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THE CHANGING FEDERAL S&T INNOVATION INSTITUTIONAL SYSTEM: AN EXPLORATORY LOOK

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INTRODUCTION

This paper provides an initial exploratory look at the changed nature of the Federal S&T Innovation Institutional System, the complex array of agencies, bodies and organizations involved in supporting and conducting science and technology activity in Canada, particularly under the broad policy idea and rubric of national systems of innovation (NSI).[1] More particularly, the paper has four basic purposes:

- To trace and broadly explain the evolution of the federal S&T Innovation Institutional System, including the recently established array of so-called "third-party" institutions;
- To explore and extend the discussion of the idea of national systems of innovation (and related regional-local innovation systems) in the shaping of the current system but also its potential to be further generalized beyond economic innovation per se to encompass how and why governments invest in, make policy for, and influence and use S&T for regulatory purposes.
- To explore the linkages being formed or changed in and across this system, including what mechanisms are available for the federal government to influence overall research directions in this new institutional mix, while preserving accountability;
- To identify and examine any major issues of the accountability of such a system of institutions, including the need for democratic transparency and accountability in an era of complex financial relationships, shared funding, and multiple agency partnership involvements.

Four core definitions must be kept in mind from the outset and will be explored and developed as the discussion and analysis unfolds. The *federal S&T Innovation Institutional System* refers to the array of federal departments, agencies, programs, funds, foundations and other entities which conduct S&T or which fund such activity in universities, businesses and the voluntary sector. There are inevitable spillovers into provincial realms of this system but the paper does not explicitly discuss provincial bodies, research councils, or individual universities as institutions. *National Systems of Innovation* (NSI) refer to an idea or paradigm for conceptualizing national S&T and innovation activity and effectiveness as being the product of complex *interactions* among institutions in any national political-economy, including universities, corporations, governments, capital markets, systems of regulation, and informed

[1] In the literature and governmental studies on innovation and the new economy both the terms "national innovation systems" and "national systems of innovation" are used by different authors to mean broadly the same thing. In this paper the latter term is used.

consumerism (Nelson 1993; Niosi, 2000; OECD, 1999; Auditor General of Canada, 1999; Wolfe, 2002;).

Linkages refer to modes and patterns of interaction for mutually encouraging, innovation and for influencing decisions and control about S&T and innovation funding, processes, activities and outcomes. Such linkages inevitably flow out of the basic instruments of government (persuasion, spending, taxation, and regulation) but are made manifest in many more specific modes of interaction such as advisory bodies, contracts, agreements, direct political pressure and lobbying and on-going networked activities and trust.

Accountability refers to systems of information, reporting and answerability by public entities. Fundamentally, this encompasses accountability to elected ministers and Parliament but, increasingly it also involves much more matrixed multi-directional accountability across and within governments, and out to clients, partners, and formal and informal networks (Aucoin, 2003; Sutherland 1991; Flinders, 2001).

The exploratory nature of the paper must be stressed from the outset. For several reasons, it inevitably raises more questions than it can answer or evaluate in any detail. First, several new federal S&T Innovation entities have been added in recent years to the system and thus their histories are new and barely underway (Canada, 2001; 2001a; 2001b; 1999). Second, the total array of entities (which we discuss below under the labels of Regime I and Regime II) is a complex mix of histories, cultures, and mandates and hence, in a brief paper, can only be captured through illustrative examples and at a fairly general level of analysis. The paper certainly does not discuss the origins and history of *each* separate S&T Innovation institutional entity or organization. Third, the sources for the paper are necessarily diverse and include reports and studies by, and about, the entities involved; general Canadian literature on S&T and Innovation; and sources related to current public sector budgeting and levered/partnered funding, as well as basic notions of accountability, governance, and alternative service delivery. The paper also draws on comparative S&T and innovation literature because clearly other countries and jurisdictions are also dealing with similar issues of institutional change (Beesely et.al, 1998; Branscombe and Keller, 1998; Crow and Bozeman, 1998; Luukkonen, 2001; Vonortas, 2000). The paper also builds on and reflects some of the author's own recent research with colleagues at the Carleton Research Unit on Innovation, Science and Environment (CRUISE) centred on examinations of areas and institutions such as the National Research Council, federal government S&T labs, Canada's science-based policy and regulatory regime, nuclear energy policy, energy policy and regulation, and intellectual property institutions and policies (Doern and Levesque, 2002; Doern and Kinder, 2002, 2001; Doern and Reed, 2000; Doern, Dorman and Morrison, 2001; Doern and Sharaput, 2000).[2]

The paper is organized into five sections. The first section sketches out the nature and evolution of the current federal S&T Innovation Institutional System characterized as a two

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[2] Special thanks are also due to Laird Roe at Industry Canada and Philip Enros at Environment for their cooperation in this project including valuable comments on an earlier draft of the paper.

regime structure. The differences in the two regimes are initially emphasized but then these regime features and assumptions are analytically relaxed, given that there are mutual influences across the regimes and among the entities already evident and in practice, even though some are barely five years old. The second part then examines the core idea of "national systems of innovation", its strengths and subtleties as an overall paradigm driven by notions of commercial innovation, and also the possible extensions of its relevance to the total institutional system being examined, a system which also includes S&T and innovation needed for broader public policy and regulatory reasons. This is followed in the third section by a closer look at the nature of institutional linkages that are emerging in this complex system. This is done first through a discussion of basic policy instruments (persuasion, taxation, spending and regulation) and then, through four illustrative examples or "micro-mappings" of a sub-set of entities: granting councils such as NSERC or the SSHRC; the Canada Foundation for Innovation (CFI) as a foundation; Technology Partnerships Canada (TCP) as a federal special operating agency, and the CANMET Energy Technology Centre (CETC) as a government lab which performs S&T as well as other S&T and related functions. These micro- mappings seek to highlight some of the linkages being formed in and by these four entities with diverse organizational forms and co-governing clients and partners. Such linkages include relations which are hierarchical as well as those which are more networked and also market-like. Section four then comments briefly on some overall accountability issues for such a system of S&T Innovation support, activity and governance. Conclusions then follow.

THE EVOLUTION OF THE S&T INNOVATION INSTITUTIONAL SYSTEM: AN INITIAL LOOK AT A TWO-REGIME STRUCTURE

We first take an initial look at the broad evolution of the S&T Innovation Institutional System by characterizing the two regimes which now exist within it. Table 1 summarizes the two lists of agencies, bodies and/ programs. Regime I refers to the S&T Innovation Institutions established historically until about the late 1980s. Regime II refers to a second tranche of institutions established in the late 1980s, 1990s and early 2000s. It must be stressed from the outset the two regimes did not arise only out of factors and forces related to S&T and innovation policy. They also arise out of changes in general approaches to governance and public administration where increasingly the focus was on how to reduce traditional hierarchies and enhance client- focussed and flexible delivery of services (Aucoin, 1997; Aucoin and Heintzman, 2000; Doern and Levesque, 2002).

The two regimes are first characterized very broadly in order to highlight their differences. As the paper progresses, however, some of these differences necessarily have to be de-emphasized or analytically relaxed. This progression is needed simply because the various bodies in both regimes are learning from, and relating to, each other in complex ways. We also address initially the question of institutional modes, particularly the question of so-called *third-party* institutions created as foundations (a key part of Regime II) versus the earlier full continuum of institutional modes and delivery and control mechanisms, a feature which is also a

part of Regime I.

Regime I encompasses an array of entities forged across more than a century of S&T policy development, some of it before Canada had explicitly stated "science policies" (Ignatieff, 1981; Salter, 1988; Dufour, 1999; Doern, 1972; Meisel, 1998; Langford, Langford and Burch, 1997; It includes very early bodies such as the Geological Survey of Canada and the agriculture experimental farms and research labs. These bodies were unambiguously tied to Canada's then resource dependent economy. A somewhat later tranche of entities flourished in the context of World War II and the post-war era including: NRC (formed in 1916 but which grew mainly in the later World War II context), AECL, the DRB, IRAP, and (after the cancellation of the Avro Arrow) DIPP. The key granting bodies, the MRC, NSERC and the SSHRC were reforged and spun out of earlier bodies in the 1960s and 1970s and were centred on peer-reviewed grants to researchers and also support for graduate students. The Canadian Space Agency also emerged from its roots in the NRC.

Table 1: The S&T Innovation Institutional System

Regime I: Early Institutions to the Late 1980s

- Geological Survey of Canada
- Agriculture Experimental Farms and Laboratories
- National Research Council (NRC)
- Atomic Energy of Canada Ltd. (AECL)
- Defence Research Board
- Industrial Research Assistance Program (IRAP)
- Defence Industries Productivity Program (DIPP)
- Medical Research Council (MRC)
- Canada Council (initially included social science grants)
- Natural Sciences and Engineering Research Council (NSERC)
- Social Sciences and Humanities Research Council of Canada (SSHRC)
- Program on Energy Research and Development (PERD)
- Canadian Space Agency
- Federal Laboratories (evolved and now in several science-based departments such as NRCan, Environment Canada, Health Canada, Department of National Defence, Fisheries and Oceans Canada) Industry Canada (telecommunications)
- Scientific Research and Experimental Development (SR&ED) Tax Credit

Regime II: The New S&T Innovation Regime: The 1990s to Early 2000s

- Networks of Centres of Excellence (NCE) (linked to NSERC and SSHRC)
- Program on Energy Research and Development (PERD) (reduced funds but more multi-departmental and competitive networked.
- Technology Partnerships Canada (TPC)
- Canada Foundation for Innovation (CFI)
- Canada Research Chairs
- Canadian Institutes of Health Research (CIHR)
- Sustainable Development Technology Fund (SDTF)
- Climate Change Action Fund: Technology Early Action Measures (CCAF-TEAM)
- Federal Laboratories (further evolved through greater requirements for revenue raising, fees, and commercial contracts, as well as intellectual property licensing and encouragement of formation of spin-off companies)

The federal laboratories trace their roots to the already mentioned early resource-centred science but by the late 1980s they included an array labs located in key science-based departments, each needing S&T to underpin their growing policy and regulatory responsibilities (Doern and Kinder, 2001; 2002). Last, but not least, in this list is the SR&ED Tax Credit administered by Customs and Revenue Canada which provides refundable tax credits for smaller, largely Canadian owned, firms as a complement to normal R&D tax deductions which are available to larger often foreign-owned firms (Doern, 1995).

