

THE EVALUATION OF THE GEOLOGIC MAPPING ACTIVITIES AND THE MANAGEMENT OF THE GEOLOGICAL SURVEY ORGANIZATIONS

ARNO LUÍS BERTOLDO¹ & NEWTON MÜLLER PEREIRA²

ABSTRACT Evaluation programs of research institutions began to be established in Europe in the late 70's, concerning the assessment of science and technology activity. In the geoscientific world this enterprise took place in the 1990's, with the implementation of evaluation processes in some national geological surveys (Australian Geological Survey Organization, Geological Survey of Canada, Council for Geoscience - South Africa, Geological Survey of Finland). Among the results of these evaluation/review processes it has been common to recommend the establishment or strengthening of Advisory Councils or Advisory Committees, made up of representatives from industry, academia and governmental agencies. On the trail of the Geological Surveys evaluation process, partnership national geological mapping programs with regional geological surveys, having customers, universities and industry representatives as advisory has also been stimulated. The National Geoscience Mapping Accord in Australia (1990), the National Geoscience Mapping Program in Canada (1991), and National Cooperative Geological Mapping Program in United States (1992) are examples of the government policies in wake of evaluation process. Nevertheless, it is important to say that institutional staff has not accepted evaluation with tranquillity or understood it as an instrument of management. This recent trend of management - making a connection to the customers/users/stakeholders - has been introduced into the Geological Surveys by initiative of government or agencies at high level hierarchy, i. e., from top to bottom, from outside to inside the corporation.

Keywords:

INTRODUCTION The scientific and technical activities of geological surveys are highly specialized and interpretative and are not a simple data collection task. In the same way as other scientific and technological activities, they are complex and very hard to be evaluated. On the other hand the social economic impact of the geological surveys only happens quite after their results are released.

The geological surveys are essential to the social and economic development of any nation and constitute a permanent activity. All over the world, either in market economies or in centrally planned ones, the geological surveys are of government responsibility and accomplished by public agencies usually named "Geological Surveys" (GSs).

This paper aims to discuss how the GSs of the United States, Canada, Australia, South Africa, France, Finland, United Kingdom and Brazil, evaluate the performance of their geologic survey activities. Another objective is to discuss how the review/evaluation of the GSs organizations, while public policies instrument, have been determinant in the implementation of management mechanisms seeking the participation of the clients, users and stakeholders.

In order to place the geological surveys evaluations in a broader context, at first we present some results about the experience of the evaluation of the S&T activities. Subsequently, we report the major evaluation mechanisms utilized by the GSs analyzed, followed by discussions and conclusions.

EVALUATION OF SCIENCE AND TECHNOLOGY ACTIVITIES

As the theory and methods of science and technology (S&T) indicators was being developed, governments and other organisms of public policy were beginning to be interested in the measurement of science and the use of quantitative analysis for public policy in science (Holbrook 1992).

The experiences of the evaluation of technical research and development (R&D) institutions from Nordic countries (Ormala 1989) reveal that there is no single correct way of doing evaluations, and different levels of evaluation require different evaluation methods. Other findings of these evaluations are:

R & D evaluation lies between the scientific and administrative worlds. It utilizes methods which are similar to those of science, but the conduct of an evaluation and the utilization of evaluation results are governed by principles characteristic of administration.

An evaluation may cause restlessness in a milieu where evaluation is not an established practice.

Evaluations help to address decision maker's attention to the most urgent problems and encourage them to make the decision required.

Evaluations contribute to the planning and direction of future research as well as to public debate on research.

Research evaluation is qualitative description rather than quantitative measurement.

If the emphasis of the evaluation is focused on the scientific value and quality of research, peer review appears to be the most appropriate method.

EVALUATION OF THE GEOLOGICAL MAPPING ACTIVITIES

While European research institutions began to be evaluated in the late 70's, the evaluation of GSs started in the late 80's, with the majority of them being established in the 90's. In all evaluation processes studied, the initiative to evaluate the GSs has come from the government or management agencies at high level hierarchy, i. e. from top to bottom, and from outside to inside the corporation.

The specific evaluation of the geological surveys activities is also a recent practice that the GSs of advanced countries have started in the late 80's and is still in progress. In short, the GSs have adopted the following mechanisms of evaluation.

United States Geological Survey (USGS) USGS mapping activities are accomplished through cooperative arrangements established by the National Cooperative Geologic Mapping Program as authorized by the National Geologic Mapping Act of 1992 (Public Law). The planning, implementation, execution and revision of the works are accomplished through a heavy net of social relationships, with representatives from the USGS, other Federal agencies, State geological surveys, academia, and the private sector. The program consists of three main parts (United States, 29/07/1999):

The FEDMAP/SUPPORTMAP components, whose objectives are to determine the geologic framework of the Nation and to develop a national geologic map database.

