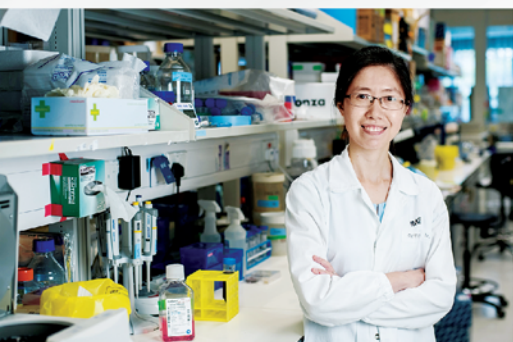
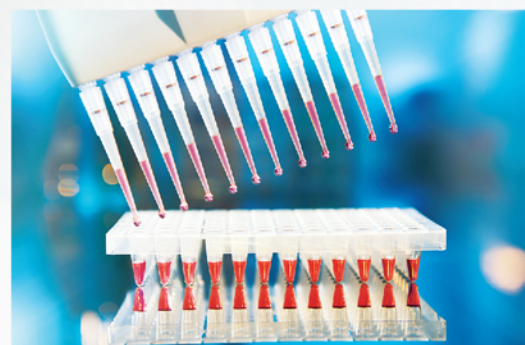


# NATIONAL SURVEY

of Research and  
Development  
in Singapore

# 2018



# **NATIONAL SURVEY OF R&D IN SINGAPORE 2018**

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## Introduction

Research, Innovation and Enterprise (RIE) are pillars in Singapore's strategy for the future economy, and linked to economic outcomes such as jobs and economic growth. In an increasingly inter-dependent and competitive global economy, these pillars are necessary to keep Singapore competitive, drive increases in productivity, and secure long-term economic growth for our industries and our workforce. Beyond economic outcomes, R&D can also positively impact societal outcomes, especially in the areas of healthcare, urban living and resource/environmental sustainability.

In 2018, Singapore's Gross Expenditure on R&D (GERD) increased by 2.4% to reach \$9.3 billion from \$9.1 billion in 2017. Singapore's GERD as a percentage of GDP was 1.8% in 2018. The increase in GERD was due to an increase in the Business Expenditure on R&D (BERD), which rose 4.7% in 2018 from 2017, while Public Expenditure on R&D (PUBERD) showed a small decrease of 0.9%. The BERD/PUBERD ratio in 2018 increased to 1.55, from 1.47 in 2017, suggesting that our efforts to catalyse R&D and innovation in the industry are bearing fruit.

R&D investments enable job creation, and in 2018, a total of 49,704 jobs were associated with R&D activities. Amongst these, RSEs (Research Scientists and Engineers) accounted for the majority at 73%, or 36,246 jobs. The bulk of RSEs were Bachelor's degree holders (almost 50%), followed by PhD (about 30%) and Master's degree holders (about 20%). The total number of RSEs continued to grow, with both the private and public sectors adding a total of 857 RSEs, to augment our RIE talent pool in 2018.

This survey would not be possible without the support of participating organisations in both the public and private sectors. We would like to thank you for your important contributions, and we look forward to continuing our work together in advancing Singapore's journey as a Global-Asia node of technology, innovation and enterprise.

*National Research Foundation,  
Agency for Science, Technology and Research*



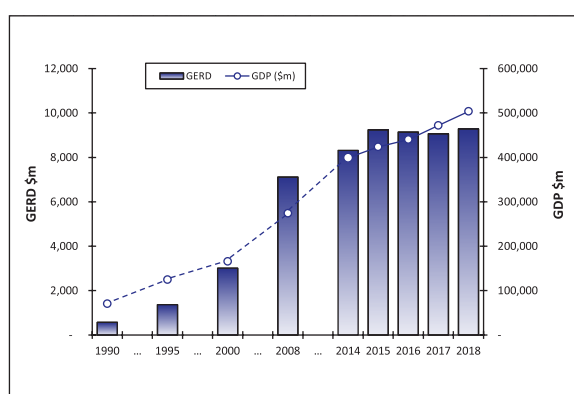
# 1. OVERVIEW OF R&D IN SINGAPORE

## 1.1. Gross Expenditure on R&D (GERD)

GERD in Singapore increased by 2.4% from \$9.1 billion in 2017 to \$9.3 billion in 2018. In the same period, Singapore's GDP (at current market prices) increased by 6.6% from \$472.1 billion to \$503.4 billion.

In 2008, GERD was above-trend, at \$7.1 billion and GDP was \$273.9 billion. The Compound Annual Growth Rate (CAGR) of GERD over the past decade (from 2008 to 2018) was 2.7%.

Fig.1.1 Gross Expenditure on R&D and GDP (1990-2018)

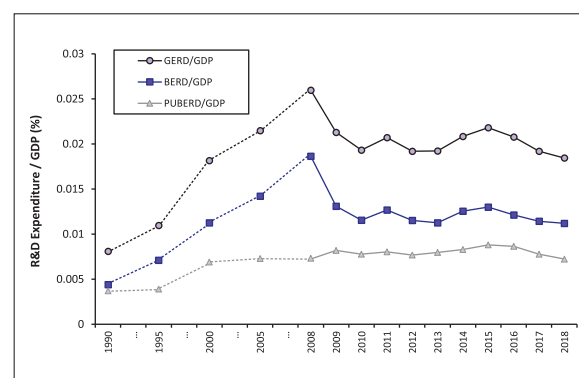


## 1.2 Ratio of Public Expenditure on R&D (PUBERD) to Business Expenditure on R&D (BERD)

GERD as a percentage of GDP decreased from 1.9% in 2017 to 1.8% in 2018. Of this, Business Expenditure on R&D (BERD) as a percentage of GDP remained constant at 1.1%, while Public Expenditure on R&D (PUBERD) as a percentage of GDP decreased from 0.8% in 2017 to 0.7% in 2018.

For every \$1 spent on research in the public sector, \$1.55 was spent in businesses in 2018.

Fig.1.2 Gross Expenditure, Business Expenditure and Public Expenditure on R&D as a percentage of GDP (1990-2018)

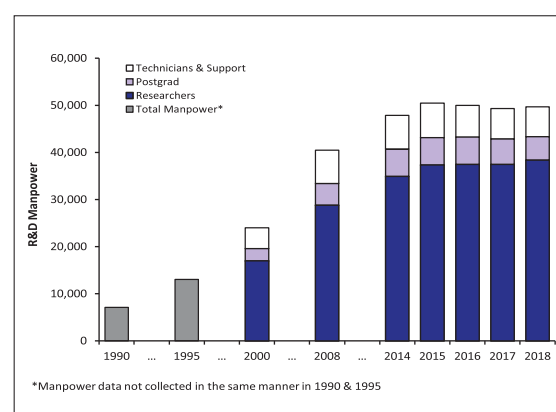


## 1.3 Manpower

Total R&D Manpower (including researchers, postgraduate students, technicians and support staff) increased by 0.8% from 49,295 persons in 2017 to 49,704 persons in 2018. This represents a CAGR of 2.1% from a base of 40,502 persons in 2008.

The number of researchers (excluding postgraduate students) increased by 2.4% from 37,471 in 2017 to 38,355 in 2018. The CAGR from 2008, with 28,758 researchers, to 2018 was 2.9%. Including postgraduate students, the total number of researchers was 43,310 in 2018.

Fig.1.3 R&D Manpower (1990-2018)



## 2. BUSINESS EXPENDITURE ON R&D (BERD)

### 2.1 Overview

In 2018, 857 private sector companies indicated that they performed R&D in Singapore. The total BERD of these companies amounted to \$5.6 billion, corresponding to 1.1% of Singapore's GDP in 2018. This represents an increase of 4.7% compared to the BERD in 2017 at \$5.4 billion. The CAGR from 2008-2018 was 1.0%, due to an above-trend BERD of \$5.1 billion in 2008.

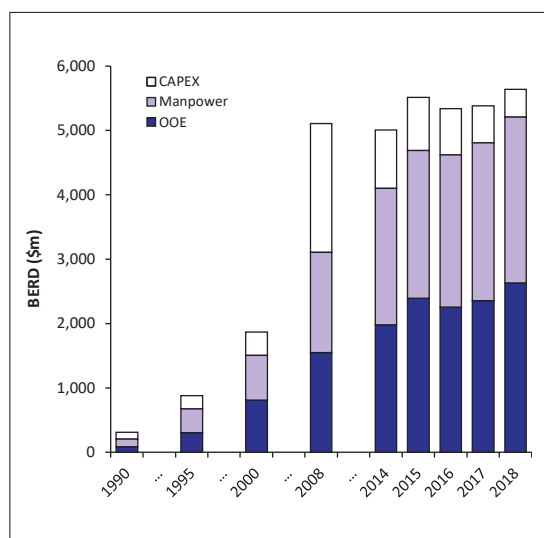
### 2.2 Type of Expenditure

Capital expenditure (CAPEX) declined by 25.2% to \$430.7 million in 2018 from \$575.9 million in 2017. From a base of \$2.0 billion in 2008, the CAGR for 2008-2018 was -14.2%.

Manpower expenditure increased by 5.0% to \$2.6 billion in 2018 from \$2.5 billion in 2017. From a base of \$1.6 billion in 2008, the CAGR for 2008-2018 was 5.2%.

Other operating expenditure (OOE) rose by 11.6% to \$2.6 billion in 2018 from \$2.4 billion in 2017. From a base of \$1.6 billion in 2008, the CAGR for 2008-2018 for OOE was 5.4%.

*Fig.2.1 Business Expenditure on R&D by type of cost (1990-2018)*



### 2.3 Type of R&D

The types of R&D conducted in private sector companies are classified into 3 categories.

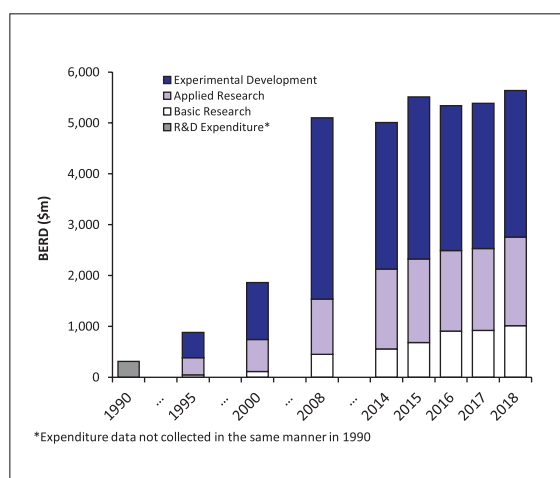
- Basic research (both experimental or theoretical work undertaken without any particular application or use in view);
- Applied research (original investigation directed primarily towards a specific practical aim or objective); and
- Experimental development (systematic work directed to producing or improving substantially materials, products and devices; or installing new processes, systems and services).

Basic research expenditure in the private sector increased by 10.1% from \$924.7 million in 2017 to \$1.0 billion in 2018. This represents a CAGR of 8.5% from 2008 when it was \$449.0 million.

Applied research by private sector companies increased by 8.2% from \$1.6 billion in 2017 to \$1.7 billion in 2018. This represents a CAGR of 4.8% from 2008 when it was \$1.1 billion.

In 2018, business expenditure on experimental development rose slightly by 1.0% from \$2.85 billion in 2017 to \$2.88 billion in 2018. However, CAGR for the period 2008 to 2018 was -2.1% as business expenditure on experimental development by private sector companies in 2008 was above-trend at \$3.6 billion.

**Fig.2.2 Type of Business Expenditure on R&D (1990-2018)**



## 2.4 Fields of Science & Technology

The types of R&D conducted are classified by Fields of Science and Technology as follows:

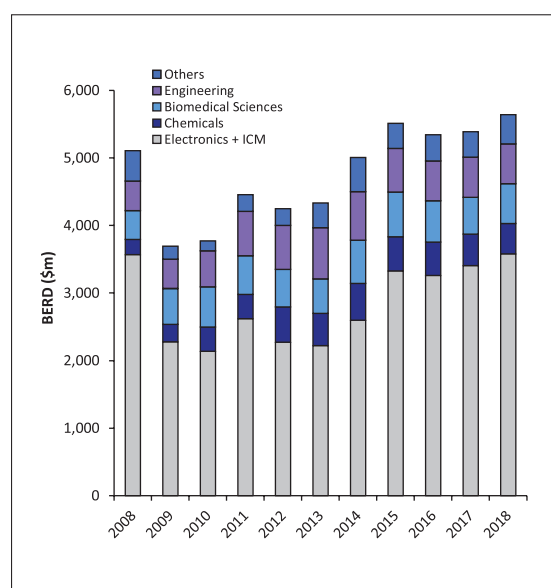
- Electronics, Infocomms and Media (ICM); Comprising: Electrical & Electronics Engineering, Info-communication & Media Technology, Computer Engineering, and Computer & Related Sciences.
- Chemicals; Comprising: Material Sciences & Chemical Engineering, and Chemical Sciences.
- Biomedical Sciences; Comprising: Biomedical & Related Sciences, and Biomedical Engineering.
- Precision & Transport Engineering; Comprising: Aeronautical Engineering, Civil & Architecture Engineering, Marine Engineering, Mechanical Engineering, and Metallurgy & Metal Engineering.
- Others; Comprising: Agricultural Sciences, Food Sciences, Earth & Related Environmental Sciences, Environmental Engineering, Physical Sciences & Mathematics, Energy, and Other Areas.

In the private sector, research expenditure in Electronics and ICM grew by 5.2% from \$3.4 billion in 2017 to \$3.6 billion in 2018,

and was similar to that in 2008. Research expenditure on Biomedical Sciences increased by 7.9% from \$545.8 million in 2017 to \$589.2 million in 2018. This was a CAGR of 3.3% from 2008 when it was \$425.8 million.

By contrast, spending in Chemicals research declined by 4.1% from \$466.5 million in 2017 to \$447.3 million in 2018. However, from a base of \$228.9 million in 2008, the CAGR was 6.9%. Expenditure in Precision and Transport Engineering research declined by 0.1% from \$593.7 million in 2017 to \$592.9 million in 2018. However, between 2008 and 2018, the CAGR was 3.1%, from a base of \$439.9 million in 2008.

**Fig.2.3 Business Expenditure on R&D by fields of science and technology (2008-2018)**



### 3. PUBLIC EXPENDITURE ON R&D (PUBERD)

#### 3.1 Overview

In 2018, 75 public institutions, including A\*STAR research institutes, institutes of higher learning, hospitals and other publicly-funded research organisations, indicated that they performed R&D in Singapore.

These organisations reported a total R&D expenditure of \$3.6 billion in 2018. This was a decline of 0.9% from \$3.7 billion in 2017. From a base of \$2.0 billion in 2008, the CAGR for 2008-2018 was 6.1%.

Expenditure in public organisations as a proportion of GDP declined slightly from 0.8% in 2017 to 0.7% in 2018.