Regime II encompasses a melange of bodies and funds established in the late 1980s, 1990s and early 2000s. This regime is most associated with the cluster of mainly "1997 and on" entities such as the CFI and SDTF which were established as foundations (the third-party bodies) in recent federal budgets. Often lumped in with these are the CIHR (the evolved successor to the MRC), the Canada Research Chairs, and CCAF-TEAM (Canada Foundation for Innovation, 2001; Sustainable Development Technology Canada, 2002; Canadian Institutes of Health Research, 2001; Tupper, 2003; Canada, 2001).

However, another feature of Regime II is the general notion of networks and competitive leveraged funding and in these respects early examples of Regime II quite crucially are the Networks of Centres of Excellence Program, the Program on Energy Research and Development (PERD) and Technology Partnerships Canada (TPC). The Centres of Excellence Program in many ways pioneered the concept of virtual networks, and competitive network bidding processes. PERD was a similar pioneer in internal governmental determinations of R&D priorities in the energy field through competitive processes among several departments with

energy-related mandates. The TPC, which grew out of abortive efforts to cancel the DIPP program in 1995, also involved competitive processes for investing in firms with provisions for repayment (see more on the TPC below).

It is useful to also consider broadly what core ideas governed the support for S&T in these two regime groupings (and periods) and also to relate the shifts which occurred to the nature of public budgets and fiscal policy, to the ideas about reinvented government and governance, and other macro political-economic imperatives.

The conceptual idea which most governed the largest part of Regime I was the post-World War II model of the spectrum of scientific activity (de la Mothe, 2000; Guston, 2000; Crow, 1994). The broad presumption of this model was broadly linear in nature. It essentially suggested that basic or pure research, broadly drove the *later* applied research and development phases and this in turn then led to inventions and ultimately to innovative products sold in markets to consumers. To this day, the federal government still partly diagrams its own sense of its S&T Innovation Institutional System by locating specific bodies, programs and funds at approximate points along this kind of continuum. Thus, this linear model still has relevance and is among the reasons why one must eventually be cautious about some of the differences between the two regimes.

Nonetheless, for at least the last 15 years this linear presumption has been challenged by other evidence and experience which shows that S&T and R&D interactions are much more complex, and indeed with causal links being often reversed and much more subtle. In short, the pathways to real innovation are multiple and complex (Nelson, 1993; de la Mothe and Paquet, 1996; Edquist, 1997; McKelvy, 1991). In an overall sense the replacement and/or complementary mode for Regime II was eventually the idea of National Systems of Innovation (NSI) which we discuss further below. Regime II was forged with this NSI framework broadly in mind but, as we see below, the NSI idea did not coalesce immediately and it had numerous versions which did not always see or express the framework in the same way. For example, there are aspects of Regime II which are similar to what Gibbons and his colleagues (Gibbons et. al. 1994) referred to as Mode 2 knowledge production in the academic community. Mode 2 was cast as "transdisciplinary" production whereas earlier Mode 1 knowledge production was centred more on disciplines and the academic interests of a specific community within it. These kind of overall Regime II characteristics, to use my terminology for mapping Canada's system, have also been extended to concepts of interactive social science (Caswell and Shove, 2000).

The new institutional linkages and partnerships between industry and universities were partly forged on the basis of this broad new understanding of the nature of innovative activity. Indeed, they create what Etzkowitz and Leydesdorff refer to as the "triple-helix" of interacting university-industry-government relations (Etzkowitz and Leydesdorff, 1997; Leydesdorff and Etzkowitz, 2003). They also create legitimate opposition centred on what this means for the independence of researchers and for science and research as a public good (Tait and Williams, 1999). These concerns centre, in effect, on whether there is any room left for public interest-based science be it in universities or in governmental labs (Tudiver, 1999; de la Mothe, 2000; Crow and Bozeman, 1998; Doern and Kinder, 2001; 2002).

The role of science in regulation (and in risk-benefit management) is also linked to NSI-style thinking because of changes in the sources of scientific information and linkages of key new knowledge-based industries to entire systems of regulation by the state (Doern and Reed, 2000; Hood, Rothstein and Baldwin, 2001). (This is discussed further below in our brief look at whether the NSI idea can be further extended). More specifically, it is suggested that the older model and era of science-based regulation was anchored around traditional sources such as epidemiological investigations, toxicological studies, and clinical trials. But more recently, and in the context of NSI linked to risk-benefit management approaches, other sources and types of scientific information have come into greater use, including: biological markers; molecular epidemiology; new toxicological assays; in vitro assays; genetics; structure activity analysis; surveillance; and population health surveys. Almost inevitably, these sources and techniques breakdown the simple continuum model. They also break down the traditional boundaries of competence among traditionally defined scientific disciplines and can show up in generational differences among the backgrounds of scientists in government and outside it. This evolution also leads to a far wider sharing, dependence and exchange of scientific and professional information and knowledge among experts in Canada and internationally in all the core institutions which compose the NSI.

In addition to shifts in core ideas in the two regimes, there have also been key impacts from fiscal policy and budget cuts, from the way new approaches to competitive levered funding occurred in the 1990s and into the current early 2000s, and from general ideas regarding reinvented government and concepts of *governance* as opposed to just government.

Science budgets and the number of scientists supporting federal policy and regulatory functions were cut quite severely in the last 15 years as a whole, particular under the impetus of the 1995-96 Program Review, cuts whose impacts extended until the end of the 1990s (Swimmer, 1996; Doern and Kinder, 2002; Kinder, 2003; Canada, 1997, 1999, 2001b). Cuts to both science-based departments and agencies (SBDAs) and to the granting bodies were large, often as high as 40 percent, particularly for the SBDAs.

In the late 1990s, when the federal deficit had been vanquished and surpluses re-emerged in the public purse, some selected aspects of science budgets have grown or been re-kindled in different ways (e.g. the CFI was generously funded; the granting councils had both cuts and then some restored or more stable funding). But by this time, more that simply the idea of NSI was taking hold. Concepts of budgeting tied to notions of reinvented government or the New Public Management (NPM) were also influencing how the new S&T Innovation Institutional System would work and how funding would be offered and managed (Foley, 1999; Solomon, 2002; Boden, et.al. 1998; Patashnik, 1999; Lane, 1995). The new system was characterized much more by the notion of competitive government and leveraged partnership funding. To get money one had to bring money. The competition for budgets was also built into an ever more explicit bidding process. This is where some of the institutional learning curve can be attributed to the initial Networks of Centres of Excellence Program and also to changes in PERD when its funds were cut severely in the 1990s from its mid-1980s levels. The formation of the CFI in 1997 then added further to this innovation-cum-budget reform model by bringing in the delivery

mechanism of a foundation, which quickly was given the label of a "third-party" delivery mechanism. The CFI was essentially established by the Minister of Finance and its form was partly defined by a desire to get surprisingly high year end surplus funds into an organizational form, the foundation, which would not be easily reached by other parts of the government with different priority demands. To some this was the unaccountable "parking" of funds in a way that was contrary to the core notions of accountable Cabinet-Parliamentary government (see more discussion below).

While there is some reasonable analytical basis for characterizing this overall S&T Innovation Institutional System in terms of two overall regimes, at some point one has to partially relax these analytical features. First, some of the newer bodies from the 1990s have been around for some time and have elicited reactions, responses, and borrowing and emulation among the older Regime I bodies. Second, some of the older bodies (e.g. NRC and NSERC) pushed hard for, and helped create, some of the newer experimental bodies such as the Networks of Centres of Excellence Program.

A logical further question to highlight here is whether these are internally integrated regimes. At one level, they are, in that, as we have suggested, some broad rubric of policy ideas guided their development and evolution. But at another level they are not internally integrated in that the constituent units or entities have their own origins, histories, values and links with different S&T and other related policy communities and client groups. While a key feature of Regime II is the more explicit recognition of complex networks (triple helix and otherwise), Regime I also had networks well before this concept was an explicit managerial fashion (e.g. the NRC, its institutes, and the IRAP program).

Third, it is a moot point regarding exactly what *third party* delivery, CFI-style, actually means (Aucoin, 2003; OECD, 2002; Treasury Board of Canada, 2002). In Regime I there were (and are) S&T organizations which could be easily located at all of the key points along the then traditional spectrum of organizational and delivery modes. These were (and still are):

- Regular ministerial departments (1st party)(e.g. NRCan, Environment Canada)
- Departmental corporations (2nd party) (e.g. NRC)
- Crown Corporations (3rd party) (e.g. AECL)

The notion of 1st, 2nd, and 3rd party refers to the locational and control distance from Parliament and the central agencies of Cabinet Government. If this continuum were used to cover the CFI and the SDTF as foundations created with corporate charters under the companies act, then they could be considered as examples of "fourth party" governance because in some ways they go beyond Crown Corporations. One would also have to find a spot on the continuum for Special Operating Agencies (SOAs) such as the TPC. The initial mention of this categorization issue is not intended simply to play analytical games with government "org charts". As we will see in the final section of the paper, there have been serious issues raised about the CFI model in terms of accountability of funding to Parliament (Aucoin, 2003). Rather, these issues are highlighted here because some full sense of the modes of delivery must be kept in mind, largely because it is so central to the concurrent developments in reinvented government (including alternative

service delivery), to our later discussion of linkages and our four sample micro-mappings, and to the modern realities of accountability (see further discussion below). And of course the choice of modes (of parties) is itself also a part of efforts to be institutionally innovative in the explicit name of S&T Innovation policy.

