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Innovation surveys

A debate on innovation surveys

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After over a decade of innovation surveys around the globe, it is time to evaluate the process and ask whether or not the* Oslo Manual *based system of surveys supports the overall objective of providing useful information on innovation. We propose to frame the debate on innovation surveys around the following conceptual and methodological dichotomies: manufacturing vs service sectors; private vs public sectors; high-tech vs low-tech; industrial classification vs clusters; new to the firm vs new to the market; successful vs unsuccessful firms; and, managers vs line innovators. We conclude with some actions that could be taken to overcome some of the problems highlighted.

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AFTER OVER A DECADE of innovation surveys around the globe, it is time to evaluate the whole process and ask whether or not the system of surveys based on the *Oslo Manual* (OECD, 1997) really supports the overall objective of providing useful information on the process and outcomes of innovation. Do these surveys provide reliable and consistent data on systems of innovation? Do they provide adequate information on individual industrial or local clusters? Are they sufficiently comprehensive to enable analysis of national or regional systems of innovation?

We propose to frame this debate around the following conceptual and methodological dichotomies:

- *Manufacturing vs service sectors* Do innovation surveys concentrate on the manufacturing sector to the detriment of understanding the role of innovation in other sectors, such as resource-based industries and the rapidly growing and increasingly complex service sector?
- *Private sector vs public sector* Several studies have acknowledged that public service entities both can, and do, innovate and are often early adopters of new technologies. So why do innovation surveys ignore the public sector?
- *High-tech vs low-tech* Many innovation studies concentrate on high-tech industries; do the surveys provide adequate information on lower-tech industries?
- *Industrial classification vs clusters* Should innovation surveys be carried out on the basis of industrial 'clusters' or should they continue to be based on standard industrial classifications?
- *New to the firm vs new to the market* The degrees of novelty and innovativeness — new to the firm, the nation or the world — are categories normally used in these surveys, but what about

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'new to the market' that a firm serves, which may not necessarily correspond to that of the nation?

- *Successful vs unsuccessful firms* Most innovation surveys only study those firms that report an innovation in the past three years: what studies have been done on supposed non-innovators, such as firms that have had no innovations but have undertaken innovative activities in that period?
- *Managers vs line innovators* Most surveys assume that the survey responses reflect the corporate opinion of the firm, but do the surveys actually reflect the opinions of the respondent (or respondents) who may, or may not, be the appropriate contact point for the surveying organization?

This paper starts with the so-called *Oslo Manual*, first published in 1992, the OECD (Organization for Economic Cooperation and Development) guideline for collecting and interpreting technological innovation data. At the time, most OECD countries were manufacturing-based, but the situation is changing, with the services industries becoming more important. Since resource-based industries were not important in most OECD countries other than as local, if high-cost, inputs to local manufacturing, the resource-based industries were not adequately surveyed.

During discussions around what later became the *Oslo Manual*, the first experiments in innovation surveys took place in Europe. The European Union (through DGXIII) and Eurostat delivered a standard questionnaire, which now is in its third version. Statistical organizations of non-European OECD countries designed their own questionnaires using the *Oslo Manual* as the theoretical, conceptual, and methodological framework.

Did the involvement of statistical institutions introduce a 'bias' in using industrial classifications instead of other concepts such as clusters or value chains? Did this develop into the second trend, that of looking mainly at high-tech sectors, with the possibly unstated assumption that low-tech traditional sectors are not innovative?

Innovation surveys are designed to measure the degree of innovativeness at the firm level, and the resources (financial and human) devoted to innovation. Since the purpose is to analyze innovation, the focus is on innovative firms meaning, in effect, a concentration on successful firms. It is common in economic literature to concentrate on success stories, but arguably we should learn not just from achievers but also from losers. Consequently, the surveys focus on results (the product or process innovation as such), rather than on the process of innovation (how the firm reaches innovation and the innovative environment).

For the purposes of this paper, we will analyze, in the light of the dichotomies presented above, the Statistics Canada innovation survey of 1999;[1] the European Community Innovation Survey (CIS II and CIS III[2]) both based on the *Oslo Manual* (OECD, 1997); the questionnaire included in the *Bogotá Manual*[3] (Jaramillo *et al*, 2000); and the Canadian Innovation Systems Research Network (ISRN) questionnaire. This article consists of three main sections: an historical review of innovation surveys and manuals; a critique of innovation surveys, based on the dichotomies set out above; and, finally, proposals for a future research agenda.

Review of innovation surveys and manuals

The OECD and its member countries' involvement in innovation surveys started, in 1988 at a meeting to discuss a Scandinavian initiative by the Nordic Fund for Industrial Development, to collect regional innovation data. The basic paper of the workshop, written by Keith Smith from the Innovation Studies and Technology Policy Group of Norway, set out a conceptual framework for developing innovation indicators. The framework was revised during a second workshop in Oslo in 1989 and presented to the OECD Group of National Experts on Science and Technology Indicators (NESTI).

After that meeting, NESTI recommended the preparation of a draft manual for the OECD member countries. Smith and Akerblom drafted the document. The theoretical development and analysis that went into the preparation of the *Oslo Manual* guidelines has been described by Smith[4] (1992). The draft was discussed and amended by OECD member countries in 1990 and 1991, and adopted and

The *Oslo Manual* uses the systems of innovation approach, from a theoretical and conceptual point of view, but questionnaires based on the *Manual* collect little information on the dynamics of national or regional innovation systems

published in collaboration with Eurostat in 1992. The manual underwent a first revision in 1996 and another revision is currently underway.

