4.69	10.80	-10.74	-0.84	-4.65
1996-2001	0.00	-0.61	3.21	-1.66	4.84	-1.33	-2.18

Source: Calculated from Table 8.
Note: Data do not round exactly to total due to rounding.
Non-oriented R&D refers to spending on research for general knowledge.

Table 10: General Expenditures on Research and Development in Canada, by Province, Total (Natural Sciences, Engineering, Social Sciences and Humanities) Expenditures, 1979-2001

(proportion of total R&D spending in Canada)

%

	Canada	NF	PEI	NS	NB	At. Can.	Que.*	ON*	NCR	Man.	Sask.	Alb.	BC	Territories
1979	100.00	0.79	0.16	2.56	2.04	5.55	19.19	35.87	9.03	2.83	2.17	9.10	5.45	0.43
1980	100.00	0.78	0.14	2.32	0.98	4.22	18.74	36.70	8.67	3.27	2.27	9.82	5.76	0.50
1981	100.00	0.86	0.16	2.06	0.84	3.92	18.62	37.76	8.27	3.08	1.93	10.67	6.02	0.79
1982	100.00	0.92	0.13	2.08	0.90	4.04	18.41	39.25	7.73	3.12	2.29	10.00	5.75	0.37
1983	100.00	1.27	0.13	2.63	0.78	4.80	18.00	40.55	7.29	3.44	2.25	8.45	6.00	0.27
1984	100.00	0.94	0.16	2.55	0.78	4.43	19.77	39.58	8.07	3.25	2.15	8.15	6.06	0.30
1985	100.00	0.99	0.13	2.42	1.30	4.84	22.85	44.51	6.41	2.86	2.49	8.86	6.99	0.19
1986	100.00	0.81	0.33	2.37	1.10	4.61	22.02	45.92	7.08	2.64	2.33	8.44	6.96	0.07
1987	100.00	0.88	0.18	2.14	1.12	4.31	23.66	46.38	7.76	2.36	2.13	7.26	6.09	0.05
1988	100.00	1.02	0.14	3.00	1.68	5.84	23.13	44.88	7.36	2.56	1.95	7.29	6.83	0.14
1989	100.00	1.04	0.17	2.47	1.69	5.37	24.35	44.38	6.97	2.63	1.99	7.21	7.04	0.08
1990	100.00	1.00	0.16	2.30	1.31	4.77	25.28	43.31	6.93	2.56	1.96	7.61	7.52	0.05
1991	100.00	0.98	0.15	2.23	1.12	4.49	26.59	42.87	6.81	2.64	2.01	7.33	7.26	0.01
1992	100.00	0.97	0.12	2.06	1.08	4.22	27.46	42.49	6.64	2.48	2.07	6.87	7.75	0.01
1993	100.00	0.91	0.14	2.01	1.07	4.13	27.04	43.75	6.35	2.43	1.91	6.85	7.52	0.02
1994	100.00	0.82	0.13	1.99	1.00	3.93	26.20	44.53	5.91	2.34	1.78	7.23	8.00	0.07
1995	100.00	0.73	0.12	1.92	1.02	3.79	26.82	44.70	5.86	2.17	1.83	7.06	7.76	0.01
1996	100.00	0.75	0.12	1.86	1.08	3.81	27.50	44.78	5.57	2.12	1.67	7.27	7.25	0.04
1997	100.00	0.70	0.11	1.76	0.87	3.44	26.87	46.39	5.23	1.82	1.94	7.17	7.09	0.04
1998	100.00	0.74	0.14	1.93	0.98	3.79	26.90	46.36	5.04	1.86	1.73	7.36	6.92	0.03
1999	100.00	0.72	0.15	1.96	0.94	3.77	27.71	45.92	4.58	2.18	1.83	6.60	7.36	0.05
2000	100.00	0.68	0.18	1.81	0.79	3.45	27.47	46.31	4.37	2.02	1.84	6.56	7.94	0.04
2001	100.00	0.64	0.16	1.65	0.70	3.15	27.85	46.56	4.19	2.05	1.77	6.83	7.59	0.02
compound average annual growth rates														
1979-2001	0.00	-0.93	-0.17	-1.98	-4.76	-2.55	1.71	1.19	-3.44	-1.45	-0.92	-1.29	1.52	-13.39
1979-1981	0.00	4.48	-1.75	-10.31	-35.86	-15.99	-1.49	2.59	-4.34	4.42	-5.77	8.27	5.11	36.24
1981-2001	0.00	-1.45	-0.01	-1.11	-0.92	-1.09	2.03	1.05	-3.34	-2.02	-0.43	-2.20	1.16	-17.22
1981-1989	0.00	2.40	0.74	2.28	9.18	4.02	3.41	2.04	-2.12	-1.97	0.39	-4.78	1.97	-24.46
1989-2001	0.00	-3.94	-0.50	-3.30	-7.13	-4.35	1.13	0.40	-4.15	-2.05	-0.96	-0.45	0.63	-12.02
1989-1996	0.00	-4.52	-5.19	-3.97	-6.23	-4.79	1.76	0.13	-3.16	-3.01	-2.43	0.12	0.41	-11.34
1996-2001	0.00	-3.13	6.44	-2.36	-8.38	-3.74	0.25	0.78	-5.53	-0.69	1.12	-1.23	0.94	-12.95

