Chapter 17
From Democratization of Knowledge to Bridge Building between Science, Technology and Society

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Abstract For the past 20 years, the Quebec Government has monitored scientific and technical culture. This chapter reviews the situation, from the viewpoint of the Conseil de la science et de la technologie (the Science and Technology Council), showing how ideas about the culture have changed over that period. The changes are closely linked to scientific and technological development and the policies connected with it. Through the democratization of knowledge and the building of bridges between science, technology and society—processes that work in both directions—the official view of scientific and technical culture has been modified. Today, it is conceived as an interface, stimulating exchanges between scientists and other social actors. As a result, research is more attuned to community needs. *Perspectives STS (science, technology, society)*—a project initiated by the Science and Technology Council—illustrates this evolution.

17.1 Introduction

Over the past 20 years, through community initiatives, public support and volunteer input, Quebec has acquired a range of science communication organizations and installations, including specialist media, science camps, museums, recreational science organizations, interpretation centres and activity groups. It now boasts an impressive variety of high-quality activities to inform and raise awareness about science and technology (S&T).

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The Quebec Government has consistently supported S&T culture throughout this period. The government relies mostly on the Conseil de la science et de la technologie (the Science and Technology Council, or STC), a part of the Ministry of Economic Development, Innovation and Export Trade, for analysis and advice on ways to develop science, technology and innovation to benefit Quebec society. The *Perspectives STS (science, technology, society)* project was launched with this goal in mind.

This chapter reviews the public discourse on S&T in Quebec, tracing its main features as it evolved along with changing conditions in knowledge production, and assesses the contribution of the *Perspectives STS* project.

17.2   Scientific and Technical Culture: a New Field of Intervention

Since its creation in 1983, the STC has continuously assessed S&T cultural development. A series of measures established at the outset to stimulate the development of S&T included the creation of Quebec's first ministry for S&T, which was mandated to promote scientific culture. Scientific culture had long been part of the public discourse, but it was only in the mid-1980s that it became a genuine field of public intervention in Quebec. Table 17.1 outlines some of the highlights of the council's work.

As in other industrialized countries, science culture has become a prime focus of S&T policy in Quebec (Godin 1999: 29). The culture has varied over time, and these variations have reflected the government's priorities and action strategies.

Table 17.1 Highlights of the Science and Technology Council's Work

1984	Establishment of a Science and technology culture committee
1986	Publication of *La diffusion de la culture scientifique et technique au Québec*, a study by J.-M. Gagnon and L. Morin
	Publication of first situation report dealing with science policy: *Science et technologie. Rapport de conjoncture 1985*
1988	Publication of second situation report on the role of scientific culture in the transfer to an information society: *Science et technologie. Conjoncture 1988*
1994	Publication of third situation report entirely devoted to science culture: *Miser sur le savoir. La culture scientifique et technologique*
1997	Publication of fourth situation report describing science culture as a component of the national system of innovation: *Pour une politique québécoise de l'innovation*
2002	Publication of an overview of science culture: *La culture scientifique et technique au Québec: Bilan*
	Publication of results of a survey of science culture: *Enquête sur la culture scientifique et technique des Québécoises et des Québécois*
2004	Publication of fifth situation report devoted to science culture: *La culture scientifique et technique. Une interface entre les sciences, la technologie et la société*

17.3   Evolution of the Discourse on Science Culture

In this section, I briefly examine the development of the Quebec Government's S&T policy.

The importance of government support to promote science culture first became apparent in 1965. At that time, science was considered a public good. Science culture for the layperson encompassed a small body of scientific and technical knowledge.

This discussion resurfaced in the government's Green Paper on culture (GQ 1976) and in the *Politique québécoise du développement culturel* (GQ 1978). A draft policy on science research, published the following year, focused on 'the situation of science in the field of culture' and 'the democratic concern to generalize and facilitate citizen access to S&T information' (GQ 1979: 2).

With the publication of *Le virage technologique* in 1982, S&T culture responded to the 'technology challenge' by adding new information and communication technologies to its toolkit (GQ 1982).

In 1983, the Quebec Government established a Ministry of Science and Technology. Scientific research was seen as a catalyst for economic growth, and programmes were developed to promote S&T culture. These communication programmes show a progressive diversification into leisure projects, exhibitions, popular magazines, audio-visual projects and other forms. The development of a scientific culture was a means 'to promote access to scientific knowledge, practices and technology for as many as possible'. The science mediation and communication system pursued the objective of 'democratization and appropriation of knowledge' (MHES 1988).

