Review of the French Industrial R&D Survey

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The purpose of the review was to discuss the accommodation of new data needs which had arisen during the 1990s: more extensive information on R&D personnel, data on biotechnology and the relationship between R&D expenditures and innovation or patents. An a priori constraint was the need to reduce overall response burden. In a context of increasing data needs, this meant that both questionnaire content and survey methodology were a prime focus of discussion, along with improvements in the phrasing of specific items.

The paper's first part lays out the review's context: external constraints (national legal obligations and international context of the Frascati manual), and internal particularities with regard to related business surveys. The second part summarizes the objects of discussion and revision, and the options that were considered. The third part lays out the steps of the review process and the roles of different actors. These included a steering committee comprised of representatives of businesses, R&D data users, and the French Ministries of Research and Industry.

The paper proceeds to assess the new questionnaire with respect to the initial project goals and the results achieved with it in the first survey. It concludes with the larger lesson drawn from this experience: In addition to conducting a full-scale review event, an ongoing process will be put in place to help maintain survey quality through time.

Role of R&D in modern economies

The conduct of research and development (R&D) is important to economic growth, since R&D is an important ingredient to innovation—the introduction of new products and services, even entire new industries. As economic structures change in response to market forces and governmental regulation, so does R&D.

Statistical needs in tracking R&D activity

R&D is an area in a perpetual and rapid evolution. To track these changes in the statistical system requires finding the balance between stability and change. Stability, because important trend data series need to be consistent over the time, requiring stable definitions and classification schemes. Change, because the statistical system needs to reflect with accuracy the new elements of the R&D activity, such as outsourcing formerly firm-internal R&D, the rise of inter-firm and industry-university R&D alliances, and the spread of R&D activities in the services sector.

The French R&D survey

The survey, formally called "Survey of Means Dedicated to R&D In Private Companies," deals with financial and human resources aspects of private companies' R&D. It collects data about intra- and extra-mural expenditures for R&D, employment, and researchers—scientists and engineers working in R&D. The survey has been performed for about 20 years. The last review prior to the one reported here took place in 1992.

The survey is conducted by the statistical office of the French Ministry of Research, which is responsible for computing and publicizing the national R&D estimates. It covers all firms that perform R&D on the French territory. Large companies (5 million francs or more of annual R&D expenditure until 2000) are surveyed annually on the basis of an extended questionnaire (16 pages). Smaller firms receive a shorter questionnaire (4 pages); A subset of these are surveyed annually, the others every two years.

The Ministry also conducts a companion survey of R&D in public institutions; while oriented to the same domain of items, it contains a number of dissimilar questions, dictated by the different R&D environments. Thus, on some questions, it is not possible to compare industrial and public R&D activities. In fact, one aim of the review of the French industrial R&D survey was to minimize existing dissimilarities between the industrial and public R&D surveys. This will again be a focus during the review of the public R&D survey, starting in 2001.

Institutional constraint: The French National Council for Statistical Information (CNIS)

CNIS (see annex n°1) acts on the basis of a 1951 Law that defines the different modes of a French public statistical survey and guarantees respondent confidentiality. In return, CNIS might declare a survey to be mandatory, meaning that non-responding companies might face legal action.

CNIS recognizes two types of statistical surveys: those labeled "General Interest," and those labeled "General Interest with Mandatory Response." No French public statistical survey may be conducted without one of these two labels. To obtain a label, all French statistical agencies must follow these steps:

- Present the survey project and its goals to the relevant Thematic Task Force which certifies that the "relevance" criterion is met: meaning the survey is useful and the information is not available elsewhere; then
- Present the survey project to the Label Committee, which examines all stages of the survey, from initial preparation to the dissemination of findings.

The Label Committee is responsible for issuing the "General Interest" or "General Interest with Mandatory Response" labels, keeping in mind the interests and needs of the

CNIS partners. It does so, based on whether a survey meets the CNIS criteria of statistical accuracy, accessibility, clarity, and confidentiality.

Constraint: International comparability

The review of the French industrial R&D survey was subject to further constraints: Guidance for the conduct of R&D surveys provided by the OECD *Frascati Manual*; and growing emphasis by the statistical agency of the European Union, Eurostat, on international quality standards and international comparability of these statistics.