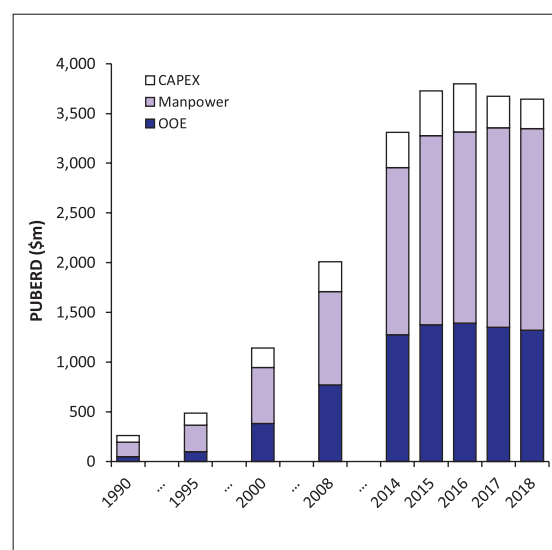
#### 3.2 Type of Expenditure

Amongst public institutions, CAPEX decreased by 7.3% from \$318.3 million in 2017 to \$295.0 million in 2018. From a CAPEX of \$298.8 million in 2008, the CAGR for 2008-2018 for CAPEX was a small decrease of 0.1%.

Manpower expenditure increased by 1.0% from \$2.01 billion in 2017 to \$2.03 billion in 2018. From a base of \$940.6 million in 2008, the CAGR for 2008-2018 for manpower expenditure was 8.0%.

OOE declined by 2.2% from \$1.35 billion in 2017 to \$1.32 billion in 2018. From a base of \$768.7 million in 2008, the CAGR for 2008-2018 for OOE was 5.6%.

Fig.3.1 Public Expenditure on R&D by type of cost (1990-2018)



#### 3.3 Type of R&D

The types of R&D conducted in public sector research organisations are as follows:

- Pure basic research (without seeking long-term economic or social benefits or making any effort to apply the results to practical problems);
- Strategic basic research (carried out with the expectation that it will produce a broad base of knowledge likely to form the basis of the solution to current or future problems or possibilities);
- Applied research (original investigation directed primarily towards a specific practical aim or objective); and
- Experimental development (systematic work directed to producing or improving substantially materials, products and devices; or installing new processes, systems and services).

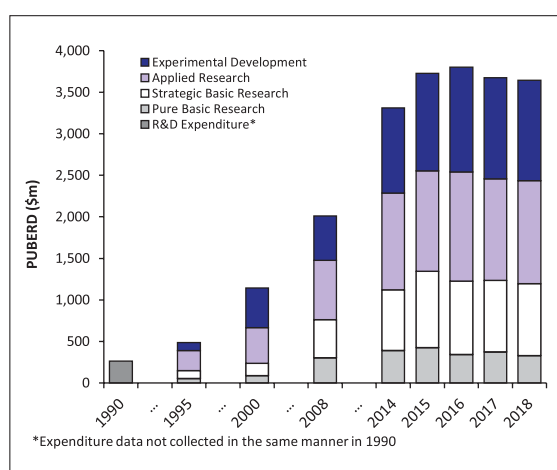
Pure basic research expenditure in public institutions decreased by 11.2% from \$371.2 million in 2017 to \$329.8 million in 2018. This represents a CAGR of 0.9% from 2008 when it was \$300.4 million.

Strategic basic research expenditure in public institutions was similar, at \$865.2 million in 2017 and \$864.9 million in 2018. This represents a CAGR of 6.5% from 2008 when it was \$462.0 million.

Applied research expenditure in public institutions increased slightly by 1.6% from \$1.22 billion in 2017 to \$1.24 billion in 2018. This represents a CAGR of 5.7% from 2008 when it was \$715.1 million.

Experimental development expenditure in public institutions decreased by 0.8% from \$1.22 billion in 2017 to \$1.21 billion in 2018. This represents a CAGR of 8.6% from 2008 when it was \$530.6 million.

*Fig.3.2 Type of Public Expenditure on R&D (1990-2018)*



### 3.4 Fields of Science & Technology

This section shows a breakdown by Fields of Science and Technology as follows:

- Electronics and ICM;
- Chemicals;
- Biomedical Sciences;
- Precision & Transport Engineering; and
- Others.

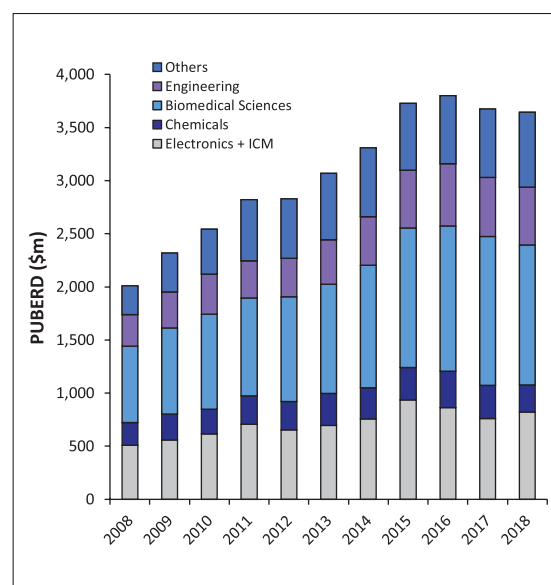
In public institutions, expenditure on R&D in Electronics and ICM increased by 8.4% from \$759.0 million in 2017 to \$822.6 million in

2018. This was a CAGR of 4.9% from 2008 when it was \$508.2 million.

By contrast, expenditure on R&D in Chemicals declined by 18.8% from \$313.5 million in 2017 to \$254.7 million in 2018. However, between 2008 and 2018, the CAGR was 1.7%, from a base of \$216.1 million in 2008.

Similarly, expenditure on R&D in Biomedical Sciences decreased by 5.9% from \$1.4 billion in 2017 to \$1.3 billion in 2018. It also fell for Precision and Transport Engineering by 2.4% from \$557.1 million in 2017 to \$543.5 million in 2018. However, between 2008 and 2018, the CAGRs were 6.3% each, from a base of \$718.1 million and \$295.6 million in 2008 respectively.

*Fig.3.3 Public Expenditure on R&D by fields of science and technology (2008-2018)*





## 4. R&D TALENT

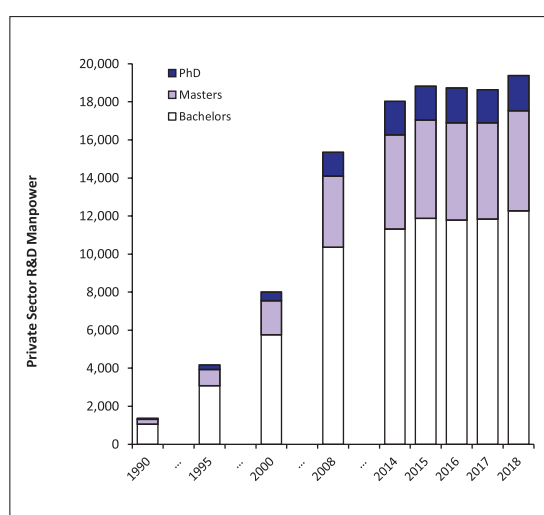
### 4.1 Total Research Scientists & Engineers

Research Scientists and Engineers (RSEs) comprise researchers who hold formal qualifications at the university degree level. RSEs exclude full-time postgraduate research students.

In 2018, the number of RSEs grew slightly by 2.4% from 35,389 in 2017 to 36,246 in 2018. This represents a CAGR of 3.5% from a base of 25,744 in 2008.

In the private sector, the number of PhD RSEs rose by 5.9% from 1,743 in 2017 to 1,845 in 2018. This was a CAGR of 4.0% from 1,246 PhD RSEs in 2008. RSEs with a Master's degree increased by 3.8% from 5,074 in 2017 to 5,268 in 2018. This was a CAGR of 3.5% from 3,741 RSEs with Master's degrees in 2008. The number of RSEs with a Bachelor's degree also increased by 3.7% from 11,833 in 2017 to 12,273 in 2018. This was a CAGR of 1.7% from 10,361 RSEs with Bachelor's degrees in 2008.

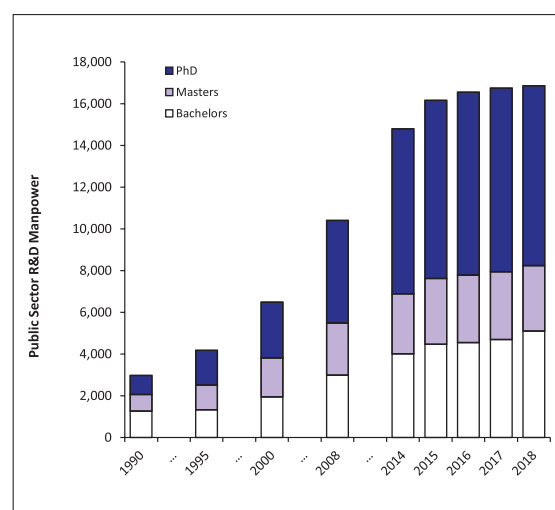
*Fig.4.1 Private Sector Research Scientists & Engineers (1990-2018)*



In the public sector, the number of PhD RSEs declined by 1.9% from 8,797 in 2017 to 8,627 in 2018. However, between 2008 and 2018, the CAGR was 5.8%, from a base of 4,901 in 2008. Similarly, RSEs with a Master's degree

decreased by 3.6% from 3,239 in 2017 to 3,124 in 2018. Nonetheless, there was still an overall CAGR growth of 2.2% from a base of 2,502 in 2008. RSEs with a Bachelor's degree grew by 8.6% from 4,703 in 2017 to 5,109 in 2018. The CAGR was 5.5% from a base of 2,993 in 2008.

*Fig.4.2 Public Sector Research Scientists & Engineers (1990-2018)*

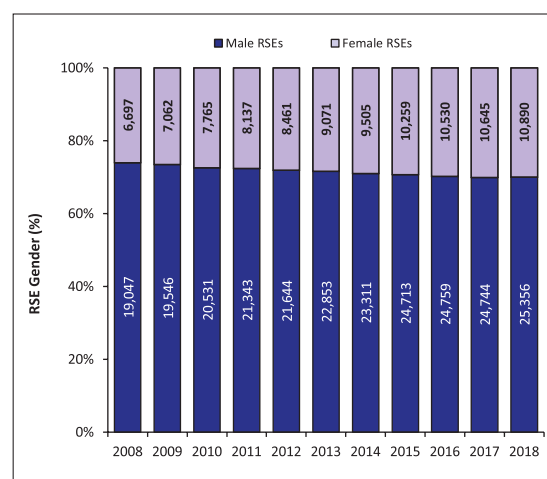


### 4.2 Profile of Research Scientists & Engineers

#### Gender

In 2018, females, at 10,890 made up 30.0% of all RSEs, similar to the 30.1% in 2017 but higher than the 26.0% in 2008. This was a CAGR of 5.0% from 6,697 female RSEs in 2008.

*Fig.4.3 Gender of Research Scientists & Engineers (2008-2018)*

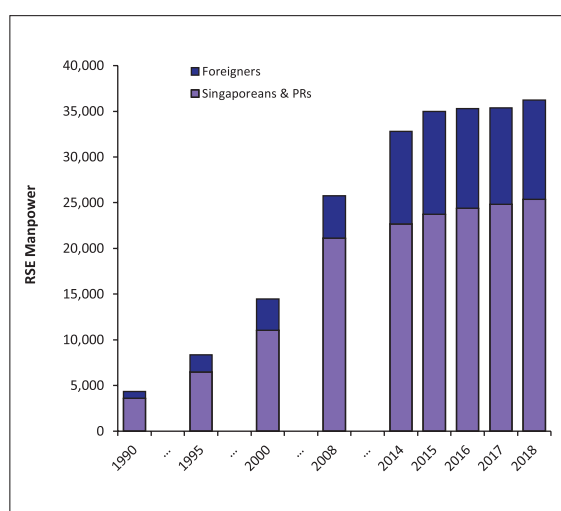


### Citizenship

The number of Singaporean and Permanent Resident (PR) RSEs increased by 2.2% from 24,824 in 2017 to 25,368 in 2018. This represents a CAGR of 1.9% from a base of 21,117 RSEs in 2008.

The number of non-resident foreign RSEs increased by 3.0% from 10,565 in 2017 to 10,878 in 2018. This represents a CAGR of 8.9% from a base of 4,627 foreign RSEs in 2008.

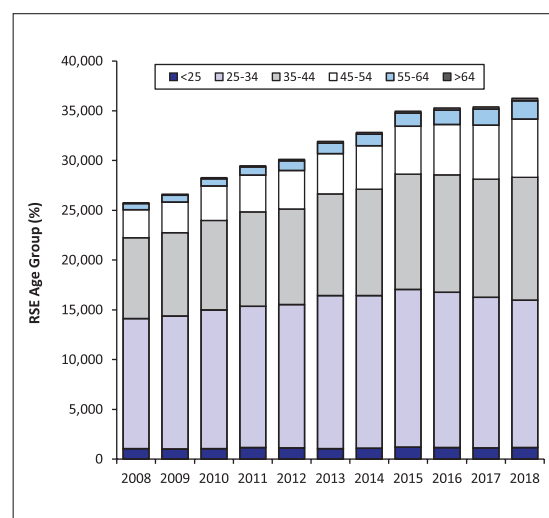
*Fig.4.4 Citizenship of Research Scientists & Engineers (1990-2018)*



### Age-Bands

In 2018, 44.1% of all RSEs were under the age of 35 and 78.1% of all RSEs were under the age of 45. Compared to 2008, these proportions had fallen from 54.9% and 86.4% respectively, as there were now more RSEs in the higher age-bands.

*Fig.4.5 Age-Bands of Research Scientists & Engineers (2008-2018)*



## 5. PATENTS

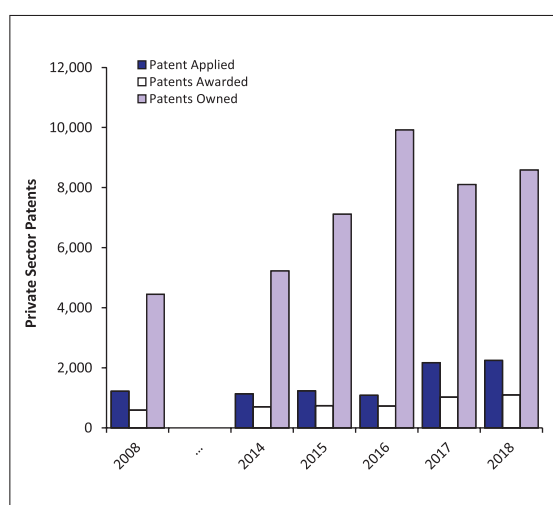
### 5.1 Patents Applied

In 2018, the total number of primary patent applications (first filings) as a result of R&D conducted in Singapore, stood at 2,896. This represents an increase of 1.5% from 2,852 patents filed in 2017, and a CAGR of 6.2% from the 1,581 patents filed in 2008.

In the private sector, 2,241 patents were filed in 2018, showing a 3.3% increase from the 2,170 patents filed in 2017, and a CAGR of 6.2% from the 1,227 patents filed in 2008.

