

# Research and Development Summary Report

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## **Introduction**

The 25<sup>th</sup> Meeting of the Voorburg Group looked at Research and Development as a pilot project in terms of classification, turnover, and prices. This was the first look at these industries by the Voorburg Group and they were chosen both because of the unique problems that are associated with the collection of output and price data for R&D and because of the SNA 2008 decision to capitalize R&D. At the completion of the session, the Voorburg Group determined that the effort was productive but the work has not yet reached a stage where a formal Sector Paper should be prepared. There are many questions to be answered about the proper scope of statistics (industry or activity based), measurement of output (should public subsidies be included as output), and the lack of price indices for R&D output that create considerable problems for the identification of best practices. The Chair requested a summary paper that includes an overview of the problems identified and possible solutions that will provide a starting point for programs that plan on developing either output or price statistics for research and development. This summary report will address each of the primary Voorburg Group topics separately.

Session Chair: John Murphy

Turnover mini-presentations: Jakob Kalko, Hanna Fischer, Mieke Berends-Ballast

Prices mini-presentations: Johanna von Borstel, Ildiko Hamvaine Holocsy, David Friedman

Discussant: Mike Horrigan

## **Classification of R&D**

A review of several industry classifications including NAICS, NACE, ISIC, JSIC and ANZSIC showed considerable comparability. The most common industry delineation was a separation between research and development in the physical sciences and research and development in the social sciences. Product classification showed a much greater level of conceptual divergence.

The CPC is broken down into 15 subject based subclasses. Examples of the subject based subclasses are research and development in chemistry and biology, research and development in economics, research and development in agricultural sciences, and research and development in law. Most other product classifications reviewed followed a similar approach although the individual classifications often chose different subject matter areas based on the needs of the users.

The North American Product Classification System (NAPCS) used a different approach to define products. The aggregation structure is based on the categories of basic research, applied

research, and product development as defined in the Frascati Manual 2002. NAPCS also includes separate product groupings for licensing the rights to use intellectual property, intellectual property works, and options agreements. The Frascati based groupings are further broken down by subject matter and the IP related groupings are broken down to identify the other significant outputs of R&D establishments.

When reviewing classifications for update or revision, it will be important to identify products that are recognizable by respondents and reflect accurately the different ways that R&D can be transacted. A listing of the reviewed classifications is included at the end of this summary paper.

### **Turnover/Output of R&D**

The turnover/output presentations from Norway, Germany, and the Netherlands all identified a common question for the research and development industries: Should turnover/output statistics be collected and measured on an industry basis or on a product (activity) basis?

Each of the turnover presentations noted that the majority of R&D activity is not market based and takes place within units classified to other industries based on their market output. Most turnover programs do not identify or tabulate data for R&D that is produced and consumed in the production of a final output. However, the change to the national accounts recommending capitalization of R&D implies production with an intellectual property output being produced. This could be a patent or other intellectual property protection based on the laws in each country.

Directly measuring the turnover levels from the R&D industries only addresses a minority of the R&D activities in the economy. The outputs can be sold and therefore measured as the sale transaction. The outputs can also be licensed and measured by those transactions. These transaction based methods are not applicable to internal R&D which will not necessarily be transacted in the market.

The definition of the output of R&D industries is also complicated by the common presence of public subsidies for R&D. These subsidies can be direct payments or implicit tax expenditures in the form of tax credits. These subsidies for production can be considered part of the payment for the R&D and agreement should be reached on their inclusion or exclusion when measuring output.

The reported output of the R&D industries and the apparent growth was also discussed at some length. The Group questioned whether or not there was true growth in R&D or if the data were

skewed because of internal R&D being outsourced. Without comprehensive information about the total R&D activity, questions of this type are not easily answered. The prevalence of internal R&D (activity performed by units classified outside of the R&D industries) also raised questions about the appropriateness of using the output of R&D industries as an indicator or proxy for innovation.

The turnover mini-presentations and discussion demonstrated that the measurement of output for research and development industries and/or activities requires substantial additional work before best practices can be delineated.