The *Oslo Manual* uses the systems of innovation approach, from a theoretical and conceptual point of view, but questionnaires based on the *Manual* collect little information on the dynamics of national or regional innovation systems.[5] It is important to note that the *Oslo Manual* initially presents a broad perspective on innovation, but, in the methodological and procedures section, narrows down the scope of what can be considered 'technological innovation'.

> "Unlike its predecessor, the OECD *Frascati Manual*, which provides a precise set of definitions for the national statistical agencies of OECD member nations, the *Oslo Manual* is both a textbook on the nature of innovation and national systems of innovation, and a compendium of socio-economic questions on the nature of innovation in a free-market economy." (Holbrook and Hughes, 2001)

Eurostat, in collaboration with the OECD, has been working on a core list of questions that permit comparable innovation surveys in Europe. The first community innovation survey (CIS) using a common questionnaire was launched in 1991 and carried out in 1992. A second version was started in 1997 and completed in 1999, and the third was launched in 2001, with the first results delivered in 2002.

In addition, the OECD, with the assistance of experts from different countries, has been reviewing the R&D surveys and innovation surveys from a methodological perspective and has found that innovation surveys, "at this stage do not appear to be producing comprehensive and reliable indicators that are either consistent between countries and across time" (Francoz and Patinson, 2000).

Following the first round of innovation surveys in OECD countries, some developing countries, especially in Latin America, started the same process. The first was Chile (1995), followed by Colombia, Venezuela, Argentina and Brazil (Sao Paulo region). These surveys were, to a greater or lesser extent, based on the *Oslo Manual*. Shortly after they were conducted, discussions started on the need to adapt the *Oslo Manual* to the particular circumstances of developing countries. The issue was not the design of questionnaires as such, but the type of questions asked and the implicit approach to innovation (Sutz, 2000). Some of the characteristics observed from the survey results of Latin American firms, which concerned analysts, were:

- informal organizational settings for conducting innovation;
- fewer R&D projects undertaken;
- innovation mainly based on the acquisition of technology embodied in capital equipment;
- the importance of organizational change in innovation processes;
- fewer resources devoted to innovation activities; and
- fragmented flows of information within national systems of innovation.

Colciencias, the Colombian Institute for the Development of Science and Technology, and RICyT (the Ibero-american Network on Science and Technology Indicators) secured funding from the Organization of American States, and a small group of experts was hired to write the Latin American manual, based on several background papers and their own expertise. The first version of the *Bogotá Manual*, as it was called since the discussion started at a meeting in Bogotá, was published in 2000 (Jaramillo *et al*, 2000).

To date, the *Bogotá Manual* with its attached questionnaire has been used in Argentina, Uruguay, and Colombia (a pilot study in Bogotá); results were published recently in a special issue of the journal *Ciencia, Tecnología y Sociedad*[6] (Baptista, 2004; Lugones and Pereirano, 2004; Vargas and Malaver, 2004). A revision of the *Bogotá Manual* is currently being undertaken, as well as a contribution to the new version of the *Oslo Manual*.

In a different approach, the Social Sciences and Humanities Research Council of Canada, the National Research Council of Canada and the Natural Sciences and Engineering Research Council of Canada have funded the Innovation Systems Research Network (ISRN), to create a network of researchers drawn from five regional nodes (Atlantic Canada, Québec, Ontario, western Canada and National Capital Region). In 2001, the project "Innovation systems and economic development: the role of local and regional clusters in Canada" was launched. It is investigating how local networks or clusters of firms and supporting infrastructure of institutions, businesses and people in communities across Canada interact to spark economic growth.[7] Research is focused on more than 27 clusters across the five regions in Canada in newly emerging knowledge-intensive areas as well as in more traditional sectors. It includes case studies in large metropolitan settings located near research-intensive universities as well as rural settings.

One of the objectives of the ISRN study is to develop a methodology to examine regional innovation systems and their constituent features, and to define the necessary and sufficient conditions for the continued existence of the clusters in the regional innovation systems. For this purpose, the research team has designed a set of interview guides based on the *Oslo Manual* and Statistics Canada innovation surveys.

Critique of innovation surveys in general

Innovation surveys in their traditional form are designed to assist policy-makers in benchmarking a country's innovative performance, and to give researchers a better understanding of innovation processes. Do they actually help, either (or both)? Are they misleading because of their inherent biases from structural determinants rather than innovation agency? Key questions have arisen from the dichotomies presented above:

- Do the surveys provide the information required by either policy-makers or researchers, to understand innovation processes?
- Do the surveys provide adequate information to analyze industrial and regional clusters?
- Do the surveys provide useful information facilitating the analysis of national and regional innovation systems?
- What should the unit of analysis be, the firm, the innovation as such,[8] or the innovation network?
- Should these surveys probe the functioning of innovation teams and other human capital issues within the firm?

There is a tendency, often for reasons of economy and expediency, to try to design innovation surveys to satisfy as many different objectives as possible. In many nations, there is constant collaboration and consultation between academic researchers, who are interested in the more fundamental characteristics of innovative firms, and government agencies acting on behalf of policy analysts who seek answers to current, and usually straightforward, policy issues.