In the public sector, the number of patent applications declined from 682 in 2017 to 655 in 2018. This represents a decrease of 4.0%, but a CAGR of 6.3% from the 354 patents filed in 2008.

*Fig.5.1 Patents Applied, Awarded and Owned in the Private Sector (2008-2018)*

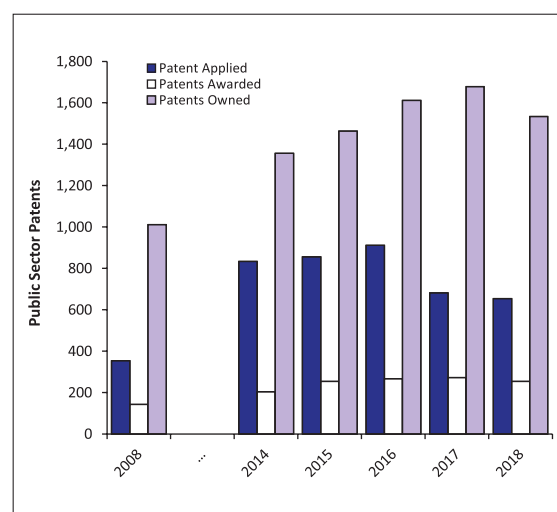


### 5.2 Patents Awarded

In 2018, the total number of patents awarded (first grants) as a result of R&D conducted in Singapore was 1,356. This represents an increase of 5.1% from 1,290 patents awarded in 2017 and a CAGR of 6.4% from the 730 patents awarded in 2008.

The number of patents awarded to private sector companies increased by 8.3% from 1,018 patents awarded in 2017 to 1,102 in 2018 and a CAGR of 6.5% from the 586 patents awarded in 2008. In the public sector, the number of patents awarded decreased by 6.6% from 272 in 2017 to 254 in 2018, but showed a CAGR of 5.8% from the 144 patents awarded in 2008.

*Fig.5.2 Patents Applied, Awarded and Owned in the Public Sector (2008-2018)*



## 6. INTERNATIONAL COMPARISON OF R&D

### 6.1 Research Intensity in Selected Countries

According to OECD Main Science and Technology Indicators 2019/02, the United States of America remained the top R&D spender, with US\$582 billion spent on research. China claimed second position in 2018, having spent US\$554 billion, while Japan in third position spent US\$171 billion. Normalised as a percentage of GDP, GERD/GDP was 2.8% in the United States, 2.2% in China and 3.3% in Japan.

Singapore's GERD/GDP was 1.9% in 2017 and 1.8% in 2018. The top 5 most research-intensive countries in the world were Israel (4.9%), Korea (4.5%), Taiwan (3.5%), Switzerland (3.4%) and Sweden (3.3%).

### 6.2 Researcher Intensity in Selected Countries

Researcher intensity is measured by Full-time Equivalence (FTEs) as a percentage of the labour force. Singapore's labour force increased by 0.5% from 3.66 million in 2017 to 3.68 million in 2018. Researcher FTEs rose by 1.0% from 38,898 in 2017 to 39,272 in 2018.

Singapore's researcher intensity (FTEs/1,000 Labour Force) was 10.6 in 2017 and 10.7 in 2018. This places Singapore within the ranks of countries such as Netherlands (10.4), France (10.3), Germany (10.0) and Japan (10.0).

The top 3 countries in terms of researcher intensity in 2018 are Israel (17.6) and Denmark (15.2) and Korea (14.7).

*Fig.6.1 Comparison of Selected Countries by Research & Researcher Intensity (2018)*



*Bubble size indicates GERD.*

*Source: OECD, Main Science and Technology Indicators 2019/02*

## 7. EXPLANATORY NOTES AND DEFINITIONS

### 7.1 DEFINITION OF R&D

7.1.1 Research and development (R&D) comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this stock of knowledge to devise new applications. R&D covers three activities: basic research, applied research and experimental development, which are defined and described below. The scope of the definition of R&D for the Survey extends to R&D in science and technology only and excludes the social sciences and humanities.

7.1.2 R&D is related to a number of other activities with a scientific and technological basis, which are often very closely linked to R&D through flows of information or in terms of operations, institutions and personnel. The basic criterion for distinguishing R&D from related activities is the presence of an appreciable element of novelty and the resolution of scientific or technological uncertainty, i.e. when the solution to a problem is not readily apparent to someone familiar with the basic stock of common knowledge and techniques for the area concerned. In particular, there is difficulty locating the cutoff point between experimental development and the related activities required to realise an innovation.

### 7.2 R&D MANPOWER

7.2.1 R&D manpower comprises all persons directly employed on R&D and those providing direct services. It includes persons who are mainly or partially engaged in R&D. It comprises the three occupation groups defined and described below: researchers; technicians; and other supporting staff.

7.2.2 Researchers are professionals engaged in the conception or creation of

new knowledge, products, processes, methods and systems, or 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 are categorised as researchers. Full-time postgraduate research students, at both the master degree and PhD level, are categorised as researchers.

7.2.3 Researchers are further sub-classified as follows:

(a) Research scientists and engineers (RSEs) comprise the researchers, excluding the full-time postgraduate research students, who hold formal qualifications at the university degree level. RSEs are classified into three subcategories according to the highest level of the formal qualifications: PhD; master degree; and bachelor degree.

(b) Non-degree researchers comprise the researchers, excluding the full-time postgraduate research students, who hold formal qualifications below the university degree level.

(c) Full-time postgraduate research students (FPGRSs).

We define also TRSEs ("total" RSEs) to be the category comprising the RSEs and FPGRSs.

7.2.4 Technicians are persons whose main tasks require technical knowledge and experience in one or more fields of science and technology. 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. The tasks of technicians include: preparing computer programmes; carrying out experiments, tests and analyses; preparing materials and equipment for experiments, tests and analyses; and recording measurements,



making calculations and preparing charts and graphs.

7.2.5 Other supporting staff comprise other persons who participate in or are directly associated with R&D projects. Managers and administrators dealing mainly with financial and personnel matters and general administration, skilled and unskilled craftsmen, and secretarial and clerical staff, are included in this heading, insofar as their activities are a direct service to R&D. Persons providing an indirect service should be excluded (but their wages and salaries should be included as an overhead costs when measuring expenditure on R&D).

7.2.6 The Survey's reporting convention for the headcount of those engaged in R&D is the number of persons as at the last day of the one year reporting period.

7.2.7 One full-time equivalence (FTE) unit may be thought of as one person-year. A person who spends 30% of his time on R&D and the rest on other activities during the one-year reporting period should be considered as 0.3 FTE. If a full-time R&D worker is employed for only six months during the one-year reporting period, this results in a 0.5 FTE.

7.2.8 R&D manpower is also classified by the following:

(a) Nationality, categorised by "Singapore citizens and Singapore permanent residents" as well as "non-PR foreign citizens".

(b) Age group, categorised by the following:  
(i) under 25 years; (ii) 25-34 years; (iii) 35-44 years; (iv) 45-54 years; (v) 55-64 years; and (vi) above 64 years.

(c) Gender.

### 7.3. R&D EXPENDITURE

7.3.1 The (intramural) R&D expenditures for an organisation comprise all expenditures on R&D performed within the organisation during the reporting period. They include expenditures made outside the organisation but in support of the R&D performed within the organisation. It excludes extramural R&D expenditures, which are the sums an organisation paid or committed to pay to another organisation for the performance of R&D, where the latter includes acquisition of R&D performed by others and grants given to others for performing R&D.

7.3.2 Intramural R&D expenditures comprise current and capital expenditures.

(a) Current expenditures comprise manpower and other operating expenditures:

(i) Manpower expenditures comprise annual wages and salaries and all associated expenditures for R&D manpower. The manpower expenditures on persons who provide an indirect service to R&D and are not categorized as R&D manpower are included as other operating expenditures on R&D and not as manpower expenditures on R&D.

(ii) Other operating expenditures (OOE) include non-capital purchases of materials, supplies and equipment to support R&D performed by the organisation. Administrative and other overhead expenditures are included and prorated if necessary. Expenditures on indirect services are included. Rents and fees associated with R&D are included.

(b) Capital expenditures (CAPEX) are the annual gross expenditures on fixed assets used in the R&D programmes of the organisation, i.e. on (i) land, buildings and other structures, and on (ii) vehicles, plant,

machinery and equipment. They are reported in full for the reporting period when they took place rather than registered as an element of depreciation.

7.3.3 Sources of R&D funds are reported by the performers of research. The surveyed organisation reports the sums which it received or will receive from various sources for the performance of (intramural) R&D during the one-year reporting period. Funds received for R&D performed during earlier periods or for R&D not yet started are excluded. The categories of sources of R&D funds are:

- (a) Within Singapore:
  - (i) Private sector;
  - (ii) Government sector;
  - (iii) Institutes of Higher Learning.
- (b) Abroad:
  - (i) Foreign-based companies;
  - (ii) Foreign governments and international organisations.

7.3.4 All monetary amounts in this report are in Singapore dollars. Monetary amounts that are reported by survey respondents in foreign currency units are converted to Singapore dollars based on the average exchange rates for the relevant year, as published by the Monetary Authority of Singapore.

## 7.4. INSTITUTIONAL CLASSIFICATION

7.4.1 Sectors. The Survey classifies organisations into four sectors:

(a) Private sector. This comprises all business enterprises, excluding institutions of higher learning.

(b) Government sector. This comprises all government organisations, but excludes the public institutions of higher learning and the A\*STAR research institutes, which are classified under separate sectors. It includes all government ministries and statutory boards.

(c) Institutes of Higher Learning. This comprises institutions of higher learning, including the universities and polytechnics.

(d) Public research institutes. This comprises the A\*STAR research institutes.

7.4.2 Industrial classification. The enterprises in the private sector are further sub-classified into industry groups and subgroups according to their classification by the Singapore Standard Industrial Classification (SSIC) 2015 (Version 2018).

7.4.3 The enterprises in the private sector are also sub-classified by ownership and size:

(a) A company with at least 30% local equity is classified as a local company, and with less than 30% local equity a foreign company.

(b) A local company is classified as a small/medium-sized enterprise (SME) if it satisfies the following criteria (following Enterprise Singapore), and a large enterprise (LE) otherwise:

- (i) Annual sales turnover of not more than \$100 million; or
- (ii) Employment size of not more than 200 workers.

## 7.5. FUNCTIONAL DISTRIBUTION

7.5.1 Type of R&D. Three types of R&D are distinguished:

(a) Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.

The performer of the research may not know about actual applications when doing the research, and therefore does not have them in view: such research is basic according to the definition. Research that is undertaken with the goal of a broad range of applications in the future, but which does not have a particular use in view, is basic according to the definition.

Thus, two types of basic research are distinguished:

- (i) Pure basic research is carried out for the advancement of knowledge, without seeking long-term economic or social benefits or making any effort to apply the results to practical problems or to transfer the results to sectors responsible for their application.

(ii) Strategic (or oriented) basic research is carried out with the expectation that it will produce a broad base of knowledge likely to form the basis of the solution to recognised or expected, current or future problems or possibilities.

(b) Applied research is also original investigation undertaken in order to acquire new knowledge. However, it is directed primarily towards a specific practical aim or objective. Applied research is undertaken either to determine possible uses for the findings of basic research or to determine new methods or ways of achieving specific and predetermined objectives. It involves considering the available knowledge and its extension in order to solve particular problems. The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods or systems. Applied research gives operational form to ideas.

(c) Experimental development is systematic work, drawing on knowledge gained from research and practical experience, that is directed to producing new materials, products and devices; to installing new processes, systems and services; or to improving substantially those already produced or installed.

7.5.2 Fields of science and technology (S&T). The areas of R&D are classified by the following S&T fields:

### Natural sciences (excluding biological sciences)

- Computer and related sciences [computer programming, computer studies, electronic data processing, information sciences, system analysis, and areas related to software development]
- Physical sciences and mathematics [astronomy and space sciences, physics and related sciences]
- Chemical sciences [chemistry and related sciences]

- Earth and related environmental sciences [geology, geophysics, mineralogy, meteorology, physical geography and other geosciences, other atmospheric sciences including climate research, oceanography, vulcanology, palaeoecology and related sciences]

#### **Engineering and technology**

- Civil and architecture engineering [architecture engineering, building sciences and engineering, construction engineering, municipal and structural engineering]
- Mechanical engineering
- Metallurgy and metal engineering
- Aeronautical engineering
- Marine engineering
- Electrical and electronics engineering [electrical engineering, electronics, communication engineering and systems]
- Computer engineering [hardware only]
- Info-communication and media technology
- Materials science and chemical engineering
- Environmental engineering
- Biomedical engineering

#### **Biomedical and related sciences**

- Basic medicine [anatomy, cytology, physiology, pharmacy, pharmacology, toxicology, immunology and immuno-haematology, pathology, neuroscience]
- Clinical medicine [anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology, oncology, geriatrics, cardiovascular, dermatology, urology, infectious diseases]
- Health sciences [public health services, social medicine, hygiene, nursing, epidemiology]

- Pharmaceutical sciences and manufacturing
- Biological sciences [biochemistry, biology, biophysics, genetics, microbiology, molecular biology, bioengineering, bioinformatics]
- Other related biomedical sciences

#### **Agricultural sciences, food sciences**

[Agronomy, agrotechnology, animal husbandry, fisheries, forestry, horticulture, bacteriology related to animals, veterinary medicine, botany, zoology, food and other related sciences]

#### **Energy**

[Clean energy systems; solar energy; wind energy]

#### **Other areas**

### **7.6. OTHER DATA**

7.6.1 The following R&D-related data are also collected by the Survey:

(a) Patenting activities arising from R&D performed in Singapore:

- (i) Number of primary patent applications during the reporting period. Only first filings of patent applications are counted, and patent applications for the same invention in more than one country are entered as one.
- (ii) Number of patent awards during the reporting period. Patent awards for the same invention in more than one country are entered as one.
- (iii) Number of patents owned as at the last day of the calendar year.

(b) Revenue data:

- (i) Licensing revenue from patents and new technologies developed in Singapore;
- (ii) Sales revenue from commercialized products/processes attributed to R&D performed in Singapore.

7.6.2 For enterprises in the private sector,

(a) The following classification data are also collected in the Survey:

- (i) Total number of employees;
- (ii) Total fixed assets;
- (iii) Total sales revenue over the one-year reporting period;
- (iv) Information on local and foreign equity in the company.

(b) The industrial classification of private sector enterprises by the SSIC 2015 (Version 2018) is obtained from the Department of Statistics.