Source: CANSIM series v13682131, v13682149, v13682181, v13682213, v13682245, v13682277, v13682309, v13682485, v13682341, v13682373, v13682405, v13682437, v13682469, December 21, 2004. Data may not sum exactly to 100 per cent due to rounding.

* Data for Ontario and Quebec exclude the NCR (National Capital Region).

Table 11: Research and Development Expenditure as a Proportion of GDP in OECD and Other Selected Countries, 1981-2003 (per cent)

	Australia	Austria	Belgium	Canada	Czech Republic	Denmark	Finland	France	Germany	Greece	Hungary	Iceland	Ireland
1981	0.94	1.13		1.24		1.06	1.18	1.93	2.43	0.17		0.64	0.68
1982		1.17		1.39		1.10		2.02	2.50				0.67
1983		1.19	1.56	1.36		1.15	1.34	2.06	2.50			0.68	0.65
1984	1.07	1.24	1.57	1.40		1.18	1.47	2.16	2.50			0.73	0.71
1985		1.24	1.62	1.44		1.21	1.56	2.22	2.68			0.74	0.77
1986	1.24	1.28	1.63	1.48		1.29	1.66	2.21	2.70	0.27		0.72	0.83
1987	1.19	1.29	1.64	1.43		1.38	1.74	2.24	2.80			0.76	0.83
1988	1.22	1.33	1.59	1.40		1.46	1.77	2.24	2.79	0.30			0.80
1989		1.35	1.65	1.47		1.51	1.81	2.29	2.79	0.37		1.02	0.80
1990	1.31	1.39		1.53		1.57	1.88	2.37	2.67		1.46	0.99	0.83
1991		1.47	1.62	1.60	2.02	1.64	2.04	2.37	2.52	0.36	1.06	1.17	0.93
1992	1.52	1.45		1.64	1.72	1.68	2.13	2.38	2.40		1.04	1.35	1.04
1993		1.47	1.70	1.70	1.21	1.74	2.16	2.40	2.33	0.47	0.97	1.36	1.17
1994	1.58	1.54	1.69	1.76	1.10		2.29	2.34	2.24		0.88	1.41	1.27
1995		1.56	1.72	1.72	1.01	1.84	2.28	2.31	2.25	0.49	0.73	1.57	1.28
1996	1.66	1.60	1.80	1.68	1.04	1.85	2.54	2.30	2.25		0.65		1.32
1997		1.71	1.87	1.68	1.16	1.94	2.71	2.22	2.29	0.51	0.72	1.88	1.28
1998	1.51	1.78	1.90	1.79	1.24	2.06	2.88	2.17	2.31		0.68	2.07	1.25
1999		1.86	1.96	1.82	1.24	2.19	3.23	2.18	2.44	0.67	0.69	2.38	1.19
2000	1.54	1.86	2.04	1.92	1.33		3.40	2.18	2.49		0.80	2.75	1.15
2001		1.92	2.17	2.03	1.30	2.40	3.41	2.23	2.51	0.65	0.95	3.06	1.15
2002		1.93		1.91	1.30	2.52	3.46	2.20	2.52		1.02	3.09	
2003		1.94		1.87					2.50				

Source: OECD, *Main Science and Technology Indicators* , December 2004.
Note: Various comparability and data issues exist, as discussed in the MSTI documentation.