Thus, the users and their respective objectives are often combined in innovation surveys. This can result in the survey instruments being too long, or too complex. Are current innovation surveys asking too many questions to engage the respondents, most of whom are entrepreneurs, for whom time is money? More research needs to be done on the scale and scope of innovation surveys.

Innovation surveys and innovation policies

Innovation surveys were originally created to provide information to policy-makers and politicians. Public R&D and innovation policies are mainly directed at the supply side, focusing on more investments in R&D support for S&T capabilities at the firm level and creation of a favourable environment for innovation. For the most part, these policies use the linear model of innovation for the theoretical framework.

The literature recognizes that innovation is much more than R&D, but still the *Oslo* and *Bogotá Manuals* devote a lot of attention to R&D as one of the main inputs for innovation (including questions about expenditures, formal unit of R&D, and types of R&D project undertaken). Additionally, innovation surveys are more concerned with measuring inputs and outputs of innovation occurring within a particular firm, and look marginally at the actual processes, dynamics, relationships, and interactions that affect innovation.

Edquist and Hommen have proposed that, on the one hand, a linear model of innovation process supports supply-side orientation in innovation policies and, on the other hand, systems approaches to innovation support perspectives on the demand-side of technology policies (Edquist and Hommen, 1999). The linear model of innovation implies that science (scientific research) leads to technology (technological development) and new technologies satisfy market needs. From a policy perspective this implies a need for more emphasis on funding (basic and applied) research, since this will 'automatically' lead to technological development. Support for R&D is therefore a supply-side innovation policy. The systems perspective of the innovation process (Edquist and Hommen, 1999):

> "explicitly recognizes the potentially complex interdependencies and possibilities for multiple kinds of interactions between the various elements of the innovation process. It is also evident … that a systems-oriented view of innovation accords great importance to the demand side, rather than concentrating primarily, if not exclusively, on the supply side. As an emerging current of thought on the economics of innovation, systems of innovation (SI) theorizing offers a non-linear perspective that is highly relevant to the formation of innovation policy. SI approaches are particularly appropriate to understanding the use of demand side policy instruments as public technology procurement."

Holbrook and Wolfe (2000) have summarized the key characteristics of a national innovation system (NIS):

- Firms are part of a network of public- and pri vate-sector institutions whose activities and interactions initiate, import, modify and diffuse new technologies.
- An NIS consists of linkages (both formal and informal) among institutions.

- An NIS includes flows of intellectual resources among institutions.
- Analysis of NISs emphasizes learning as a key economic resource and that geography and location matters.

As noted above, the *Oslo Manual* makes reference to the systems of innovation approach, but questionnaires based on it have collected little data on how these systems work, especially in the initial rounds of surveys conducted in Europe. The mapping of national innovation systems worldwide cannot be attributed entirely to innovation survey exercises. Following the Holbrook and Wolfe framework, those areas not adequately covered by innovation surveys are:

- the diffusion of new technologies (as opposed to their creation);
- linkages between the firms and other agents of the innovation system; and
- lifelong training and learning.

Kim and Dahlman (1992) characterize S&T policy as a set of instruments that governments use in promoting and managing the process and direction of acquiring technological capabilities. Their definition of S&T is broad, including not only R&D policy but also industrial policy, as it affects S&T development. They divide technology policy into three major components, policies designed to:

- strengthen the supply side, increasing S&T capabilities;
- strengthen the demand side, creating market needs for technology;
- provide effective linkages between the demand and supply sides by attempting to make innovation activities technically and commercially successful.

Based on the Kim and Dahlman categorization of technology policy, we can see that innovation surveys have mainly focused on the first set of policies (supply side), taking into account the emphasis made on innovation inputs — activities, expenditures, and facilities. Today, the third category, policies supporting linkages, networks and collaboration among actors, are the most important, but innovation surveys throw little light on how these networks are created, function and develop over time.[9] Innovation surveys are moving in that direction, acknowledging the importance of networks, collaboration and cooperation in innovation. Future analyses of these data, will show whether they take adequate account of those dynamics.

Manufacturing vs services

The principal dichotomy is that innovation surveys focus on the manufacturing sector to the detriment of understanding the role of innovation in the resource and service sectors. Innovation surveys concentrate on 'technological' innovation, and especially on hard technologies, often disregarding other types of innovation based on soft technologies (for instance, management). As a result, they concentrate on manufacturing industries, where hard technologies are to be found, and where most innovation is supposed to occur.

Innovation surveys focus on the manufacturing sector to the detriment of understanding the role of innovation in the resource and service sectors: they concentrate on 'technological' innovation, often disregarding other types based on soft technologies

Most OECD economies were, until recently, manufacturing economies, but things have changed. At present, services should be of major concern for innovation studies, mainly because this sector is predominant in most OECD economies (as well as other developed and developing economies).[10] In recent studies, it has been acknowledged that, contrary to 'popular' belief, not all services are technologically backward and non-innovative. The service sector is highly segmented and heterogeneous, and some services are highly innovative (for instance, telecommunications and software) (Tether *et al*, 2002). Miles (2001) notes that, at present, the issue is not whether services can be innovative, but rather "how innovative are services? and which services are the most innovative?".