Several years later, based on an evaluation of results, access to Quebec Government science culture programmes was expanded to include new social actors: schools, scientists, high educational institutions and private enterprise (Schiele et al. 1994: 28). This transfer coincided with the government's decision to further integrate research and innovation, promote collaborations between government, universities and enterprises, and nurture an industrial culture (STC 1988: 13–14).

Box 17.1   A Definition of Scientific and Technical Culture

The Science and Technology Council adheres to a very broad definition of scientific and technical culture that includes individual and societal factors. It defines this culture as the ability to appropriate a body of scientific and technical knowledge and competencies. Scientific and technical culture also includes an objective view of the reality of S&T, its methods, impact, limitations and inherent challenge. Scientific and technical culture is manifested through knowledge, competencies, representations, values, behaviour and the means applied to achieve S&T mastery, and to guide its development. (STC 2004a: 9–10)

In 1994, responsibility for scientific and technical culture was transferred to the Ministry of Industry, Trade, Science and Technology, which targeted further actions to promote careers in S&T and encourage scientists to participate in public awareness activities.

Two years later, the S&T cultural programmes were moved again, this time to the Ministry of Culture and Communications, which redefined and widened the mandate to include different forms of cultural expression. Scientific culture became part of a new humanistic approach, 'able to reconcile the sciences, human sciences and artistic creation' (Arpin 1994: 19). The stay at the Ministry of Culture and Communications was brief.

In 1997, responsibility for government S&T culture was passed to the Ministry of Research, Science and Technology. The ministry's 2001 science and innovation policy paper designated individual training and appropriation of S&T as the first of its three points of policy. Scientific and technical culture was a central focus, leading to a knowledge society (MRST 2001).

S&T culture was then transferred to the Ministry of Economic Development, Innovation and Export Trade (MEDIET), an economy-driven ministry, at a time when advances in S&T posed new social questions (particularly about the life sciences and nanotechnology). A concerned public was turning its mind to risk management, ethics and citizen participation in choosing research and development priorities.

Despite the changing discourse on S&T culture over this period, the perspective has remained clearly diffusionist. Quebec's approach has been consistent, reflecting a vision similar to that of other societies engaged in S&T cultural projects. Most Quebec Government initiatives continue in this tradition.

17.4   Public Efforts in Scientific and Technical Culture

This section describes government support for the development of scientific cultural activities, and suggests that Quebec's diffusionist approach will have positive long-term effects.

For more than two decades, the Quebec Government has funded a dedicated—even if not so generous—programme to promote S&T culture. Since the mid-1990s, total grants from the responsible ministry have averaged $4.5 million per year (STC 2004a: 109; MEDIET 2006a: 51). Very recently, the *Stratégie québécoise de la recherche et de l'innovation* earmarked a $7 million increase for the three-year budget envelope allocated to S&T culture and to the Science and Technology Ethics Committee (MEDIET 2006b: 64).

This level of commitment is not exemplary, especially considering the STC's 2004 recommendation that the government earmark an annual public investment of $12.5 million for scientific culture (STC 2004a: 96). Be that as it may, neither private funding nor the support of publicly funded volunteer resources should be underestimated; both make possible the development of Quebec's

science communication system. For such a small society as Quebec, the government's contribution is significant.[1]

Rather than going to public institutions, Quebec Government assistance mainly supports small, private non-profit organizations and so-called 'major' participants whose basic mission is S&T culture. Most subsidized activities use traditional channels of dissemination—the science press and broadcast media, leisure activities and museums. Public debates are organized on science, technology and civil society relationships, notably through 'science bars' and more frequent exchanges between scientists and other groups in the population.

The general goal of Quebec's efforts within the science communication system is to increase public awareness of science, technology and their socio-economic impacts, to emphasize the importance of S&T for the growth and well-being of society, and often to encourage young people's interest in careers in S&T. Overall, however, it is difficult to say how much fruit these awareness efforts have borne among Quebecers.

Whether or not the Quebec science communication system can achieve its goals, placing S&T alongside other forms of human expression in the public space certainly makes it more visible outside the scientific sphere. For instance, the STC's 2002 overview of science culture showed significantly more S&T communication facilities in Quebec than there were 20 years ago. There has been similar growth among other groups of social actors (companies, high educational institutions, local economic development organizations, other cultural sectors, etc.), with an increasing number devoted to scientific and technical culture (STC 2002b).