Table 11: Research and Development Expenditure as a Proportion of GDP in OECD and Other Selected Countries, 1981-2003 (per cent) (cont.)

	Italy	Japan	Korea	Luxem-bourg	Mexico	Nether-lands	New Zealand	Norway	Poland	Portugal	Slovak Republic	Spain	Sweden
1981	0.88	2.12				1.79		1.18				0.41	2.22
1982	0.90	2.21				1.88		1.25		0.30		0.47	
1983	0.95	2.34				1.92		1.30				0.46	2.47
1984	1.01	2.43				1.87		1.38		0.34		0.48	
1985	1.12	2.56				1.99		1.48				0.53	2.78
1986	1.13	2.53				2.11				0.38		0.59	
1987	1.19	2.60				2.19		1.66				0.62	2.86
1988	1.22	2.62				2.13				0.41		0.69	
1989	1.24	2.71				2.04	0.87	1.68				0.73	2.80
1990	1.29	2.79				2.07	0.99			0.51	1.66	0.82	
1991	1.23	2.76	1.92			1.97	0.98	1.64			2.13	0.84	2.72
1992	1.18	2.71	2.03			1.90	1.00			0.61	1.78	0.88	
1993	1.13	2.63	2.22		0.22	1.93	1.01	1.72			1.38	0.88	3.17
1994	1.05	2.58	2.44		0.29	1.97			0.71		0.90	0.81	
1995	1.00	2.69	2.50		0.31	1.99	0.96	1.70	0.65	0.57	0.93	0.81	3.35
1996	1.01	2.78	2.60		0.31	2.01			0.67		0.92	0.83	
1997	1.05	2.84	2.69		0.34	2.04	1.10	1.64	0.67	0.62	1.09	0.82	3.54
1998	1.07	2.95	2.55		0.38	1.94			0.68	0.69	0.79	0.89	
1999	1.04	2.96	2.47		0.43	2.02	1.02	1.65	0.70	0.75	0.66	0.88	3.65
2000	1.07	2.99	2.65	1.71	0.37	1.90			0.66	0.80	0.65	0.94	
2001	1.11	3.07	2.92		0.39	1.89	1.18	1.60	0.64	0.85	0.64	0.95	4.27
2002		3.12	2.91					1.67	0.59	0.93	0.58	1.03	
2003													