The European Union started to assess innovation in services in the second round of CIS. Several 'market' services sectors[11] were included, but the questionnaire as such was not altered, except for the substitution of the word 'service' for the word 'product' (Tether, 2001). In CIS III, more service sectors were included and the questionnaire underwent minor transformations. Nevertheless, the terminology is still biased to technological innovation, and organizational innovation, which can be highly correlated to innovation in services, is not taken into account (Djellal and Gallouj, 1999; Tether *et al*, 2002). The focus on supply-side innovation policies, mainly support for R&D, works against the service sector. For example, CIS II data confirmed that innovative service enterprises were less likely to engage in R&D than innovating manufacturers (Tether *et al*, 2002).

The issue now is how to define innovation in services: here are some examples of why we need to

differentiate between innovation in manufacturing and in services:

- The distinction between product and process innovation may be appropriate for technological innovation, but not for service innovation, since services are often produced and delivered at the same time they are consumed.
- The exclusion of organizational/managerial innovation in the case of services is difficult, as many services are not embodied in technologies, but in (organizational) competences and routines.
- Service firms are characterized as having close relationships with their clients, so that the service provider tries to meet its client's needs. This focus on the client seems to be a critical feature of innovation dynamics in services. In this sense Tether *et al* (2002) ask: "Does the provision of customized services equate to innovation, or is the innovation found mainly in the ability to provide customized services?". There is no easy and direct answer to that question.
- The distinction between products and services has blurred. In today's market, it is difficult to say when companies are selling a product with a service (for instance, machinery with a maintenance servicing package),[12] or a service with a product (for instance, software bundled to a computer and with telephone support). Fundamentally, these companies are creating 'solutions', they do not sell a product or a service, but a 'package' or 'system' of closely linked goods and services.

There has been some evolution in the way innovation in services is being studied based on quantitative methodologies (surveys). Djellal and Gallouj (1999) divide these changes into three phases: indifference (or ignorance); subordination; and autonomy. Studies on service innovation, and, more generally, on services, were long excluded from economic analysis, because the sector was considered unproductive, not adding value to gross domestic product (GDP). The engine of economic growth was considered to be manufacturing industries, and services were just a peripheral economic activity, less developed, and second-class. Thus surveys of innovation followed the same path, 'ignoring' innovation in services, just focusing on manufacturing industries.

The next phase was a timid introduction of services in the survey exercises, but looking at them from a manufacturing perspective (subordination), which meant concentration on technological innovation. Until very recently, no attempt was made to design surveys specific to services (autonomy phase), adapting definitions, indicators and procedures of data collection (Djellal and Gallouj, 1999).

In the same line of discussion as Djellal and Gallouj, Tether *et al* (2002) propose three different approaches to studies on innovation in services:

- Assimilation: This approach sees innovation in services as being fundamentally similar to innovation in manufacturing, and it is therefore studied using methods and concepts developed for manufacturing
- Demarcation: In this case, it is considered that innovation in services is highly distinct from innovation in manufacturing, and new theories and instruments are being acquired or developed to understand innovation in services dynamics.
- Synthesis: This approach recognizes that studies on innovation in services have thrown light on neglected aspects of innovation processes, highlighting different types of innovation, especially important in modern economies.

Do we need to compare technological innovation in manufacturing, innovation in services, and organizational innovation? Perhaps not; what is important is to acknowledge all of them, knowing that there are some synergies among them, and that they feed each other. Innovation surveys should be able to account for activity in different sectors, using different definitions, methodologies and procedures for data collection. Traditional approaches to innovation in the manufacturing sector should not drive studies in other areas.

Private sector vs public sector

Statistics Canada conducted innovation surveys in 1996 and 1999 including the service sector, in both regulated and unregulated service industries. They used the computer services industry as a model of a service provided essentially without regulation in a free market, and the banking and financial sector as an example of a heavily regulated service. Mohnen and Rosa (1999) reported on barriers to innovation in regulated and unregulated service industries. Additionally, Statistics Canada (2002) found, in the Survey of Electronic Commerce and Technology, that public and private sectors had equal rates of adoption in existing technologies that were new to their organization, but the development of new technologies was greater in the public sector than in the private sector.

The Centre for Policy Research on Science and Technology (CPROST) at Simon Fraser University has carried out a pilot study consisting of a number of structured interviews in the federal public service in the Canadian Pacific region on technological innovation activities in these units. There was clear evidence that most of the units had, as expected, adopted new technologies to improve their efficiency or increase the level of services they provide. What was surprising was that, in at least two cases, the innovations were new to the country and not just new to the "firm", to use *Oslo Manual* terminology. The results from these proof-of-concept interviews suggest a need to carry out these studies on a larger scale and on a more rigorous basis.

While the *Oslo Manual* admits the possibility of innovation in the public sector, it only explicitly covers studies in the private sector. Studies on innovation in the public sector have focused mainly on organizational innovation, and have left aside technological innovation. Holbrook (2002) has argued that:

> "governments frequently innovate with new forms of organization. Sometimes it is a chicken and egg situation: a new technology, such as the Internet, results in new products or services, which in turn lead to new forms of organization which then lead to the adoption of newer technologies, etc."

Often, their innovations are simply adaptations of existing technologies from other sectors, but governments can, and do, develop innovations that are new to the country or even new to the world. Which comes first — technological innovation or organizational innovation? In another (orthogonal) dimension, there is also the question, which comes first — technological innovations or policy and program developments that require new technologies?