7.6.3 The convention for reporting data such as sales revenue may differ across organisations.



## 7.7 LIST OF ABBREVIATIONS:

<b>BERD</b>	Business Expenditure on R&D
<b>BMS</b>	Biomedical Sciences
<b>CAPEX</b>	Capital Expenditure
<b>CAGR</b>	Compound Annual Growth Rate
<b>EDB</b>	Economic Development Board
<b>FPGRS</b>	Full-time Postgraduate Research Student
<b>FTE</b>	Full-time Equivalence
<b>GDP</b>	Gross Domestic Product
<b>GERD</b>	Gross Expenditure on R&D
<b>ICM</b>	Info-communication & Media Technology
<b>IPOS</b>	Intellectual Property Office of Singapore
<b>LE</b>	Large Enterprise
<b>OOE</b>	Other Operating Expenditure
<b>PG</b>	Post Graduate
<b>PUBERD</b>	Public Expenditure on R&D
<b>R&amp;D</b>	Research & Development
<b>RSE</b>	Research Scientists and Engineers
<b>SME</b>	Small & Medium Enterprise
<b>SSIC</b>	Singapore Standard Industrial Classification
<b>S&amp;T</b>	Science and Technology
<b>UEN</b>	Unique Entity Number

## 8. METHODOLOGY

### 8.1. METHODOLOGY

8.1.1 The National Survey of R&D in Singapore is conducted under the Statistics Act (Chapter 317), which makes the submission of returns mandatory. Individual returns received are kept in confidence with the Statistics Act. The Act is available on the Singapore Department of Statistics' website ([www.singstat.gov.sg](http://www.singstat.gov.sg)).

8.1.2 The approach is to survey all organisations that are known to perform R&D. A register of R&D performing organisations is maintained. The Survey form is sent to the organisations on the register. The register comprises all organisations that had reported previously to the Survey that they performed R&D, after excluding those that subsequently reported that they did not perform R&D or ceased operations. The register is updated annually through a Preliminary Survey of organisations that are potentially performing R&D but are not on the register. The list of organisations surveyed in the Preliminary Survey is compiled annually from various sources, and includes all companies that are in receipt of government R&D grants.

### 8.2. RESPONSES

8.2.1 The organisations that reported to the Survey that they performed R&D in 2018 comprised private sector enterprises, government organisations, institutions of higher learning and the public research institutes. A total of 857 private sector enterprises reported that they performed R&D in 2018.

8.2.2 12,940 survey forms were sent out in the Preliminary Survey. Subsequently, 1,473 survey forms were sent out to private sector enterprises in the 2018 register of R&D-performing organisations. From these, 857 private sector enterprises (58.2%) reported that they performed R&D in 2018, 466 (31.6%) reported that they did not perform

R&D in 2018 or had ceased business operations, and 150 (10.2%) did not respond or provided incomplete / late submissions.

8.2.3 In 2018, the top 150 private sector enterprises (by R&D expenditure in 2017) accounted for 83% (\$4.7 billion) of private sector R&D expenditure. 145 (96.7%) reported that they performed R&D in 2018 and their returns were either reported under their own name or under a parent or subsidiary and 5 (3.3%) reported that they did not perform R&D in 2018 or had ceased business operations.

8.2.4 100% of all the government organisations, institutions of higher learning and public research institutes that were surveyed in 2018 responded.

### 8.3. CONVENTIONS

8.3.1 The reporting period of the Survey is one year in length. The actual period may vary across Survey respondents but it would usually be the calendar or fiscal year.

### 8.4. HISTORICAL NOTES

8.4.1 The National Survey of R&D in Singapore was conducted by the Singapore Science Council on a triennial basis from 1978 to 1987. Since 1990, it has been conducted and published annually by the Agency for Science, Technology and Research (formerly the National Science and Technology Board).

8.4.2 Postgraduate research students (at the master degree and PhD levels) have been reported as R&D manpower only since the 2000 Survey. In the 2000 Survey, both full-time and part-time postgraduate research students were counted. Since the 2001 Survey, only full-time postgraduate research students (FPGRSs) have been included.

8.4.3 In 2000 and 2001, the Survey published data on patents applied and awarded that combined data from the

Survey with data from the public databases of the Intellectual Property of Singapore (IPOS). Specifically, the published data combined the patenting data of the Survey respondents with the patenting data in the IPOS databases of locally-based companies (and individuals) that were not among the Survey's respondents. (The IPOS data contributed an additional 128 patents applied and 46 patents awarded in 2000, and an additional 193 patents applied and 51 patents awarded in 2001.) Since 2002, the Survey publishes only the patenting data of Survey respondents.

8.4.4 Since the 2002 Survey, (a) the industrial classification of enterprises in the private sector by industry groups was revised to ensure overall consistency of the classifications with SSIC 2000 and to align the definitions of the industry groups in the manufacturing industries with EDB's new definitions; (b) basic research in the private sector was not sub-classified into the subtypes of pure and strategic basic research; (c) "licensing revenue from acquired patents and new technologies" and "sales revenue from commercialised products and processes attributed to R&D performed in Singapore within the last 2 years" ceased to be published; (d) the Survey asked additionally for the age group and gender of R&D manpower to be reported; (e) the Survey included "computer engineering", "info-communication & media technology", "biological sciences", "basic medicine", "clinical medicine", "health sciences", "pharmaceutical sciences & manufacturing" and "other biomedical related sciences" as disaggregated options under the fields of science & technology category for both researchers and R&D expenditure; and (f) the Survey asked for the disaggregation of reported R&D expenditure in each field of science & technology by the type of R&D.

8.4.5 Prior to 2005, the classification of survey respondents from the private sector was based on the Singapore Standard Industrial Classification (SSIC) 2000. In 2005, it was updated to SSIC 2005, in 2010, to SSIC 2010, in 2015, to SSIC 2015, and in 2017, to SSIC 2015 (version 2018). In 2017, the aggregation of manufacturing activities into the EDB-defined manufacturing subsectors was also updated with EDB's revised classification. These revisions have some but limited impact on the comparability of the published R&D statistics in the 2017 survey report relative to those in the preceding survey reports.

8.4.6 Hitherto, organisations which were known to have performed R&D in the survey period, but which did not submit a survey return or submitted an incomplete survey return, have been excluded from the published survey results. With effect from the 2006 survey report, such organisations would be captured in the published survey results through a mechanism of imputation, where this is feasible. The imputed data would be based on the previous year's survey returns and/or the current year's incomplete returns. The impact on the published statistics was marginal considering the survey already had a high response rate.

Imputation was used for 15 (1.0%) of the 1,565 entities surveyed in 2018.

8.4.7 With effect from the 2007 Survey, an exercise would be undertaken on a yearly basis to update any changes made by the Department of Statistics to an organisation's Unique Entity Number (UEN) which could in turn impact its SSIC code. This is to capture any changes in the organisation's core activity so as to ensure that the organisation is placed in the correct industry classification.

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**Table 1.1A R&D Manpower**

Type of R&D Manpower	Private Sector	Government Sector	Higher Education Sector	Public Research Institutes	Total
Researchers	21,160	3,697	15,010	3,443	43,310
RSEs <sup>#</sup>	19,386	3,534	9,957	3,369	36,246
PhD	1,845	584	6,077	1,966	10,472
Master	5,268	1,109	1,533	482	8,392
Bachelor	12,273	1,841	2,347	921	17,382
Postgrad students*	-	-	4,955	-	4,955
Non-Degree	1,774	163	98	74	2,109
Technicians	1,315	346	334	248	2,243
Other Supporting Staff	2,037	1,373	448	293	4,151
Total	24,512	5,416	15,792	3,984	49,704

\* Local postgraduate students at the Public Research Institutes are reported under the Higher Education Sector.

<sup>#</sup> RSE is a definition used within Singapore context. It includes researchers with at least a degree. For more detailed definition regarding RSE, please see page 12 of explanatory notes.

**Table 1.1B R&D Manpower (FTE)**

Type of R&D Manpower	Private Sector	Government Sector	Institutes of Higher Learning	Public Research Institutes	Total
Researchers	20,206.6	2,501.0	13,215.3	3,349.5	39,272.4
RSEs <sup>#</sup>	18,567.1	2,369.4	8,175.3	3,275.5	32,387.2
PhD	1,766.2	483.7	4,685.8	1,900.7	8,836.4
Master	5,069.7	703.0	1,292.8	473.0	7,538.6
Bachelor	11,731.2	1,182.6	2,196.7	901.8	16,012.3
Postgrad students*	-	-	4,955.0	-	4,955.0
Non-Degree	1,639.6	131.6	85.0	74.0	1,930.2
Technicians	1,128.9	310.1	222.9	243.4	1,905.3
Other Supporting Staff	1,800.1	1,261.4	295.4	281.8	3,638.7
Total	23,135.7	4,072.5	13,733.6	3,874.7	44,816.4

Table 1.2 R&amp;D Manpower by Nationality

Type of R&D Manpower	Private Sector			Government Sector			Institutes of Higher Learning			Public Research Institutes			Total
	Singapore Permanent Residents	Citizens	Foreign	Singapore Permanent Residents	Citizens	Foreign	Singapore Permanent Residents	Citizens	Foreign	Singapore Permanent Residents	Citizens	Foreign	
Researchers	15,572	5,588		3,509	188		6,692	8,318		2,782	661		28,555
RSEs*	14,050	5,336		3,348	186		5,255	4,702		2,715	654		25,368
PhD	1,301	544		514	70		2,689	3,388		1,444	522		5,948
Master	3,465	1,803		1,059	50		832	701		401	81		5,757
Bachelor	9,284	2,989		1,775	66		1,734	613		870	51		13,663
Postgrad students*	-	-	-	-	-	-	1,349	3,606	-	-	-	-	1,349
Master Level	-	-	-	-	-	-	138	138	-	-	-	-	138
PhD Level	-	-	-	-	-	-	1,211	3,468	-	-	-	-	1,211
Non-Degree	1,522	252		161	2		88	10		67	7		1,838
Technicians	1,002	313		311	35		313	21		238	10		1,864
Other Supporting Staff	1,542	495		1,314	59		436	12		291	2		3,583
Total	18,116	6,396		5,134	282		7,441	8,351		3,311	673		34,002

Table 1.3 R&amp;D Manpower by Age Group

Type of R&D Manpower	Private Sector			Government Sector			Institutes of Higher Learning			Public Research Institutes			Total
	<25	25-34	35-44	45-54	55-64	>64	<25	25-34	35-44	45-54	55-64	>64	
Researchers	638	7,709	8,048	3,864	830	71	80	1,333	1,230	757	252	45	1,942
RSEs*	518	7,305	7,555	3,356	610	42	63	1,317	1,189	699	227	39	1,147
PhD	1	543	807	377	102	15	0	108	261	152	56	7	4
Master	94	1,637	2,178	1,151	203	5	8	363	376	264	88	10	168
Bachelor	423	5,125	4,570	1,828	305	22	55	846	552	283	83	22	975
Postgrad students*	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Degree	120	404	493	508	220	29	17	16	41	58	25	6	628
Technicians	114	539	331	217	98	16	19	141	94	40	46	6	173
Other Supporting Staff	117	558	661	503	171	27	87	588	374	205	91	28	239
Total	869	8,806	9,040	4,584	1,099	114	186	2,062	1,698	1,002	389	79	2,354

**Table 1.4 R&D Manpower by Gender**

Type of R&D Manpower	Private Sector		Government Sector		Institutes of Higher Learning		Public Research Institutes		Total
	Male	Female	Male	Female	Male	Female	Male	Female	
Researchers	15,608	5,552	2,355	1,342	9,894	5,116	2,121	1,322	29,978
RSEs*	14,333	5,053	2,265	1,269	6,670	3,287	2,088	1,281	25,356
PhD	1,359	486	385	199	4,449	1,628	1,350	616	7,543
Master	4,096	1,172	737	372	935	598	297	185	6,065
Bachelor	8,878	3,395	1,143	698	1,286	1,061	441	480	11,748
Postgrad students*	0	0	0	0	3,177	1,778	0	0	3,177
Non-Degree	1,275	499	90	73	47	51	33	41	1,445
Technicians	818	497	159	187	190	144	165	83	1,332
Other Supporting Staff	921	1,116	332	1,041	117	331	85	208	1,455
Total	17,347	7,165	2,846	2,570	10,201	5,591	2,371	1,613	32,765
									16,939

**Table 1.5 R&D Expenditure by Type of Costs**

Type of Costs	Private Sector		Government Sector		Institutes of Higher Learning		Public Research Institutes		Total
	Male	Female	Male	Female	Male	Female	Male	Female	
Capital Costs	430.67	59.54	153.57	81.84	725.63				
Land, Buildings & Other Structures	50.28	20.92	7.40	9.48	88.08				
Vehicles, Plant, Machinery & Equipment	380.40	38.62	146.17	72.35	637.55				
Manpower Costs	2,577.80	537.34	1,025.72	465.95	4,606.81				
Researchers	2,323.11	425.20	938.69	420.02	4,107.02				
RSEs*	2,166.46	407.61	797.11	416.16	3,787.34				
Postgrad students*	0	0	136.70	0	136.70				
Non-Degree	156.65	17.59	4.88	3.87	182.98				
Technicians	82.16	21.73	13.47	19.74	137.09				
Other Supporting Staff	172.53	90.41	73.56	26.19	362.70				
Other Operating Costs	2,629.91	472.29	472.00	375.14	3,949.34				
Total	5,638.39	1,069.17	1,651.29	922.93	9,281.79				

\$ million

**Table 1.6 R&D Expenditure by Source of Funding**

Source of Funding	Private Sector	Government Sector	Institutes of Higher Learning	Public Research Institutes	Total
Own Funds	4,687.82	155.34	230.13	34.77	5,108.06
Private Sector	97.82	31.74	62.33	47.06	238.95
Government Sector	244.62	864.90	1,332.75	835.71	3,277.99
Higher Education Sector	0.81	6.80	6.32	0.19	14.12
Foreign-Based Companies	588.96	9.89	11.62	4.89	615.36
Foreign Governments & International Organisations	18.36	0.50	8.15	0.31	27.32
Total	5,638.39	1,069.17	1,651.29	922.93	9,281.79

**Table 1.7 Patenting Indicators**

Patenting Indicators	Private Sector	Government Sector	Institutes of Higher Learning	Public Research Institutes	Total
Patents Applied	2,241	87	412	156	2,896
Patents Awarded	1,102	18	134	102	1,356
Patents Owned (Cumulatively as at 31 Dec 2019)	8,579	107	771	657	10,114

**Table 1.8 Revenue Indicators**

Revenue Indicators	Private Sector	Government Sector	Institutes of Higher Learning	Public Research Institutes	Total
Licensing Revenue from Patents and New Technologies Developed in Singapore	268.16	0.94	6.00	5.66	280.76
Sales Revenue from Commercialised Products/Processes Attributed to R&D Performed in Singapore	31,769.97	0.18	0.24	35.81	31,806.21

