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R&D and innovation surveys in service sectors; current experience, conceptual and practical problems and future prospects.

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A B S T R A C T

This paper discusses problems and future prospects for conducting R&D and innovation surveys in the service sectors and how these could be more closely related to the ongoing development of surveys on use of ICT and E-commerce applications in enterprises. The paper also raises some questions for future discussion.

Introduction

R&D surveys have been conducted in almost all OECD countries since the sixties or the seventies. Innovation surveys are a more recent development, mainly during the nineties. OECD methodological guidelines in the Frascati and Oslo manuals developed and approved by member countries cover both. The aim of this paper is to discuss some problems and future prospects for conducting R&D and innovation surveys with a specific emphasis on the service sectors. There also seems to be some areas of common interest between the innovation survey and the ongoing development of surveys on use of ICT and E-commerce applications in enterprises. In the future development of both surveys there might be a need for co-ordination of development efforts. The intention of the paper is therefore also to raise some questions for future discussion in this context. Before going to this it might however be useful as a background with some more detailed information on the current state of arts of R&D and innovation surveys.

Status of R&D and innovation surveys

R&D surveys

R&D surveys are undertaken annually or at least every second year in almost all OECD countries. The surveys are based on methodological guidelines given by the OECD in the Frascati Manual, issued for the first time in the beginning of the sixties. The fifth revision is being finalised (but not yet formally approved) and later in this paper some aspects in this revision with particular relevance for the service sectors will be discussed. The data collected usually include information on R&D personnel, R&D expenditure and from which sources the R&D expenditure are funded. The information on R&D is further broken down by product field in many countries.

The Frascati Manual is originally designed for the manufacturing sectors but surveys have gradually been extended to cover more and more service sectors. Among sectors often included are

The ICT sectors

- Telecommunication (ISIC rev. 3, 642), although for confidentiality reasons often included in a broader aggregate post and telecommunication (ISIC rev.3, 64) or even more broadly together with transport and telecommunication in (ISIC rev. 3, 60-64).
- Computer and related activities (ISIC, rev 3, 72)

And some others like

- R&D services (ISIC rev 3, 73)
- Architectural, engineering and other technological activities (ISIC rev 3, 742)

One of the main themes in the fifth revision of the Frascati Manual has been the improvement of R&D data in the service sectors. In the forthcoming revised Frascati Manual a more explicit recommendation on coverage has been added. It is now recommended to also include in R&D surveys systematically wholesale (ISIC 50) and financial intermediation (ISIC 65-67). Many countries include them already now, especially if information is available from other sources that firms in these industries perform R&D. In addition some examples of R&D in the service sectors have been added. These are presented in the next section.

The collected information is published both nationally and by the OECD on the basis of collecting aggregate data twice a year for the MSTI (Main Science and Technology Indicators) publication and detailed data once a year for the Basic Statistics publication. In addition Eurostat collects regional breakdowns for the most important variables.

Innovation surveys

During the eighties several countries, like Italy, Germany, France, United States undertook quantitative studies, partly of a pilot nature, in order to measure also other aspects of innovation than just R&D. Based on the experience of these countries the Nordic countries (Finland, Sweden, Norway and Denmark) developed a common questionnaire for use in a common Nordic innovation survey. This was the first internationally comparable innovation survey. As a result of a co-operation between the Nordic Industrial Fund funding the Nordic work and the OECD the first international guidelines for innovation surveys were developed and adopted in the first Oslo Manual published in 1992 and revised in 1997.

Innovation surveys include a combination of qualitative questions such as different aspects of the industrial innovation process (effects, barriers, co-operation), description of the most important innovation and quantitative questions like sales due to innovative products and the resources devoted to innovation activities. National data on innovation activities are generally collected by means of surveys addressed to industrial firms. Most of the OECD Member countries have organised such surveys, and it is on their experience that the Oslo Manual is based. With some exceptions these surveys are conducted at rather long intervals and on an ad hoc basis. A few countries have also introduced some questions on innovation in other surveys, like the R&D survey.