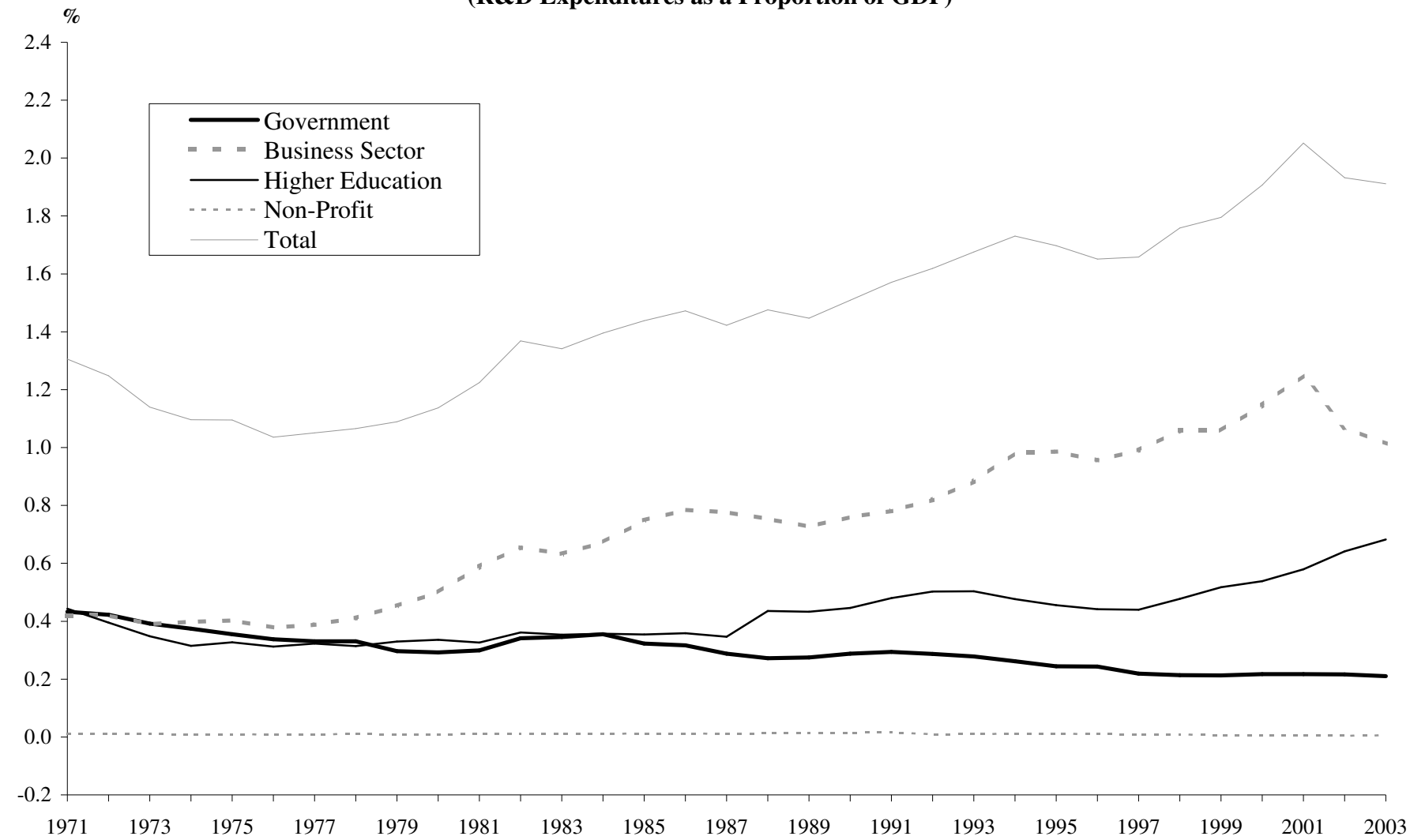
Source: OECD, *Main Science and Technology Indicators* , December 2004.
Note: Various comparability and data issues exist, as discussed in the MSTI documentation.

Table 11: Research and Development Expenditure as a Proportion of GDP in OECD and Other Selected Countries, 1981-2003 (per cent) (cont.)

	Switzer-land	Turkey	United Kingdom	United States	Total OECD	Argentina	China	Israel	Romania	Russian Federation	Singapore	Slovenia	Chinese Taipei
1981	2.12		2.38	2.34	1.93								
1982				2.52	2.02								
1983	2.14		2.20	2.59	2.08								
1984				2.64	2.14								
1985			2.24	2.76	2.24								
1986	2.73		2.26	2.73	2.24								
1987			2.20	2.69	2.25								
1988			2.14	2.65	2.23								
1989	2.74		2.15	2.62	2.24								
1990		0.32	2.15	2.65	2.28					2.03			
1991		0.53	2.07	2.72	2.22		0.74	2.50	0.79	1.43			
1992	2.59	0.49	2.02	2.65	2.18		0.74	2.57	0.85	0.74			
1993		0.44	2.05	2.52	2.13		0.72	2.68	0.91	0.77		1.60	
1994		0.36	2.01	2.43	2.08		0.65	2.68	0.77	0.84	1.09	1.76	
1995		0.38	1.95	2.51	2.09		0.60	2.74	0.80	0.85	1.15	1.61	1.78
1996	2.67	0.45	1.88	2.55	2.12	0.42	0.60	2.90	0.71	0.97	1.38	1.36	1.80
1997		0.49	1.81	2.58	2.14	0.42	0.68	3.15	0.58	1.04	1.49	1.35	1.88
1998		0.50	1.80	2.60	2.16	0.41	0.70	3.33	0.49	0.95	1.82	1.40	1.97
1999		0.63	1.87	2.65	2.20	0.45	0.83	3.83	0.40	1.00	1.90	1.44	2.05
2000	2.57	0.64	1.84	2.72	2.24	0.44	1.00	4.72	0.37	1.05	1.88	1.46	2.05
2001			1.86	2.74	2.28	0.42	1.07	5.04	0.39	1.16	2.10	1.57	2.16
2002			1.88	2.67	2.26	0.39	1.23	4.72	0.38	1.24	2.15	1.54	2.30
2003				2.62									