It seems that inclusion of the public sector in innovation surveys would make sense, especially for innovation in services, since the public sector is a major service provider. As with any service industry, it can improve its levels of service, which is a social benefit. It can also improve its productivity — an economic good. Public-service managers need to innovate both to improve efficiency and to increase client satisfaction. In any case, it seems likely that the public sector is innovative, providing services, for example, in the adoption of information and communication technologies, which have an important demonstration effect on other economic areas.

High-tech vs low-tech

Innovation surveys have another structural bias: it is widely assumed that innovative sectors are those based on new technologies.[13] This underestimates the innovativeness of traditional sectors of the economy. It is difficult to track the origins of the bias, but a couple of arguments can be put forward. When innovations surveys were first carried out, literature on the development of new high-technology sectors was also booming, therefore raising the profile of these new sectors and industries. Additionally, one could argue that Keith Pavitt's sectoral taxonomy of technical change[14] (Pavitt, 1984) had some influence in this perception, even if we do not know the degree of awareness by analysts at statistics agencies of this kind of scholarly work.

A counter-example is the measurement of innovation in resource-based industries, where many of the innovations used in the sector come from the machinery sector supplying the resource sector. In this sense, it is important to note the initiative taken by Statistics Canada, which included in its 1999 innovation survey a set of questions asking whether a company's products were used by natural resources industries — mining, logging and forestry, oil and gas extraction, and electrical utilities. These questions will begin to provide information about innovation linkages and dynamics upstream and downstream in competitive chains.

Industrial classification vs clusters

It is acknowledged that standard industrial classification methodologies have problems, whether ISIC (promoted by the United Nations), NAICS (the North American version), or NACE (the European version).[15] These systems are constantly under review but some industries (especially high-tech ones) are still difficult to classify. For example, the biotechnology sector is not shown as a distinct industry by ISIC, and the services sector is not explicitly defined by industry classifications. The main problem arises when we start to analyze value chains, industrial districts, and regional clusters. In which sectors do innovations originate and in which are they developed? How do we measure the synergies created within clusters and industrial districts? How are innovations diffused within them?

The unit of analysis[16] is an issue regarding surveys that is always under discussion, with no clear solution in the short term. Today, innovation takes place increasingly across networks of firms and other institutions, rather than within a single firm, or more precisely within an enterprise unit (so-called industrial establishment), which is usually the unit used by statistical agencies.

R&D outsourcing, distributed models of innovation (for large multinational firms), and networks of firms that collaborate or compete rather than individual enterprises, are becoming more common (Tomlinson, 2000). Based on these features, it seems that using the firm as the unit of analysis may be less relevant. Unfortunately, from a statistical perspective it is extremely difficult to adopt a different unit.

While, from a theoretical point of view, we do have a theory of the firm, it does not extend to the enterprise unit. What is needed is to include in innovation surveys questions that track relationships (both formal and informal) among firms and institutions, and corporate strategies, to enable the use of sociometric analysis for economic mapping.

Innovation surveys should gather information about linkage capabilities — a concept developed by Sanjaya Lall — that the firm posses in order to be part of an innovation network. The concept of 'linkage capabilities' is the ability of a firm to establish collaborative and cooperative relationships with other firms, R&D institutes, universities, government agencies, consultants, and so on, which are key to its competitive and technological performance (Lall, 1992).

CIS III investigates collaborative innovation, asking about who (the firm alone) introduced technology-based product and process innovations or with

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whom they were introduced. Additionally, CIS III asks about cooperation in innovation, consid ering different types of partner, their relative importance, and locations. Following the same reasoning, Statistics Canada's innovation survey includes a section on collaborative and cooperative agree ments regarding innovation, asking about why the firm engaged in those activities, the type of partner and ts location. Location data is useful for cluster studies, but unfortunately no analyses have been done or released to date, based on these data (for a number of reasons, including confidentiality requirements).

The *Bogotá Manual* includes in its recommended questionnaire few questions trying to characterize the networks and collaboration agreements (formal and informal) in which the firm is involved, how successful they are, and how frequently the firm uses these kinds of relationship with external organizations.

On the other hand, the ISRN survey is directed towards this type of mapping. It is not a traditional innovation survey by any standard, since it is not trying to characterize innovation activities at the firm level. Its main purpose is to characterize clusters, how firms work together, the role of innovation-related institutions, and the linkages between firms and institutions. In doing this, 'location' is the key feature of the enterprise, the clients, the suppliers, the competitors, related universities, R&D centres and technology transfer institutes. Differential relationships with local and non-local agents become meaningful in this analysis.

New to the firm vs new to the market

The definitions of innovation used by the *Oslo Manual*, Statistics Canada, and the *Bogotá Manual* are all consistent. However, they are not consistent with the perceptions of innovation held by entrepreneurs and business people. The *Oslo* and *Bogotá Manuals* propose three levels of novelty: new to the world; new to a nation; and new to the firm. This division facilitates data collection, but does not sufficiently address the competitive environment in which innovation occurs, that is, the market where the firm actually performs. Indeed it raises some questions, as Holbrook and Hughes (2001) point out:

- A product or process that is new to the world is obviously innovative, but can a product or process that is new to a particular nation, geographic or political region also be considered innovative?
- A product or process new to one of the major industrial nations may well be innovative, but what about a product new to a developing nation? An innovation in Colombia may have been developed in Colombia, or it may have been imported, but still is new to the country.
- A product or process could be new to a firm, but is it necessarily an innovation? A company introducing a product in response to a competitor's innovation is not innovative, it is merely responding to the market in order to stay in it.