THE IDEA OF NATIONAL SYSTEMS OF INNOVATION: EVOLUTION AND EXTENSIONS

For many practitioners in the federal S&T Innovation policy community, the notion of innovation and of the need for innovation strategies is so clear and compelling in a knowledge-based economy that their eyes glaze over at the thought of any discussion of its definitions or its subtleties. In some respects, this instinct is understandable but it is also unwise. The basic idea of NSI has already been introduced and highlighted but it is important to discuss this paradigm or idea further through a brief discussion of: a) how the idea arrived and congealed on the policy agenda; and b) its strengths and weaknesses as an idea and the degree to which it might be extended and built-upon beyond its larger economy and commercial focus to include more explicitly all realms of federal S&T Innovation support and activity, including that needed to support expanding regulatory mandates. At its core, innovation usually refers to the development of commercial and market-centred products and processes, but to what extent is it advisable to use it as a policy and analytical label for S&T used and developed by the state for public goods reasons and for characterizing S&T needed for supporting regulatory purposes?

The Arrival and Gestation of the NSI Idea: The Decline of Traditional Industrial Policy

The emergence of the NSI paradigm does not mark the seamless or inevitable arrival of a new idea. To trace its development, we look at two elements of interaction and change beyond our initial discussion of the earlier relative demise (but not disappearance) of the linear R&D continuum model: the decline of traditional industrial policy; and the different notions of innovation as a market-centred process in the economy as the latter is transformed to a knowledge-based economy or simply the *new* economy (Thurow, 1999; Courchene, 1996; Kelly, 1998). The latter discussion is important on its own terms but is also necessary given our overall discussion of how, if at all, the NSI concept might be extended to public goods science and S&T for regulatory roles.

Traditional industrial policy in Canada was focussed on different policy focal points and policy instruments. For example, in longer historical terms, the tariff was the centre-piece of John A. Macdonald's National Policy and was focussed on building and supporting central Canadian industry in a long historical period where there was no liberalized trade regime such as the General Agreement on Tariffs and Trade (GATT). In the late 1940s, 1950s and 1960s, federal industrial and trade policy, supported a more liberal international trade regime, even as it developed programs for various sectoral and infrastructure-based targets of policy, including

"managed trade" realms such as the Auto Pact. This occurred within the context of high but declining tariffs, moderate subsidization, and relatively deep federal budgetary pockets.

In the 1970s and early 1980s, while tariffs came down further and some new non-tariff barriers were erected (e.g. import quotas, voluntary export restraint agreements), federal industrial policy was cast much more explicitly in terms of regions and sectors. As tariff protection declined, expenditure subsidies and industrial policy grants increased, at least as long as federal money was available. The provinces too, seeking to create regionally vital industries in the name of province-building, played their own style of the spending version of sectoral/regional industrial policy. Industrial policy in this period was also characterized by a debate on foreign ownership and the need to screen foreign investment. Indeed, the technologies transferred through such foreign ownership were often cast as part of a painless way to innovate and to keep up-to-date with the rest of the world.

There were also periodic concerns and debates about Canada's science and technology policies and overall R&D support as an element of industrial policy (Doern, 1972). But during this period policy makers were far more likely to concern themselves with the volume and nature of R&D spending as a percentage of GNP than they were about rates of patent applications and approvals or rates of diffusion of foreign technology (Conference Board of Canada, 1999; de la Mothe, 2000; Baldwin, 1997). Or, attention focussed on the relative generosity of Canada's tax breaks for R&D. It is only recently that intellectual property, and other regulatory aspects of R&D and "pre-competitive" R&D have begun to receive the attention they deserve (Baldwin, 1997; Doern and Sharaput, 2000).

By the mid-to-late 1980s, as the Canada-US Free Trade Agreement was being negotiated, federal industrial and trade policy under the Mulroney Conservative Government shifted into what is now its basic form. When the federal department of Industry, Science and Technology Canada (ISTC) was formed in 1987, it was given a micro-economic mandate that to a greater extent than ever before focussed upon international technology-based competitiveness. This focus on a non-subsidizing "knowledge role" was crystallized even further in the 1993 reorganization that produced the present Industry Canada (Doern, 1995). This period also witnessed a new focus on business framework laws. Such laws on competition policy, intellectual property, corporate governance and the like have always been a part of domestic policy. However, the new focus, especially following the NAFTA and GATT-WTO agreements of the 1990s, is on how to link and harmonize international framework regimes in these areas to traditional trade policy.

However, if traditional industrial policy was increasingly less favoured or feasible, just what replaces it? Innovation policies, and eventually the NSI have in some sense supplanted traditional industrial policy but the term is not always clear cut or easily packaged and sold to various economic and political interests. The Mulroney Government certainly spoke of competitiveness and innovation but it was the Chretien Government which made innovation the central concept in its main 1994 micro economic policy paper Building a More Innovative Economy (Industry Canada, 1994). The document reflected the need for a knowledge role but was also very eclectic about just what this role was and about what was meant by the term continuous innovation.

Evolving out of free trade, the globalization of production, the revolution in telecommunications, computers, and capital and financial mobility, the dominant view inherent in innovation policies was that liberalized markets were the best overall policies for governments to follow. But within this cluster there remained important debates about just what the remaining connections are among a range of policy fields and stakeholders and institutions. There were also quite practical notions of what areas of the new economy were politically and economically seen as interesting by ministers. In this respect, there is little doubt that telecommunications sector, and the telecommunications revolution became the favoured realm for speeches, announcements and new programs, including those such as School-Net, Community Access, and eventually the commitment to "connecting Canadians" which found its way into several late 1990s Speeches from the Throne as a central policy theme of the Chretien era. These were also linked repeatedly to the jobs priority and hence, to what we refer to as average voters' ideas about what innovation might mean (see more below)

The NSI Idea: Multiple Conceptions of Innovation as Market-Centred Processes

There are at least four key conceptions of innovation which compete for analytical attention and therefore influence how the federal government might express and communicate their adoption of innovation policy or innovation strategies: 1) innovation as a form of Schumpeterian market-technology-centred "destructive competition"; 2) innovation as market-centred continuous product and process adaptation and change; 3) innovation as the product of a partnered cooperating national and regional system of innovation (the NSI per se, including regional versions of this approach and an increasingly explicit reference to the notion of "clusters) ; and 4) innovation as a layman's concept and synonym for gradual improvement in jobs and the humane role of organizations.

Schumpeterian innovation refers to the analytical insights of Joseph Schumpeter who challenged the basis of classical economics by showing how capitalism and markets are also characterized by longer cycles of destructive competition where innovators and firms were not competing in and around a narrow band of market equilibrium and stable markets but rather were engaged in a process of creative destruction (Freeman and Louca, 2001; Freeman and Soete, 1997; Best, 1990; de la Mothe and Paquet, 1996). This behaviour was observable around longer cycles of change when new technologies and production processes (almost invariably involving both product and process) were aggressively exploited. This Schumpeterian view of innovation is of considerable import in the current era because of the prevailing view that the last decade has been, and the early 2000s continue to be, centred around such new technologies as biotechnology and information technologies.

The Schumpeterian notion of innovation imposes a quite different standard of success and failure in that it inherently begs questions about whether Canada's industry contains firms capable of being such radical innovators or capable of catching and exploiting such waves of change, or alternatively and more damagingly of being obliterated by them. However, as Lipsey and Carlaw point out, the task of "taking Schumpeter seriously" on policy matters is no easy task (Lipsey and Carlaw, 1998; Courchene, 1996). It requires a more "structural" rather than neo-

classical approach to thinking about and implementing policies for innovation and technology.

A second notion of market based innovation is one which is centred around a smaller band of change and perhaps equilibrium markets where innovation centres on continuous new incremental product development and improvement. Thus innovation in this view is also very much centred in the firm. Analyses of many kinds in the 1980s and 1990s increasingly saw this form of innovation as being accompanied by the emergence of a "new competition" centred much more on what Best refers to as the "entrepreneurial firm" which, while market based and continuously sensitive to improvement in methods, products and processes, is inherently a more flexible, social and cooperative entity (Best, 1990). These analyses of everything from Japanese production to small Italian firms and regional cooperative ventures pointed to something other than mass production industrial firms that have dominated the last seventy or so years of capitalist competition and industrial structure.

Much of this thinking was also critical of mainstream neo-classical economics for having failed to appreciate the role of networked cooperation among many firms and institutions in the overall innovation process as well as the organizational requirements of innovation. New questions were also being raised about the role of strategic alliances among firms, including cooperation in research and development. Some saw such alliances as a threat to competition and others as a manifestation of the socio-economic nature of innovation.

As these debates occurred the ground was shifting away from the earlier post-World War II era where a goods trading economy was the dominant assumption and reality. But what is different when one adds the new realities of a knowledge-based economy or simply the new economy? Economists lead the way in the theoretical discussion of these changes with their thinking taking many forms and organizing concepts. First, at one level, some economists caution against the idea that growth is now more knowledge based than in the past (Howitt, 1996). They point to frequent earlier periods where new dominant technologies and organizational innovations (textiles, agriculture; autos) were analysed as being crucial determinants of growth.

But many economists are turning their attention to a re-examination of growth theory with a focus on endogenous growth. This is because earlier simpler aggregate growth theory treated knowledge and technology much like they were "just another good, capable of being accumulated like capital and aggregated with the same precision (or lack of precision) as capital" (Howitt, 1996, p. 9). Endogenous growth theory has questioned and researched the way in which knowledge, as an essentially tacit, intangible, and highly mobile entity, is different from physical goods and hence must be thought about differently in crucial matters of exchange in markets, particularly when it comes to information that either markets or governments might use to assess knowledge-based development. It implies that there is a new form of knowledge-based competition (Thurow, 1999).