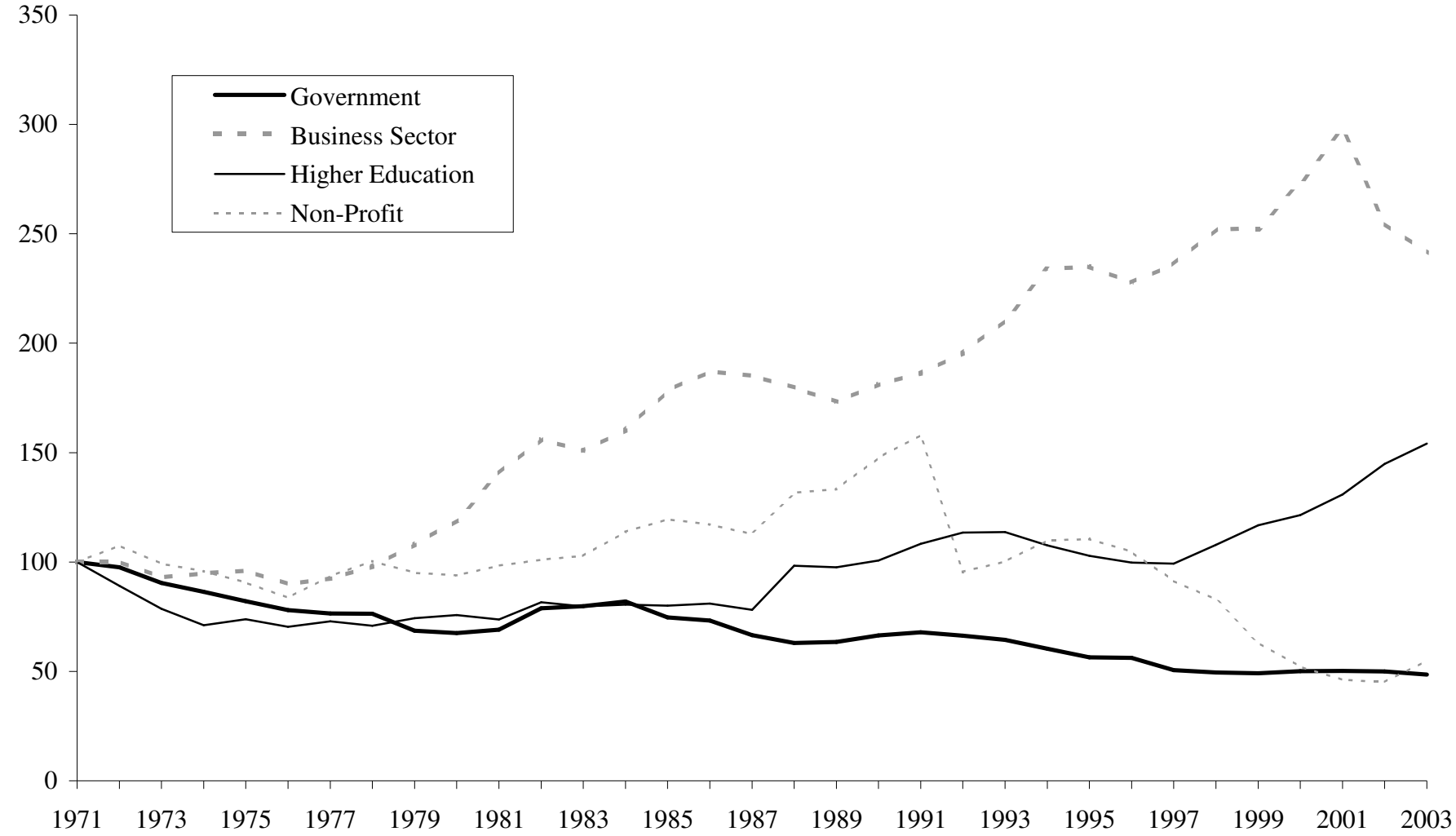
Source: OECD, *Main Science and Technology Indicators* , December 2004.
Note: Various comparability and data issues exist, as discussed in the MSTI documentation.