The STATEMAP component supports the States in cooperative agreements to produce geologic maps. States Advisory Committees determine mapping priorities and the highest priority proposals are forwarded to a peer panel with effective participation of the American Association of State Geologists.

The EDMAP component provides funding for academic research programmes through cooperative agreements, and ensures the training of students in producing geologic maps.

The National Geologic Mapping Act also established a Federal Advisory Committee with 16 members, including representatives from Federal agencies (Department of Agriculture, Office of Science and Technology Policy, Department of Energy, and the Environmental Protection Agency), and representatives from the USGS, State geological surveys, universities, and the private sector. The Federal Advisory Committee plays the following roles:

review and critique the draft implementation plan prepared by the USGS;

review the scientific progress of the geologic mapping program;

submit an annual report to the Secretary of the Interior that evaluates the progress of the Federal and State mapping activities.

In addition, the geologic survey activities are supervised through the Government Performance and Results Act, passed by the Congress in 1993, which requires that all Federal agencies set quantitative performance targets and annually report to them.

1 - CPRM - Geological Survey of Brazil, Av. Pasteur 404, CEP 22.290-240, Rio de Janeiro, Brazil. E-mail: arno@cprm.gov.br

2 - Instituto de Geociências - UNICAMP, Caixa Postal 6152, CEP 13.083-970, Campinas, São Paulo, Brazil. E-mail: newpe@ige.unicamp.br

Geological Survey of Canada (GSC) The Earth Sciences Sector (ESS), the second operational level of the organization chart of the Natural Resources Canada, coordinates the scientific review process of the GSC. The Minister's National Advisory Board for Earth Sciences (MNABES) reviews ESS's activities.

Formal internal and external peer reviews of all published outputs are part of the normal operations of the ESS. The progress and effectiveness of GSC research is assessed regularly at both the divisional and branch levels (at the project level), and at the Science Program Committee (at the program level), through all stages of each project's lifetime (Canada 1998).

In the external review process, the MNABES and the Minister's Advisory Council for Science and Technology provide advice concerning goals, objectives, strategies and priorities. Specific steering and review committees for major programmes or projects focus on more programmatic issues and detailed technical questions. Examples of these are the National Geoscience Mapping Program steering committee and ad hoc committees formed to review specific program elements. Program directions are set through discussions with each province and territory, as set out in Intergovernmental Geoscience Accord of 1996, and the bilateral agreements currently being negotiated.

Audit and evaluation programmes such as "An Evaluation of the Geological Survey of Canada", of 1992 (Canada 1994), receive financial and technical support from the Audit and Evaluation Branch, from the Natural Resources Canada.

Australian Geological Survey Organization (AGSO)

AGSO has a strong liaison with the States and Territorial GSs, and with the mineral and oil industry. Among the GSs studied it was the first to be evaluated and the pioneer in establishing an Advisory Council and a geologic mapping program articulated with the regional GSs as the National Geoscience Mapping Accord (NGMA). The Advisory Council was established in 1985, following the recommendations of the ASTEC Review of 1978, while the NGMA was established in 1990, on the trail of the Woods Review of 1988 (Australia 1993).

Recently, the AGSO has undergone a number of significant changes in the way it operates and its Board of Management and Advisory Committee no longer exists (personal information from Tony Robinson, General Manager, AGSO). AGSO Project Leaders are now responsible for all aspects of their project, including output quality and delivery. Project Leaders report directly to Research Group Leaders (RGLs) who have scientific leadership and management responsibilities for a group of projects. The RGLs report directly to a Chief of Division.

Council for Geoscience (CGS) - South Africa The Geoscience Act No.100 of 1993 established the CGS (the successor of the Geological Survey of South Africa) and specifies that in order to achieve the objectives of the Council, "its affairs shall be managed by a Management Board" which determines the policy and goals of the Council and exercises control over the performance of the functions of the Council (South Africa 1997).

The Management Board consists of: a) a chairman appointed by the Minister; b) an executive officer, who shall serve ex officio as a member of the Management Board; c) at least eight but no more than ten other members appointed by the Minister (nominated officials from the Departments of Mineral and Energy Affairs, Environment Affairs, Regional and Land Affairs, Water Affairs and Forestry; a person involved in commerce; nominated persons by the Chamber of Mines, Geological Society of South Africa and Industrial Development Corporation).

The review of the Council for Geoscience of 1997 (South Africa 1998) recommended that the Management Board must play a much greater role in strategic planning of the Council and must provide direction at a strategic level. Also recommended that the Technical Advisory Committee (TAC), which held his first meeting on October 1996 and has not met since then, should be reactivated. But the TAC never lived up to expectations, and the matter is under consideration again (personal information from Danie Barnardo, Information Management, CGS).