Novelty is an issue of innovation, but so too is the degree of innovativeness or uniqueness (Holbrook and Hughes, 2001).

> "It is commonly suggested that new is necessary but not sufficient for innovation. For a product or process to be innovative, it must have a sense of uniqueness to it. This does not mean that every innovation must be a world first. Nor does it mean that innovation must be radical, and that incrementally improving a product or process over time is not innovating. What it does mean is that innovation occurs within a competitive milieu, and firm-level innovation should not be considered in isolation from the competitive environment in which the firm exists."

Holbrook and Hughes argue that 'new to the firm' should not be considered the entry point for innovation. Instead, new to the market offers a better approach, but poses a methodological problem for many innovation researchers — how to define and operationalize 'the market'. It seems that this is a problem for academics but not for business practitioners. To a business person, 'your market' has a specific meaning and he/she can describe it well (Holbrook and Hughes, 2001). Interestingly enough, CIS III has incorporated a question regarding the enterprise's most important market: innovation survey questionnaires are slowly moving in the direction of leaving the operationalization of novelty to the enterprise.

Successful vs unsuccessful firms:

Innovation surveys were commissioned by governments to measure the level of innovative activity in their countries as performance indicators, and the amount of financial and human resources devoted to innovation activities as input indicators. The focus was on innovative firms — usually just two types of

firm are considered: innovators and non-innovators — in other words, on successful firms within a specific period of time.

One could argue that innovation surveys 'freeze the picture' of innovation processes. They provide a snapshot, asking for innovations obtained in the past three years, and categorizing as non-innovators those firms that are developing new products and processes, but which, by the time of survey, have not yet completed the innovation. This approach results in a major structural bias, concentrating on the results of innovation — product or process (TPP) innovation using *Oslo Manual* wording — instead of focusing on how the firm obtained that innovation.

Even if we can argue that the *Oslo Manual* has a subject approach (the firm) rather than an object approach (the innovation), the main concern is the innovations obtained rather than innovation processes (actions). The unit of analysis of the questionnaires based on the *Oslo Manual* is the firm (which is why it is claimed to be a subject approach), rather than tracking specific innovations, which some would argue is the 'proper' object approach (Godin, 2002).

Pereirano, in making a comparison between the CIS III and the *Bogotá Manual* questionnaires, concluded that the main differences are in the conceptual approach, rather than in the concrete one. The main differences in the conceptual approach are:

- CIS III: the focus of the survey is the results; innovative firms are the object of the study; and it has adopted a restricted definition of innovation (just TPP innovation).
- Bogotá Manual: the focus of the survey is the activities; the objects of study are three types of firm (innovative, potentially innovative and non-innovative); and it has adopted a broad definition of innovation, including organizational innovation and commercialization as well as technological innovation (Pereirano, 2002).

Our argument, based on the discussion around the *Bogotá Manual*, is that the subject approach must be more than simply having the firm as the unit of analysis. The subject approach should consider focusing on all the activities that the company undertakes to achieve innovation, and the environment that enables the enterprise to be innovative. If the study's focus is on the process of innovation rather than on the outcomes of the innovation, we can avoid the bias of studying only successful innovators at a specific period of time, and then trying to infer a 'moving' picture of innovation. Tether *et al* (2002), in their methodological recommendations regarding CIS II, propose to eliminate an extensive and somewhat abstract definition of innovation and rather ask questions about the activities that firms have undertaken related to innovation.

The *Bogotá Manual*, which was developed specifically for developing nations, adopted a broad definition of innovation, including not only technological but also organizational innovation. In addition, the acquisition of technology embodied in capital equipment was included as an innovative activity, even though some researchers may argue this is not real innovation.

The type of innovation activities developed by the firms, the degree of novelty, and the recognition that Latin American enterprises serve different markets from OECD firms, resulted in a new classification of firms. The *Oslo Manual* definition was adopted for innovative firms, but clearly making the distinction of the market being served (local, national or international). The new category refers to potentially innovative firms,[17] enterprises having demonstrated innovation actions, but not yet obtaining any results, or the outcome of innovation was a failure.[18]

CIS III includes at the very end of its questionnaire a question regarding 'other' important strategical and organizational changes in the enterprise, contemplating "creative improvements" ranging from strategy, management, organization, marketing, and aesthetic changes. Although they are not yet considered activities linked to innovation, it is clear that their correlations with innovation are being examined.

We argue that it is as important to study non-innovative behaviour and failures,[19] as well as innovative behaviour and success stories, using indicators that include processes as well as results. Innovation surveys should target as their object of analysis not just firms obtaining TPP innovations but also enterprises undertaking innovation activities: the *Bogotá Manual* and CIS III contemplate this possibility.

Managers vs line innovators

There needs to be greater discussion of the position of the respondent in the firm to the surveys. Many official survey institutions assume the respondent to be the Chief Executive Officer (CEO), or another high-ranking manager in the firm who speaks for the firm. Generally, most researchers do not know for sure who the respondent is. It can be argued that the respondents should be line innovators or middle managers, who deal with innovation on a daily basis.

It can also be argued that, since a lot of information on innovation uses investment as an indicator, financial managers are better suited as target respondents (Holbrook and Hughes, 1998). Yet, are monetary indicators the best measures for innovation activities, or do we need to start looking for new non-monetary indicators?