## **SPPIs for R&D**

The SPPI mini-presentations were largely theoretical because there are very few current price indices for research and development activities in existence. The task of developing papers on how the challenging R&D industries might be priced provided some interesting alternatives but also highlighted many of the same problems of output definition and measurement that were identified in the turnover mini-presentations.

A key problem when developing deflators for R&D is the need to deflate the output of R&D industries and the need to deflate the production of R&D based on a total product approach addressing all industries that undertake the R&D activity. The lack of an appropriate sampling frame is hard to overcome when addressing both internal and external R&D activities as in scope of a price program. An appropriate deflator might be based on an input approach or an output approach.

Another key hurdle to developing an SPPI is the proper measurement of the output. The turnover discussions left many questions that will need to be resolved in order to match a deflator with the output. Further, there are outstanding questions of what the output is to be addressed – the expenditures on intangible goods that can be converted to investment or a market based output.

If the assumption that R&D activities must be treated as output is applied, the market component could be priced using traditional methods and then those results could be used to impute a price for the nonmarket activities.

The mini-presentations also addressed several alternative pricing methodologies. Because there is an assumption that R&D initiatives are unique, model pricing or charge out rates might be appropriate methodologies. This option requires the ability to identify a model and the

ability of the respondent to accurately report changes to the specified model. It is not clear if that will be the case for R&D. Another option would be to use a margin approach looking at the difference between receipts and costs. There are drawbacks to this approach as well because it requires recurring transactions or the availability of substitutes that would require quality adjustment.

An unconventional approach to derive an implicit price for R&D was discussed by the group based on a multifactor productivity approach with inputs collected at the establishment level and aggregated to the sector level. If R&D is productivity enhancing and the productivity could be measured for each establishment, it would be possible to create an implicit price based on that. The data collection requirements, particularly to identify detailed inputs of goods and services, create an almost insurmountable obstacle. Because internal R&D can come from establishments in all industries, detailed input data would be required from all establishments.

## Conclusion

The System of National Accounts, 2008 provides a description of research and development as fixed capital formation in chapter 10:

*“Research and development*

*10.103 Intellectual property products include the results of research and development (R&D). Research and [experimental] development consists of the value of expenditures on creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and use of this stock of knowledge to devise new applications. This does not extend to including human capital as assets within the SNA. The value of research and development (R&D) should be determined in terms of the economic benefits it is expected to provide in the future. This includes the provision of public services in the case of R&D acquired by government. In principle, R&D that does not provide an economic benefit to its owner does not constitute a fixed asset and should be treated as intermediate consumption. Unless the market value of the R&D is observed directly, it may, by convention, be valued at the sum of costs, including the cost of unsuccessful R&D, as described in chapter 6.*

***10.104 R&D should be recognized as part of capital formation. In order to achieve this, several issues have to be addressed. These include deriving measures of research and development, price indices and service lives. Specific guidelines, together with handbooks on methodology and practice, will provide a useful way of working towards solutions that give the appropriate level of confidence in the resulting measures.***

*10.105 With the inclusion of R&D expenditure as capital formation, patented entities no longer feature as assets in the SNA. The patent agreement is to be seen instead as the legal agreement concerning the terms on which access to the R&D is granted. The patent agreement is a form of*

*license to use which is treated as giving rise to payments for services or the acquisition of an asset.*<sup>1</sup> (emphasis added)

The pilot review of classification, turnover, and prices for research and development by the Voorburg Group is a step toward developing accepted methods to measure output and prices for R&D. The experiences of price and turnover statisticians highlighted the difficulty in deriving output measures for research and development and price indices for research and development. While the Voorburg Group does not present best practices for measurement of R&D or pricing of R&D, the work of the experts on the papers, presentations, and discussions should provide valuable insight into the practical limitations faced by producers of statistics.

Much work is still needed develop answers to these complex questions so that there is an “appropriate level of confidence in the resulting measures”.