The notion of innovation being generated and fostered by an even larger *national system of innovation* thus arose from several strands of the above analyses and debates which eventually permeated economic and science policy departments in most OECD governments in the 1990s (McKelvey 1991; Nelson, 1993; Niosi, 2000; OECD, 1999). As de la Mothe has stressed, "an 'innovation system' approach allows us to move towards more accurate depictions of how

knowledge actually leads to growth, underpins our economic and social union, and how institutions adapt to rapidly changing circumstances. This embraces the reality that no institution -- firm, research lab or government agency -- can 'know it all' or 'do it all'" (de la Mothe, 2000).

It is an analytical conception that trades on the development among key institutions of partnerships and cooperation of many kinds; in funding, exchange of information and knowledge and through decision making processes which are kept as close to those most able to decide and to be responsive (Rycroft and Kash, 1999; Vonortas, 2000). At the national level this view broadens the scope of policies and departments that are considered systematically to be a part of such an innovation system. For example, competition (anti-trust), intellectual property, environment, and even bankruptcy laws, policies and departments are swept into consideration in ways that they were not as recently as the early to mid- 1980s. So also do related human capital and education policies and institutions and consumer policies.

It is also useful in one sense to mention in the same breadth as national systems of innovation, the concepts of *regional and local systems of innovation* (Holbrook and Wolfe, 2002; Canada, 2002; Edquist, 1997; de la Mothe and Paquet, 1998). The latter refers to local spatial clusters of institutions (universities; firms; city and local governments; venture capital firms and special regional funding authorities) which similarly partner and interact to create "bottom-up" growth and development. This world of actual or "hoped for" Silicon Valleys, is often seen as the antithesis of national industrial policy (and of the old traditional linear R&D spectrum model) and also, to some extent, of *national* innovation systems. In one sense, they are conceptually similar to national systems of innovation at least in their view of all-encompassing interaction among key institutions. They are also both ultimately "spatial" in nature, with the former coinciding with national territorial boundaries and the later in a smaller local or regional spatial context (e.g. Kanata; Kitchener-Waterloo; Mississauga). But in other key respects, the concept of local innovation systems are seen conceptually as being in conflict with national innovation systems. This is largely because the crucial clustering and learning which goes on within a local-regional space is seen as being inherently more dynamic (OECD, 1998; Doern and Levesque, 2002; Regional Innovation Forum, 1998).

The various notions of innovation must ultimately be linked to the ways that laypersons or average citizens might see innovation. From a citizen and voter perspective, innovation may simply be a synonym for gradual change and improvement. In the economic literature on innovation this larger political view of innovation is scarcely even mentioned. This is because, in economic and industrial circles, innovation is equated more with new products or services or with the other notions referred to above. But the layperson's concept of innovation warrants mention in a political-institutional analysis such as the present paper, because it can affect the way the innovation message is received. For example, in a practical sense, it is hard to be "against" innovation especially if innovation is presented as a gradual improvement. This notion has a soft reassuring quality to it on which a residue of support can perhaps be built and communicated. But if innovation is cast in harder quasi- Schumpeterian terms or is linked with even harsher-sounding concepts such as competitiveness, productivity, and job losses. the politics of innovation moves, especially for politicians, to another realm and to another degree

of difficulty. Politicians may want to link institutional players in the innovation policy era to job creation, educational opportunity, and electronic commerce and digitally "connected Canadians", and hence to a more populist and differently expressed innovation agenda.

Extensions of the NSI Idea to Government Performed and S&T-Based Activities?

There is no mistaking the overall ascendancy of the NSI idea as the dominant overarching way of thinking about and developing approaches for the Canadian economy as it becomes a knowledge-based economy. A succession of policy papers and debates have gradually used this concept and extended it to various elements of the overall S&T Innovation Institutional System. The strength of the NSI idea is that it does capture and describe the underlying need to see the innovation and competitive process in very broad terms and in explicit inter-institutional terms. The nature and quality of interactions among institutions in the NSI are the focal point for generating and producing new innovative products and production processes. For governments, the main task is to continuously nurture those interactions or linkages.

The weaknesses of the NSI idea are partly and inherently the weaknesses of all big paradigm concepts. The NSI suggests ultimately that everything is related to everything else. Complex relations are summed up in simple summary concepts and easily get caught up in slogans about "innovation strategies" where the mantra of innovation is endlessly repeated as if repetition itself brings clarity when often it plainly does not. Some of this was evident in the 2002 federal Innovation Strategy paper (Canada, 2002). While this paper continued the longer term central message of promoting innovation, it also succumbed to a severe bout of sloganeering in a way that many of the earlier federal innovation policy studies of the 1990s did not (de la Mothe, 2003). This was also a feature of the consultation processes which were a part of the overall innovation strategy process in 2002.

The issue of whether the NSI idea can be extended and built-upon beyond its larger economy and commercial focus involves a discussion of a potential weakness of the NSI idea. This weakness is that the core of the concept is still, and understandably, driven by notions of *commercial* and product and process innovations *in firms and markets*. Governments and key public institutions are a part of the NSI but they are cast overwhelmingly in terms of how they might foster such commercial innovation.

The NSI does not seem to emphasize more explicitly all realms of federal S&T Innovation support and activity, including that needed to support expanding regulatory mandates where the state has crucial public interest responsibilities, statutory and non-statutory. These broader realms may indirectly help markets and innovation in the long term but in the short term they may need to serve public interest and public goods roles.

Does the NSI idea have enough elasticity and stretch within it to encompass these actual and potential market restraining functions, which thus far are being underplayed? If it does not, does public debate require some alternative ideas, including potentially some very old ideas to characterize and support these other key aspects of federal support for, and understandings of, the non-commercial or less commercial aspects of the S&T

Innovation Institution System?

In one sense the NSI idea already does extend beyond a strictly commercial notion of innovation. This occurs because the concept does imply interactions with some institutions which produce *public goods*, that is, goods whose benefits cannot be appropriated by firms, and which, if the state or public sector institutions did not supply them, would result in an under-supply of such goods. Educational institutions and university researchers are a part of the NSI system and idea in that they clearly provide such public goods in the form of a pool of public knowledge and also highly qualified students and professionals. Intellectual property

and related marketplace framework rules (the rules of capitalism writ large) are also a part

of a significant public goods component (Drahos and Mayne, 2002; Doern and Sharaput, 2000). At its heart, intellectual property has always been debated in terms of just where the private property protection versus public knowledge dissemination trade-off should be made

about inventions and creativity.

In the above contexts and tasks, the NSI idea can be seen to include government S&T-based activities including the provision of funds and grants and the provision of basic and sound marketplace-framework rules. But what of government performed S&T activity?

The NSI idea could potentially be extended or be more explicitly seen as a rationale for innovative systems of science-based regulation as well. There is obviously a public goods and externalities role for regulations to protect health and safety or to manage risks to society as a whole (Hood, Rothstein and Baldwin, 2001). Some of this has been evident in studies of federal laboratories and agencies where the managers of such labs often see long term public goods value by working with firms on the best ways of designing regulatory technologies that are efficient and potentially profitable and which produce simultaneously good regulatory outcomes. At the same time, some business lobby groups have a partial public goods rationale in mind when they press countries into having efficient *systems or regimes of regulation*. Many regulations or regulatory bodies have obviously been established "one at a time" or in an adhoc fashion with at best only periodic thought given to the efficacy and efficiency of entire systems of regulation. Industries are increasingly lobbying for a continuous understanding of such systems of regulation. The NSI idea accordingly has some resonance with the notion of innovative regulation and also the new (innovative) public management referred to earlier in the paper.

At some point, however, one needs to ask the question of whether lumping all key values into one umbrella paradigm idea such as the NSI or innovative activity as an imperialistic adjective is worth it. The same question can be asked about other contemporary paradigms such as *sustainable development* or *social inclusion*. Does everything have to be shoe-horned into an analytical slipper that simply does not fit the princess, in short, in our case, whose capacities for clarity and understanding simply lose their value and precision of meaning. Some aspects of regulation where S&T is crucial to its effective prosecution have these limits. Other concepts are needed to debate, discuss, and justify them. Many of these other concepts are very old ones indeed, such as public interest regulation and health, safety and environmental regulation where there can be no disguising the fact that such rule making is intended to *restrain* firms and markets

(and citizens as individuals) and not to help produce new products or to facilitate better quarterly returns on the stock market or related versions of innovation, defined commercially.

In effect, both of the next two sections of the paper, those on *linkages* and on *accountability* are also key parts of this question of the "stretching capacity" or limits of the NSE idea. This is because they both deal with the issues of exactly how public sector influence and broader public and governance notions of innovation are brought to bear in and among the new melange of bodies, agencies and funds. One of the key aspects of this extended sense of the NSI idea is government S&T itself. A considerable proportion of this support is intended to underpin regulatory tasks in the fields of health, safety and environment which have been growing rapidly. Other parts of federal S&T are tied not to doing R&D or S&T but to funding it. In some respects, as we will see from the illustrative micro-mappings of linkages in the next section, the NSI could be readily and usefully extended. In other respects, the limits of the NSI idea are soon evident.

INSTITUTIONAL LINKAGES: INSTRUMENTS AND MICRO-MAPPINGS

Thus far, we have traced the broad nature of the overall dual structure of the S&T Innovation Institution System and characterized the arrival, gestation, content and possible extensions of NSI as the now dominant paradigm or idea. We now need to examine somewhat more specifically the nature of linkages within and across the two regimes, a process which almost inevitably means that the boundaries between regimes are breaking down through learning, and mutual observation of each other's activities and evolution even with only a few years of existence for some of the newer Regime II bodies.

Many of the federal government's publications mention and use of linkages is analytically quite sparse and undeveloped and often never really defined, simply "stated". In this exploratory paper, we seek to examine linkages further in a two- stage process. First we map the linkages which arise out of the normal use of the main policy instruments: taxation, spending, regulation and persuasion. Second, we sample in very broad illustrative ways through brief case studies, the nature of some of the more specific linkages which are emerging within and across the two nominal regimes sketched out earlier. This is done through a kind of micro-mapping of the linkages where issues of hierarchical control but also networks are inevitably juxtaposed against issues of freedom from control, which is often also synonymous with innovation or the freedom to do and try new things.

