Puerto Rico Institute of Statistics

Survey of Science and Technology 2012-13: Research and Development (R&D)

[Questionnaire for Private Business]

Purpose – This survey collects data that will be used to estimate the resources dedicated to Research and Development in Puerto Rico

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Definitions – Please read the definitions and instructions provided at the end of the questionnaire before giving your answers. These can help you to better understand the information that is being requested.

Questions – The research team is available to answer any questions, and can be contacted by telephone: (787) 993-3336 or by email: cienciaytecnologia@estadisticas.gobierno.pr.

Address – This form, when completed, can be submitted via e-mail (cienciaytecnologia@estadisticas.gobierno.pr), or mailed to the following address: Instituto de Estadísticas de Puerto Rico, P.O. Box 195484, San Juan, PR 00919-5484.

THE INFORMATION YOU PROVIDE IN THIS FORM IS CONFIDENTIAL and is protected under Act 209 of 2003, as amended. Data provided in this form will be used only for statistical analysis by the Puerto Rico Institute of Statistics and will not be shared with any other public or private entity. The results of the study will be published in a final report, which will be made available to you as a participant in this survey.

THANK YOU for your cooperation**.** Your response is very important to the success of this study.

1. COMPANY IDENTIFICATION INFORMATION

1.1. Company name

1.2. ¿Are the headquarters of your company located in Puerto Rico?

YES ☐ In which municipality?

NO ☐ In which country?

1.3. Name of the president or executive director of your company in Puerto Rico

1.4. Name of person who completed this form

1.5. Position

1.6. E-mail address

1.7. Telephone

1.8. Date (mm/dd/yy)

2. INFORMATION ABOUT YOUR COMPANY

2.1. What is the main economic activity of your company in Puerto Rico?

2.2. List the units or establishments of your company whose information is included in your answers to this questionnaire

Name or location	Relationship with your company	¿Does it perform R&D activities?

2.3. Is your company owned by a parent company?

NO ☐

Yes ☐

2.3.1. Name of the parent company

2.3.2. Relationship (partner, subsidiary, etc.)

2.4. In what year was your company founded? (If the company's headquarters is outside Puerto Rico, in what year was it founded in Puerto Rico?)

2.5. What was your company's total income (including sales and other sources of income) in Puerto Rico in fiscal year 2012-13? [This information will be used to better understand the relative importance of Research and Development activities in your company].

$

2.6. Did your company engage in exporting from Puerto Rico in fiscal year 2012-13?

NO ☐

YES ☐

2.6.1. Approximately what percentage of the above income results from exporting??

%

2.7. As of March 12, 2013, how many people were employed by your company?

Full Time

Part time

The questionnaire is divided in two sections, Section I: Research and Development (R&D) Activities and Section II: Innovation. If your company does not perform R&D activities, please go to Section II, page 9.

SECTION I: RESEARCH AND DEVELOPMENT ACTIVITIES (R&D)

Research and Experimental Development (R&D), for the purposes of this survey, is defined as 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.

R&D covers both formal R&D and informal or occasional R&D.

The term R&D covers three activities:

- **Basic research:** 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:** original investigation undertaken in order to acquire new knowledge, which differs from basic research in that it is directed primarily towards a specific practical aim or objective.
- **Experimental development:** systematic work, drawing on existing knowledge gained from research and/or practical experience, which 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.

For the purposes of this survey, the term R&D does not cover activities lacking an appreciable element of novelty or routine or activities that do not lead to the resolution of scientific and/or technological uncertainty. [The Appendix of this Questionnaire provides further detail as to the inclusion or exclusion of specific activities].

3. INFORMATION ABOUT RESEARCH AND DEVELOPMENT (R&D) ACTIVITIES IN YOUR COMPANY

3.1. According to the above definition, did your company engage in Research and Experimental Development (R&D) in Puerto Rico between July 1st, 2012 and June 30th, 2013 (fiscal year 2012-13)?