Perhaps some of these new indicators would take better account of innovation activities as a social and geographic process, not just as an economic process. Additionally, it is acknowledged that the *Oslo Manual* definition of innovation, allows different interpretations. Two equally informed respondents in a firm may give different answers to whether the firm introduced 'significantly improved' products or

processes, and therefore, whether the firm was an innovator or not (Tether, 2001).

While Oslo-type questionnaires do not contain explicitly gender-biased language, some of the biases reflected above also have a gender-bias overlay, in that, in many economies, female employment is concentrated in the services sector, or women innovators are far less visible and in less senior positions in most organizations.

The Women's Advisory Group on Innovation Studies (WAGIS) was set up at CPROST, with Status of Women Canada funding, to test innovation survey instruments for gender bias. Results of focus groups testing carried out during the summer of 2002, showed that the ISRN interview guide does not have a manifest gender bias in language, but a latent one in design. The failure to capture demographic information of the respondent was an obvious oversight. As a consequence of this study, the ISRN interview guide and the corresponding database have been changed to capture gender data on respondents. A simple measure that institutions in charge of innovation surveys could adopt.

> "There are many possible sources of gender bias in studies measuring innovation, from theoretical foundations to actual survey tools. Current studies of technological innovation rely heavily on responses of men and seem to ignore systemic barriers to women's inclusion in the target survey populations. Innovation studies do not generally take into account or expli-citly seek out the views of women on innovation processes or their roles in innovation, and they do not consider the possibility that women's and men's contributions to innovation may differ" (Crowden, 2003).

There are important gender-influenced assumptions made in the very first step of determining what type of person should be interviewed. The type of innovation (for instance, technological, organizational) an individual participates in depends on their position of power within the workplace, which is inevitably influenced by gender, and which can differ sharply across industry sectors.

Since men and women often adopt different roles within the firm, women are less likely to participate in the ISRN project or innovation surveys in general, as they are not represented in senior management positions or as corporate spokespersons — those who are being interviewed. Thus the gender of the individual interviewed may affect the responses, as their answers will be conditioned by the different types of innovation they are involved with.

Although the ISRN- and the *Oslo Manual*-based questionnaires are not directly gender biased in terms of the language of the questions, it is likely as a result of the nature of organizational structures that innovation surveys are inherently gender biased.

The discussions in the focus groups supported findings in the current literature that women in high-tech professions often occupy the 'almost top level' positions in the firm, and are more likely to contribute to innovation through supportive networking, collaborative thinking and adopting interdisciplinary approaches, rather than through radical, individualistic innovative actions. By focusing more on the process of innovation in the firm than the outputs, the consequence would be to include a more gen der-inclusive dimension in the measurement of innovation.

Important gender-influenced assumptions are made in the first step of determining what type of person to interview: the type of innovation an individual participates in depends on their position in the workplace, which is influenced by gender

Conclusions: a future research agenda

Some of the problems and biases presented in this paper cannot be easily overcome, but some can be solved by taking relatively easy actions. The paragraphs below offer a set of remedial actions, not intended to be exhaustive, but rather to demonstrate that the process of measuring innovation can be improved.

A shift from seeing and studying innovation as a result, to studying innovation as an activity is needed. We need better comprehension of what firms do to be innovative and the kinds of activity they undertake, their innovative capabilities, so that better public policy can be formulated. In doing so, we will come out with a better understanding of innovative firms, seeing them in an evolutionary process of becoming, and staying, innovative. For instance, it would be useful to follow specific firms over time, especially those that once were characterized as non-innovators, or unsuccessful.

Innovation activities have changed. Now it is a more collaborative, cooperative, globalized, and complex activity than in the past. We need to understand how innovation networks function, and how knowledge is created and diffused within these networks. Innovation surveys as we know them, do not answer those questions, since their unit of analysis is the firm, but the firm does not work alone. Measuring the inputs to innovation may still be important, but we need to understand what happens within the 'black box'.

Therefore new methodological tools are needed

that measure capacities and propensity of firms to innovate, and that account for a firm's most important asset: human capital. Part of this attempt must be to encompass different types of innovative firm and avoid the black and white categorization of innovators and non-innovators.[20] In addition, comparative 'sectoral' studies should be carried out (as per ISRN) to develop models of how innovations diffuse from one industrial sector to another, how clusters and networks function, and how high-tech sectors contribute to low-tech sectors.

In relation to the manufacturing/services dichotomy, specific innovation survey instruments for service industries should be developed, and not adaptations of existing ones. Since, as has been shown by European surveys, there is still a bias against services and the innovative activities service firms perform, and the resulting innovations, it may be necessary to include non-technological innovations.

The problem around novelty can be solved easily, by adding, or substituting for the usual three categories, a category of 'new to market', and additionally asking in which market firms compete. Additionally, it would be desirable to develop models of how innovations diffuse from one market to another.

Finally, regarding the issue of who to interview and how that may be affecting the responses obtained, surveys should have a specific respondent in the firm (for instance, the CEO), and record details of the respondent (that is, demographic data such as age, gender, and education). It would also be helpful to carry out comparative surveys within a single firm with different individuals, and to conduct gender-based studies of innovation.

As noted above, one of the principal objectives of innovation surveys is to measure innovative activity amongst enterprises. After analyzing different surveys, even if manuals and questionnaires are standardized, the understanding of what constitutes innovation and the value of innovation expenditure is highly variable among economies (see differences among innovative firms in the European Community[21]), among sectors in the same country, and even within firms (if we were to interview different people in the same organization). To what extent is it important to have representative behaviour, taking into account that innovation is about change, and all genuine innovations are different?