The Main Policy Instruments and More Detailed Modes of Linkage

As set out in the Introduction, *linkages* refer to modes and patterns of interaction for mutually influencing decisions and control about S&T and innovation processes, activities and outcomes. Such linkages inevitably flow partly out of the basic instruments of government (persuasion, spending, taxation, and regulation) but are made manifest in many more specific modes of interaction such as:

- funding (grant-based and levered-partnership joint funding);
- boards of directors and advisory bodies;
- participation in studies and reviews;
- roles and links in grant and funding selection and peer-review processes;
- formal contracts; licensing and other agreements;
- participation in regulation and guideline-setting processes; and in compliance.
- direct advocacy and pressure politics; and
- on-going networked activities and relationships of trust and continuous exchange at professional and S&T staff levels.

However, the simpler core set of instruments are a natural starting point. Governments have always used an array of such instruments to persuade, induce, or require citizens, firms and stakeholders to behave in ways broadly intended as purposeful as determined by elected democratic governments (Pal, 2000; Doern and Phidd, 1992; Howlett and Ramesh, 1995). Similarly, firms, universities and other players in the S&T system express strong preferences for some instruments over others. The use of these core instruments almost inevitably produce both intended and unintended outcomes in any given policy field. In the S&T Innovation realm all the core instruments and therefore linages have naturally been in use for many decades.

Taxation is still a central tool both through normal deductions for R&D expenditures by firms and also through the payment of tax credits under the SR&ED (Doern, 1995). Debates have also arisen periodically over whether general levels of income or corporate taxation help create a "brain drain" from Canada to the U.S. (Kesselman, 2000). Innovation in the form of supporting initial R&D is encouraged and induced by such tax measures but the very same instrument is also a control or limiting device. Thus, neither tax deductions or refundable credits can be allowed to bleed the public purse dry. Rules about *eligible* R&D or *eligible* SR&ED have to be defined and enforced.

Regulation is a tool used frequently, again with both intended and unintended effects. Regulations are rules of behaviour backed up by the sanctions of the state. S&T in government science means the need for quite specific forms of *regulatory science* and related scientific activity (RSA) where independent monitoring is crucially required (Doern and Reed, 2000). Regulation in general or specific kinds of regulation (e.g. so-called command and control regulation) is also cast by many as being antithetical to fostering innovation because it adds costs to industries and is not sufficiently sensitive to the diverse circumstances different firms and industries face. But it is also seen as "innovation inducing" since tough rules such as in some realms of pollution control and sustainable production may help create new profitable industries, products or production processes. Important rules and rule making, including guidelines which function like rules, are also embedded deeply in the conduct of R&D. These include rules regarding peer review, research ethics on human subjects and animals, and other issues, and field trials, and the submission of data on pharmaceutical drug applications.

Spending is obviously inherent in the support of S&T in any number of ways. Grants are the central device for the "granting" councils. Spending is the tool which allows the hiring of S&T staff in government labs and in universities. Spending has the great value of being fluid, malleable and divisible. But all spending comes with rules. Governments do not drop the money from an airplane for just anyone to grab or use anyway they might like. Grants by the granting bodies have rules. Funds used to hire S&T staff have rules regarding personnel, language and merit. TPC investments in firms are assessed on the basis of risk and commercial benefits and probabilities of profitable innovation.

Persuasion as an instrument has a wide range of uses. The instruments of persuasion can include the publication of studies, the holding of review and advisory meetings; and the general exchange and communication which is inherent in the day- to- day social system of science. Performance targets in various kinds of business plans and evaluation reports are often more exhortatory than regulatory in nature (Aucoin and Heintzman, 2000).

The above basic set of points about instruments is a useful starting point but such a discussion of instruments is more customary when one is thinking about the role of government where government does things with the use of its basic tool kit. But the key difference in thinking in the last 15 years is that S&T Innovation Institutional System, along with virtually all public policy fields, is now a realm of **governance**, not just **government** (Aucoin, 1997; Guston, 2000; OECD, 2002). Governance implies that there are deeper, broader, and more complex forms of governance and authority with formal governments and officials sharing authority, power, influence and capacity with other stakeholders and institutions in society and in the economy nationally, regionally, and globally.

The actual tool kit in even the earlier era of government was always more complex than just the simple listing of taxation, spending, regulation and persuasion. But in the governance era the arrays and mixtures of devices have become more complex (Solomon. 2002). In part, this is also because government has also aspired to be, and has been pressured to be, less hierarchical than it has been historically. It has also sought to be more networked and more market-like, and flexible as governance occurs. (Lane, 1995; Lowndes, 1996; Pierson, 2000).

This is where the notion of linkages becomes almost inevitably conjoined with instruments to form the modern array of approaches to governance. Funding "with rules" (a very old tool indeed) becomes a process of receiving taxpayers money but only by bringing money to the table. The new rule is that one does not get certain kinds of innovation money without showing that you have raised money and with the latter requirement being a surrogate but very real test that your funding partner is as committed to the project as the applicant institution is. The availability of partners with money is both a better guarantor of innovative ideas (hopefully, but not always) and also a control mechanism (with partnered money, the government spends less than it would otherwise likely have to spend). But it is also the case that if a potential applicant (such as a poorer university) does not have money to bring to the table, it may not get to play the innovation game at all!

Four Case Study Micro-Mappings of Linkages

It is important to have some sense of the above lists of basic and more detailed

instruments and modes of linkage, but ultimately one must see them more closely in real institutional and S&T Innovation governance situations. Since we cannot possibly discuss all of the agencies and linkages in the combined nominal Regimes I and II listed earlier in Table 1, we attempt in this sub-section, four exploratory micro-mappings of such linkages. They are "micro" in that they deal with one agency or program. They are "mappings" in that they list, describe, and suggest sample linkages, some of which are hierarchical and some of which cascade out in more network-like fashion. These micro-mappings are illustrative only and extremely brief in their presentation. The micro-mappings deal with: a) basic granting council relationships and linkages; b) the Canada Foundation for Innovation; c) Technology Partnerships Canada; and d) CANMET Energy Technology Centre. In each micro-mapping, we simply try to describe some of the modes of linkage. The brevity of the description does not allow us time or space to actually assess the efficacy of these linkages.

The Granting Council

This first sample of a micro- mapping could refer to both NSERC and the SSHRCC as basic Regime I institutions. Table 2 shows that some of the relationships and linkages are those that are quite hierarchical and proceed through a set of principal-agent reporting relationships but others are much more those of networks and horizontal linkages of a non-hierarchical kind (Van der Meulen, 1998). These linkages are replete with efforts both to leave room for innovation and S&T creativity and also to control, induce, and persuade S&T bodies and staff to move in either general or often quite specific directions or to conduct their research in certain ways.

The hierarchical *depth* of the linkages is in one sense fairly obvious in that one easily moves from overall mandates and goals set by Parliament and Ministers through to funding levels regarding overall budgets and then cascading right down to individual researchers and teams of researchers applying for grants and then eventually carrying out the research, a process that also includes the training of future S&T personnel studying as graduate students. The horizontal and networked *breadth* of linkages is less readily captured by Table 2's "listing" approach. The actual networks involved in the awarding of the research grants and then their management, conduct and evaluation is massively broad.

Table 2- A Sample Mapping of Granting Council Linkages

1) Overall mandates and goals (by Parliament and Cabinet, statutory and non-statutory) and appointment of all members of the granting council.

2) Total aggregate funding decisions: how much does each council get (by Ministers, Finance Department and Treasury Board)

3) Priorities and Allocations Among Granting Programs (President and Board of Directors And Senior Management with the Board consisting of persons drawn from different regional, disciplinary and sectoral areas of S&T.

4) Pressures to Induce Support for New Research Themes and Priorities (by all of above listed players)

5) Pressures to Alter the Configuration of Disciplinary and Inter-disciplinary research;

6) Bottom-up applications by researchers for individual and major collective networked grants (researchers can be male or female; new/young or older and established with reputations)

7) Peer review by other qualified researchers plus by some user groups in industry or private sector.

8) Decisions by Disciplinary or Interdisciplinary Panels to Rank Applications and Determine Winners and Losers

9) Actual conduct of research regulated with respect to ethics, treatment of human subjects, animal welfare, and field trials with human health or environmental risks from the research process itself. Research grant budgets managed overall for probity in use of funds by universities or research bodies.

10) Requirements for final post-grant reports and evaluations

11) Direct and Indirect political pressure and concern *a priori* or *ex-poste* over the regional distribution of grants across the country or about some subjects which become controversial for valid or invalid reasons.

12) Eventual publication of research after further peer review and also development of patents, products, and processes and the establishment of spin-off companies linked to the original granting activity.

Table 2 and the discussion above is fairly self-explanatory for the two classically structured granting councils such as NSERC and the SSHRC. The former Medical Research Council would have involved a similar mapping. But the new Canadian Institutes for Health Research (CIHR) would need an even more complex mapping given its several institutes.

The formation of the CIHR was certainly influenced by the CFI model but its immediate genesis was the work of a Task Force of leaders in the Canadian health research community which met in 1998 and which discussed ways to better link researchers from all disciplines and also ways in which resources could be focussed on Canada's major health challenges (Canada, 1999b). The guiding principles for the CIHR are to:

- Adopt research priorities that are linked with Canadian health priorities and complement the provincial investment in research, education, and health;
- Encompass and support the full spectrum of health research-from basic science to clinical research to population health- recognizing the important role of investigator- initiated research;
- Ensure Canadian researchers succeed in the worldwide research community through the application of peer review as fundamental to the evaluation of research excellence and internationally competitive levels of funding;

- Encourage individual Institutes within the network to conduct unique programs- from capacity-building to third party partnerships- in pursuit of the improved health and well-being of Canadians;
- Collaborate with all organizations that have demonstrated a capacity to support or conduct health research. CIHR supports and recognizes the major contributions to health research by voluntary health organizations, universities, provincial granting bodies and individual research centres;
- Recognize and support the central role that universities and associated health science centres play in education, in training and in creating interdisciplinary research opportunities (Canada 1999b, p. 9).