NO ☐

[If you answered "No," please go to Section II, page 9]

YES ☐

3.1.1. What type of R&D activities did your company perform in Puerto Rico in fiscal year 2012-13, and what proportion of total R&D expenditures were each one?
(Check all that apply)

Type of activity	Did you perform this? (Yes/No)	Proportion of total R&D expenditures
Basic Research		%
Applied Research		%
Experimental Development		%

3.1.2. Please describe briefly what type of R&D activities your company performed.

3.2. Which departments or divisions within your company perform Research and Development activities in Puerto Rico? [Specify by name]

3.3. In what year did your company begin Research and Development activities in Puerto Rico? ____

3.4. Please complete the following tables with information about the **number of people who performed Research and Development activities in your company in Puerto Rico** during **fiscal year 2012-13**. Include independently contracted external consultants, but do not include personnel employed by consulting firms or other companies that provide R&D services to your company. [See Appendix for details regarding who to consider as R&D personnel].

Number of researchers, technicians and auxiliary personnel in 2012-13	***Total***	*By gender*	
		Women	Men
Researchers (includes scientists, engineers, personnel who manage or coordinate R&D tasks, and research assistants)			
Technicians			
Office staff and other auxiliary personnel			

Time in R&D activities	Average number of hours per week dedicated to R&D activities
Researchers	hours, average
Technicians	hours, average
Office staff and other auxiliary personnel	hours, average

3.5. Please complete the following chart with information about the number of people engaged in Research and Development activities in your company in fiscal year 2011-12:

Number of researchers, technicians and auxiliary personnel **in 2011-12**	***Total***	*By gender*	
		Women	Men
Researchers			
Technicians			
Office staff and other auxiliary personnel			

3.6. Please complete the following tables with information about the profile of **researchers** who performed **Research and Development activities** in your company in Puerto Rico during **fiscal year 2012-13**.

Relationship with the company	Number of researchers
Full time employees	
Part time employees	
External consultant	
Other (specify)_____	

[Don't include technicians and auxiliary personnel]

Researchers' education level (highest level of education completed)	Number of researchers
Bachelor Degree	
Master	
Ph.D. or similar	
Medicine Doctor, Juris Doctor or similar	
Other (specify)_____	

[Don't include technicians and auxiliary personnel]

4. RESEARCH AND DEVELOPMENT (R&D) EXPENDITURES WITHIN YOUR COMPANY

4.1. Please fill in the following table with information about Research and Development (R&D) **expenditures within your company** in Puerto Rico. [If exact numbers are not available, provide an estimate].

	Amount spent, in dollars	
Type of expense	2011-12	**2012-13**
Remuneration to researchers* (salaries, wages, other compensation, etc.)	$	$
Salaries and other compensation to R&D support staff (technicians and office staff)	$	$
Materials purchased and other running costs related to R&D**	$	$
Equipment and instruments used for R&D activities	$	$
Buildings and properties used for R&D activities	$	$
Other R&D expenditures (software, utilities, property and other taxes, etc.)	$	$
TOTAL, R&D EXPENDITURES	**$**	**$**

* Include fringe benefits of employees engaged in R&D in your company.

** Include contracts for the provision of services necessary to carry out R&D activities. However, exclude the purchase of R&D services, since they will be addressed in a separate question.

4.2. Please complete the following table with information about the sources of financing for Research and Development activities performed within your company in 2009. [If exact numbers are not available, provide an estimate].

Sources of financing for R&D activities	Amount
Funding provided by **your company** in Puerto Rico	$
Funding provided by the **parent company** or other subsidiaries or affiliates	$
Funding provided by **other companies*** ☐ Companies in Puerto Rico ☐ Companies outside of Puerto Rico	$
Funding provided by the **Government of Puerto Rico** * By which agency or agencies? ☐ Subsidy or donation ☐ Contract	$
Funding provided by the **U.S. Federal Government** * ¿De qué agencia o agencias? ☐ Subsidy or donation ☐ Contract	$
Funding provided by **other entities** (universities, municipal governments, etc.) Name of entity	$
TOTAL	$

* Include only those funds specifically granted for R&D activities, or the portion of other contracts destined specifically to R&D activities.