The CGS doesn't have regional GSs. The Strategic Planning Unit reviews their reports and maps.

Bureau de Recherches Géologiques et Minières (BRGM)

- France While the BRGM structure is very complex, mixing public tasks with private activities, the mission of the Service Géologique National (SGN) is very simple. Inserted into the organizational structure of the BRGM, the SGN has the mission to carry out the systematic mapping of the France territory in the 1:50.000 scale (France 14/03/99).

To evaluate the quality of their products (maps and explanatory notes), the SGN established in 1987 the Comité de la Carte Géologique de la France (Geological Map of France Committee). This assessment committee, with 14 members (7 from universities), has a classic peer review system with similar functions as the editorial committees of the major scientific journals (personal information from Philippe Rossi, Directeur de Programme, SGN).

Geological Survey of Finland (GTK) In 1991, the *Geologian tutkimuskeskus* formalized the GTK Board, or Board of Directors, constituted by 8 members representatives from the academia, the mining industry, the steel industry, business, the Ministry of Trade and Industry (MTI), GTK management and GTK staff.

In relation to the Board of Directors, the international evaluation of the GTK (Finland 1996) recommends that "...its membership and remit should be broadened and it should be more involved in setting program priorities and in monitoring of deliverables." It also recommends the formation of a user's group to develop the mapping program and priority areas to be mapped.

Their geological maps are mainly reviewed only within the map production unit. External reviewers (personal information from Kaj Kortman, Communications Director, GTK) mainly review the printed GTK publications within the Survey but sometimes also.

British Geological Survey (BGS)

The BGS Board was established in 1997 by the Natural Environment Research Council (NERC) to support the management and strategic direction of the Survey, as required in the Management Statement and Financial Memorandum agreed between the NERC and the BGS (United Kingdom, Sep 06 1999).

The Board was inaugurated in January 1998 as the successor body to the Programme Board after it was dissolved in December 1997. Its terms of reference include to advise and support the Director in the management and to furtherance of the Survey's mission, aim and objectives and to review and monitor the quality and relevance of all aspects of the Survey's work. Members comprise: a non executive, part time Chairman; the Director of BGS; Council's Chief Executive or his nominee, currently the NERC Finance and Information Systems Director; and 6 to 10 non-executive members (currently they are 8) including senior representatives of industry, government agencies and academia.

In 1996, the BGS reviewed the options to be privatized, transfer to a university or to be contracted, either in whole or in part. The review concluded that the BGS should remain in public sector (United Kingdom 1996).

The BGS is also periodically reviewed by a Science Management Audit set up by the NERC (personal information from Tony Evans, Inquiries Office, BGS).

Geological Survey of Brazil (CPRM)

The CPRM is managed by a Board of Management and an Executive Directory. The Board of Management is constituted by a Chairman nominated by the Minister of Mines and Energy (MME) and appointed by the President of the Republic; by a co-chairman, represented by the Director President of CPRM; and by 4 Advisers, 3 of them nominated by the MME and one nominated by the Minister of Budget and Planning. The Executive Directory is constituted by a Director President and up to 4 Directors elected by the Board of Management (CPRM 1995).

The Board of Management has the role to deliberate about plans, programmes and action norms, basic organizational structure, and economic and financial affairs.

Brazil does not possess well-organized regional GSs as in the United States, Canada and Australia. CPRM doesn't have Advisory Councils or Committees. The review of the geological maps and reports has been done internally and informally. The technical and informative journals of CPRM do not have editorial committees.

DISCUSSION AND CONCLUSIONS The evaluation of the S&T activities is a recent practice and the evaluation of the geoscientific activities is still more recent. While European research institutions began to be evaluated in late 70's, the GSs started to be evaluated in late 80's, however most of the evaluation programmes were established in the 90-decade.

The initiative for the evaluation/review of the GSs has been arisen from government or agencies of public policies at high level hierarchy, i. e., from top to bottom, and from outside to inside the corporation. Through the common recommendations to establish (or to strength) a Board, Advisory Councils or Advisory Committees, and to establish partnership geologic mapping programmes with the regional GSs, these evaluation processes have been determinant to approach customers, users and stakeholders to the geological mapping activities.

The specific evaluation of the geological mapping activities is also a recent practice that GSs of advanced countries started in the late 80's and which still is under way. The methods and mechanisms utilized such as peer review process, and the establishment of advisory councils or advisory committees are essentially qualitative.

The establishment of advisory councils and/or advisory committees including representatives from the clients, users and stakeholders, in the planning, monitoring and evaluation of the geologic surveys projects and programmes, constitute a current and future trend in the management of the GSs (Findlay 1997). The institution of these advisory councils and committees, making a bridge to the customers and users, approaches the first primary tenet of the Total Quality Management (the customer is the ultimate determiner of quality).