In structural terms, the CIHR is, like the Medical Research Council (MRC), an agency of the federal government reporting to Parliament through the Minister of Health. The CIHR incorporates the current operations of the MRC itself but its core structural feature is its series of Institutes. Its initial set of 13 Institutes emerged in 2000 from further consultation and includes institutes on traditional or familiar areas of research such as one on cancer research but also several that meet the test of broader interdisciplinary realms such as the Institute of Healthy Ageing and the Institute of Aboriginal People's Health. Federal policy stresses that "the Institutes would not be centralized 'bricks and mortar' facilities. Instead these virtual organizations would support and link researchers who may be located in universities, hospitals and other research centres across Canada" (Canada, 1999b, p. 4). Another key feature about the institutes is that they "would support researchers who approach health challenges from different disciplinary perspectives" (Canada, 1999b, p. 4). The vision of transformation which the CIHR was to bring saw the old existing system and model as having " *dispersed* research efforts, disciplinary *separation*, *separate* from delivery, and *multiple agendas"* whereas the new model anchored in the CIHR would be *"integrated* : across geography/institutions; across scientific disciplines; into the health system; and with the national health agenda" (Canada, 1999b, p. 6).

With respect to funding, the CIHR initially received $65 million in 2000-2001 and funding of $175 million in 2001-2002. But when placed on top of the existing MRC budget and other related health funding, the CIHR funding for 2001-2002 is about $506 million.

The Canada Foundation for Innovation

Table 3 shows a micro- mapping of the CFI as a "third party" foundation with complex levels of hierarchy and a diverse cascading set of linkages moving "down and out" to dozens of universities and research networks among universities and extending well into the internal governance and planning processes of universities and other recipient bodies such as hospitals. Some key differences in degrees of arms-length distance from federal government control emerge near the top of Table 3 but then the cascading process of linkages becomes similar in its ever broadening and complex array of linkages, relations and efforts and mutual learning and control.

The Canada Foundation for Innovation (CFI) was created in 1997. The CFI provides funding for research infrastructure in Canadian universities, research hospitals, post-secondary

college or educational institutions and eligible non-profit organizations with capacities to support or conduct research. Established in the February 1997 Budget, the CFI has had several infusions of funds such that at present it has received $3.1 billion, $1.8 billion of which has been distributed (Canada Foundation for Innovation, 2000, 2000a, 2001, 2002, 2002a, Brochu, 1999). The CFI's initial mandate was to fund *infrastructure* in the realms of science, health, engineering, and environment. Later, infrastructure funding in the social sciences and humanities was added.

Table 3: A Sample Micro-Mapping of CFI Linkages

1) Creating the foundation in the first place with initial "endowment" but also with later infusions of funds (with perhaps designated new program areas specified by the donor)

2) Overall initial mandates and goals (by Parliament and Cabinet, statutory and non-statutory) through Budget Implementation Act.

3) Appointment of Chair and initial six Members but remaining Members (the majority) are appointed by the initial six Members; similar processes for CFI Board of Directors which reports to the CFI (ie.its Members)

4) Priorities and Allocations Among CFI Programs (President and Board of Directors And Senior Management with the Board consisting of persons drawn from different regional, disciplinary and sectoral areas of S&T.

5) Pressures to Gain Support for New Areas of Infrastructure (by all of above listed players) e.g. extension to social sciences infrastructure not included in initial mandate)

6) Bottom-up applications by eligible institutions for infrastructure investment support with 40 percent coming from CFI and 60 percent from applicant and funding partners.

7) Assessment and allocations by nine Multi-disciplinary Assessment Committees (MACs) each composed of 12 members with processes modelled on peer review.

8) Successful institutional recipients must sign institutional agreements with the CFI as well as Award agreements, and must submit institutional impact reports.

10) Requirements for evaluations of CFI Programs and also annual reports submitted by the Minister of Industry to Parliament. Special external Royal Society of Canada review in 2001.

11) Direct and Indirect political pressure and concern *a priori* or *ex-poste* over the regional distribution of investments across the country and also over whether projects are always about supporting "innovation".

12) Concerns by Auditor General of Canada (which does not audit CFI) about absence of traditional Parliamentary and Ministerial accountability.

The CFI's mandate and governance is set out in the Budget Implementation Act. The CFI was formed as an independent non-profit corporation. Initially the federal government appointed

six Members of the CFI which in turn selected nine further members. The Members approve the CFI's financial and auditing policies and practices and appoint the CFI's external auditor which is not the Auditor General of Canada. The CFI is also governed by a Board of Directors of 15 persons, with its Chair appointed by the federal government. Six of the board members are also appointed by the federal government. The Board is accountable to the Members and has responsibility for approving CFI policies and programs and allocating funds to projects and recipients. The CFI is accountable to Parliament through the Minister of Industry but only through the latter's tabling of the CFI's annual reports. The minister cannot order or require changes in missions or programs. The Minister of Finance, however, can and has given new infusions of funds in three different budget speeches.

The purposes of the CFI's programs are to:

- build Canada's capacity for innovation;
- attract and retain highly skilled research personnel in Canada;
- strengthen research training of young Canadians for the knowledge economy;
- promote networking, collaboration and multi-disciplinarity among researchers;
- ensure the optimal use of research infrastructure within and among Canadian institutions; and
- contribute to economic growth and job creation as well as to improvements in health, environment and the quality of life.

The programs are structured so that the CFI provides for 40 percent of eligible capital costs of research infrastructure with the remaining 60 percent coming from the recipients and their funding partners. At present, there are four Canadian and two international programs. The Canadian programs are: the Innovation Fund, New Opportunities Fund; Infrastructure Operating Fund, and the Canada Research Chairs Infrastructure Fund. The international programs consist of the International Joint Ventures Fund and the International Access Fund.

Functioning within, but also broadening out from, these core organizational elements as a foundation, is an elaborate assessment system for reviewing and deciding on projects. Funding proposals are reviewed by Multi-disciplinary Assessment Committees (MACs). Nine such MACs function through norms and processes similar to peer review in the granting councils. Each composed of 12 members based on their research expertise, the MACs are structured by the CFI to ensure as much as possible a balanced mix in terms of language, gender, region, economic sector, and discipline and type of institution. Typically, one third of MAC members are from outside Canada and the two thirds from Canada are drawn about 60 percent from academe, 25 percent industry, and the rest from government and other entities.

In addition to the MACs the CFI's governance requirements include provisions for evaluations of its programs based on an evaluation framework approved by the CFI's board.

As mentioned, it also provides an annual report which also contains audited financial statements. The institutions receiving funds also have to sign an institutional agreement and submit institutional impact reports and there is also an award agreement. Finally, to augment these processes, the CFI also requested the Royal Society of Canada to arrange for an international panel to review the early impacts of CFI activities on research infrastructure. The Royal Society's 2001 report was broadly favourable stressing in particular improvements in research infrastructure and a considerable strengthening of strategic planning processes within universities (Royal Society of Canada, 2001).It also pointed to certain difficulties, including excessive amounts of paperwork and bureaucracy and the inability of some poorer universities to bring money to the table. The CFI was also creating a pent-up demand for future increases in NSERC and SSHRC because once the infrastructure was build, there had to S&T personnel with grants put in place.

In addition to the above issues and characteristics, the CFI has been the object of concern by the Auditor General of Canada regarding accountability to ministers and Parliament, or the lack thereof (Auditor General of Canada, 1999a; Aucoin, 2003). We discuss this in the final section of the paper on accountability.

Technology Partnerships Canada

Table 4 provides a micro-mapping of Technology Partnerships Canada (TPC). It shows how TPC is a useful third case study sample for this exploratory paper in that it deals directly with strategic federal technology investment with firms, is structurally a Special Operating Agency (SOA) of Industry Canada, and functions more closely with government than either the granting bodies or the CFI.

Table 4: A Sample Mapping of TPC Linkages

1) Established (reformulated) in 1996 as program by Cabinet in wake of Program Review effort to cut the Defence Industries Productivity Program (DIPP).

2) No statutory base to the program but policy directives from Cabinet via a Special Operating Agency Framework Document specify overall purposes and a policy that two-thirds of program will go to aerospace and defence and one-third to environmental and enabling technologies.

3) TPC is Special Operating Agency headed by Executive Director within Industry Canada departmental hierarchy.

4) Discretion for TPC to make investment decisions below threshold level but larger projects go to Cabinet Committee on Economic Union for discussion and approval.

5) Links to Department of Foreign Affairs and International Trade (DFAIT) and trade policy, including WTO and trade disputes, over ensuring that investments are not subsidies and that they do operate at the pre-competitive stage of development.

6) Strong pressures from Cabinet and Members of Parliament regarding regional balance.

7) Links and partnerships with other federal programs including NRC's IRAP program and SMEs and with Industry Canada's regional agencies.

8) Policy and practice of 25 to 30 percent risk-share with firms has generated complex links with 478 projects/firms spread fairly evenly across regions but with larger projects in Ontario and Quebec where aerospace and defence industries are centred.

9) Normal Estimates-centred accountability to Parliament for overall annual allocations.

10) TPC subject to current overall operational review within which there are some important policy issues being studied.

than the granting bodies and the CFI samples) and indeed needs to obtain Cabinet approval for specific investments above a threshhold size (Technology Partnerships Canada, 1999; 2002; 2002a). The TPC does not have a direct statutory mandate but rather one which flows from a Cabinet directive or policy contained in its Special Operating Agency (SOA) Framework Document. Ultimately Parliamentary approval for its annual spending occurs through the Estimates process but the TPC does not have the same extent of arms-length status as the CFI does. It is a program SOA agency within Industry Canada, headed by an Executive Director. It is not a departmental corporation and has no arms-length Board of Directors. It has an Advisory Board, chaired by the Minister of Industry with up to 12 members appointed by the Minister.