> "… in one sense innovation cannot be directly compared, and nor can 'the proportion of innovators' be compared — this not philosophically the same as assessing the proportion of households with a car or a colour TV, for example." (Tether *et al*, 2002)

It is clear that innovation scholars need to keep refining their definitions of innovation, making the necessary distinctions between sectors (and economies). It seems that the past decade of survey experience has not resulted in unified methodologies and procedures to collect data.

Does this mean that innovation researchers should move away from innovation surveys and develop more diverse studies? Maybe not, but complementarity, diversity, and more feedback between different studies and approaches is needed. The goal for scholars in this area must be to improve innovation studies and to understand innovation processes better. This will enable researchers to improve their understanding of collaborative innovation and the role of networks, innovation in services and national and regional innovation systems.

Notes

1. Statistics Canada also conducted a survey in 2001 on biotechnology firms, and in 2003 a new innovation survey was launched.
2. Both questionnaires are used here since, to date, few results regarding CIS III have been released.
3. An online version of the Bogotá Manual, both in Spanish and English, can be downloaded from RICyT web page <http://www.ricyt.org>.
4. In this article, Keith Smith analyzed some of the innovation surveys already conducted by several OECD countries. In this respect, Smith noted that "although, many of the data gathering exercises were nominally independent, they were also affected by collective developments, discussions and workshops".
5. There is neither a single accepted definition of a national innovation system (NIS) nor of a regional innovation system (RIS). The most commonly used are:

   - "An NIS can be defined as the interaction of innovative capabilities of firms with a set of institutions that determine the firm's capacity to innovate. The interrelationship of these institutions is also important, since they do not always work in the same direction and easily together, nor is the system purpose-built" (Nelson and Rosenberg, 1993).
   - An NIS is "the elements and relationships, which interact in the production, diffusion and use of new and economically useful knowledge … and are either located or rooted inside the border of a nation state" (Lundvall, 1992).
   - "An RIS is a set of economic, political and institutional relationships occurring in a given geographical area, which generates a collective learning process leading to the rapid diffusion of knowledge and best practice" (Nauwelaers and Reid, 1995).
   - "An RIS denotes regional clusters surrounded by supporting organizations" (Asheim and Isaksen, 2002).

6. Reports from the Chilean and Mexican innovation surveys were also included, but those are based on the *Oslo Manual* and not the *Bogotá Manual*.
7. To date, four books have been published with proceedings of the ISRN annual conferences, which include interim reports of the project, as well as contributions from international scholars (Holbrook and Wolfe, 2000; 2002; Wolfe, 2003; Wolfe and Lucas, 2004). See also <www.utoronto.ca/isrn>.
8. Tether *et al* (2002) proposed that future versions of the innovation survey should focus on a single innovation — the most important — within the firm. Even so, the unit of analysis would be 'something' in between the firm and the innovation as such.
9. CIS III and Statistics Canada 1999 innovation surveys ask about cooperation in innovation, but analyses of these data are yet to be published.
10. In Europe, services account for roughly two-thirds of GDP and employment, according to Eurostat. In Canada, services

also account for two-thirds of GDP and three-quarters of employment, according to Statistics Canada.

11. The services that were included were: wholesale, transport, telecommunications, financial, computer, and technical. Electricity, gas and water distribution utilities were also included. These account for 20% of economic activity of European market services.
12. Some companies that were known as manufacturing firms are now in fact genuine service companies, for instance, IBM and Benetton.
13. For example, innovation surveys in a number of developed countries were preceded by surveys of advanced manufacturing technologies.
14. Pavitt (1984) proposed to organize industrial sectors around four categories (supplier-dominated, scale-intensive, specialized supplier, and science-based firms) based on the sources of technology or innovation, the means of appropriability, and the nature of the user needs, and therefore characterizing firm's innovative activities.
15. The Voorburg group on services statistics has been working for quite a few years in the development of a convergence between the NAICS and NACE (implicitly also with ISIC) regarding the services-sector classification. This initiative has been undertaken by the statistical organizations of Europe, Canada and the USA.
16. Statistics Canada has a 'unique' unit of analysis, the provincial enterprise, that is a group of all establishments of a given firm in the same industry within a province.
17. This new type of innovative firm was first introduced by the research team in charge of the analysis of the Colombian innovation survey (Durán *et al*, 1998).
18. Eurostat has contemplated a type of 'enterprise with innovative activities' in the same line of discussion as the *Bogotá Manual*, but these are not considered part of the innovative firms (Tether, 2001).
19. The focus group participants of the Women's Advisory Group on Innovation studies (see next section for a brief description of the study) "suggested there is a market or success bias in the [TPP] *Oslo Manual* definition because it does not necessarily include processes — such as trial and error, failed innovations and the methodologies used in their development — that create tacit knowledge and add to work place productivity. By 'ignoring' failed innovations, the *Oslo Manual* definition excludes some of the factors contributing to future successful innovations" (Crowden, 2003).
20. See Tether (2001) for an interesting categorization proposal.
21. Tether *et al* (2002) argue that a large proportion of the differences between innovators and non-innovators in European countries is because of the differences in the interpretation of what constitutes innovation, among other reasons.

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