The surveys in Europe have been co-ordinated by Eurostat, which has launched three Community Innovation surveys in 1992, 1997 and 2001 using a common questionnaire. The first survey was based on the 1992 Oslo manual. The second and third surveys were developed on the basis of the 1997 Oslo manual making several modifications to the questions and definitions in the Manual. The innovation surveys done so far (at least in Europe) have met certain problems, such as low response rates if the surveys are not mandatory and also big item non-response to certain difficult questions. In addition, the information on R&D in innovation surveys is generally not consistent with R&D statistics.

On the basis of all experience gained the second revision of the Oslo manual will most probably be launched in 2003 on the basis of preparatory work expected to start late in 2002.

During this revision process, which might be rather substantial, it is most likely that all the aspects of innovation surveys will be reviewed such as

- Conceptual framework, including basic definitions
- Which questions to be asked
- Survey options (continued separate innovation surveys, asking for innovation questions in other surveys like R&D and ICT surveys or in the structural business survey)
- Methodological aspects

Problems of conducting R&D and innovation surveys in the service sectors

The problems involved relate largely to the understanding of the R&D concept and the innovation concept in the service sectors. We are talking here about the service sectors even if it from the conceptual point of view might be better to talk about R&D and innovation linked to service activities. The borderline between manufacturing and service activities is becoming more and more diffuse. Service components are more and more embedded in manufacturing products and manufacturing elements are included in service products. There is also a problem of survey coverage for the service sectors, which we will shortly tackle.

Definitions and examples of R&D and innovation

R&D

The basic definitions of R&D in the Frascati Manual, which will remain unchanged in the fifth revision, are the following:

Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

The term R&D covers three activities: basic research, applied research and experimental development; Basic **research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view. **Applied research** is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective. **Experimental development** is systematic work, drawing on existing knowledge gained from research and/or practical experience, that is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

From the point of service sectors these definitions may seem somewhat abstract and practical experience has shown difficulties in applying them, especially for certain industries, like financial services. In the current draft revised Frascati Manual a set of examples have been developed to guide respondents to evaluate what is R&D in service sectors. These are showed below.

Examples of R&D in banking and insurance

- Mathematical research relating to financial risk analysis.
- Development of risk models for credit policy.
- Experimental development of new software for home banking.
- Development of techniques for investigating consumer behaviour for the purpose of creating new types of accounts and banking services.

- Research to identify new risks or new characteristics of risk that need to be taken into consideration in insurance contracts.
- Research on social phenomena with an impact on new types of insurance (health, retirement, etc.), such as on insurance cover for non-smokers.
- R&D related to electronic banking and insurance, Web-related services and e-commerce applications.
- R&D related to new or significantly improved financial services (new concepts for accounts, loans, insurance and saving instruments).

Examples of R&D in some other service activities

- Analysis of the effects of economic and social change on consumption and leisure activities.
- Development of new methods for measuring consumer expectations and preferences.
- Development of new survey methods and instruments.
- Development of tracking and tracing procedures (logistics).
- Research into new travel and holiday concepts.
- Launch of prototype and pilot stores.
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The following examples illustrate what could be considered as R&D in software.

- R&D producing new theorems and algorithms in the field of theoretical computer science.
- Development of information technology at the level of operating systems, programming languages, data management, communications software and software development tools.
- Development of Internet technology.
- Research into methods of designing, developing, deploying or maintaining software.
- Software development that produces advances in generic approaches for capturing, transmitting, storing, retrieving, manipulating or displaying information.
- Experimental development aimed at filling technology knowledge gaps as necessary to develop a software programme or system.
- R&D on software tools or technologies in specialised areas of computing (image processing, geographic data presentation, character recognition, artificial intelligence and other areas).

In the draft Manual a list is given of software-related activities of a routine nature, which do not involve scientific and/or technological advances or resolution of technological uncertainties and therefore are not to be included in R&D. Examples are:

- Business application software and information system development using known methods and existing software tools.
- Support for existing systems.
- Converting and/or translating computer languages.
- Adding user functionality to application programmes.
- Debugging of systems.
- Adaptation of existing software.
- Preparation of user documentation.

Innovation

The basic definition of technological innovation activities and technological innovations in the Oslo manual is the following:

Technological innovation activities are all of the scientific, technological, organisational, financial and commercial steps, including investments in new knowledge, which actually, or are intended to, lead to the implementation of technologically new or improved products and processes. R&D is only one of these activities and may be carried out at different phases of the innovation process. It may act not only as the original source of inventive ideas but also as a means of problem-solving which can be called upon at any point up to implementation.