4.3. Do you expect that R&D expenditures of your company in Puerto Rico **in 2013-14** will:

☐ Increase ☐ Remain the same ☐ Decrease ☐ I don't know

4.3.1. What about during the **next three years** (2013-14 to 2015-16)? Expenditures in R&D will:

☐ Increase ☐ Remain the same ☐ Decrease ☐ I don't know

5. INFORMATION ABOUT THE PURCHASE OF R&D SERVICES BY YOUR COMPANY

5.1. During 2012-13 **did you purchase Research and Development services** from or fund R&D activities in other organizations (including other companies, universities and other organizations)?

NO ☐

YES ☐

5.1.1. Specify what type of organization you purchased services from or funded Research and Development activities for

☐ Other subsidiaries of affiliates in your group
☐ Other company in Puerto Rico
☐ Other company outside Puerto Rico
☐ University in Puerto Rico
☐ University outside Puerto Rico
☐ Other (specify) _____

5.1.2. What was your company's total expenditure in the purchase of Research and Development services in 2012-13? $ _____

5.2. In 2012-13, did your company engage in Research and Development activities as part of an alliance, *joint venture*, or other **collaborative arrangement** with other organizations?

NO ☐ | YES ☐

5.2.1. With what type of organization? Please specify:

- ☐ Other subsidiaries of affiliates in your group
- ☐ Other company in Puerto Rico
- ☐ Other company outside Puerto Rico
- ☐ University in Puerto Rico
- ☐ University outside Puerto Rico
- ☐ Other (specify) _____

6. INFORMATION ABOUT THE NATURE OF RESEARCH AND DEVELOPMENT (R&D) IN YOUR COMPANY IN PUERTO RICO

6.1. **During 2012-13**, have Research and Development activities in any of the following areas been performed within your company? [Please see Appendix for definitions of these activities before responding].

	No	Yes	Proportion in total R&D expenditures
Natural sciences	☐	☐	%
Engineering and technology	☐	☐	%
Medical sciences	☐	☐	%
Agricultural sciences	☐	☐	%
Social sciences	☐	☐	%
Humanities	☐	☐	%
Other (specify): _____			%

Áreas específicas

	No	Yes	Proportion in total R&D expenditures
Information and Communication Technologies (ICT)	☐	☐	%
Nanotechnology	☐	☐	%
Biotechnology	☐	☐	%

BIOTECHNOLOGY – ADDITIONAL QUESTIONS

If you marked "Biotechnology" in question 6.1, please answer the following questions:

6.1.1. What **type of biotechnology** was used or developed in your company **during 2012-13**?
[Please see Appendix for definitions of these types of biotechnology before responding].

	It was used	It was developed	It is the main type of biotechnology developed by the company
DNA (coding) related technology	☐	☐	☐
Proteins and molecules related technology	☐	☐	☐
Cell and tissue culture and engineering	☐	☐	☐
Process biotechnologies	☐	☐	☐
gene therapy and viral vectors	☐	☐	☐
Bioinformatics	☐	☐	☐
Nanobiotechnology	☐	☐	☐
Other (specify): ☐	☐	☐	☐

6.1.2. In what areas have **final applications** the produts developed using biotechnology during 2012-13?
[Please see Appendix for definitions of these areas before responding].

	No	Yes
Human health	☐	☐
Animal health and aquaculture	☐	☐
Food	☐	☐
Agriculture	☐	☐
Environment	☐	☐
Industry	☐	☐
Other (specify): ☐	☐	☐

6.1.3. Please complete the following chart with information about the number of people engaged in R&D activities **in biotechnology** in your company in fiscal year 2012-13.

Number of researchers, technicians and auxiliary personnel **in biotecnología**	***Total***	*By género*		Average number of hours per week dedicated to R&D activities in biotechnology
		Women	Men	
Researchers				hours, average
Technicians				hours, average
Office staff and auxiliary personnel				hours, average

6.2. What **socio-economic objectives** had the R&D activities in your company during 2012-13? [Please see Appendix for definitions of these objectives before responding].

	No	Yes	Proportion in total R&D expenditures
Exploration and exploitation of the Earth			%
Infrastructure and general planning of land use			%
Control and care of the environment			%
Protection and improvement of human health			%
Production, distribution and rational utilization of energy			%
Agricultural production and technology			%
Industrial production and technology			%
Social structures and relationships			%
Exploration and exploitation of space			%
Non-oriented research			%
Other civil research			%
Defence			%
Other (specify):			%

SECTION II: INNOVATION

An **innovation** is the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method or in-business practice, workplace organization or external relation. The minimum requirement for an innovation is that the product, process, marketing method or organizational method must be new (or significantly improved) to the firm. This includes products, processes and methods that were originally developed in your firm, as well as those that were adopted from other organizations.