Chart 1: R&D Intensity in Canada by Performer, 1971-2003
(R&D Expenditures as a Proportion of GDP)



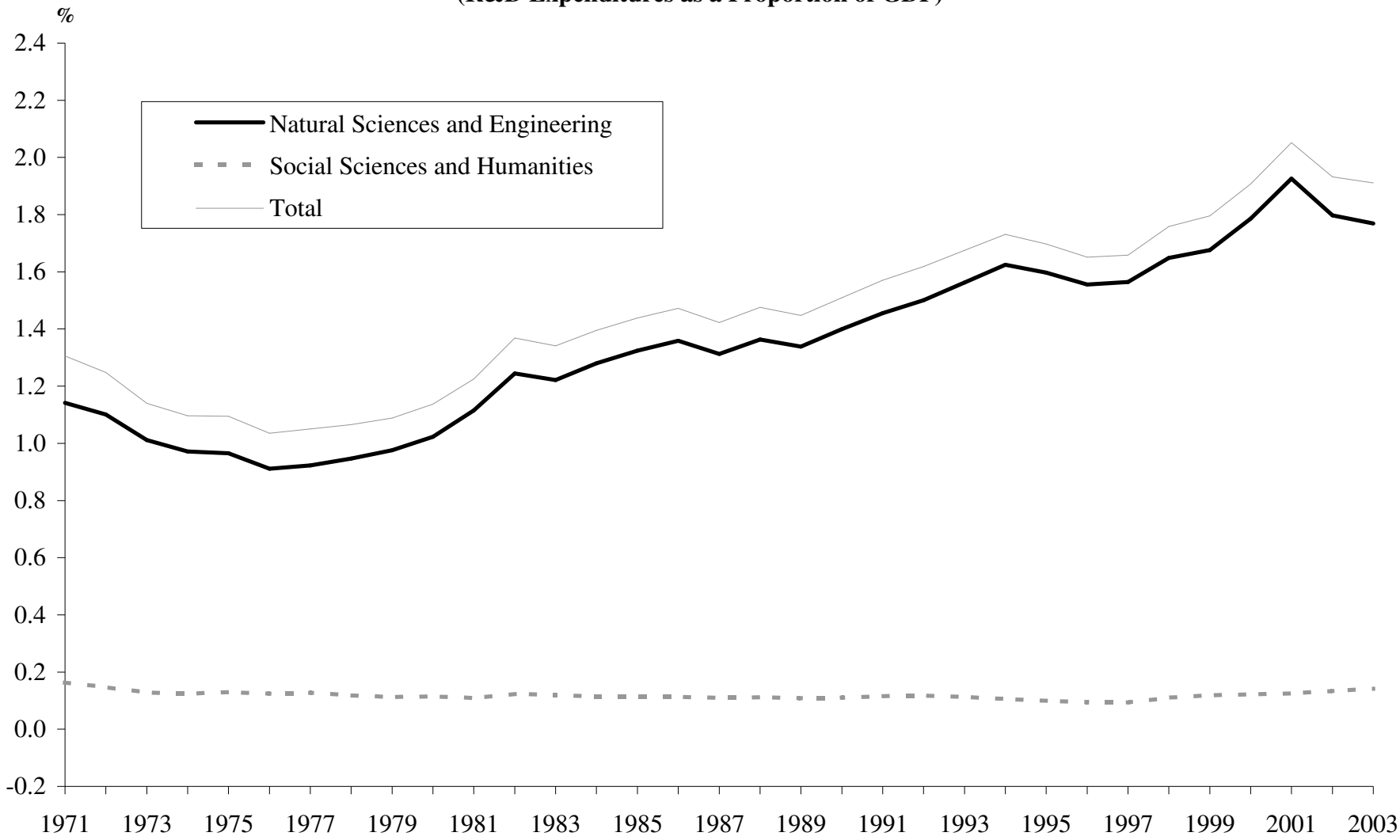
Source: Table 3.