This new trend of management of the GSs, focused on the customers and users may be explained due to the more effective control supported by the governments through public policies, resulting on the restriction or decrease of their budgets. In an attempt to survive, the GSs are changing, trying to justify their activities to the society, discussing more broadly and deeply their projects and programmes, and establishing agreements and partnership programs.

In this sense it is symptomatic the fact that the national GSs of Australia, Canada and United States established partnership programs with their regional GSs almost at the same time. The AGSO established the National Geoscience Mapping Accord in 1990; the GSC established the National Geoscience Mapping Program in 1991; and the USGS, through a government Act established in 1992, the National Cooperative Geological Mapping Program.

The presence of regional GSs, advisory councils/committees, universities, as well as associations of mineral and oil producers, or entities, as American Association of States Geologists, in interaction with the national GSs, characterize the existence of a heavy net of social relationship. This "social network" (Dagnino and Thomas 1998), among governmental agencies, the private sector and academia, resulted on the establishment of priorities in the geological surveys activities and promoted the evaluation of the quality of the products and services.

In GSs of developed countries, with large territorial extension and great production of mineral resources, such as United States, Canada and Australia, it is evident the presence of a heavy net of social relationship. In GSs of developing countries, either in important producers of mineral resources, such as South Africa and Brazil, this social network may be considered incipient.

This social network density reflects the social insertion of the GSs and their capacity to better evaluate the quality of their products and services. Consequently, the denser the social network, the better are the conditions to manage the GSs activities.

Acknowledgments The authors acknowledge the comments made on the text by Jorge C. Palma, Sabino C. Loguercio and Cleverson G. Silva, and the information provided by Yvon T. Maurice and Arvin Anand (GSC), Neil Williams, David Newham and Tony Robinson (AGSO), Philippe Rossi (BRGM - SGN), Kaj Kortman (GTK), W. Herzberg and Danie Barnardo (CGS), Paul M. Young (USGS), and Tony Evans (BGS). To two anonymous referees for the critical review of the manuscript.

References

- Australia. 1993. *Review of the Australian Geological Survey Organisation: composition, structure and administrative arrangements*. Australian Government Publishing Service, Canberra, 127p.
- Canada. 1994. *An Evaluation of the Geological Survey of Canada*. Alconsult International Ltd. and Audit & Evaluation Branch. Summary Report. 47p.
- Canada. 1998. *ESS'S Scientific Review and Assessments*. Unpublished draft, 11p.
- CPRM – Companhia de Pesquisa de Recursos Minerais. 1995. *Legislação básica da CPRM*. Ed. rev. e aum. Rio de Janeiro : Assessoria da Diretoria de Geologia e Recursos Hídricos, 166p.
- Dagnino R. & Thomas H.E. 1998. Os caminhos da Política Científica e Tecnológica Latino-Americana e a comunidade de pesquisa: ética corporativa ou ética social? *Avaliação - Revista da Rede de Avaliação Institucional da Educação Superior*, Campinas, v. 3, n. 5.
- Findlay C. 1997. National geological surveys and the winds of change. *Nature & Resources*, 33:18-25.
- Finland. 1996. *New challenges for geoscience in society. International evaluation of the Geologian tutkimuskeskus - GTK*. Ministry of Trade and Industry. Helsinki, 102p.
- France. 14/03/99. Bureau de Recherches Géologiques et Minières. *Home page*: <http://www.brgm.fr>
- Holbrook J. D. 1992. Why measure science? *Science and Public Policy*, 19:262-266
- Ormala E. 1989. Nordic experiences of the evaluation of technical research and development. *Research Policy*, 18:333-342.
- South Africa. 04/07/1999. Council for Geoscience. *Home page*: <http://www.geoscience.org.za>
- South Africa. 1997. *Review of the Council for Geoscience*. Department of Arts, Culture, Science and Technology, 83p.
- South Africa. 1998. *The System Wide Review of Public Sector Science, Engineering and Technology Institutions*. A Report Submitted to the Department of Arts, Culture, Science and Technology of the Government of South Africa. Pretoria, 69p.
- United Kingdom. 1996. *Future Options for the British Geological Survey*. British Geological Survey Technical Report WQ/96/2, 16p.
- United Kingdom. 06/08/99. British Geological Survey. *Home page*: <http://www.bgs.ac.uk>
- United States. 29/07/99. United States Geological Survey. *Home Page*: http://ncgmp.usgs.gov/ncgmp_adv.comm.html

Contribution IGC-124

Received March 1, 2000

Accepted for publication April 29, 2000