- **Product innovation**: introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics. It doesn't matter if it is commercially successful. Changes of a solely aesthetic nature are not included.
- **Process innovation:** implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software, and in ancillary support activities, such as purchasing, accounting, computing and maintenance.

7.1. In the last three years, did your company introduce a new or significantly improved good, service, or process in Puerto Rico?

	No	Yes, in 2012-13	Yes, between 2010-11 and 2012-13
New or significantly improved goods [exclude the simple resale of new goods and changes of a solely aesthetic nature]	☐	☐	☐
New or significantly improved services	☐	☐	☐
New or significantly improved processes:			
- methods of manufacturing or producing goods or services	☐	☐	☐
- logistics, delivery, or distribution methods	☐	☐	☐
- supporting activities for your processes, such as maintenance, systems or operations for purchasing, accounting, or computing	☐	☐	☐
Ongoing innovation activities specifically undertaken to develop and/or implement an innovation, they still did not result in an innovation	☐	☐	☐
Innovation activities specifically undertaken to develop and/or implement an innovation, but they were abandoned or suspended before completion	☐	☐	☐

7.1.1. Please describe the most important product or process innovation of your company in Puerto Rico

7.1.2. If your company developed and/or implemented innovations in Puerto Rico, please specify if the product or process was

	2012-13	Between 2010-11 and 2012-13
New or significantly improved for your company	☐	☐
New or significantly improved for your business sector in Puerto Rico	☐	☐
New or significantly improved for the global market	☐	☐

7.1.3. If your company developed and/or implemented product innovations in Puerto Rico between 2010-11 and 2012-13, please give the percentage of your total income in 2012-13 from these products.

	2012-13
Income earned from products that were new to your market (Puerto Rico or global)	%
Income earned from products that were only new to your firm, not to your market	%
Income from other products (goods or services)	%
Total income in 2012-13	100%

- **Marketing innovation:** implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.
- **Organizational innovation:** implementation of a new organizational method in the firm's business practices, workplace organization, or external relations. It must be the result of strategic decisions taken by management. Exclude mergers or acquisitions, even if for the first time.

7.2. In the last three years, did your company introduce **marketing innovations** in Puerto Rico?

	No	Yes, in 2012-13	Yes, between 2010-11 and 2012-13
Significant changes to the aesthetic design or packaging of a good or service (exclude routine and seasonal changes)	☐	☐	☐
Significant changes or new methods for promotion or placement, such as internet selling, first-time use of franchising or distribution licenses, direct selling. Include new methods of pricing goods and services.	☐	☐	☐

7.2.1. Please describe the most important marketing innovation of your company in Puerto Rico.

7.3. In the last three years, did your company introduced **organizational innovations** in Puerto Rico?

	No	Yes, in 2012-13	Yes, between 2010-11 and 2012-13
New **business practices** for organizing procedures (i.e. supply chain management, business re-engineering, knowledge management, lean production, quality management, etc)	☐	☐	☐
New methods of **organizing work responsibilities and decision making** (i.e. first use of a new system of employee responsibilities, team work, decentralization, integration or de-integration of departments, education/training systems, etc)	☐	☐	☐
New methods of organizing external relations with other firms or institutions (i.e. first use of alliances, partnerships, outsourcing or sub-contracting, etc)	☐	☐	☐

7.3.1. Please describe the most important organizational innovation of your company in Puerto Rico.

8. The information you provide in this form is confidential and is protected under Act 209 of 2003, as amended. Data provided in this form will be used only for statistical analysis by the Puerto Rico Institute of Statistics and will not be shared with any other public or private entity, but the Puerto Rico Institute of Statistics would like to publish a list with the name of the companies and organizations that report R&D activities in Puerto Rico and the municipality in which they are located. **Do you authorize the Puerto Rico Institute of Statistics to include the name of your company in this list and the municipality in which it is located?**

☐ **Yes,** I authorize the Puerto Rico Institute of Statistics to include the name of my company and the municipality in which it is located **in the list of companies that have Research and Development (R&D) activities in Puerto Rico.** That is the only information provided in this form that will be published.