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<sup>1</sup> System of National Accounts, 2008. Document ST/ESA/STAT/SER.F/2Rev.5, Copyright 2009, page 206 accessed at: <http://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf>

## **Comparison of Selected Industry Classifications**

### **JSIC**

- 71 SCIENTIFIC AND DEVELOPMENT RESEARCH INSTITUTES
- 710 ESTABLISHMENTS ENGAGED IN ADMINISTRATIVE OR ANCILLARY ECONOMIC ACTIVITIES (71 SCIENTIFIC AND DEVELOPMENT RESEARCH INSTITUTES)
  - 7101 Establishments engaged in administrative or ancillary economic activities
- 711 RESEARCH INSTITUTES FOR NATURAL SCIENCES
  - 7111 Research institutes for physical sciences
  - 7112 Research institutes for engineering
  - 7113 Research institutes for agriculture
  - 7114 Research institutes for medicine and pharmacy
- 712 RESEARCH INSTITUTES FOR HUMANITIES AND SOCIAL SCIENCES
  - 7121 Research institutes for humanities and social sciences

### **ANZSIC**

- 691 Scientific Research Services
- 6910 Scientific Research Services

### **NACE Rev 2**

- 72 Scientific research and development
  - 72.1 Research and experimental development on natural sciences and engineering
    - 72.11 Research and experimental development on biotechnology
    - 72.19 Other research and experimental development on natural sciences and engineering
  - 72.2 Research and experimental development on social sciences and humanities
    - 72.20 Research and experimental development on social sciences and humanities

### **ISIC Rev 4**

- 72 Scientific Research and Development
  - 721 Research and experimental development on natural sciences and engineering
    - 7210 Research and experimental development on natural sciences and engineering
  - 722 Research and experimental development on social sciences and humanities
    - 7220 Research and experimental development on social sciences and humanities