**Table 2.1A Researchers by Field of Science & Technology**

Field of Science & Technology	Private Sector				Government Sector				Higher Education Sector				Public Research Institutes				Total	
	PhD	Master	Bachelor	Non-Degree	PhD	Master	Bachelor	Non-Degree	PhD	Master	Bachelor	Postgrad Students	Non-Degree	PhD	Master	Bachelor		Postgrad Students
Agricultural & Food Sciences	144	138	464	90	25	20	32	6	345	78	112	32	7	4	238	611	32	103
Agricultural Sciences	59	18	40	4	21	20	29	2	26	7	5	1	1	0	45	74	1	7
Food Sciences	85	120	424	86	4	0	3	4	319	71	107	31	6	4	193	537	31	96
Biomedical & Related Sciences	289	182	423	30	299	351	775	50	1,671	336	675	1,238	22	779	1,006	2,323	1,238	132
Basic Medicine	21	12	26	4	7	2	3	0	211	38	104	91	2	98	60	195	91	8
Biological Sciences	177	67	176	2	40	16	40	4	598	81	214	579	10	554	254	709	579	29
Clinical Medicine	11	18	19	2	147	193	571	31	340	94	153	186	3	57	324	792	186	37
Health Sciences	18	9	10	0	79	129	135	2	415	112	182	169	7	21	258	350	169	9
Pharmaceutical Sciences & Manufacturing	57	70	167	18	8	3	12	0	89	9	19	74	0	34	89	220	74	21
Other Related Biomedical Sciences	5	6	25	4	18	8	14	13	18	2	3	139	0	15	21	57	139	28
Engineering & Technology	1,148	4,159	9,745	1,404	177	511	727	99	1,931	594	669	2,001	38	904	5,537	11,544	2,001	1,576
Aeronautical Engineering	6	45	159	18	19	23	49	1	31	12	22	25	1	46	25	73	3	23
Biomedical Engineering	56	85	166	22	2	4	2	0	271	45	79	171	5	61	137	256	171	27
Civil & Architecture Engineering	17	27	95	24	23	42	46	1	282	138	103	232	5	1	207	244	232	30
Computer Engineering	133	786	1,840	117	9	25	55	1	221	47	75	259	1	0	858	1,970	259	119
Electrical & Electronics Engineering	487	1,967	4,226	519	73	216	326	66	308	111	108	311	6	116	24	2,318	4,722	613
Environmental Engineering	17	41	84	21	26	35	53	3	139	26	24	133	2	6	104	161	133	26
Infocommunication & Media Technology	131	449	1013	169	4	48	93	1	169	92	113	258	6	134	665	1,255	258	176
Marine Engineering	24	64	197	31	0	5	0	0	7	9	7	9	1	7	78	204	9	32
Material Sciences & Chemical Engineering	159	184	424	84	5	19	7	4	311	48	76	373	5	302	294	578	373	103
Mechanical Engineering	107	492	1,495	388	16	94	96	22	172	62	55	212	4	223	748	1,798	212	414
Metallurgy & Metal Engineering	11	19	46	11	0	0	0	0	20	4	7	18	2	8	23	53	18	13
Natural Sciences (excluding Biological Sciences)	231	665	1,417	197	70	207	278	2	1,119	171	283	907	4	267	70	60	8	211
Chemical Sciences	128	146	331	83	11	9	24	0	240	16	33	294	1	56	6	24	7	91
Computer & Related Sciences	73	481	1035	91	26	142	201	2	162	46	81	181	1	156	58	30	1	95
Earth & Related Environmental Sciences	17	15	27	19	14	6	5	0	200	59	73	97	1	0	80	105	97	20
Physical Sciences & Mathematics	13	23	24	4	19	50	48	0	517	50	96	335	1	55	6	6	0	5
Energy	22	43	56	8	0	0	0	0	209	33	40	311	1	0	76	96	311	10
Other Areas	11	81	168	45	13	20	29	6	802	321	568	466	26	12	422	770	466	77
Total	1,845	5,268	12,273	1,774	584	1,109	1,841	163	6,077	1,533	2,347	4,955	98	1,966	482	921	74	2,109

**Table 2.1B Researchers (FTE) by Field of Science & Technology**

Field of Science & Technology	Private Sector				Government Sector				Institutes of Higher Learning				Public Research Institutes				Total											
	PhD	Master	Bachelor	Non-Degree	PhD	Master	Bachelor	Non-Degree	PhD	Master	Bachelor	Non-Degree	Postgrad Students	Bachelor	Master	PhD	Non-Degree	Postgrad Students	Bachelor	Master	PhD	Non-Degree	Postgrad Students	Bachelor	Master	PhD	Non-Degree	Postgrad Students
Agricultural & Food Sciences	131.1	126.6	424.6	82.2	22.1	16.2	18.1	4.4	274.3	73.1	107.5	32.0	5.7	4.0	1.9	3.0	-	431.4	217.8	553.3	32.0	92.3						
Agricultural Sciences	55.3	17.7	38.9	4.0	18.1	16.2	15.7	1.3	19.5	3.5	4.9	1.0	0.2	-	-	-	-	92.9	37.4	59.5	1.0	5.5						
Food Sciences	75.8	108.9	385.7	78.2	4.0	-	2.4	3.1	254.7	69.6	102.6	31.0	5.5	4.0	1.9	3.0	-	338.5	180.3	493.8	31.0	86.8						
Biomedical & Related Sciences	280.0	175.3	410.1	29.1	270.0	175.3	450.2	43.8	1,274.9	292.4	645.2	1,238.0	21.4	761.1	133.9	438.7	30.8	2,585.9	777.0	1,944.1	1,238.0	125.0						
Basic Medicine	21.0	12.0	26.0	4.0	9.3	1.3	8.3	-	173.6	37.8	95.8	91.0	2.1	101.6	9.1	63.0	2.0	305.5	60.2	193.1	91.0	8.1						
Biological Sciences	169.7	64.7	173.3	4.0	39.9	16.3	40.0	4.0	430.50	74.52	209.53	579.0	9.28	528.75	84.9	265.55	12.95	1,168.9	240.4	688.4	579.0	30.2						
Clinical Medicine	9.0	14.3	16.4	2.0	137.5	90.6	263.4	27.4	263.0	66.6	142.4	186.0	3.0	60.8	20.1	49.6	1.0	470.2	191.5	471.8	186.0	33.4						
Health Sciences	18.0	8.6	9.6	-	59.2	58.5	111.3	2.0	332.5	104.0	177.2	169.0	6.7	21.0	7.7	23.5	0.3	430.8	178.8	321.6	169.0	9.0						
Pharmaceutical Sciences & Manufacturing	57.3	70.0	162.6	15.9	10.3	3.0	17.3	-	59.7	7.8	17.8	74.0	0.3	34.0	7.1	22.0	3.5	161.3	87.8	219.7	74.0	19.6						
Other Related Biomedical Sciences	5.0	5.8	22.2	3.2	13.7	5.7	9.8	10.4	15.6	1.8	2.5	139.0	-	15.1	5.0	15.0	11.0	49.4	18.3	49.5	139.0	24.6						
Engineering & Technology	1,099.7	4,011.8	9,344.2	1,295.1	123.5	377.2	532.4	76.8	1,494.8	475.2	599.2	2,001.0	30.3	857.4	267.0	395.0	35.0	3,575.4	5,131.1	10,870.8	2,001.0	1,437.3						
Aeronautical Engineering	3.3	45.0	125.3	15.3	15.2	18.4	39.2	0.8	21.9	9.6	14.1	25.0	1.1	46.0	25.0	73.0	3.0	86.4	98.0	251.6	25.0	20.2						
Biomedical Engineering	52.2	84.5	164.0	21.0	2.0	3.2	1.8	-	215.3	36.1	73.1	171.0	2.0	61.0	3.0	9.0	-	330.4	126.8	247.9	171.0	23.0						
Civil & Architecture Engineering	8.3	21.5	65.7	11.9	18.0	31.8	34.7	1.0	222.6	132.9	103.2	232.0	5.0	1.0	-	-	-	249.8	186.1	203.6	232.0	17.9						
Computer Engineering	128.8	767.4	1,798.1	114.1	8.2	22.0	45.6	0.8	154.6	40.2	70.7	259.0	0.4	-	-	-	-	291.6	829.6	1,914.4	259.0	115.3						
Electrical & Electronics Engineering	475.2	1,913.2	4,108.1	499.4	58.4	173.2	262.2	52.8	240.9	72.9	90.7	311.0	5.1	116.0	24.0	62.0	22.0	890.5	2,183.3	4,523.0	311.0	579.3						
Environmental Engineering	13.2	34.7	75.7	21.0	3.5	12.5	20.6	0.3	100.2	21.2	22.7	133.0	2.0	6.0	2.0	-	-	123.0	70.5	119.0	133.0	23.3						
Infocommunication & Media Technology	125.0	429.5	957.7	165.5	1.5	20.3	43.7	0.1	132.5	71.0	94.8	258.0	5.3	134.0	76.0	36.0	-	393.0	596.8	1,132.2	258.0	171.0						
Marine Engineering	23.0	60.0	194.1	31.0	-	4.0	-	-	5.7	4.8	6.7	9.0	1.0	7.0	-	-	-	35.7	68.8	200.8	9.0	32.0						
Material Sciences & Chemical Engineering	157.1	177.0	406.3	81.1	4.0	15.4	5.8	3.2	259.8	43.2	72.7	373.0	5.4	255.4	37.0	63.0	10.0	676.3	272.6	547.8	373.0	99.8						
Mechanical Engineering	102.8	461.9	1,411.3	325.4	12.8	76.4	78.8	17.8	123.8	40.6	46.2	212.0	2.6	223.0	100.0	152.0	-	462.3	678.9	1,688.3	212.0	345.8						
Metallurgy & Metal Engineering	11.0	17.2	38.0	9.6	-	-	-	-	17.4	2.7	4.3	18.0	0.2	8.0	-	-	-	36.4	19.9	42.2	18.0	9.8						
Natural Sciences (excluding Biological Sciences)	222.5	635.4	1,346.3	187.8	57.6	118.0	158.0	1.8	823.9	150.2	270.1	907.0	3.6	266.2	70.2	60.1	8.2	1,370.2	973.9	1,834.5	907.0	201.4						
Chemical Sciences	127.1	141.0	304.8	80.2	9.6	7.4	22.6	-	180.9	13.8	31.5	294.0	1.2	55.0	6.0	24.1	7.1	372.6	168.2	383.0	294.0	88.4						
Computer & Related Sciences	67.5	457.4	990.9	85.3	18.6	64.6	91.4	1.8	114.7	35.2	72.8	181.0	1.3	156.2	58.2	30.0	1.1	357.0	615.4	1,185.0	181.0	89.5						
Earth & Related Environmental Sciences	17.0	15.0	27.5	19.0	14.0	6.0	5.0	-	155.6	53.9	70.4	97.0	0.8	-	-	-	-	186.6	74.9	102.9	97.0	19.8						
Physical Sciences & Mathematics	10.9	22.1	23.2	3.3	15.4	40.0	39.0	-	372.7	47.3	95.5	335.0	0.5	55.0	6.0	6.0	-	453.9	115.4	163.7	335.0	3.7						
Energy	22.0	40.6	48.7	0.9	-	-	-	-	174.5	28.6	36.7	311.0	0.6	-	-	-	0.1	196.5	69.2	85.4	311.0	1.6						
Other Areas	11.0	80.0	157.2	44.5	10.6	16.4	24.0	4.8	643.4	273.3	538.0	466.0	23.4	12.0	-	5.0	-	677.0	369.7	724.2	466.0	72.7						
Total	1,766.2	5,069.7	11,731.2	1,639.6	483.7	703.0	1,182.6	131.6	4,685.8	1,292.8	2,196.7	4,955.0	85.0	1,900.7	473.0	901.8	74.0	8,836.4	7,538.6	16,012.3	4,955.0	1,930.2						

**Table 2.2 Private Sector Researchers by Enterprise Ownership/Size and Field of Science & Technology**

Field of Science & Technology	Local SMEs				Local LEs				Foreign Companies				Total			
	PhD	Master	Bachelor	Non-Degree	PhD	Master	Bachelor	Non-Degree	PhD	Master	Bachelor	Non-Degree	PhD	Master	Bachelor	Non-Degree
Agricultural & Food Sciences	62	20	65	23	0	4	23	11	82	114	376	56	144	138	464	90
Agricultural Sciences	55	13	29	1	0	0	0	0	4	5	11	3	59	18	40	4
Food Sciences	7	7	36	22	0	4	23	11	78	109	365	53	85	120	424	86
Biomedical & Related Sciences	123	64	106	12	0	0	5	0	166	118	312	18	289	182	423	30
Basic Medicine	10	5	8	0	0	0	0	0	11	7	18	4	21	12	26	4
Biological Sciences	89	29	49	1	0	0	0	0	88	38	127	1	177	67	176	2
Clinical Medicine	7	8	5	2	0	0	0	0	4	10	14	0	11	18	19	2
Health Sciences	3	5	5	0	0	0	0	0	15	4	5	0	18	9	10	0
Pharmaceutical Sciences & Manufacturing	13	15	22	5	0	0	5	0	44	55	140	13	57	70	167	18
Other Related Biomedical Sciences	1	2	17	4	0	0	0	0	4	4	8	0	5	6	25	4
Engineering & Technology	242	651	1,658	319	91	630	1,843	284	815	2,878	6,244	801	1,148	4,159	9,745	1,404
Aeronautical Engineering	1	18	20	8	2	26	133	10	3	1	6	0	6	45	159	18
Biomedical Engineering	29	24	58	7	11	16	15	6	16	45	93	9	56	85	166	22
Civil & Architecture Engineering	5	10	48	8	8	9	43	16	4	8	4	0	17	27	95	24
Computer Engineering	39	112	262	24	4	143	294	15	90	531	1,284	78	133	786	1,840	117
Electrical & Electronics Engineering	53	188	473	71	41	278	702	124	393	1,501	3,051	324	487	1,967	4,226	519
Environmental Engineering	11	23	61	20	4	8	12	0	2	10	11	1	17	41	84	21
Infocommunication & Media Technology	31	123	346	38	3	23	49	5	97	303	618	126	131	449	1,013	169
Marine Engineering	11	46	121	13	0	9	71	18	13	9	5	0	24	64	197	31
Material Sciences & Chemical Engineering	38	34	102	33	9	23	70	7	112	127	252	44	159	184	424	84
Mechanical Engineering	24	73	165	93	8	91	436	82	75	328	894	213	107	492	1,495	388
Metallurgy & Metal Engineering	0	0	2	4	1	4	18	1	10	15	26	6	11	19	46	11
Natural Sciences (excluding Biological Sciences)	51	160	333	36	15	241	613	41	165	264	471	120	231	665	1,417	197
Chemical Sciences	13	24	51	11	1	5	9	4	114	117	271	68	128	146	331	83
Computer & Related Sciences	32	131	264	21	14	236	601	37	27	114	170	33	73	481	1,035	91
Earth & Related Environmental Sciences	1	3	9	1	0	0	0	0	16	12	18	18	17	15	27	19
Physical Sciences & Mathematics	5	2	9	3	0	0	3	0	8	21	12	1	13	23	24	4
Energy	8	14	25	1	0	3	7	7	14	26	24	0	22	43	56	8
Other Areas	4	14	27	1	0	30	9	29	7	37	132	15	11	81	168	45
Total	490	923	2,214	392	106	908	2,500	372	1,249	3,437	7,559	1,010	1,845	5,268	12,273	1,774