☐ **No,** I do not authorize the Puerto Rico Institute of Statistics to include the name of my company and the municipality in this list.

9. How much time did it take you to complete this questionnaire? _____ hours

10. Comments

When you have completed this form, please submit it by e-mail to cienciaytecnologia@estadisticas.gobierno.pr or mail it to the following address: Instituto de Estadísticas de Puerto Rico, P.O. Box 195484, San Juan, PR 00919-5484.

APPENDIX – DEFINITIONS

[Taken from Frascati Manual, OCDE, 2002]

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:** 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:** also original investigation undertaken in order to acquire new knowledge, it differs from basic research in that it is directed primarily towards a specific practical aim or objective.
- **Experimental development:** systematic work, drawing on existing knowledge gained from research and/or practical experience, which 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.

R&D covers both formal R&D in R&D units and informal or occasional R&D in other units.

For purposes of this survey, the term R&D **does not apply** to activities lacking an appreciable element of novelty, or to routine activities that do not lead to the resolution of scientific and/or technological uncertainty.

The following activities should be excluded from R&D:

- Education and training
- Other related scientific and technological activities, except when carried out solely or primarily for the purposes of an R&D project. That means that the following are excluded: general purpose data collection, routine tests, maintenance of national standards, feasibility studies, specialized health care, administrative and legal work connected with patents and licenses, policy-related studies, routine software development, and other specialized activities like collecting, coding, recording, classifying, disseminating, translating, analysis and evaluation.
- Other industrial activities of innovation, like the acquisition of technology (embodied and disembodied), tooling up and industrial engineering, industrial design n.e.c., other capital acquisition, production start-up and marketing for new and improved products. Also excluded are the industrial pre-production and production and distribution of goods and services and the various allied technical services in the business enterprise sector and in the economy at large, together with allied activities using social science disciplines, such as market research.
- The raising, management and distribution of R&D funds to performers, and indirect support activities.

R&D Personnel *[question 3.4]:* All persons employed directly in R&D should be counted, as well as those providing direct services such as R&D managers, administrators, and clerical staff.

Researchers: professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned.

Managers and administrators engaged in the planning and management of the scientific and technical aspects of a researcher's work also fall into this category.

Postgraduate students at the PhD level engaged in R&D should be considered as researchers.

Technicians: persons whose main tasks require technical knowledge and experience in one or more fields of engineering, physical and life sciences or social sciences and humanities. They participate in R&D by performing scientific and technical tasks involving the application of concepts and operational methods, normally under the supervision of researchers.

Other supporting staff includes skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with such projects.

Definitions of research areas *[question 6.1.]*

Natural sciences: Mathematics and computer sciences, physical sciences, chemical sciences, earth and related environmental sciences and biological sciences.

Engineering and technology: civil engineering, electrical engineering, electronics, chemical engineering, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialized subdivisions, as wells as the science and technology of food production, and specialized technologies.

Medical sciences: basic medicine, clinical medicine and health sciences.

Agricultural sciences: agricultura, fisheries and allied sciences, as well as veterinary medicine.

Social sciences: psycology, economics, educational sciences, anthropology, ethnology, demography, administration, law, linguistics, political sciences, sociology, among others.

Humanities: history, archaeology, numismatics, palaeography, genealogy, languages, philosophy, arts, religion, among others.

Specific areas

Information and Communication Technologies (ITC): Refers to the development of software, hardware and information technology services, as well as to technological developments in communications systems.

Nanotechnology: the creation and utilization of materials, devices, and systems sized at the level of atoms and molecules. This includes R&D in the range of 1 to 100 nanometers.

Biotechnology: The application of S&T to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

Socio-economic objectives *[question 6.2.]:*

Exploration and exploitation of the Earth: covers research with objectives related to the exploration of the Earth's crust and mantle, seas, oceans and atmosphere, and research on their exploitation. It also includes climatic and meteorological research, polar exploration and hydrology. It does not include soil improvement and land use, research on pollution, and fishing.