The TPC's linkages also, like our previous two sample micro-mappings, cascade down and out with multiple investment linkages to numerous firms and projects in several industrial sectors, across the regions, and among other sister agencies with S&T and economic and regional development mandates.

TPC was launched in 1996 and had its mandate changed somewhat in 1999 following a WTO challenge/dispute launched by Brazil. But the TPC has a longer lineage that predates 1996. Its predecessor program was the Defence Industries Productivity Program (DIPP) which was slated for cancellation in 1995 under Program Review but which was rescued at the last minute by a strong lobby from the Toronto and Montreal- centred aerospace industry, the principal beneficiary of DIPP (Doern, 1996). DIPP itself had emerged as a program in 1958 following the cancellation of the Avro Arrow aircraft by the Diefenbaker Conservative Government.

Thus aerospace and related defence industries were central to the new 1996 TPC but it was extended beyond these sectors to enable the federal government to invest in high risk industrial research and pre-competitive development in other key areas of the knowledge-based economy such as environmental technologies and other enabling technologies including advanced materials, advanced manufacturing, biotechnology, and information technologies. It also partners with NRC through its technology programs such as IRAP which focus on small and medium-sized businesses.

The TPC risk-shares 25 to 30 percent of the R&D costs, a strategy which for the firms essentially reduces the upfront financial exposure, shortens the payback period, and moves the break-even point earlier in the development cycle. Care must be taken to ensure that the R&D investment is at the pre-competitive stage so as not to incur trade remedy challenges on the grounds that the support is a subsidy. TPC investments are to be repaid by the firms.

Of crucial importance is the fact that the Cabinet has directed that two-thirds of TPC investments must be in the aerospace and defence sectors and one-third in the environmental and

enabling technologies sectors. The TPC has been funded at over $315 million per year with a capacity to grow based on repayments (those these are not yet large). There are no limits on the size of the project or firm which might be supported. As of late 2002, TPC's portfolio consisted of 478 projects representing a multi-year investment of over $2 billion.The distribution has been 56 percent in aerospace and defence on 102 projects, and 44 percent in environmental and enabling technologies on 376 projects. 416 projects target the SME community. The overall $2billion TPC investment is linked to an additional $8.5 billion in private sector investment.

Because of the historic focus of aerospace and defence in Ontario and Quebec, there has always been significant Cabinet concern about regional balance in overall TPC investments. The percentage of *projects* has reasonable regional balance, though they still favour Ontario and Quebec whereas the percentage of *funding* is more pro-central Canada in part because defence and aerospace projects are typically much larger investments and go to larger aerospace firms.

In the last two years TPC has been undergoing an operational review. But it includes key policy questions such as whether the 2/3:1/3 allocation policy between aerospace and defence and environmental and enabling technologies should be changed and this question, in turn, is firmly linked to the issue of regional balance. There are also concerns about ensuring that TPC fits in with the federal innovation strategy and the actual commercialization of knowledge. But there is also concern that the nature of innovation processes vary across sectors and therefore the question arises as to whether TPC risk-sharing approaches should reflect such differences. Structurally, the review is also concerned with establishing a greater regional presence and a strengthening client service. Given the establishment of other S&T funds, TPC always has to ensure that it is partnering in a relevant and efficient way with other federal agencies and players, including the regional agencies in the Industry Canada portfolio.

A Government Lab: The CANMET Energy Technology Centre

Table 5 provides a micro-mapping of CANMET Energy Technology Centre (CETC). It shows how the CETC is a useful fourth case study sample for this exploratory paper in that it deals with a federal lab in which S&T is directly performed (as well as funded) and where the lab functions more directly within a federal department, Natural Resources Canada (CETC, 2000; Doern and Kinder, 2002).

Table 5: A Sample Mapping of CETC Linkages

1) Established (reformulated) in 1996 after the amalgamation of three earlier CANMET divisions dealing with energy research, alternative energy, and energy efficiency. But has links back to federal labs in early years of 20th century.
2) No statutory base to the CETC other than broad departmental legislation governing the purposes and role of Natural Resources Canada.
3) The CETC is based in Ottawa at two locations and is a division of the CANMET Energy Technology Branch (CETB) of the Energy Sector of Natural Resources Canada. It interacts with two other divisions in the CETB, the CANMET Western Research Centre in Devon Alberta, and the CANMET Energy Diversification Research Laboratory in

Varennes Quebec.

4) CETC functions within and is linked to NRCan and government-wide policy and program requirements such as: the submission of Business Plans; performance-based management; policies on fee and revenue raising; rules on public service staffing and hiring; and numerous rules regarding criteria for funding on funding programs such as PERD.

5) Current structure of the CETC is centred on two corporate groups and nine technology groups with the latter consisting of groups for:

   - Advanced combustion technologies;
   - Energy for high temperature processes;
   - Building energy technologies;
   - Renewable energy technologies;
   - Federal Industrial Boiler Program and the Industrial Energy R&D Program;
   - Processing and Environmental Catalysis;
   - Community Energy Systems; and
   - Transportation Energy Technologies;
   - Characterization

6) CETC services and products are delivered to clients in all regions of Canada with the focus on small to medium-sized companies but also with relations with large companies, associations, research institutes, utilities, universities, other government departments and other levels of government, including municipalities.

7) The CETC's staff level in 2001-2002 was 203 persons broken down into 130 scientific and professional, 40 technical, 30 administrative, and 3 executive. These numbers do not include students, visiting fellows and guest workers which number about 20.

8) The CETC's total budget in 2001-2002 of $43.9 million consisted only of $5.6 million of A-Base funding with the rest coming from sources or pools of money such as PERD ($19.4 million), TEAM ($11 million), the Climate Change Action Plan 2000 (0.8 million), revenue generation of $7.5 million including internal transfers for services from within NRCan ($1.1 million).

9) Links to universities important at individual level but have declined overall in the last decade due to budget cuts and greater commercial focus.

10) Linkages to companies are extensive but vary with different S&T activities and sub-programs (building energy technologies versus community technologies versus energy efficiency)

All federal labs are different in some respects in their exact mix of functions and thus the CETC can only be seen to some limited extent as a sample of all government labs (Doern and Kinder, 2001; 2002). For our purposes, however, even the brief list of points in Table 5 is

indicative of some common linkages which labs have developed in recent years. These include: a greater focus on commercial links and co-funding; a lessened reliance on, and availability of, taxpayer A-base funding; the greater use of policy or S&T special funds centred on competitive and levered bidding processes; more constraints due to funding limitations in the maintenance and modernization of equipment, and in the hiring and pay of S&T staff; and the fact that they are not allowed to be eligible for new funding such as CFI funding.

The mission of the CANMET Energy Technology Centre (CETC) is "to work with a broad network of partners to assess, develop and deploy energy technologies that will reduce environmental impact (notably GHG emissions), increase productivity and generate knowledge-based economic growth in Canada" (CETC, 2000). The CETC says that its success will be measured by its ability to:

- Build Canada's capacity to discover, develop and supply energy-related technologies for domestic and global markets.
- Encourage early adoption of energy-related technologies; and
- Provide the technical, scientific and technological underpinnings to NRCan's energy policy and program activities (CETC, 2000).

The CETC functions through three core programs: clean conventional energy; renewables and alternatives; and energy efficiency. However, within and across these programs, the CETC offers four things:

- Shared Money (funding for work done outside government)
- Laboratories and Research Capabilities
- Technical Expertise and Information
- Brokering

It does this through a strategic process of decision making which involves:

- Assessing Needs (Industry/clients and Policy)
- Assessing Technology (both opportunities and costs)
- Developing Technologies (through R&D and testing-field trials)
- Deploying Technology (standards, design tools, workshops, training, marketing).
- Commercializing (full scale implementation; reduce to practice, market penetration) with CETC as facilitator.

These capacities and processes involve a very difficult trade-off between the program demands and wishes in particular of "the government" and the "private sector customer" with the

CETC interacting with both. For the former, these demands and policy pressures have included: deficit reduction; public goods S&T related to environment, sustainable development and health and safety; S&T to support regulations and standards; and growth, jobs and exports. For the latter, the demands relate to private sector concerns for cost reductions, enhanced sales, productivity, and cost-effective regulation.

Care must be taken to some extent in characterizing these as zero-sum trade-offs in that the CETC seeks out projects and partnerships which achieve both. It seeks the development of technologies which address private sector benefits such as cost reductions, productivity gains, and access to new markets as well as public policy goals such as a environmental gains and jobs. In this sense, the CETC seeks to achieve core federal S&T policy purposes which under the BEST report and other policy statements have stressed federal S&T alignment with mandate and policy, excellence and linkages. The CETC's linkages are thus embued with multiple values and the tracing of them must go well beyond what has been sketched out in this brief discussion.

The four micro-mappings presented above, along with the basic discussion of core policy instruments, indicates that the linkages in the current evolved S&T Innovation Institutional System are complex, varied, dense, matrixed and multi-directional. They imply and confer, at virtually the same instant, both realms of independence and discretion (and room to innovate) but also numerous points of control and mutual influence in the name of different values and norms important in the overall conduct of S&T and in the encouragement of innovation.

In this section, and in the paper as a whole, we have not, and could not evaluate these linkages and the particular modes used. We have simply explored them in a very preliminary way. But there are potentially thirty or more institutional mappings that one would have to do to appreciate the system as a system. What is clear is that the system is evolving and being spun out further from the central agencies of the state due to a dual set of influences, one centrally tied to debates about NSI and innovation as a commercial concept but the other tied to broader (than S&T) notions of reinvented government and deeply embedded governance, including alternative service delivery mechanisms.