Table 2.3 R&amp;D Expenditure by Type of R&amp;D and Field of Science &amp; Technology

Field of Science & Technology	Private Sector			Government Sector			Institutes of Higher Learning			Public Research Institutes			Total		\$ million			
	Basic Research	Applied Research	Experimental Development	Pure Basic Research	Strategic Basic Research	Applied Research	Strategic Basic Research	Applied Research	Experimental Development	Pure Basic Research	Strategic Basic Research	Applied Research	Experimental Development					
Agricultural & Food Sciences	30.52	115.16	114.37	0.00	12.11	5.21	0.00	12.70	25.78	28.60	18.90	0.00	0.18	1.32	0.00	81.28	150.29	133.28
Agricultural Sciences	11.73	9.35	3.35	0.00	12.11	2.54	0.00	1.76	1.40	6.03	4.39	0.00	0.00	0.00	0.00	27.01	17.91	7.74
Food Sciences	18.79	105.81	111.02	0.00	0.00	2.68	0.00	10.93	24.37	22.57	14.51	0.00	0.18	1.32	0.00	54.27	132.37	125.54
Biomedical & Related Sciences	118.97	128.73	230.46	14.61	15.67	166.02	139.23	77.00	195.51	164.29	58.80	41.19	151.15	134.19	59.64	614.10	593.24	488.13
Basic Medicine	1.64	0.18	27.63	0.00	0.00	4.52	6.58	2.99	31.92	15.85	5.31	0.00	0.48	37.81	0.85	37.03	58.35	40.38
Biological Sciences	75.17	42.37	96.58	6.92	0.69	7.49	14.92	38.33	62.88	51.23	15.94	41.19	125.76	69.19	26.34	350.93	170.29	153.79
Clinical Medicine	7.15	27.36	5.37	0.00	9.15	117.23	67.93	10.82	49.99	48.91	19.45	0.00	9.44	4.70	31.99	86.56	198.20	124.75
Health Sciences	1.31	5.34	2.02	7.69	5.83	36.24	25.31	21.94	45.02	40.63	15.24	0.00	0.65	7.83	0.46	82.43	90.04	43.02
Pharmaceutical Sciences & Manufacturing	31.20	51.93	96.31	0.00	0.00	0.49	5.40	2.41	5.19	5.98	2.17	0.00	6.89	8.09	0.00	45.69	66.49	103.88
Other Related Biomedical Sciences	2.49	1.55	2.55	0.00	0.00	0.05	19.09	0.51	0.51	1.70	0.68	0.00	7.94	6.57	0.00	11.45	9.86	22.32
Engineering & Technology	623.64	1319.88	2257.38	0.33	0.28	75.19	531.35	81.58	170.64	170.35	71.69	5.48	30.81	260.34	166.09	912.77	1825.76	3026.52
Aeronautical Engineering	3.48	17.85	22.32	0.00	0.00	0.00	47.18	0.54	1.65	6.82	2.38	0.00	0.51	35.94	0.00	6.18	60.60	71.89
Biomedical Engineering	25.52	29.45	56.02	0.00	0.28	0.26	16.17	10.38	21.17	22.35	7.87	5.48	5.74	5.74	5.48	68.58	57.80	85.54
Civil & Architecture Engineering	2.25	7.80	7.96	0.00	0.00	14.52	16.41	5.12	39.82	29.54	10.92	0.00	0.09	0.09	0.00	47.28	51.94	35.30
Computer Engineering	46.17	306.50	232.97	0.00	0.00	6.74	46.12	13.89	24.24	9.22	4.23	0.00	0.00	0.00	0.00	84.30	322.46	283.32
Electrical & Electronics Engineering	449.84	545.08	1406.88	0.00	0.00	44.31	203.83	14.06	26.23	24.52	19.42	0.00	2.21	128.68	0.00	492.34	742.58	1630.13
Infocommunication & Media Technology	19.22	3.91	1.16	0.33	0.00	1.85	7.77	4.44	3.07	16.07	2.39	0.00	0.60	0.77	0.00	27.66	22.59	11.32
Electrical & Electronics Engineering	12.59	166.25	88.76	0.00	0.00	0.00	18.60	4.90	17.55	19.66	9.68	0.00	13.89	32.12	28.44	48.93	218.03	145.47
Marine Engineering	0.34	19.67	6.32	0.00	0.00	0.00	10.07	0.00	0.78	3.10	0.00	0.00	0.60	0.60	0.00	1.72	23.37	16.39
Material Sciences & Chemical Engineering	34.04	45.01	138.64	0.00	0.00	4.87	0.53	19.03	24.85	19.02	6.21	0.00	3.87	27.01	64.48	81.79	95.90	209.87
Mechanical Engineering	29.84	174.54	277.54	0.00	0.00	2.64	164.65	7.47	11.15	18.14	8.45	0.00	2.64	28.74	67.69	51.09	224.07	518.33
Metallurgy & Metal Engineering	0.35	3.83	18.82	0.00	0.00	0.00	0.00	1.74	0.13	1.93	0.13	0.00	0.68	0.68	0.00	2.90	6.43	18.95
Natural Sciences (excluding Biological Sciences)	207.86	120.94	255.10	0.00	0.00	27.61	59.25	58.03	107.63	72.77	33.05	0.00	19.13	47.17	3.30	392.66	268.49	350.70
Chemical Sciences	118.63	63.27	47.73	0.00	0.00	15.54	9.60	4.37	13.76	15.93	4.29	0.00	4.64	16.70	0.00	141.40	111.43	61.61
Computer & Related Sciences	83.04	47.41	195.71	0.00	0.00	1.06	39.35	5.87	11.47	11.97	12.26	0.00	11.68	13.04	3.30	112.06	73.48	250.62
Earth & Related Environmental Sciences	2.69	6.42	2.17	0.00	0.00	0.00	6.34	26.65	32.16	16.58	11.10	0.00	0.00	0.00	0.00	61.50	23.00	19.62
Physical Sciences & Mathematics	3.50	3.84	9.49	0.00	0.00	11.01	3.97	21.14	50.24	28.29	5.40	0.00	2.81	17.43	0.00	77.69	60.58	18.86
Energy	4.45	17.82	4.29	0.00	0.00	0.00	0.00	9.08	10.71	18.56	7.89	0.00	0.00	0.00	0.04	24.24	36.37	12.22
Other Areas	32.32	39.91	16.57	0.00	0.00	0.00	22.30	29.77	123.73	69.09	35.15	0.00	1.53	1.36	0.00	187.35	110.37	74.02
Total	1017.77	1742.44	2878.19	14.94	28.07	274.03	752.14	268.15	634.00	523.66	225.48	46.67	202.81	444.38	229.07	2212.40	2984.51	4084.87

Table 2.4 Private Sector R&amp;D Expenditure by Enterprise Ownership/Size, Type of R&amp;D and Field of Science &amp; Technology

Field of Science & Technology	Local SMEs			Local LEs			Foreign Companies			Total	\$ million	
	Basic Research	Applied Research	Experimental Development	Basic Research	Applied Research	Experimental Development	Basic Research	Applied Research	Experimental Development			
Agricultural & Food Sciences	12.93	8.88	7.02	0.00	2.85	1.66	17.59	103.42	105.69	30.52	115.16	114.37
Agricultural Sciences	11.73	6.80	2.26	0.00	0.00	0.00	0.00	2.55	1.09	11.73	9.35	3.35
Food Sciences	1.20	2.09	4.76	0.00	2.85	1.66	17.59	100.87	104.60	18.79	105.81	111.02
Biomedical & Related Sciences	65.17	17.44	65.04	0.00	0.00	0.19	53.81	111.29	165.24	118.97	128.73	230.46
Basic Medicine	1.64	0.18	0.33	0.00	0.00	0.00	0.00	0.00	27.30	1.64	0.18	27.63
Biological Sciences	61.73	6.65	6.93	0.00	0.00	0.00	13.44	35.72	89.66	75.17	42.37	96.58
Clinical Medicine	0.30	6.78	0.89	0.00	0.00	0.00	6.85	20.58	4.48	7.15	27.36	5.37
Health Sciences	0.60	0.39	0.32	0.00	0.00	0.00	0.71	4.95	1.70	1.31	5.34	2.02
Pharmaceutical Sciences & Manufacturing	0.70	2.45	54.91	0.00	0.00	0.19	30.51	49.48	41.21	31.20	51.93	96.31
Other Related Biomedical Sciences	0.20	1.00	1.65	0.00	0.00	0.00	2.29	0.55	0.90	2.49	1.55	2.55
Engineering & Technology	65.99	121.82	273.73	32.77	319.74	254.22	524.88	878.32	1729.43	623.64	1319.88	2257.38
Aeronautical Engineering	0.73	1.58	2.26	2.47	14.96	18.14	0.28	1.30	1.93	3.48	17.85	22.32
Biomedical Engineering	18.37	5.45	12.25	3.82	7.56	3.22	3.33	16.44	40.55	25.52	29.45	56.02
Civil & Architecture Engineering	0.44	3.36	1.29	0.00	4.24	2.55	1.81	0.20	4.12	2.25	7.80	7.96
Computer Engineering	10.19	17.66	46.06	0.75	10.60	35.55	35.22	278.24	151.36	46.17	306.50	232.97
Electrical & Electronics Engineering	2.07	16.87	125.62	15.66	175.75	163.41	432.11	352.46	1117.85	449.84	545.08	1406.88
Environmental Engineering	19.22	0.77	0.95	0.00	2.48	0.12	0.00	0.66	0.10	19.22	3.91	1.16
Infocommunication & Media Technology	5.19	45.73	14.57	0.18	5.54	6.68	7.22	114.98	67.51	12.59	166.25	88.76
Marine Engineering	0.20	14.98	5.86	0.03	2.83	0.00	0.11	1.86	0.46	0.34	19.67	6.32
Material Sciences & Chemical Engineering	5.63	7.94	20.03	1.15	9.56	10.46	27.26	27.51	108.15	34.04	45.01	138.64
Mechanical Engineering	3.83	7.45	43.81	8.70	85.10	9.50	17.31	82.00	224.23	29.84	174.54	277.54
Metallurgy & Metal Engineering	0.11	0.04	1.04	0.00	1.12	4.61	0.24	2.67	13.17	0.35	3.83	18.82
Natural Sciences (excluding Biological Sciences)	13.99	17.92	31.27	64.19	19.07	29.10	129.68	83.94	194.73	207.86	120.94	255.10
Chemical Sciences	2.51	1.70	4.38	0.40	7.14	1.28	115.71	54.42	42.08	118.63	63.27	47.73
Computer & Related Sciences	8.44	12.44	25.06	63.76	11.71	27.60	10.84	23.26	143.05	83.04	47.41	195.71
Earth & Related Environmental Sciences	0.53	3.52	0.00	0.00	0.00	0.00	2.17	2.89	2.17	2.69	6.42	2.17
Physical Sciences & Mathematics	2.51	0.26	1.83	0.03	0.22	0.23	0.96	3.37	7.44	3.50	3.84	9.49
Energy	3.90	7.18	0.08	0.00	0.14	0.82	0.55	10.50	3.39	4.45	17.82	4.29
Other Areas	0.45	2.91	7.75	0.00	9.94	0.36	31.87	27.06	8.47	32.32	39.91	16.57
Total	162.43	176.16	384.89	96.96	351.74	286.34	758.38	1214.54	2206.95	1017.77	1742.44	2878.19

**Table 3.1 Private Sector R&D Expenditure as Percentage of Total Sales Revenue by Enterprise Ownership/Size and Industrial Classification**