Infrastructure and general planning of land use: covers research on infrastructure and land development, including research on the construction of buildings and research into protection against harmful effects in town and country planning but not research into other types of pollution.

Control and care of the environment: covers research into the control of pollution, aimed at the identification and analysis of the sources of pollution and their causes, and all pollutants, including their dispersal in the environment and the effects on man, species (fauna, flora, micro-organisms) and the biosphere. Development of monitoring facilities for the measurement of all kinds of pollution is included. The same is valid for the elimination and prevention of all forms of pollution in all types of environment

Protection and improvement of human health: covers research aimed at protecting, promoting and restoring human health, broadly interpreted to include health aspects of nutrition and food hygiene. It ranges from preventive medicine, including all aspects of medical and surgical treatment, both for individuals and groups, and the provision of hospital and home care, to social medicine and paediatric and geriatric research.

Production, distribution and rational utilisation of energy: covers research into the production, storage, transportation, distribution and rational use of all forms of energy. It also includes research on processes designed to increase the efficiency of energy production and distribution, and the study of energy conservation.

Agricultural production and technology: covers all research on the promotion of agriculture, forestry, fisheries and foodstuff production. It includes: research on chemical fertilisers, biocides, biological pest control and the mechanisation of agriculture; research on the impact of agricultural and forestry activities on the environment; research in the field of developing food productivity and technology.

Industrial production and technology: covers research on the improvement of industrial production and technology. It includes research on industrial products and their manufacturing processes, except where they form an integral part of the pursuit of other objectives (e.g. defence, space, energy, agriculture).

Social structures and relationships: covers research on social objectives, as analysed in particular by social and human sciences, which have no obvious connection with other socio-economic objectives. This analysis includes quantitative, qualitative, organisational and forecasting aspects of social problems.

Exploration and exploitation of space: covers all civil space research and technology. Although civil space research is not in general concerned with particular objectives, it frequently has a specific goal, such as the increase of general knowledge (e.g. astronomy), or relates to particular applications (e.g. telecommunications satellites).

Non-oriented research: This covers all those appropriations or outlays which are earmarked for R&D but which cannot be attributed to an objective. A supplementary breakdown by field of science may be useful.

Other civil research: covers civil research which cannot (yet) be classified to a particular socio-economic objective.

Defense: includes all R&D programs undertaken primarily for defense reasons, regardless of their content or whether they have secondary civil applications. Thus, the criterion is not the nature of the product or subject (or who funds the program) but the objective. The objective of defense R&D is the creation or enhancement of techniques or equipment for use by national, overseas or multinational armed forces.

Biotechnology

DNA (Coding) related technolgoy Tecnology: genomics, pharmaco-genetics, gene probes, DNA sequencing/synthesis/amplification, genetic engineering.

Proteins and molecules (functional blocks) related technology: protein/peptide sequencing/synthesis, lipid/protein glyco–engineering, proteomics, hormones and growth factors, cell receptors/ signalling/pheromones.

Cell and tissue culture and engineering : cell/tissue culture, tissue engineering, hybridisation, cellular fusion, vaccine/ immune stimulants, embryo manipulation.

Process biotechnologies: bioreactors, fermentation, bioprocessing, bioleaching, biopulping, biobleaching, biodesulphurisation, bioremediation and biofiltration.

Gene therapy, viral vectors. Sub-cellular organisms.

Bioinformatics: Software development, data bases for management, analysis and integration of data in genomic and proteomic (large scale study of proteins), sequencies of process models and biological systems.

Nanobiotechnology: Instruments or materials developed by the combination of nanoscale engineering and biology, for the study of biosystems and applications in drug administration, diagnostics, etc.

R&D IN SPECIFIC SECTORS

R&D in software development

For a software development project to be classified as R&D, its completion must be dependent on a scientific and/or technological advance, and the aim of the project must be the systematic resolution of a scientific and/or technological uncertainty.

Software development is an integral part of many projects which in themselves have no element of R&D. The software development component of such projects, however, may be classified as R&D if it leads to an advance in the area of computer software. Such advances are generally incremental rather than revolutionary. Therefore, an upgrade, addition or change to an existing program or system may be classified as R&D if it embodies scientific and/or technological advances that result in an increase in the stock of knowledge. Use of software for a new application or purpose, however, does not by itself constitute an advance.