Chart 2: Growth in R&D Intensity in Canada by Performer, 1971-2003
(Indexes of R&D Expenditures as a Proportion of GDP, 1971=100)



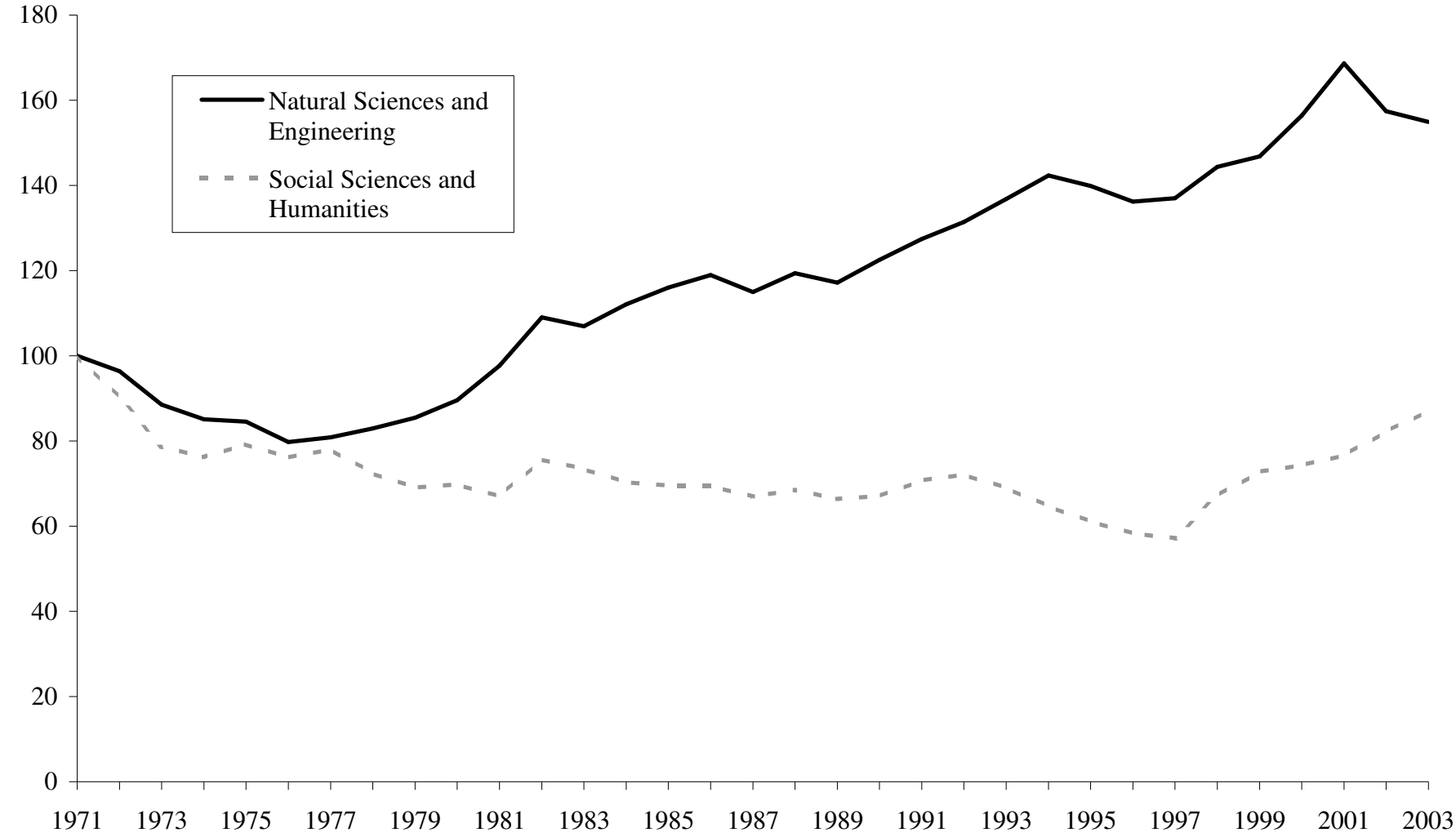
Source: Calculated from Table 3.