Technological innovation activities may lead to implemented technological innovations, which are defined as follows

Technological product and process (TPP) innovations comprise implemented technologically new products and processes and significant technological improvements in products and processes. A TPP innovation has been implemented if it has been introduced on the market (product innovation) or used within a production process (process innovation). TPP innovations involve a series of scientific, technological, organisational, financial and commercial activities. The TPP innovating firm is one that has implemented technologically new or significantly technologically improved products or processes during the period in review.

In the Oslo Manual an attempt was also made to give some aid to service companies on the interpretation of the concept of innovation by providing a list of examples. Especially in the third community innovation survey this list was expanded.

Box 1. Examples of TPP innovations in selected service industries

Wholesaling of machinery, equipment and supplies

- Creation of web sites on the Internet, where new services such as product information and various support functions can be offered to clients free of charge.
- Publication of a new customer catalogue on CD (compact disc). The pictures can be digitally scanned and recorded directly on the CD where they can be edited and linked to an administrative system giving product information and prices.
- New data processing systems.

Road transport companies

- Use of cellular phones to re-route drivers throughout the day. Allows clients greater flexibility over delivery destinations.
- A new computer mapping system used by drivers to work out the fastest delivery route (*i.e.* from one destination to another). This makes it possible to offer clients faster deliveries.
- The introduction of trailers with eight globe-shaped containers instead of the usual four.

Post and telecommunications companies

- Introduction of digital transmission systems.
- Simplification of the telecommunications net. The number of layers in the net has been reduced by using fewer but more highly automated switching centres.

Banks

- The introduction of smart cards and multipurpose plastic cards.
- A new bank office without any personnel where clients conduct “business as usual” through the computer terminals at hand.
- Telephone banking which allows clients to conduct many of their banking transactions over the phone from the comfort of their own homes.
- Switching from image scanning to OCRs (Optical Character Readers) in the handling of forms/documents.
- The “paperless” back-office (all documents are scanned for entry into computers).

Software consultancy and supply companies

- The development of a whole range of different customer packages in which clients are offered varying degrees of assistance/support.
- The introduction of new multimedia software applications that can be used for educational purposes and thus eliminate the need for a real life human instructor.
- Making use of object-oriented programming techniques in automatic data processing systems development.
- The development of new project management methods.
- Developing software applications through computer-aided design (CAD).

Technical consultancy companies

- A new method of purifying water abstracted from lakes for use as household drinking water.
- Offering customers a new “supply control system” which allows clients to check that deliveries from contractors meet specifications.
- The development of a standard for construction work carried out in already densely built-up areas (where care has to be taken not to inflict damage on any of the surrounding buildings).

Advertising and marketing companies

- Delivering lists of potential customers on diskette together with a list filing system (software) that allows the client firms themselves to analyse and draw samples from the list.
- Being able to assist clients in direct marketing campaigns by offering to distribute pre-labelled advertising leaflets, etc., addressed to selected households.
- Initiating a control process to check by phone with random households that they are actually receiving the adverts/leaflets they are supposed to.
- Delivering the software applications needed for clients themselves to be able to analyse data along with statistical databases.

Problems in applying these definitions and examples

As have been stated earlier the definitions in the Oslo manual refer to **technological innovations** and they have originally been developed mainly from a manufacturing perspective. A deliberate choice has been made to delimit the concept to technological innovation excluding other types of innovations like organisational innovations and market innovations. No country had real experience of quantitative surveys using a broader concept of innovation. The idea behind the innovation concept is that the innovation should be a product or process with improved performance characteristics, which could be objectively measured.

There are problems both with the interpretation of the word technological and the word innovation. Experience has shown that the word technological is interpreted differently in different languages. In the English language the meaning may be relatively broad, while the interpretation in other languages may be rather restricted in the sense that a higher degree of novelty is thought to be needed to qualify for a technological improvement being interpreted as an innovation.

The technological dimension was mentioned more explicitly in the revised version of the Oslo manual, compared with the first version, even if the intention was not to change the substance of the definition. This wording of the revised Oslo Manual was used in the implementation of the second Community Innovation Survey and it led to a dramatic decrease in the shares of innovators in several countries, which shows the sensitiveness of wordings. In the third Community innovation survey a reference to the technological dimension is given only in the explanatory text. The effect of this is not yet clear. Some preliminary evidence shows again an increase in the shares of innovators.