Internationally, desirable statistical practices regarding R&D activities are defined in the *Frascati Manual* implemented by OECD and its members. Its first version was published in 1963, and a revision started in 2000 is about to conclude. The manual defines variables, classifications, and procedures for the collection of statistics on R&D funding and personnel, in order to produce data that are consistent over time and across countries. The current *Frascati* revision has led to inclusion of a paragraph on services sector R&D; a new chapter on survey methodology and procedures; development of indicators related to human resources; and inclusion of an annex on new areas of special interest (R&D in health, information and communication technologies, and biotechnology).

As a European Union member, France and its statistical offices have certain obligations toward Eurostat, the European Commission's statistical department. The European Parliament and Council have decided on the development and production of Community statistics on science and technology. This decision will obligate member states to deliver to Eurostat their national R&D and innovation statistics. Furthermore, countries are encouraged to use a common methodology in order to improve the quality and comparability of these statistics. Most EU countries are members of both OECD and Eurostat and are already following *Frascati Manual* recommendations. Areas requiring work are generally addressed by multinational task forces.

Constraint: Quality criteria

The quality of statistical data on R&D has been a growing focus of national and international attention over the last decade and is now of very high interest. It has been the focus of discussion in a series of recent international conferences.

In 2001, Eurostat and Statistics Sweden organized a conference dedicated to "quality in official statistics." Eurostat defines statistical quality with reference to eight criteria: relevance, accuracy, timeliness, accessibility and clarity, comparability, coherence, completeness, cost and burden. It started a working group, whose conclusions are reported in two documents [2], [3]. The French national statistical institute, INSEE, published a report on the subject [4] and proposed guidelines [5] to follow in measuring the quality of business surveys.

None of these reports placed specific binding constraints on the review of the quality of the French industrial R&D survey. However, they provided important quality standards

that the survey strives to meet, and they have influenced the review's findings, decisions, and subsequent actions.

Focus of the review

Topics in the review of the French industrial R&D survey can be grouped under "new needs" and "improvements."

New topics included expanded coverage of human resources, data on R&D outputs, and gathering data on topical areas of interest such as biotechnology R&D.

- We had gathered data on R&D personnel by type (e.g., researchers, technicians, administrative and other support personnel) in the main questionnaire. Detailed data on researchers were gathered via a four-page supplemental questionnaire, included in the main survey but sent only to the biggest companies (with R&D expenditures exceeding 1,5Meuros). Questions covered researcher's level of education, by sex; and their hiring and departure from the firm (headcount). The review considered the inclusion of a breakdown of R&D personnel by gender in the main questionnaire. We also considered adding new questions to the supplemental questionnaire, as well as the enlargement of the survey population to include all companies with R&D activities. This is in line with the revised *Frascati Manual's* greater emphasis on human resources (HRST) aspects and on better coordination with data from the surveys of public research agencies (the French public sector survey already has more extensive items on HRST).

  Furthermore, the HRST supplement had not been mandatory in the past and had a lower response rate than the main part of the survey. The proposal was made to make it mandatory to increase the response rate on these items.

- The link between **R&D and innovation** is evident but was not reflected in the questionnaire, which included only input indicators—funds and personnel. The proposal was to include output indicators on innovation activities, along with an indirect indicator, patents.

- The National Accounts section requested two changes to simplify the estimation of the R&D function in the input-output matrix. They asked for a new question on the share of R&D performed by the company from its own funds. They also requested that the publicly funded R&D amounts be split by funding method, that is, into grants and contracts.

- New topics for which no data were available included environmental R&D, research in the software area, biotechnology, and ICT. They are the objects of more and more requirements and growing data demands.

Improvements focused on three issues: eliminating or altering some questions with uncertain respondent interpretation or low response rates; consideration of the survey's

overall response burden; and whether to link the survey with the French business register—of major importance for easier updating of the survey frame and some variables.

- Analysis of the current questionnaire showed that some questions were not well understood by the respondent firms. The issue was whether to remove some questions that had a low response rate or to change their wording to make them more easily understood and more meaningful to the reporting firms.

- The very specific nature of the target population—firms that perform R&D—makes it difficult to use business registers to allow for easier sampling procedures. A possible improvement, linking the R&D survey with the French business register, would allow the updating of some variables and the inclusion of new businesses in the industrial R&D survey. Thus, the sampling methods needed to be carefully examined, taking into account the specific nature of the target population. New sources to update the target population were examined. A contributory element in the discussion was the need to lighten respondent burden.