Chart 3: R&D Intensity in Canada by Type of Expenditure, 1971-2003
(R&D Expenditures as a Proportion of GDP)



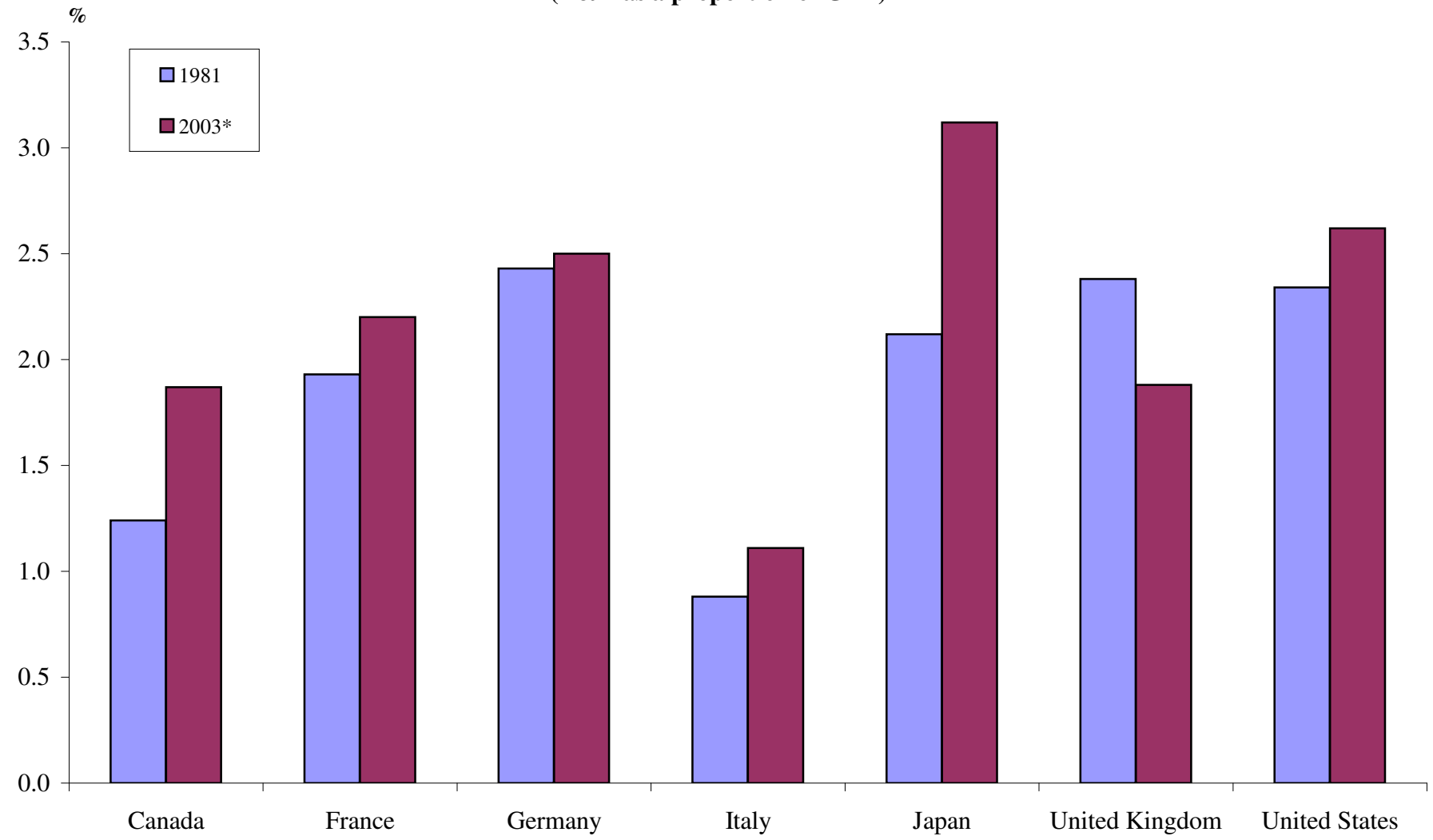
Source: Table 7.

Chart 4: Growth in R&D Intensity in Canada by Type of Expenditure, 1971-2003
(Indexes of R&D Expenditures as a Proportion of GDP, 1971=100)



Source: Calculated from Table 7.

Chart 5: R&D Intensity in the G-7 Countries
(R&D as a proportion of GDP)



Source: Table 11.

* 2002 for France, Japan and the United Kingdom and 2001 for Italy.