Another indication of S&T's greater visibility is its increased exposure on TV and in newspapers and general interest magazines. The findings of three opinion polls on science culture in the Quebec population show a notable upswing over the past two decades (Tremblay and Roy 1985, Filiatrault and Ducharme 1990, STC 2002a). The proportion of respondents who say they are regular or fairly frequent viewers of TV science programmes rose from 46.1% in 1985 to 58.7% in 2002. The proportion claiming to read scientific articles in newspapers and general interest magazines increased from 36.5% to 54.8%.

Twenty years of promotion through a gamut of activities and communication channels, and the growing circulation of scientific information aimed at the general public, have probably made S&T a familiar part of Quebecers' daily lives.

The work of educational system, technology and innovation organizations and regulatory bodies has also been a major factor in the development of a popular scientific culture. In Quebec, these organizations include the Bureau d'audiences publiques sur l'environnement (Quebec's environmental public hearings board), the Agence d'évaluation des technologies et des modes d'intervention en santé (the agency responsible for health services and technology assessment), and

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[1] This does not include Canadian federal grants to Quebec organizations or institutions located in Quebec. This level of government also participates in the science culture field; for example, it operates the Montreal Science Centre and the PromoScience programme of the Natural Sciences and Engineering Research Council of Canada.

the Commission de l'éthique de la science et de la technologie (the Science and Technology Ethics Committee). Although these organizations have varying impacts, they nonetheless function like interacting relay points disseminating messages about S&T. They complement each other in educating, informing and sensitizing the population, shaping representations and transmitting values associated with S&T. If we consider this systemic perspective, the STC assumes that the science communication system actively fulfils a need and gets positive results.

17.5 Which Level of Scientific Culture?

A look at several indicators used in recent years sheds light on the overall state of S&T culture in Quebec.

In its 2004 situation report, the STC concluded that, overall, Quebec's level of social and individual approval of S&T compares favourably with that of other societies (STC 2004a: 22).

The proportion of gross domestic product that Quebec allocates to research and development rose from 1.86% in 1991 to 2.74% in 2004, compared to a 2004 average of 2.47% for OECD countries (GQ 2007). In 2002, Quebec had 8.6 researchers per 1,000 active population, while this ratio averaged 6.3 per 1,000 in OECD countries (MEDIET 2005: 61).

Figures for recent years show Quebec's educational system performing well in terms of enrolments and graduates in the science disciplines (CETECH 2004, MEDIET 2005, MELS 2007). Women continue to make strides at university and in the workplace, although they remain under-represented in the pure and applied sciences (MERDR 2004). While there are frequent sectoral imbalances in labour supply and demand, especially in emerging or rapidly expanding sectors of industry, Quebec does not face an overall labour shortage in S&T (STC 2004b: 179).

Despite considerable criticism about the space and treatment accorded science disciplines in elementary and high school, Quebec students fare very well in national and international competitions, such as Canada's School Achievement Indicators Program (MELS 2005), the OECD's Programme for International Student Assessment (Bussière et al. 2007), and the Trends in International Mathematics and Science Study (ME 2004).

A survey of the Quebec population in 2002 also paints quite a good picture of S&T literacy at the individual level. Respondents' performance in the survey's natural sciences and engineering knowledge test (62%) compares favourably with performance in France (61%), Europe (60%) and the United States (64%) assessed in 2001 (STC 2002a: 48). In the human and social sciences, respondents averaged 67%.

Compared to Europeans, more Quebecers are interested in S&T (70.7%; Europeans 45.3%) and consider themselves well informed (56.1%; Europeans 33.4%) (STC 2002a: 4–5). In 2001, a significant majority expressed confidence in scientific development (67.9%)—slightly less than in the United States (72%) but higher than in Europe (50.4%) (STC 2002a: 15). More than half turned to mass

media for science-related information, and 12% indicated that their scientific interest was a leisure activity. Around 65% had visited a science museum or establishment at least once in the previous year, the most popular being zoos, aquariums and botanical gardens (49.4%), followed by natural history museums, S&T museums and interpretation centres (45.9%).

Overall, the survey results show a good individual level of science culture, but the culture's uneven spread across the population is striking, although this unevenness is not confined to Quebec. Another notable distinction is the greater confidence and interest in science among the more highly educated and higher income earners, who often pursue many more science leisure activities and participate in more information-access activities than the others. These groups also score higher on knowledge tests. Comparisons with earlier surveys show that these inequalities have persisted over time, despite Quebec's progress in S&T development, education and communication (Tremblay and Roy 1985, Filiatrault and Ducharme 1990).