Review process: The Steering Committee

A consultative body, a Steering Committee comprised of thirteen external members and guided by four members of the statistical office of the Ministry of Research, played the central role in the formal review process which lasted 15 months. The external Committee members included representatives of:

- Industrial firms (3): EADS; THOMSON; ALCATEL, CIT;
- French employers' organization (1): MEDEF;
- Ministry of Industry (2): Statistical office;
- French National Statistical Office INSEE (2) responsible for national accounts and R&D in service industries;
- Ministry of Research (2);
- OECD (1);
- Representatives of other public organizations using these data (2).

The Steering Committee met six times over the 15-month period and reacted to mailed proposals once.

The review itself proceeded in two stages. The first dealt with incremental improvements in the 1999 questionnaire (survey launched in 2000); the second, with more specific changes for the 2000 survey (launched in 2001) cycle and beyond.

For the 1999 survey Stage One review, questions were to be added dealing with patents, innovation, and company-funded industrial R&D. To formulate the questions, we interviewed specialists from the French Patent Office (INPI) and the Ministry of Industry (which conducts the European Union's Community Innovations Survey).

Review process: The company interviews

Throughout the review process, we kept in very close contact with firms: conducting one-on-one interviews, meetings to test items, and mailing test items for comment. We consulted these companies at different stages of the development of the new questionnaire, to help us define the new items, and subsequently to confirm our choices.

Between September 1999 and September 2000, we conducted interviews with five firms. The content of these interviews evolved over the period. We proceeded from the general to the specific, from the overall questionnaire (do you have problems understanding parts of it? which parts? why?) to the specific new items under consideration. Here we would ask: Do you understand the question? Is it possible for you to answer it? Is it easy to gather these data? Are there similar data that would be easier to collect? Their responses influenced the penultimate version of the questions.

To test this expanded 1999 questionnaire version, we requested ten companies to participate in a test meeting; five agreed. We mailed the questionnaires two weeks ahead of the meeting, then debriefed the participants in a group. This procedure was efficient in that it saved time and effort over individual debriefings, but in addition, it created a synergy among discussants which resulted in information that would have been difficult to obtain in individual sessions.

We asked these five companies to help us in the second part of the review with the development of new questions. During that second step, we communicated with them by mail. We drafted an exhaustive list of fields of science and engineering and asked: Are you able to allocate your intramural R&D expenditures into that list of fields? At the least, are you able to give us the share of Intramural R&D expenditure dedicated to biotechnology, software development or environment protection ?

A different set of companies participated in the final test of the resulting 2001 questionnaire version; we interviewed five of them, and ten others answered by mail. This brought to a close the extended review process which had involved interactions between firms, expert consultants, and the Steering Committee.

Changes resulting from the review

In addition to addressing the specific issues described above, the review provided an occasion to think about the broad concepts that are used to describe industrial R&D activities. Not all of this discussion was translated into survey or questionnaire changes.

Among the questionnaire changes were the following. In the 1999 questionnaire, three new questions were added dealing with:

- Innovation;
- Patents; and
- the share of intramural R&D expenditures funded by the company itself.

The 2000 questionnaire was modified more extensively:

- A new question was introduced on the share of intramural R&D expenditure by fields of science;
- The question on R&D personnel was expanded to include data by gender for researchers (those actively engaged in R&D) and for other R&D personnel (those in various support roles);
- Two questions about researchers were added: one on age by gender, and one on the discipline of researchers, again by gender;
- Again for researchers, we proposed a novel way of answering. As an alternative way of responding, we proposed that companies send us an anonymous list of their researchers which would include all the characteristics we asked for in the tables. This solution seemed to be of special interest for companies with only a few researchers, as well as for big companies with a developed database on personnel that included all the information we were looking for.

Three changes in sampling methodology accompanied these questionnaire changes. They are intended to reduce the response burden.

- The R&D volume limit for receipt of the full questionnaire was raised from 5MF to 10MF or 1,5Meuros.
- The survey on researchers was extended to all companies, on a sample basis for small companies and a census for large one.
- To compensate, the formerly annual survey was transformed into a biennial one.

A first assessment of these changes

No definitive assessment of the success of these changes is possible after so short a time. However, among the questions introduced in 1999, that concerning the share of company-funded intramural R&D expenditures was a failure. We had tried hard during the review process to develop a consensus on this issue, but industry representatives kept warning that this item would be very difficult to answer, or it was a very sensitive question that companies would not want to answer. As a result, we deleted this question from the 2000 survey.