Industrial Classification	Local SMEs				Local LEs				Foreign Companies				Total	\$ million
	R&D Expenditure	Total Sales Revenue	R&D Expenditure as % of Total Sales Revenue		R&D Expenditure	Total Sales Revenue	R&D Expenditure as % of Total Sales Revenue		R&D Expenditure	Total Sales Revenue	R&D Expenditure as % of Total Sales Revenue			
Primary Industries & Construction	27.19	411.93	6.60%		8.76	1,119.51	0.78%		1.17	195.98	0.60%		37.12	1,727.43
Agriculture & Fishing	0.19	45.45	0.41%		-	-	-		-	-	-		0.19	45.45
Mining, Quarrying, Energy & Water	19.41	187.92	10.33%		3.51	715.12	0.49%		-	-	-		22.92	903.04
Construction	7.59	178.56	4.25%		5.24	407.40	1.30%		1.17	195.98	0.60%		14.01	778.94
Manufacturing	179.92	2,680.13	6.71%		303.40	39,377.70	0.76%		2,239.83	132,554.58	1.69%		2,723.15	174,972.42
Biomedical Manufacturing	11.68	39.38	29.66%		0.19	166.46	0.11%		154.16	16,759.73	0.92%		166.02	16,965.57
Medical Technology	10.74	38.19	28.13%		-	-	-		111.01	5,237.73	2.12%		121.75	5,275.92
Pharmaceuticals	0.94	1.19	78.62%		0.19	166.46	0.11%		43.15	11,522.00	0.37%		44.27	11,689.65
Chemicals	4.20	339.05	1.24%		12.20	7,905.26	0.15%		281.15	9,869.59	2.85%		297.56	18,113.91
Petrochemicals	0.56	90.96	0.62%		5.12	6,537.47	0.08%		4.10	551.39	0.74%		9.78	7,179.82
Petroleum	0.06	64.40	0.10%		-	-	-		0.54	18.92	2.84%		0.60	83.32
Specialties	2.23	128.61	1.73%		7.08	1,367.79	0.52%		41.40	2,026.57	2.04%		50.71	3,522.98
Other Chemicals	1.35	55.07	2.45%		-	-	-		235.12	7,272.72	3.23%		236.47	7,327.79
Electronics	48.03	946.75	5.07%		82.38	21,273.70	0.39%		1,350.62	86,925.90	1.55%		1,481.04	109,146.35
Computer Peripherals	0.41	11.44	3.62%		0.63	140.33	0.45%		71.44	10,866.21	0.66%		72.49	11,077.98
Data Storage	-	-	-		0.20	11,333.22	0.00%		23.64	380.29	6.22%		23.84	11,713.51
Electronics Modules & Components	0.89	11.83	7.56%		-	-	-		64.46	1,408.94	4.57%		65.35	1,420.77
Infocomms & Consumer Electronics	5.61	52.31	10.73%		63.73	9,220.35	0.69%		43.71	546.50	8.00%		113.05	9,819.15
Semiconductor	41.11	871.17	4.72%		17.83	579.80	3.07%		1,147.37	73,723.97	1.56%		1,206.31	75,174.94
Precision Engineering	99.13	887.48	11.17%		98.38	2,915.85	3.37%		277.78	9,150.48	3.04%		475.29	12,953.81
Machinery & Systems	72.42	282.46	25.64%		42.25	1,595.83	2.65%		238.58	7,541.28	3.16%		353.24	9,419.58
Precision Modules & Components	26.71	605.02	4.41%		56.14	1,320.02	4.25%		39.20	1,609.20	2.44%		122.05	3,534.24
Transport Engineering	5.74	147.18	3.90%		103.64	6,905.10	1.70%		78.94	3,266.22	2.42%		188.32	9,508.50
Aerospace	0.83	6.88	12.09%		35.15	4,915.21	0.72%		43.97	848.41	5.18%		79.96	5,770.50
Land	0.01	5.00	0.12%		65.88	713.08	9.24%		5.60	587.24	0.95%		71.48	1,306.32
Marine & Offshore Engineering	4.90	135.30	3.62%		2.61	466.81	0.56%		29.36	1,830.57	1.60%		36.87	2,432.68
General Manufacturing	11.14	320.29	3.48%		6.60	1,381.33	0.48%		97.18	6,582.66	1.48%		114.92	8,284.29
Food, Beverage & Tobacco	1.35	176.03	0.77%		4.51	908.88	0.50%		69.46	3,276.17	2.12%		75.32	4,361.08
Printing & Recorded Media	0.06	2.17	2.71%		-	-	-		-	-	-		0.06	2.17
Other Mfg Industries	9.73	142.09	6.85%		2.09	472.46	0.44%		27.72	3,306.49	0.84%		39.54	3,921.04
Services	516.36	4,694.31	11.00%		422.89	37,644.81	1.12%		1,938.87	163,551.24	1.19%		2,878.12	205,890.36
R&D	247.71	100.83	245.67%		-	-	-		639.38	770.54	82.98%		887.09	871.36
Biotechnology, Life, Medical Science	146.30	50.94	287.22%		-	-	-		235.97	207.85	113.53%		382.27	258.79
Chemicals	39.64	8.54	464.40%		-	-	-		8.02	15.54	51.62%		47.66	24.08
Electronics	35.10	20.21	173.72%		-	-	-		318.99	447.80	71.23%		354.09	468.01
Engineering	13.29	5.83	227.78%		-	-	-		7.43	8.08	91.91%		20.71	13.91
Environment & Clean Technologies	4.79	3.65	131.16%		-	-	-		7.28	4.55	160.14%		12.07	8.20
IT	8.12	11.17	72.68%		-	-	-		13.16	38.69	34.01%		21.28	49.86
Other Natural Sciences	0.47	0.49	95.54%		-	-	-		48.53	48.02	101.05%		49.00	48.52
Financial Intermediation & Other Business Activities	97.96	1,819.43	5.38%		287.48	28,385.11	1.01%		222.68	14,061.25	1.58%		608.13	44,265.80
Engineering, Scientific & Technical Activities	13.33	169.64	7.86%		94.95	390.97	24.29%		40.24	697.68	5.77%		148.53	1,258.29
Finance & Insurance	28.52	90.03	31.68%		67.81	15,952.29	0.43%		13.02	1,530.74	0.85%		109.35	17,573.05
Other Business Activities	56.10	1,559.76	3.60%		124.73	12,041.86	1.04%		169.42	11,832.84	1.43%		350.25	25,434.46
Education, Health & Social Services	3.04	17.00	17.88%		-	-	-		6.19	13.52	45.81%		9.23	30.51
Information & Communications	95.06	466.86	20.36%		1.66	300.89	0.55%		247.00	2,356.12	10.48%		343.73	3,123.87
Logistics	0.10	2.56	3.71%		7.61	2,710.00	0.28%		10.29	721.41	1.43%		18.00	3,433.97
Wholesale & Retail Trade	66.96	2,116.31	3.16%		126.13	6,248.81	2.02%		812.55	145,551.47	0.56%		1,005.65	165,916.68
Other Services	5.54	171.33	3.23%		-	-	-		0.77	76.94	1.00%		6.31	248.27
Total	723.47	7,786.38	9.29%		735.04	78,502.03	0.94%		4,179.87	296,301.81	1.41%		5,638.39	382,590.21

**Table 3.2 Private Sector Patenting Indicators by Enterprise Ownership/Size and Industrial Classification**

Industrial Classification	Local SMEs			Local LEs			Foreign Companies			Total	
	Patents Applied	Patents Awarded	Patents Owned	Patents Applied	Patents Awarded	Patents Owned	Patents Applied	Patents Awarded	Patents Owned	Patents Applied	Patents Owned
Primary Industries & Construction	12	4	13	2	0	4	0	0	0	14	4
Agriculture & Fishing	0	0	0	0	0	0	0	0	0	0	0
Mining, Quarrying, Energy & Water	1	1	1	2	0	4	0	0	0	3	1
Construction	11	3	12	0	0	0	0	0	0	11	3
Manufacturing	75	54	462	42	90	955	305	247	3,320	422	391
Biomedical Manufacturing	13	2	90	0	0	0	16	9	351	29	11
Medical Technology	13	2	90	0	0	0	16	9	351	29	11
Pharmaceuticals	0	0	0	0	0	0	0	0	0	0	0
Chemicals	0	0	0	0	0	1	4	0	14	4	0
Petrochemicals	0	0	0	0	0	1	4	0	0	4	0
Petroleum	0	0	0	0	0	0	0	0	0	0	0
Specialties	0	0	0	0	0	0	0	0	14	0	14
Other Chemicals	0	0	0	0	0	0	0	0	0	0	0
Electronics	9	5	42	34	67	834	182	177	1,566	225	249
Computer Peripherals	0	0	0	0	0	0	22	0	10	22	0
Data Storage	0	0	0	0	0	0	0	0	0	0	0
Electronics Modules & Components	0	0	0	0	0	0	5	0	0	5	0
Infocomms & Consumer Electronics	3	0	3	8	4	40	3	30	200	14	34
Semiconductor	6	5	39	26	63	794	152	147	1,356	184	215
Precision Engineering	39	40	209	0	0	0	40	18	1,269	79	58
Machinery & Systems	15	16	141	0	0	0	18	4	852	33	20
Precision Modules & Components	24	24	68	0	0	0	22	14	417	46	38
Transport Engineering	9	2	51	8	23	120	44	20	61	61	45
Aerospace	0	0	0	0	0	9	13	8	3	13	8
Land	0	0	0	7	23	110	9	9	58	16	32
Marine & Offshore Engineering	9	2	51	1	0	1	22	3	0	32	5
General Manufacturing	5	5	70	0	0	0	19	23	59	24	28
Food, Beverage & Tobacco	0	0	0	0	0	0	1	0	28	1	0
Printing & Recorded Media	0	0	0	0	0	0	0	0	0	0	0
Other Mfg Industries	5	5	70	0	0	0	18	23	31	23	28
Services	305	133	1,530	17	17	39	1,483	557	2,256	1,805	707
R&D	220	96	580	0	0	0	78	28	328	298	124
Biotechnology, Life, Medical Science	108	61	186	0	0	0	13	17	307	121	78
Chemicals	4	1	4	0	0	0	2	0	0	6	1
Electronics	79	24	276	0	0	0	22	10	20	101	34
Engineering	25	10	111	0	0	0	39	0	0	64	10
Environment & Clean Technologies	2	0	3	0	0	0	2	0	0	4	0
IT	2	0	0	0	0	0	0	1	1	2	1
Other Natural Sciences	0	0	0	0	0	0	0	0	0	0	0
Financial Intermediation & Other Business Activities	37	20	694	5	4	0	61	28	327	103	52
Engineering, Scientific & Technical Activities	3	14	148	0	0	0	14	10	56	17	24
Finance & Insurance	2	0	143	0	0	0	0	0	0	2	0
Other Business Activities	32	6	403	5	4	0	47	18	271	84	28
Education, Health & Social Services	5	1	1	0	0	0	0	0	0	5	1
Information & Communications	26	8	38	0	0	3	21	13	3	47	21
Logistics	0	0	0	1	0	0	0	0	0	1	0
Wholesale & Retail Trade	15	8	186	11	13	36	1,323	488	1,598	1,349	509
Other Services	2	0	31	0	0	0	0	0	0	2	0
Total	392	191	2,005	61	107	998	1,788	804	5,576	2,241	1,102
											8,579

Table 3.3 Private Sector Licensing Revenue from Patents and New Technologies Developed in Singapore and Sales Revenue from Commercialised Products/Processes Attributed to R&D Performed in Singapore by Enterprise Ownership/Size and Industrial Classification

Industrial Classification	Local SMEs			Local LEs			Foreign Companies			Total	\$ million
	Licensing Revenue	Sales Revenue	Licensing Revenue	Licensing Revenue	Sales Revenue	Licensing Revenue	Sales Revenue	Licensing Revenue			
Primary Industries & Construction	0.46	8.49	0.00	0.00	23.68	0.00	0.00	0.00	0.46	32.17	
Agriculture & Fishing	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	
Mining, Quarrying, Energy & Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Construction	0.46	8.10	0.00	0.00	23.68	0.00	0.00	0.00	0.46	31.78	
Manufacturing	9.96	325.53	221.54	11.06	3,188.65	237.05	20,629.57	24,143.75			
Biomedical Manufacturing	0.00	23.46	0.00	5.15	83.32	5.15	83.32	106.78			
Medical Technology	0.00	22.38	0.00	5.15	83.32	5.15	83.32	105.69			
Pharmaceuticals	0.00	1.08	0.00	0.00	0.00	0.00	0.00	1.08			
Chemicals	0.00	37.86	0.00	1,570.17	239.97	0.00	239.97	1,848.01			
Petrochemicals	0.00	0.00	0.00	1,570.17	36.86	0.00	36.86	1,607.03			
Petroleum	0.00	16.52	0.00	0.00	0.00	0.00	0.00	16.52			
Specialties	0.00	21.30	0.00	0.00	0.00	0.00	200.69	221.99			
Other Chemicals	0.00	0.04	0.00	0.00	0.00	0.00	2.43	2.46			
Electronics	0.13	103.25	0.00	5.91	389.63	6.05	18,653.90	19,146.77			
Computer Peripherals	0.00	0.00	0.00	0.00	0.00	2.97	0.00	0.00			
Data Storage	0.00	0.00	0.00	0.00	0.00	0.00	380.29	380.29			
Electronics Modules & Components	0.00	0.00	0.00	0.00	0.00	0.00	265.71	265.71			
Infocomms & Consumer Electronics	0.00	33.87	0.00	0.85	389.63	0.85	1.96	425.46			
Semiconductor	0.13	69.38	0.00	2.09	18,005.93	2.22	18,075.31				
Precision Engineering	9.82	106.08	0.01	0.00	0.00	9.82	1,245.48	1,351.56			
Machinery & Systems	9.42	70.95	0.01	0.00	981.05	9.42	1,052.00				
Precision Modules & Components	0.41	35.13	0.00	0.00	264.42	0.41	299.55				
Transport Engineering	0.00	10.02	0.00	0.00	344.64	0.00	0.00	1,424.01			
Aerospace	0.00	0.00	0.00	0.00	843.58	0.00	0.00	843.58			
Land	0.00	0.00	0.00	0.00	225.77	0.00	342.86	568.62			
Marine & Offshore Engineering	0.00	10.02	0.00	0.00	1.79	0.00	0.00	11.81			
General Manufacturing	0.00	44.86	221.53	0.00	159.51	216.04	62.27	266.63			
Food, Beverage & Tobacco	0.00	0.95	221.53	0.00	159.51	216.04	22.40	182.86			
Printing & Recorded Media	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Other Mfg Industries	0.00	43.90	0.00	0.00	0.00	0.00	39.87	83.77			
Services	11.42	311.23	0.00	19.22	357.55	30.65	6,925.27	7,594.05			
R&D	3.44	12.48	0.00	6.55	151.74	9.99	164.21				
Biotechnology, Life, Medical Science	3.31	8.51	0.00	2.70	79.10	6.01	87.61				
Chemicals	0.00	0.00	0.00	0.47	0.51	0.47	0.51	0.51			
Electronics	0.00	1.17	0.00	0.00	0.00	0.00	72.12	73.29			
Engineering	0.08	1.46	0.00	0.00	0.00	0.08	0.00	1.46			
Environment & Clean Technologies	0.05	0.00	0.00	0.00	0.00	0.05	0.00	0.00			
IT	0.00	1.34	0.00	0.03	0.00	0.03	0.00	1.34			
Other Natural Sciences	0.00	0.00	0.00	3.35	0.00	3.35	0.00	0.00			
Financial Intermediator & Other Business Activities	0.00	18.94	0.00	0.00	295.95	0.00	3,872.98	4,187.86			
Engineering, Scientific & Technical Activities	0.00	6.27	0.00	0.00	157.60	0.00	2.46	166.32			
Finance & Insurance	0.00	0.00	0.00	0.00	0.00	0.00	1.29	1.29			
Other Business Activities	0.00	12.67	0.00	0.00	138.36	0.00	3,869.22	4,020.25			
Education, Health & Social Services	0.00	0.00	0.00	0.08	0.00	0.08	0.00	0.00			
Information & Communications	7.98	86.98	0.00	12.48	1.10	20.47	36.30	124.38			
Logistics	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Wholesale & Retail Trade	0.00	154.76	0.00	0.11	2,864.26	0.11	3,079.52				
Other Services	0.00	38.08	0.00	0.00	0.00	0.00	0.00	38.08			
Total	21.84	645.25	221.54	30.28	27,554.84	268.16	31,769.97				