## **NAICS United States 2007**

5417 Scientific Research and Development Services

54171 Research and Development in Physical, Engineering, and Life Sciences

541711 Research and Development in Biotechnology

541712 Research and Development in Physical, Engineering, and Life Sciences (except Biotechnology)

54172 Research and Development in the Social Sciences and Humanities

5417120 Research and Development in the Social Sciences and Humanities

## **Comparison of Selected Product Classifications**

### **CPC V2**

81 Research and development services

811 Research and experimental development services in natural sciences and engineering

8111 Research and experimental development services in natural sciences

81111 Research and experimental development services in physical sciences

81112 Research and experimental development services in chemistry and biology

81119 Research and experimental development services in other natural sciences

8112 Research and experimental development services in engineering and technology

81121 Research and experimental development services in biotechnology

81129 Research and experimental development services in other engineering and technology

8113 Research and experimental development services in medical sciences and pharmacy

81130 Research and experimental development services in medical sciences and pharmacy

8114 Research and experimental development services in agricultural sciences

81140 Research and experimental development services in agricultural sciences

812 Research and experimental development services in social sciences and humanities

8121 Research and experimental development services in social sciences

81211 Research and experimental development services in psychology

81212 Research and experimental development services in economics

81213 Research and experimental development services in law

81219 Research and experimental development services in other social sciences

8122 Research and experimental development services in humanities

81221 Research and experimental development services in languages and literature



81229 Research and experimental development services in other humanities

813 Interdisciplinary research and experimental development services

8130 Interdisciplinary research and experimental development services

81300 Interdisciplinary research and experimental development services

814 Research and development originals

8140 Research and development originals

81400 Research and development originals

## **CPA 2008**

72 Scientific research and development services

72.1 Research and experimental development services in natural sciences and engineering

72.11 Research and experimental development services in biotechnology

72.11.1 Research and experimental development services in health, environmental,  
agricultural

and other biotechnology

72.11.11 Research and experimental development services in health biotechnology

72.11.12 Research and experimental development services in environmental and industrial  
biotechnology

72.11.13 Research and experimental development services in agricultural biotechnology

72.11.2 Research and development originals in biotechnology

72.11.20 Research and development originals in biotechnology

72.19 Research and experimental development services in other natural sciences and  
engineering

72.19.1 Research and experimental development services in other natural sciences

72.19.11 Research and experimental development services in mathematics

72.19.12 Research and experimental development services in computer and information  
sciences

72.19.13 Research and experimental development services in physical sciences

72.19.14 Research and experimental development services in chemistry

72.19.15 Research and experimental development services in earth and related environmental  
sciences

72.19.16 Research and experimental development services in biological sciences

72.19.19 Research and experimental development services in other natural sciences

72.19.2 Research and experimental development services in engineering and technology,  
except

biotechnology

72.19.21 Research and experimental development services in nanotechnology

72.19.29 Other research and experimental development services in engineering and technology,  
except biotechnology

72.19.3 Research and experimental development services in medical sciences

72.19.30 Research and experimental development services in medical sciences

72.19.4 Research and experimental development services in agricultural sciences

72.19.40 Research and experimental development services in agricultural sciences

72.19.5 Research and development originals in natural sciences and engineering, except for biotechnology

72.19.50 Research and development originals in natural sciences and engineering, except for biotechnology

72.2 Research and experimental development services in social sciences and humanities

72.20 Research and experimental development services in social sciences and humanities

72.20.1 Research and experimental development services in social sciences

72.20.11 Research and experimental development services in economics and business

72.20.12 Research and experimental development services in psychology

72.20.13 Research and experimental development services in law

72.20.19 Research and experimental development services in other social sciences

72.20.2 Research and experimental development services in humanities

72.20.21 Research and experimental development services in languages and literature

72.20.29 Other research and experimental development services in humanities

72.20.3 Research and development originals in social sciences and humanities

72.20.30 Research and development originals in social sciences and humanities

**NAPCS (DRAFT 2010 - aggregates)** A complete list of draft products is included in appendix 1.

## 1 Production services for basic research

1.1 Basic research in natural and exact sciences, except biological sciences

1.2 Basic research in engineering and technology

1.3 Basic research in biological sciences

1.4 Basic research in medical and health sciences

1.5 Basic research in agricultural, veterinary, and environmental sciences

1.6 Basic research in social sciences and humanities

## 2 Production services for applied research

2.1 Applied research in natural and exact sciences, except biological sciences

- 2.2 Applied research in engineering and technology
- 2.3 Applied research in biological sciences
- 2.4 Applied research in medical and health sciences
- 2.5 Applied research in agricultural, veterinary, and environmental sciences

### 3 Production services for product development

- 3.1 Development services by field-of science related categories
  - 3.1.1 Development services in natural and exact sciences, except biological sciences
  - 3.1.2 Development services in engineering and technology
  - 3.1.3 Development services in biological sciences
  - 3.1.4 Development services in medical and health sciences
  - 3.1.5 Development services in agricultural, veterinary, and environmental sciences
  - 3.1.6 Development services in social sciences and humanities
- 3.2 Development services for products
  - 3.2.1 Development services for goods
  - 3.2.2 Development services for service products, processes, systems, or methods

### 4 Licensing of rights to use intellectual property

- 4.1 Licensing of rights to use Intellectual property protected by copyright
- 4.2 Licensing of rights to use intellectual property protected as industrial property

### 5 Intellectual property works

- 5.1 Intellectual property works protected by copyright
- 5.2 Intellectual property protected as industrial property

### 6 Options agreements

#### **ANZSPC**

#### **81100 Research and development services in natural sciences and engineering**

81100.05 Mathematical sciences research and development services

81100.10 Physical sciences research and development services

- 81100.15 Chemical sciences research and development services
- 81100.20 Earth sciences research and development services
- 81100.25 Biological sciences research and development services
- 81100.30 Information, computing and communication sciences research  
and development services
- 81100.35 Engineering and technology research and development services
- 81100.40 Agricultural, veterinary and environmental sciences research  
and development services
- 81100.45 Architecture, urban environment and building research and  
development services
- 81100.50 Medical and health sciences research and development services
- 81200 Research and development services in social sciences and  
humanities**
- 81200.05 Education research and development services

81200.10	Economics research and development services
81200.15	Commerce, management, tourism and services research and development services
81200.20	Policy and political science research and development services
81200.25	Studies in human society research and development services
81200.30	Behavioural and cognitive sciences research and development services
81200.35	Law, justice and law enforcement research and development services
81200.40	Journalism, librarianship and curatorial studies research and development services
81200.45	The Arts research and development services
81200.50	Language and culture research and development services
81200.55	History and archaeology research and development services
81200.60	Philosophy and religion research and development services
<b>81300</b>	<b>Interdisciplinary research and development services</b>

81300.00 Interdisciplinary research and development services