In the 2000 survey, we were generally pleased with the item response rates on the remaining two new questions which were new in 1999. The response rate for the question on innovation was 75 percent; for patents, 97 percent. Moreover, the share of companies declaring fewer than five patents declined from 89 percent in 1999 to 81 percent in 2000, which we take as an indicator of a growing understanding of our questionnaire over the years.

The success of the questions introduced in 2000 is more difficult to evaluate, because we have only one year of observation. However, the response rate for the item on R&D personnel by gender was 95 percent, after follow-up contacts with the largest companies that failed to respond initially.

Regarding the share of intramural R&D expenditure by field of science, the survey had an apparent item non response rate of 44 percent. However, this included lack of response from companies that did no R&D in any of the five fields we had specified.

The response rate for the detailed survey on researchers was lower than that of the main questionnaire, as had been the case in the past. We tried to get the largest companies to give us detailed data and were able to get this information for 72 percent of the researchers reported on the main questionnaire. However, we noticed partial non response on certain questions.

Regarding the optional company response by table or list, 52 percent of them chose to report by table only, and 48 percent by list split into 8 percent who answered only by list and 40 percent who provided information both ways. The majority of list responses (72 percent) were by companies with fewer than 10 researchers. However, 9 large firms with more than 100 researchers, representing about 1 percent of list-answering companies, also used this option.

The change of criterion for distinguishing between small and large companies had an unanticipated consequence: Companies that had previously been sent the long form and received the reduced questionnaire in 2000 had a lower response rate than before. However, for these companies, the change of questionnaire was accompanied by a change in the imputation method. Thus we need to further analyze these results before reaching a firm conclusion about their significance.

We also had to deal with a lack of information on the public funding for R&D. The question in the extended questionnaire had more items than in the reduced one. This produced, at a very detailed level, a broken series. To solve this problem, we performed an *a posteriori* imputation.

The quality objective and the Advisory Committee

This first assessment demonstrates quite convincingly that a review process does not end with the production of a new questionnaire. Rather, it requires continuous work to take into account defects that could not be detected during the initial review, or that were introduced as a result of it. There always remains a degree of uncertainty about item formulation, the way responding companies will understand the question, etc. For that reason, we decided to create an Advisory Committee that would meet twice a year on a continuing basis.

The Advisory Committee will meet for the first time in November 2002. It will be composed of the same stakeholders as the Steering Committee: companies' representatives (with a representative of small and medium-sized firms), and representatives of users from other ministries or from universities.

The Committee's mandate is to examine the results of the survey from a methodological perspective (response rate, global or partial, question wording, etc.), to give advice on new projects, to give agreement to proposed questionnaire changes for subsequent surveys, and to suggest new themes of interest.

The agenda of the next meeting will include the following items:

- A first assessment on the changes in the 2000 questionnaire;
- Assessment of the project to change the sampling and imputation methods;
- Examination of changes needed in the 2002 questionnaire;
- Presentation of a new way to answer our questionnaires (with the internet);
- Presentation and discussion of the pilot survey on R&D in the services sector;
- Presentation of an ad hoc survey project on business partnerships which might be launched in early 2003, in preparation for introducing a question on R&D partnerships in the 2004 questionnaire, based on the 2003 data.

The service sector pilot survey is intended to lead to an expansion of the R&D survey's coverage to services in 2004, based on 2003 results. It should help to determine the proper way to ask questions about R&D in the services sector, so that such firms can properly delineate their R&D activities, which will not necessarily be of the same nature as R&D in the manufacturing sector.

However, we realize that periodic meetings with our Advisory Committee are by themselves insufficient to keep us in touch with our respondent community. For that reason, we are meeting with about 10 companies per year, some of which have contacted us to discuss specific issues with the survey. We take such requests as an occasion to discuss with them questionnaire content and on-going projects. We believe that this interplay of information gained from direct contact with companies and from our Advisory Committee will enrich the content and quality of the survey.

Conclusion

Surveys require attention to quality and needed improvements, as well as to the effects of such improvements on the ability to preserve key trend data. Such attention is best given continuously, rather than at widely separated points in time. Discussion will focus on measures of all aspects of survey quality: relevance, accuracy, timeliness, accessibility and clarity, comparability, coherence, completeness, cost and burden. Studies and discussions of these elements will not necessarily translate into immediate changes in the survey, but they will be important contributing elements to the ongoing task of quality control.