**Table 4.1 Private Sector Survey Respondents by Enterprise Ownership/Size and Industrial Classification**

Industrial Classification	Foreign Companies													Total
	Local SMEs	Local LEs	USA	Canada	UK	France	Germany	Netherlands	Italy	Japan	China (incl. HK)	Taiwan	Asean (excl. Spore)	Others
Primary Industries & Construction	21	3	0	0	0	0	0	0	0	2	0	0	0	1
Agriculture & Fishing	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Mining, Quarrying, Energy & Water	4	1	0	0	0	0	0	0	0	0	0	0	0	0
Construction	15	2	0	0	0	0	0	0	0	2	0	0	0	1
Manufacturing	136	33	32	1	9	2	7	13	1	30	7	5	2	23
Biomedical Manufacturing	16	1	4	0	3	0	1	2	0	2	2	0	0	5
Medical Technology	14	0	3	0	2	0	1	1	0	2	2	0	0	2
Pharmaceuticals	2	1	1	0	1	0	0	1	0	0	0	0	0	3
Chemicals	18	4	9	0	1	0	1	2	1	7	1	0	1	5
Petrochemicals	2	3	1	0	0	0	0	0	1	2	0	0	0	0
Petroleum	2	0	0	0	0	0	0	1	0	0	0	0	0	0
Specialties	7	1	6	0	1	0	1	1	0	5	1	0	1	1
Other Chemicals	7	0	2	0	0	0	0	0	0	0	0	0	0	4
Electronics	18	8	8	1	2	1	1	7	0	5	0	4	1	3
Computer Peripherals	2	1	0	0	0	0	0	1	0	1	0	0	0	0
Data Storage	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Electronics Modules & Components	4	0	2	0	0	0	0	0	0	3	0	0	0	0
Infocomms & Consumer Electronics	7	5	1	0	0	1	1	0	0	0	0	0	1	2
Semiconductor	5	1	5	1	2	0	0	6	0	0	0	4	0	1
Precision Engineering	49	5	8	0	0	0	3	2	0	9	4	1	0	5
Machinery & Systems	27	4	3	0	0	0	1	1	0	7	3	0	0	3
Precision Modules & Components	22	1	5	0	0	0	2	1	0	2	1	1	0	2
Transport Engineering	8	9	1	0	1	1	0	0	0	3	0	0	0	2
Aerospace	2	6	0	0	1	1	0	0	0	0	0	0	0	0
Land	1	2	0	0	0	0	0	0	0	2	0	0	0	0
Marine & Offshore Engineering	5	1	1	0	0	0	0	0	0	1	0	0	0	2
General Manufacturing	27	6	2	0	2	0	1	0	0	4	0	0	0	3
Food, Beverage & Tobacco	13	4	1	0	2	0	0	0	0	3	0	0	0	2
Printing & Recorded Media	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Mfg Industries	13	2	1	0	0	0	1	0	0	1	0	0	0	1
Services	311	15	31	1	10	9	13	20	1	39	12	3	5	59
R&D	107	0	15	0	1	1	2	2	0	11	5	0	2	16
Biotechnology, Life, Medical Science	48	0	4	0	0	0	1	0	0	6	1	0	1	7
Chemicals	5	0	1	0	0	0	0	0	0	1	0	0	0	1
Electronics	16	0	5	0	0	0	1	2	0	2	4	0	0	2
Engineering	17	0	1	0	0	0	0	0	0	0	0	0	1	4
Environment & Clean Technologies	10	0	0	0	1	1	0	0	0	0	0	0	0	1
IT	10	0	2	0	0	0	0	0	0	1	0	0	0	0
Other Natural Sciences	1	0	2	0	0	0	0	0	0	1	0	0	0	1
Financial Intermediation & Other Business Activities	52	7	4	0	1	2	2	3	0	7	2	1	0	7
Engineering, Scientific & Technical Activities	25	2	0	0	0	0	1	0	0	2	1	1	0	2
Finance & Insurance	8	3	1	0	0	1	1	0	0	1	0	0	0	1
Other Business Activities	19	2	3	0	1	1	0	3	0	4	1	0	0	4
Education, Health & Social Services	3	0	0	0	2	0	0	0	0	0	1	0	0	1
Information & Communications	91	2	7	0	2	2	2	1	0	1	2	0	1	13
Logistics	1	1	1	0	0	0	0	0	0	0	1	0	0	2
Wholesale & Retail Trade	48	5	4	1	3	4	7	14	1	20	1	2	1	20
Other Services	9	0	0	0	1	0	0	0	0	0	0	0	1	0
Total	468	51	63	2	19	11	20	33	2	71	19	8	7	83

Table 4.2 Private Sector Survey Respondents by Bands of R&D Expenditure and Industrial Classification

Industrial Classification	\$200,000 & below	\$200,001 - \$500,000	\$500,001 - \$1,000,000	\$1,000,001 - \$2,000,000	\$2,000,001 - \$5,000,000	\$5,000,001 - \$10,000,000	\$10,000,001 - \$15,000,000	\$15,000,001 - \$20,000,000	\$20,000,001 - \$30,000,000	\$30,000,001 & Above	Total
Primary Industries & Construction	14	3	4	1	4	0	0	1	0	0	27
Agriculture & Fishing	2	0	0	0	0	0	0	0	0	0	2
Mining, Quarrying, Energy & Water	1	2	0	0	1	0	0	1	0	0	5
Construction	11	1	4	1	3	0	0	0	0	0	20
Manufacturing	61	47	43	33	37	30	15	5	13	17	301
Biomedical Manufacturing	6	3	10	3	5	6	0	0	2	1	36
Medical Technology	5	2	8	2	3	5	0	0	1	1	27
Pharmaceuticals	1	1	2	1	2	1	0	0	1	0	9
Chemicals	9	13	9	6	6	2	1	1	2	1	50
Petrochemicals	1	2	2	2	2	0	0	0	0	0	9
Petroleum	2	0	1	0	0	0	0	0	0	0	3
Specialties	2	7	6	3	4	2	1	0	0	0	25
Other Chemicals	4	4	0	1	0	0	0	1	2	1	13
Electronics	7	5	4	3	6	11	4	4	5	10	59
Computer Peripherals	1	1	1	0	0	1	0	0	0	1	5
Data Storage	1	0	0	0	0	0	0	0	1	0	2
Electronics Modules & Components	2	2	0	0	2	1	1	0	0	1	9
Infocomms & Consumer Electronics	2	2	3	2	3	3	0	1	1	1	18
Semiconductor	1	0	0	1	1	6	3	3	3	7	25
Precision Engineering	16	20	9	12	11	9	5	0	1	3	86
Machinery & Systems	9	11	4	6	6	7	3	0	1	2	49
Precision Modules & Components	7	9	5	6	5	2	2	0	0	1	37
Transport Engineering	2	1	5	4	6	1	4	0	0	2	25
Aerospace	0	1	2	2	2	0	2	0	0	1	10
Land	2	0	0	0	1	1	0	0	0	1	5
Marine & Offshore Engineering	0	0	3	2	3	0	2	0	0	0	10
General Manufacturing	21	5	6	5	3	1	1	0	3	0	45
Food, Beverage & Tobacco	12	2	4	2	2	0	1	0	2	0	25
Printing & Recorded Media	1	0	0	0	0	0	0	0	0	0	1
Other Mfg Industries	8	3	2	3	1	1	0	0	1	0	19
Services	130	92	73	69	66	45	12	10	6	26	529
R&D	43	28	23	24	17	11	2	3	2	9	162
Biotechnology, Life, Medical Science	11	12	11	16	6	3	0	2	2	5	68
Chemicals	0	1	1	3	0	2	0	0	0	1	8
Electronics	12	4	5	0	2	4	2	1	0	2	32
Engineering	9	5	2	2	5	0	0	0	0	0	23
Environment & Clean Technologies	6	3	2	0	1	1	0	0	0	0	13
IT	5	1	2	2	2	1	0	0	0	0	13
Other Natural Sciences	0	2	0	1	1	0	0	0	0	1	5
Financial Intermediation & Other Business Activities	16	18	11	14	10	7	2	3	1	6	88
Engineering, Scientific & Technical Activities	9	9	4	4	5	1	0	1	0	1	34
Finance & Insurance	2	1	4	2	2	3	1	0	0	1	16
Other Business Activities	5	8	3	8	3	3	1	2	1	4	38
Education, Health & Social Services	1	2	1	2	0	1	0	0	0	0	7
Information & Communications	39	25	17	15	17	5	3	0	0	3	124
Logistics	2	0	1	1	0	2	0	0	0	0	6
Wholesale & Retail Trade	23	16	19	13	21	19	5	4	3	8	131
Other Services	6	3	1	0	1	0	0	0	0	0	11
Total	205	142	120	103	107	75	27	16	19	43	857



Table 4.3 Private Sector Survey Respondents by Bands of R&amp;D Expenditure and R&amp;D Manpower

No. of R&D Manpower	\$200,000 & below	\$200,001 - \$500,000	\$500,001 - \$1,000,000	\$1,000,001 - \$2,000,000	\$2,000,001 - \$5,000,000	\$5,000,001 - \$10,000,000	\$10,000,001 - \$15,000,000	\$15,000,001 - \$20,000,000	\$20,000,001 - \$30,000,000	\$30,000,001 & Above	Total
5 and Below	188	98	50	22	6	1	1	0	0	0	366
6 - 10	15	34	48	34	15	3	0	1	0	0	150
11 - 20	1	9	14	30	41	10	2	1	2	1	111
21 - 40	1	1	6	17	34	27	4	2	1	0	93
41 - 60	0	0	0	0	4	22	7	2	3	5	43
61 - 80	0	0	2	0	3	5	5	2	1	1	19
81 - 100	0	0	0	0	2	3	5	5	8	5	28
101 and Above	0	0	0	0	2	4	3	3	4	31	47
Total	205	142	120	103	107	75	27	16	19	43	857

Table 5.1 Time Series of Some Key Indicators

Year	RSEs	Private Sector RSEs	PhD RSEs	PG Students	RSEs per 10k Labour Force	RSEs + PG Students per 10k Labour Force	Total R&D Expenditure (\$m)	Private Sector R&D Expenditure (\$m)	Private Sector R&D Expenditure as % of Total R&D Expenditure	Total R&D Expenditure as % of GDP	Private Sector R&D Expenditure as % of GDP
1993	6,629	3,248	1,630	-	37.6	-	997.93	618.58	61.99%	1.02%	0.63%
1994	7,086	3,561	1,724	-	38.5	-	1,174.98	736.23	62.66%	1.04%	0.65%
1995	8,340	4,163	1,887	-	47.7	-	1,366.56	881.37	64.50%	1.10%	0.71%
1996	10,153	5,085	2,237	-	50.1	-	1,792.14	1,133.42	63.24%	1.32%	0.83%
1997	11,302	5,792	2,485	-	53.4	-	2,104.56	1,314.52	62.46%	1.42%	0.88%
1998	12,655	6,573	2,733	-	57.8	-	2,492.26	1,536.10	61.63%	1.74%	1.07%
1999	13,817	7,502	3,054	-	62.6	-	2,656.30	1,670.86	62.90%	1.82%	1.14%
2000	14,483	7,997	3,111	2,570	66.1	77.8	3,009.52	1,866.05	62.00%	1.82%	1.13%
2001	15,366	8,389	3,347	3,211	65.9	79.7	3,232.68	2,045.02	63.26%	2.01%	1.27%
2002	15,654	8,598	3,639	3,723	67.5	83.5	3,368.34	2,055.01	61.01%	2.03%	1.24%
2003	17,074	9,827	3,791	4,065	73.8	91.4	3,396.90	2,053.62	60.46%	2.00%	1.21%
2004	18,935	11,596	4,063	3,705	80.9	96.7	4,041.47	2,569.56	63.58%	2.08%	1.32%
2005	21,338	13,217	4,575	3,718	90.1	105.8	4,569.55	3,018.67	66.06%	2.15%	1.42%
2006	22,675	13,893	5,005	3,761	87.4	101.9	4,998.55	3,281.84	65.66%	2.12%	1.39%
2007	24,506	14,921	5,637	4,094	90.4	105.5	6,326.26	4,222.16	66.74%	2.32%	1.55%
2008	25,744	15,348	6,147	4,605	87.6	103.2	7,113.55	5,105.46	71.77%	2.60%	1.86%
2009	26,608	15,068	6,751	5,295	87.8	105.3	6,012.86	3,694.61	61.45%	2.13%	1.31%
2010	28,296	15,640	7,477	5,760	90.2	108.6	6,315.21	3,773.80	59.76%	1.93%	1.15%
2011	29,480	16,535	7,752	5,990	91.1	109.6	7,275.60	4,456.43	61.25%	2.07%	1.27%
2012	30,105	16,492	8,365	5,924	89.6	107.2	7,078.13	4,249.28	60.03%	1.92%	1.15%
2013	31,924	17,598	9,109	6,012	92.7	110.2	7,402.40	4,333.18	58.54%	1.92%	1.13%
2014	32,816	18,026	9,648	5,800	92.9	109.4	8,316.61	5,006.89	60.20%	2.08%	1.26%
2015	34,972	18,816	10,299	5,862	96.9	113.1	9,239.47	5,511.94	59.66%	2.18%	1.30%
2016	35,289	18,736	10,603	5,734	96.1	111.7	9,140.22	5,340.95	58.43%	2.08%	1.21%
2017	35,389	18,650	10,540	5,367	96.8	111.3	9,061.55	5,386.13	59.44%	1.92%	1.14%
2018	36,246	19,386	10,472	4,955	98.6	112.1	9,281.79	5,638.39	60.75%	1.84%	1.12%

Table 5.1 - Time Series of Some Key Indicators (Continued)

Year	Patents Applied	Patents Awarded	Patents Owned	Licensing Revenue from Patents and New Technologies Developed in Singapore (\$m)	Sales Revenue from Commercialised Products/Processes Attributed to R&D Performed in Singapore (\$m)	Private Sector Survey Respondents	Labour Force <sup>1</sup> ('000)	GDP <sup>2</sup> (\$m)
1990	-	-	-	-	-	266	1562.8	70,492.3
1991	-	-	-	-	-	311	1673.7	78,542.8
1992	-	20	96	38.45	-	331	1733.6	84,920.2
1993	142	52	200	41.22	-	410	1,762.7	97,923.1
1994	263	58	204	52.80	-	427	1,842.2	112,555.4
1995	242	51	256	111.41	-	440	1,749.3	124,463.3
1996	316	91	614	27.34	6,381.02	496	2,024.9	135,777.2
1997	490	132	831	26.61	9,647.26	508	2,116.0	148,664.4
1998	579	136	847	50.97	13,369.92	571	2,187.9	143,474.9
1999	673	161	1,077	671.89	10,663.94	593	2,208.7	146,252.5
2000	774	239	1,268	74.63	15,577.77	539	2,192.3	165,632.4
2001	913	410	1,456	55.17	16,659.52	513	2,330.5	160,885.6
2002	936	451	1,739	87.50	11,445.60	519	2,320.6	165,698.1
2003	1,001	460	2,314	132.37	10,360.46	617	2,312.3	170,117.9
2004	1,257	599	2,570	82.70	12,068.56	765	2,341.9	194,433.0
2005	1,594	877	3,475	93.66	13,508.99	900	2,367.3	212,723
2006	2,036	933	4,717	139.15	25,678.32	897	2,594.1	236,159
2007	1,727	953	5,786	127.88	16,385.51	992	2,710.3	272,697.6
2008	1,581	730	5,455	42.43	21,548.76	887	2,939.9	273,941.6
2009	1,562	747	6,061	31.80	12,299.85	852	3,030.0	282,395
2010	1,762	653	5,450	34.69	10,908.47	798	3,135.9	326,980.1
2011	1,913	855	4,763	95.63	13,478.21	803	3,237.1	351,367.9
2012	1,722	817	5,048	1,358.06	21,297.28	696	3,361.8	368,770.5
2013	2,144	934	5,275	1,458.02	22,308.06	810	3,443.7	384,870.3
2014	1,965	911	6,579	475.60	25,237.34	881	3,530.8	398,947.9
2015	2,090	988	8,575	322.55	23,227.05	807	3,610.6	423,444.1
2016	1,997	988	11,534	298.45	29,318.35	773	3,672.8	440,218.2
2017	2,852	1,290	9,784	295.94	26,314.41	850	3,657.0	472,079.1
2018	2,896	1,356	10,114	280.76	31,806.21	857	3,675.6	503,395.2

<sup>1</sup>Source - Yearbook of Statistics 2019<sup>2</sup>Source - Singapore Department of Statistics: <https://www.tablebuilder.singstat.gov.sg/publicfacing/createDataTable.action?refId=16035> (Last updated 17 Mar 2020)

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