The science communication activities implemented up to now have made S&T more visible in the public place and helped to shape popular representations, but the level of S&T culture in the population does not necessarily meet expectations (Schiele 2005). In other words, it seems to have reached a threshold.

To create a more vibrant interface between science, technology and civil society, the STC now believes it must go further. It must urge the scientific community to be more open to society's needs and demands. Besides initiatives for better public understanding of S&T, recognition of its contributions and consideration of issues of concern, there is also an abiding need for reciprocal exchanges and bridge building between S&T on the one hand and civil society on the other. This is a crucial step towards a true knowledge society.

17.6   Bridge Building between Science, Technology and Society: Altering the Angle of Approach

S&T assumes even greater importance in a knowledge society. Today, it is the prime source of innovation and the major lever of socio-economic development. S&T knowledge is growing exponentially in all disciplines, and is reconfiguring its own means of production and management.

Among the most striking transformations have been the diversification of places of knowledge creation, the heterogeneous mix of participants, burgeoning exchange networks, increased contextualization of research, and greater social responsibility on the part of scientists (Gibbons et al. 1994). The research poles represented by universities, industry and government are reshaping modes of operation, questioning traditional roles and becoming more interdependent. New actors (related milieus, unions, non-governmental organizations, etc.) do their own research work and compete with the more classical institutions. Fields of knowledge are simultaneously specializing and expanding, opening up boundaries, blurring and merging. Research activities are increasingly transdisciplinary, integrating all forms of

knowledge from the most basic to the most applied. The transfer and valorizing of research takes on greater importance, while the funders have greater and more pressing expectations for spin-offs from the work.

These strongly results-driven changes affect knowledge workers, who must be more open and amenable to other disciplinary fields, other forms of creation, other participants in research activities and other social groups, whether they are potential new knowledge users, representatives of pressure groups or the general public.

Scientists may have reservations about this openness, but increasing interactions between scientific communities and other social actors, and improved research outcomes to meet economic, social and cultural needs, will ultimately make it more acceptable to them. Those interactions better acknowledge social demands and spur innovation (Latour 1998: 209).

The new need for openness requires a strategy to bring science, technology and society closer together: greater public awareness of S&T culture is not enough. Quebec's current science communication efforts, while promising, leave the effort incomplete (STC 2004a: 79–85). Scientific communities are ultimately responsible for helping other groups of actors understand more fully the return on research effort, but the communication cannot be one-way. It is crucial to operate a two-way communication—a process in both directions—from S&T to civil society and from civil society to S&T. This second part of the relationship has been less discussed until now (Valenduc and Vendramin 1997).

Building bridges between scientists and other social actors requires us to recognise that other social actors also have and produce knowledge, and to be open to the needs, expectations, fears and demands of the groups affected by S&T development This is a new approach, fostering a 'retrospective informational effect' from other social actors to researchers.

This perspective remains marginal today, although some bridge-building efforts date back to the 1970s. Examples include the 'science boutique' formula begun in the Netherlands and the community-based research centres in the United States. In Quebec, the Programme Actions concertées of the Fonds québécois de recherche sur la société et la culture supports partnership programmes in areas of practice, including community groups, civil society representatives, health care organizations, education and social services networks, etc. There is also a Canadian version of this programme: CURA (Community–University Research Alliances), overseen by the Social Sciences and Humanities Research Council of Canada. France has Picri (Partenariat Institutions Citoyens pour la Recherche et pour l'Innovation), which was developed in the Île-de-France region. Both programmes are more recent.

Actions within this perspective began in research milieus rather than through scientific and technical culture organizations, and involved research and transfer activities. Bridge building is not intended specifically to disseminate S&T information, but exists in the context of co-producing knowledge and integrating it into practices.

The participation of social actors who may be less familiar with S&T production, which helps to achieve a more 'socially robust' knowledge and enriches the

problematic (Gibbons et al. 1994),[2] is now in sync with research and innovation policies that valorize the work (to commercialize and integrate it into practices) and also yield spin-offs. This is the case in Quebec (MEDIET 2006b).

This wider participation brings the research closer to social requirements. As well as the discourse on the social relevance of research, partnership research programmes affect the representations and the openness of the scientists, ultimately stimulating partnership researches and knowledge transfer.