These discussions must take place in a framework that allows survey managers, data providers, and users to interact in continuous, focused fashion. The survey team is not always in the best position to make decisions affecting the survey. Many such decisions will be improved by information and reactions from those who are at some distance from the technical survey aspects. The survey team needs the help of all the actors, including

data providers and data users. The seeming burden such a process imposes on the survey team—preparing draft papers for meetings, discussions, etc.—is in fact the way to ensure that the survey's quality objective can be met.

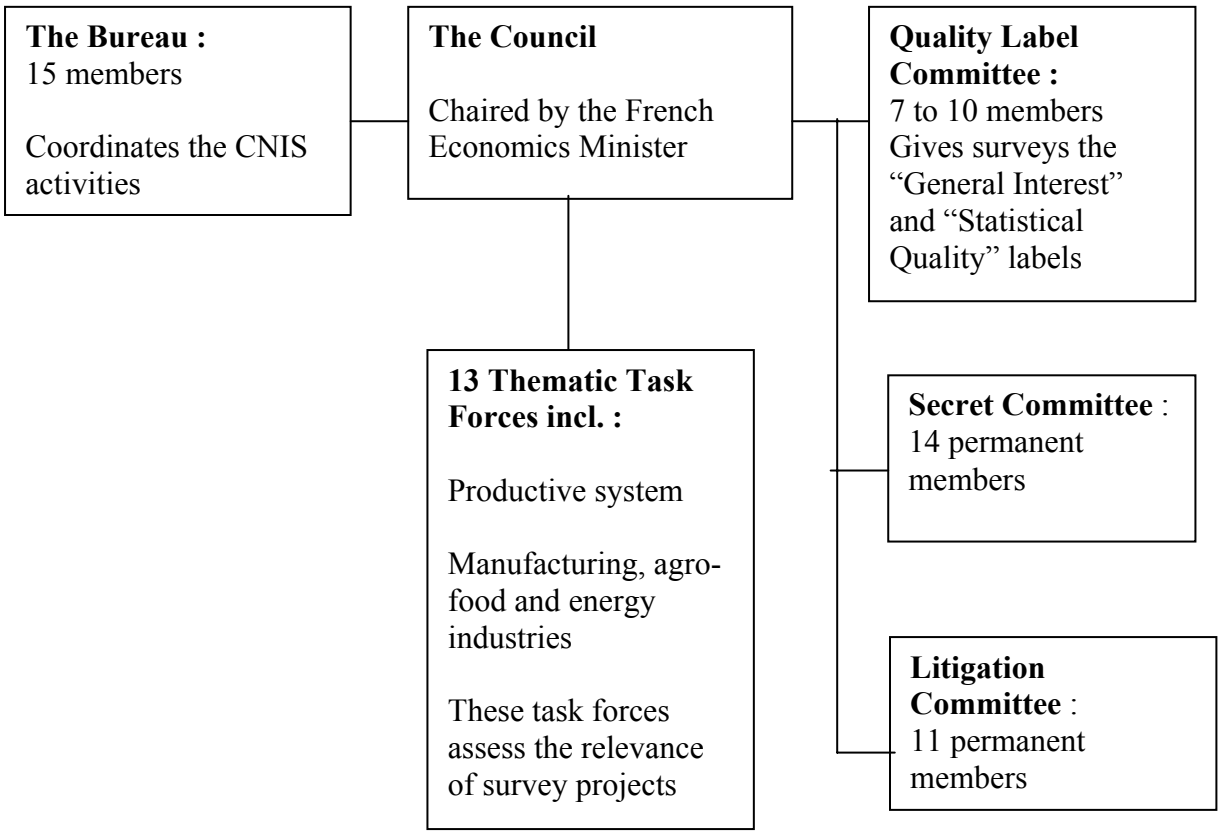
Annex n°1 : The French public statistical organization and the National Council for Statistical Information (CNIS)

The **French National Council for Statistical Information (CNIS)** reviews the activities of all French public statistical organizations. CNIS' goals are defined as follows:

"The National Council for Statistical Information provides a forum for producers and users of public statistics. As **coordinator** of government statistical activities, it prepares a medium-term program, and—within that framework—an annual program incorporating all **public surveys**." [1]

CNIS acts as **coordinator** between statistics producers and CNIS partners, including businesses and labor organizations. Government statistical agencies submit their **public surveys**—including surveys, registers, panels and compilations from government records—to CNIS members. The latter examine what each project seeks to achieve, how it will fit into the French statistical information system, and whether or not it deserves priority.

Tab 1 : CNIS organizational structure :



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