In addition to the software that is part of an overall R&D project, the R&D associated with software as an end product should also be classified as R&D.

A scientific and/or technological advance in software may be achieved even if a project is not completed, because a failure can increase knowledge of the technology of computer software by showing, for example, that a particular approach will not succeed.

Should be included in R&D:

– 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 program or system.

– R&D on software tools or technologies in specialized areas of computing (image processing, geographic data presentation, character recognition, artificial intelligence and other areas).

– R&D producing new theorems and algorithms in the field of theoretical computer science.

Software-related activities of a routine nature which do not involve scientific and/or technological advances or resolution of technological uncertainties 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 programs.

– Debugging of systems.

– Adaptation of existing software.

– Preparation of user documentation.

R&D in the social sciences and humanities

For the social sciences and humanities, an apreciable element of novelty or a resolution of scientific/technological uncertainty is again a useful criterion for defining the boundary between R&D and related (routine) scientific activities. This element may be related to the conceptual, methodological or empirical part of the project concerned. Related activities of a routine nature can only be included in R&D if they are undertaken as an integral part of a specific research project or undertaken for the benefit of a specific research project. Therefore, projects of a routine nature, in which social scientists bring established methodologies, principles and models of the social sciences to bear on a particular problem, cannot be classified as research.

The following are examples of work which might fall into this routine category are generally not R&D: commentary on the probable economic effects of a change in the tax structure, using existing economic data; use of standard techniques in applied psychology to select and classify industrial and military personnel, students, etc., or to test children with reading or other disabilities.

R&D in service activities

The following are among the criteria that can help to identify the presence of R&D in service activities:

– Links with public research laboratories.

– The involvement of staff with PhDs, or PhD students.

– The publication of research findings in scientific journals, organization of scientific conferences or involvement in scientific reviews.

– The construction of prototypes or pilot plants

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 behavior 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, Internet-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 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.

R&D and industrial activities

If the primary objective is to make further technical improvements on the product or process, then the work comes within the definition of R&D. If, on the other hand, the product, process or approach is substantially set and the primary objective is to develop markets, to do preproduction planning or to get a production or control system working smoothly, the work is no longer R&D.
Care must be taken to exclude activities which, although undoubtedly a part of the innovation process, rarely involve any R&D, e.g. patent filing and licensing, market research, manufacturing start-up, tooling up and redesign for the manufacturing process.

Specific cases:

- **Prototypes**: Included in R&D, as long as the primary objective is to make further improvements.
- **Pilot plant**: Included in R&D, as long as the primary purpose is R&D.
- **Industrial design and drawing**: Include design required during R&D. Exclude design for production process.
- **Industrial engineering and tooling up**: Include "feedback" R&D and tooling up industrial engineering associated with development of new products and new processes. Exclude for production processes.
- **Trial production**: Include if production implies full-scale testing and subsequent further design and engineering. Exclude all other associated activities.
- **After-sales service and trouble-shooting**: excluded from R&D.
- **Patent and license work**: excluded from R&D.
- **Routine tests**: excluded from R&D.
- **Data collection**: excluded from R&D.

Clinical trials

Before new drugs, vaccines or treatments can be introduced on the market, they must be tested systematically on human volunteers to ensure that they are both safe and effective. These clinical trials are divided into four standard phases, three of which take place before permission to manufacture is accorded. For the purposes of international comparison, by convention, clinical trial phases 1, 2 and 3 can be treated as R&D. Phase 4 clinical trials, which continue testing the drug or treatment after approval and manufacture, should only be treated as R&D if they bring about a further scientific or technological advance. Moreover, not all activities undertaken prior to permission to manufacture are considered to be R&D, especially when there is a significant wait after the completion of phase 3 trials, during which marketing and process development activities may be started.

[*Most definitions and explanations included in this Appendixa are quotations from the Frascati Manual, OCDE, 2002. This Manual contains the internationally agreed-upon definitions and methodologies used to estimate the resources dedicated to Research and Development in each country*].