Many engineers in responding enterprises do not agree with the definition of innovation either. Innovation is in their mind the same as invention. It is not understood that significant product and process improvements should be regarded as innovations even if not being world novelties.

These problems cause problems of comparison at all levels; between various survey years, between countries, between industries within a country and between enterprises in a given industry in a country. These are problems common for manufacturing industries and service industries, as the basic definitions of innovation have been the same. The problems with innovation surveys do not in practice seem to particularly depend on the use of common definitions of innovations.

Several arguments have been raised that there are some conceptual difficulties in applying the same definitions for the manufacturing and service sectors. The innovations in manufacturing sectors are more tangible for example a new machine with significantly improved performance characteristics. The service innovations are more intangible, for example a new method for doing something including new knowledge as one main component. This makes them more difficult to measure. The technological dimension is even more difficult to apply in service innovations and may have a different meaning in these sectors. The examples cited above refer almost all to innovations based on the use of ICT. It might be argued that the restriction of the concept of innovation to technological innovation is not an adequate measure for innovation in the service sector.

It could be necessary to start discussing the possibilities for and feasibility of broadening the innovation concept to also include other types of innovation, such as organisational innovation and market innovation. That will mean the development of operational definitions, field testing of questions based on this broader view of innovation. There is of course a danger that more or less all firms may be counted as innovators. This is not necessarily any drawback as such as long as indicators on the various types of innovation could be developed.

Problems of coverage

R&D

It is hoped that the recommendation of the draft revised Frascati Manual for certain service sectors to be systematically included and the model examples of R&D provided will contribute to a further harmonisation of coverage between member countries. A goal could be to at least have comparable data for the core sectors included in the recommendation. Few countries have possibilities to systematically survey all service sectors. Many countries have however information on certain service sectors based on data from enterprises known or supposed to perform R&D, which may give a satisfactory but nevertheless incomplete picture of the situation.

Innovation

For the European countries the coverage is more harmonised through the Community Innovation surveys but the coverage is more or less restricted to the same core sectors. Some countries have however tried to include more service sectors into their innovation surveys than recommended.

Relationship between innovation surveys and surveys on ICT and E-commerce

During the last few years the OECD has developed a new survey on ICT use and more specifically E-commerce applications and the implementation for the European countries is co-ordinated by Eurostat. For the service sectors innovation according to the current Oslo definition is to a great extent based on the use

of ICT applications. One interesting topic is the effect of ICT use and E-commerce applications on the ways of conducting business, which may be the next step in the development of these ICT and E-commerce surveys. This again is very close to the topic of innovation in service industries, at least in the broader sense according to the discussion above.

A closer co-ordination between R&D and innovation surveys has been discussed in a joint Eurostat/OECD task force. Key indicators on innovation are needed more frequently than the big ad hoc surveys of innovation have been able to provide. More consistent information on R&D has also been one of the objectives of these co-ordination efforts. In the task force has also been discussed a broader co-ordination with other business surveys, like the ICT survey the knowledge management survey or the structural business survey.

Some preliminary national experience is already available from asking some questions on ICT in innovation surveys and to include some questions on innovation to an ICT use survey. Eurostat has already suggested inclusion of ICT related questions to be discussed in the context of the next revision of the Oslo Manual for innovation surveys. The probable new questions in the ICT survey may relate to other innovation aspects than those covered by innovation surveys, but there is also a possibility that some countries may wish to put some core questions on innovation according to the Oslo framework to existing ICT surveys. This is facilitated by the modular structure of the ICT-survey and the possibility that the innovation survey concept also will develop in that direction. This might contribute to a broader understanding of both innovation and the role of various ICT applications.

Possible questions to discuss for future development of surveys

1. Should an attempt be made to try to enlarge the concept of innovation especially in service industries to also include other types of innovation, such as market innovations and organisational innovation? How could the concept of innovation be better understood by enterprises?
2. Should some links between innovation surveys and ICT use surveys be established according to the ideas presented above? Would a closer co-ordination of development efforts related to these surveys be necessary? How could this be organised?