ACCOUNTABILITY IN THE S&T INNOVATION INSTITUTIONAL SYSTEM

The final task of the paper is to identify and examine any major issues of the accountability of such a system of institutions, including the need for democratic transparency and accountability in an era of complex financial relationships, shared funding, and multiple agency partnership involvements. We comment on this question in two stages: core Cabinet ministerial and Parliamentary accountability; and complex accountabilities (Flinders, 2001; Auditor General of Canada, 1999a; Aucoin and Heintzman, 2000)

Core Accountability to Ministers and Parliament

In terms of basic Cabinet Parliamentary Government, accountability refers to systems of

public information, reporting and answerability by public entities (Sutherland, 1991). Fundamentally, this encompasses accountability to elected ministers and Parliament, with Parliament's Auditor General of Canada (AOG) being a key agency in supporting Parliament's overall role. But other agencies and statutes are ultimately also a part of this basic accountability regime, including requirements for access to information, secrecy, privacy, and language laws. Many of the linkages traced in the previous micro-mappings are inherently founded in such core accountability requirements in that they are structured into reporting relations up quite complex hierarchies to some form of ultimate answerability to elected ministers, the Cabinet and Parliament.

Accountability is tied ultimately to the concept of ministerial responsibility both for policy and for administrative actions carried out by a politically neutral civil service. It is also a democratic concept which implies that if something goes wrong, then elected political authorities will be able to take corrective action. The use by the federal government of independent foundations such as the CFI has raised some concerns about whether accountability has been breached by this mode of delivery and organization. Political scientist, Peter Aucoin, has argued that basic accountability norms and practices have been breached, that effectively there has been a privatization of public funds to a set of foundation members who cannot be held to account to ministers and Parliament (Aucoin, 2003). Aucoin argues that for the new foundations,

> the government has sought to secure public accountability primarily by reliance on results-based reporting to the public. As applied to government departments and agencies, results-based reporting to Parliament is a much more technically ambitious,
>
> but much less political, approach to accountability than the partisan jousting of ministers and opposition in the House of Commons.....Whether the scaled down version that has been applied to independent foundations, an application that excludes
>
> both the Access to Information regime and the Auditor General, constitutes an acceptable structure for democratic accountability where state authority for the governance of public business, using endowed public money, has essentially been privatized is the fundamental question (Aucoin, 2003, p. 3).

Aucoin argues that privatization has in fact occurred. Drawing on the Auditor General's own criticisms of the foundation model and relating accountability to other forms of arms-length governance, Aucoin sees the foundation model, regardless of its "innovation" virtues, as very flawed in basic accountability terms. He also argues that the fact that these flaws have not garnered much criticism from the political opposition is due to the political system's general mistrust of elected ministers due to issues such as real and alleged corruption in contracting and distributive political patronage in some federal departments. If a CFI is to be a patron of S&T and Innovation, then the political system seems to be saying it is OK if it is the patronage of experts, in short S&T experts handing out money to other experts who have brought money to the equation in the form of levered partnered funding. These core notions of accountability for the CFI or for foundations are indeed important and always warrant concern.

Complex Accountabilities

However, the remit for this paper is also to examine issues of accountability for the overall S&T Innovation Institutional System. In both of its nominal regime components, there are already, and have been for decades, quite varied degrees of arms-length relations. In many other areas of governance such as energy and environment and health care, there are similar degrees of concern about just what accountability and modern arms-length *governance* mean (Flinders, 2001). The general logic of these analyses in the last decade or so is that accountability is now a system of accountabilities in the plural, accountability "up" to Cabinet and Parliament, "across" to other ministers and players inside the government as a whole, and "down" and "out" to clients, partners, and citizens in some broader overall sense (Hill, 1999). For those who wish emphasis to be placed on accountability to Cabinet and Parliament and to elected representative government, these latter forms and directions of accountability are a matrix gone mad. But multiple accountabilities seem to be increasingly the order of the day and in a very real sense it flows from the larger logic of both the NSI agenda and the governance agenda traced in this paper.

The overall changes in Canada's S&T Innovation Institutional System make basic political and democratic accountability more matrix-like. They are more complex, multi-directional and difficult in a number of other ways as well, especially when one attempts to answer questions such as accountability to whom? by whom? for what? And over what time frame? First, as the two regimes interact and meld with one another, there is, at a most basic level, the issue of accountability *by whom* and *to whom.* As we have seen, Canadian S&T is very much a distributed governance system involving multiple public players negotiating, cooperating, networking and often conflicting with one another over tax, spending and regulatory decisions and processes involving S&T and innovation. This complex interdependence and institutional opaqueness may render the determination of accountability within the system vulnerable to finger-pointing between institutions of the state when controversial events require a rendering of accounts. It is not difficult to imagine a number of entities abdicating responsibility for mistakes while pointing their fingers at one another.

Next, there is the question of accountability *for what.* Here, as we have shown, the chief alternatives are *performance* criteria (such as, " is commercialization actually occurring") versus *process* criteria, (such as adherence to peer review or ethics review processes). The desirable accountability criteria would probably represent some combination of these two approaches but when combined they add up to complex criteria and even conflicting criteria.

The final question about accountability that is rendered more complicated in the contemporary period is accountability *over what time frame.* This is an important consideration because the intended outcome of some of the changes taking place in Canadian S&T and Innovation are of a medium to long term nature. As such, the appropriate time frame may be measured in years rather than in quarters or months or annual Parliamentary reporting or even three year agency business plans.

While our four micro-mappings in the previous section were designed to provide a sense of the linkages involved, they almost inevitably, at the same time, reveal some of the multiple

notions and directions of accountability inherent in the discussion above. Systems of reporting to, information for, and seeking advice from, are plainly evident in these brief portraits of the granting council, the CFI, TPC and the CETC. The granting council example showed multi-directional reporting and decision processes that ranged from processes inherent in peer review among diverse S&T staff but also to those engaged in reviewing research ethics. The CFI had multiple reporting processes and requirements extending into the inner-most workings of universities. The TPC portrait shows complex links centred around an SOA agency but with numerous specific reporting relationships with individual firms as well as up to the minister and Parliament. The CETC account shows accountability which starts and plays itself out much closer to the tentacles of ministers and departments but also stretches out across the government and down and out to firms, and many other partner bodies and clients.

In short, the day has long since past, if it ever existed, when any hypothetical average informed citizen could follow the accountability trail in any simple single directional or hierarchical fashion. This is true whether one is examining the S&T Innovation Institutional System, the concern of this paper, or the health care system, or Canada's system for managing sustainable development. What exists now in these complex realms of governance is some form of accountability grid, a set of bodies and players watching each other while simultaneously engaged in the shaping and delivery of complex services and activities. To the hypothetical individual citizen, this may well look more like gridlock but there appears to be no way to simplify something that is inherently complex.

CONCLUSIONS

The overall purpose of this paper has been to take an exploratory look at the federal S&T Innovation Institutional System, a system requiring a new tentative form of commentary largely because key new parts of it have been established in the last six years, when new budgetary surpluses happily converged with, and helped lend support to, the idea of National Systems of Innovation (NSI). Some initial conclusions and observations emerge from this exploratory look which we tie to the four more specific purposes set out in the Introduction.

Our effort to trace and broadly explain the evolution of the federal S&T Innovation Institutional System, including the recently established array of so-called "third-party" institutions suggests that there is some initial value in characterizing them as two regimes. Regime I and Regime II's constituent bodies do reflect their formation and different basic time periods when some different S&T policy ideas and organizational modes were in place and were dominant.

We have stressed also that the observed changes or characteristics were not simply the product of S&T Innovation ideas or criteria. They were also the product of more general forces and ideas linked to reinvented government, the growing importance of *governance* rather than just government, and accompanying changes in public finance, including preferences for competitive budgeting and levered partnered fiscal measures and approaches. We have also argued that the changed nature of Regime II institutions is generally a positive development in that it has allowed

and fostered innovation, defined broadly.

The paper has also shown that, analytically, at some point, the distinctions between Regimes I and II lose their analytical and practical utility because in practice, even after only six years of experience with some of them, the many varied bodies, programs and funds have become densely linked partly through simple emulation and the nature of their complex relations.

With respect to our discussion of the NSI idea, we have shown that its gradual ascendancy has been an important factor in defining and shaping the S&T Innovation Institutional System as a whole. The paper has also shown that there are different notions of what innovation means under this rubric and that it has by no means fully replaced earlier policy notions which centred on a more linear continuum of basic, applied and developmental S&T activity. The analysis suggests that there is some potential for the NSI idea to be further generalized beyond economic innovation per se to encompass how and why governments invest in, make policy for, and influence and use S&T for regulatory purposes and in the necessary development of public goods which benefit private markets. But there also limits as to how much one can extend this concept given broader notions of public interest-centred S&T activity and given the need for government S&T to support regulation which may not always be innovative per se but which in fact is intended to restrain firms and markets from producing adverse social and environmental effects.

The paper's exploration of the linkages being formed or changed in and across the S&T Innovation Institutional System has covered, necessarily in my view, both some old and new ground. The older ground has been to ensure that any discussion of linkages is anchored in quite traditional understandings of basic policy instruments such as persuasion, taxation, spending and regulation. All have inevitably been used in both the older and new bodies and with dense mixtures and packages of these instruments. The newer ground has been to attempt four micro-mappings. These have shown, even more specifically, what a complex array of linkages have been structured within and around the four sample bodies examined. We have not attempted to assess the efficacy of these linkages but there can be little doubt that they are complex, partly hierarchical, and partly cascading and network- like.

There are certainly no shortages of linkages available to the federal government to use and foster but very few of them are one-way streets of federal influence and control. It also means that other governance players in this system call many of the shots simply because that is what is intended in a world of deliberative and distributed governance.

Finally, we conclude that the accountability of such a system of S&T Innovation institutions does raise important issues. With respect to the issue of core accountability issues related to accountability to ministers and Parliament, there is no doubt that there are grounds for concern in that foundations such as the CFI do seem to privatize public funds to an unnecessary degree. But in other respects, it is hard not to conclude that accountability has simply had to become a more pluralistic multi-directional concept. Both the nature of innovation and innovation systems, and the nature of governance compel systems of reporting, answerability, and "mutual watch-dogging" that are increasingly more grid-like than hierarchical.

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