However, while we perceive greater understanding on the part of scientists about the need to be closer to other population groups (Vetenskap och Allmänhet 2003, Royal Society 2006, Alix 2007), researchers do not always grasp the benefits of bridge building. Therefore, the STC feels that government should encourage scientists to recognize social demands more fully, particularly during their training. Many high educational institutions already provide services to act on social demands.[3]

17.7   Perspectives STS: A Unique Experience

Perspectives STS (science, technology, society), a project to promote reciprocal exchanges between scientists and the eventual users of research outcomes, was initiated in 2003 by the STC in collaboration with other partners.[4] The project objectives are to:

- Encourage broader participation in determining research paths for the future.
- Put S&T into service to deal with major challenges confronting society.
- Highlight the contribution of S&T in socio-economic development.
- Develop a long-term vision of research.

The first phase of the project pinpointed major challenges Quebec would face in the years ahead. A public inquiry was launched to hear people's concerns about the future, and the results served as the basis for participants' discussions at a futures workshop. About a hundred people from a wide variety of sectors (education,

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[2] For Gibbons et al., 'socially robust' knowledge is created after scientific knowledge is empirically confirmed and proven in reality.

[3] For example, the Valorisation des innovations et du capital intellectuel (Vinci) project at the University of Montreal and the Valorist project at the University of Quebec, both of which are funded through the Intellectual Property Mobilization Programme of the Natural Sciences and Engineering Research Council of Canada.

[4] Partners include the Ministry of Economic Development, Innovation and Export Trade; Valorisation-Recherche Québec; the Fonds de la recherche en santé du Québec; the Fonds québécois de la recherche sur la nature et les technologies; the Fonds québécois de la recherche sur la société et la culture; the Association francophone pour le savoir and the Association de la recherche industrielle du Québec. Other contributors to the development of research strategies include the Ministry of Education, Leisure and Sport; the Ministry of Employment and Social Solidarity; the Ministry of Health and Social Services; Hydro-Quebec; the Agency for Energy Efficiency; and the Lucie and Andre Chagnon Foundation.

business, environment, industry, culture, etc.) participated in this exercise. They were asked to identify the major challenges for Quebec over the next 20 years.

Several months later, a consultation was held with researchers from all milieus and disciplines. Participants were asked to choose from the major challenges selected at the preceding stage. Seven main challenges were selected:

- Promote the adoption of healthy living habits.
- Use our natural resources more efficiently.
- Provide access to high-quality education for all.
- Increase the effectiveness of the health system.
- Make Quebec a leader in new and renewable energies.
- Adopt innovative actions to fight poverty.
- Target strategic niches and development priorities.

In the second phase of *Perspectives STS*, a steering committee was set up for each designed challenge. The committee included researchers and representatives from areas of practice, government bodies and potential funders. The goal was to develop a research and knowledge transfer strategy to meet the challenges. This work should be completed in the autumn of 2008.

Each strategy will be overseen and implemented by interested groups of social actors, with research funds allocated and in partnership with the areas of practice. Once the strategies have been implemented, a *Perspectives STS* report will be issued, describing the work and serving as a guide for future initiatives.

This bridge-building initiative between science, technology and society, which complements science communication efforts, reverses the trend of traditional research methods. In this regard, *Perspectives STS* reflects changes occurring in the production and management of knowledge.

From the social needs identified by the reference groups, *Perspectives STS* is trying a different form of governance of S&T development. To develop the research and transfer strategies, it is bringing together scientists, decision makers and potential users of the research results to formulate a theoretical framework, prioritize the themes, and choose target objectives and ways to implement them. The project will ultimately mandate the implementation of these strategies by teams of actors representing this same mix. *Perspectives STS* adds an original dimension to this threefold perspective, and as far as we know is the only initiative of its kind.

17.8   Conclusion

Along with other industrialized societies, Quebec has redoubled its efforts over 20 years to develop a strong research and innovation system. The government-supported science communication initiatives to enlarge the public place for S&T have contributed to the development of this system.

Current research activities are now more results-driven and emphasize integration into practices. Efforts in science–society bridge building now tend to focus on the openness of the scientific milieus to produce results more attuned to community needs.

Neither of the two efforts—communication and bridge building—replaces the other. On the contrary, they are complementary.

Today's growing number of partnerships between researchers and other social groups will enhance research activities and their results. In coming years, these exchanges could also extend to developing public policies in S&T. In Quebec, *Perspectives STS* is a precursor project for such future initiatives. Inevitably, the future lies in greater expertise and knowledge sharing.

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