R&D survey best practice toolkit

Guidelines, best practices, and resources for conducting an R&D survey.

SCIENCE GRANTING COUNCILS INITIATIVE SGCI IOSRS INITIATIVE DES ORGANISMES SUBVENTIONNAIRES DE LA RECHERCHE SCIENTIFIQUE

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Evi-Pol
Enabling more effective use of evidence in policy and decision making by science granting councils

ACTS
HSRC Human Sciences Research Council
CeSTII Centre for Science, Technology & Innovation Indicators

Contents

Preface

The “Strengthening the Capacity of African Science Granting Councils in the Use of Data for Policy” project, commonly known as (Evi-Pol), has been instrumental in strengthening the capabilities of African science granting councils (SGCs) to review and draft national science, technology, and innovation (STI) policies, and manage STI data effectively. The second phase of this project, Evi-Pol II, initiated in May 2023, has further expanded on these objectives, with a particular focus on strengthening data management systems through supporting African SGCs to implement monitoring, evaluation and learning (MEL) plans, develop STI policies and their implementation plans; systematise data for policy through operationalising research and experimental development (R&D) data; deepen support for peer-learning among councils and; deepen gender, equality, and inclusion (GEI) considerations across the project.

The importance of conducting R&D surveys for African countries cannot be overstated. These surveys are critical for gathering valuable data that can inform STI policy decision-making. They provide insights into the current state of R&D and innovation within a country, highlighting areas of strength and identifying gaps that need to be addressed. This data is crucial for shaping policies that can foster a conducive environment for scientific research and technological innovation, thereby driving economic growth and social development. It provides a quantitative basis for formulating, implementing, and evaluating policies promoting STI. By tracking R&D expenditures, human resources, and outputs such as patents and publications, countries can assess their STI capabilities and identify areas of strength and weakness. This information can guide investment decisions, help to set national priorities and enable the monitoring of progress towards STI and sustainable development goals.

Moreover, measuring R&D can stimulate innovation by highlighting successful sectors or institutions, thereby encouraging others to emulate their practices. It can also facilitate international comparisons and benchmarking, helping countries to learn from each other’s experiences and to identify best practices. Furthermore, it can contribute to transparency and accountability, as it allows policymakers, researchers, and the public to see how resources are being used and what results are being achieved.

However, measuring R&D is not without challenges. It requires robust statistical systems, trained personnel, and a culture of data collection and use. Many African countries are still developing these capabilities. International cooperation and support, including through initiatives such as the African Science, Technology, and Innovation Indicators (ASTII) initiative, can play a vital role in this regard.

Measuring R&D is an essential tool for promoting STI policy development in African countries. It provides valuable insights into the functioning of STI systems, supports policy-making and implementation, stimulates innovation, facilitates learning, and enhances transparency and accountability. Despite the challenges involved, efforts to strengthen R&D measurement capacities in Africa should be a high priority for policymakers, researchers, and international partners alike.

This toolkit forms part of CeSTII’s broader efforts to build capabilities for African SGCs with limited resources to conduct R&D surveys. Recognising the challenges that these countries face, through this toolkit CeSTII aims to build on the ASTII R&D survey questionnaires and data table templates to provide the necessary support and resources to enable them to carry out these surveys effectively. To this end, CeSTII seeks to promote better data management practices within African SGCs, thereby enhancing their ability to make informed policy decisions based on robust and reliable data.

The Evi-Pol CeSTII team hereby wishes to offer our sincerest thanks to the CeSTII R&D Survey team for using their process documents that fed into the development of this toolkit. We further wish to express our sincerest thanks to the Ugandan National Council for Science and Technology (UNCST), the National Science and Technology Commission (NSTC) of Zambia, and the Direction Générale de la Recherche et de l’nnovation (DGRI) of Senegal for testing components of the toolkit during R&D survey training sessions hosted by CeSTII and to the reviewers for their valuable feedback during the production of this toolkit.

ABOUT THIS **TOOLKIT**

Why this toolkit?

Measuring Research and Development (R&D) impact is a key priority for African Science Granting Councils (SGCs) and science research institutes specifically to ensure efficient utilisation of resources and maximise the return on investment in R&D.

The South African National Survey of Research and Experimental Development (R&D survey) has been conducted annually since 2002 by the Human Science Research Council's Centre for Science, Technology and Innovation Indicators (CeSTII) on behalf of the Department of Science and Innovation (DSI). Over time we have developed specific strategies for conducting an R&D survey that we have captured in this toolkit.

The R&D survey toolkit empowers you to navigate an R&D survey process with confidence and contribute to shaping the future of national R&D.

MAIN AIM OF THIS TOOLKIT

Contains knowledge and tools needed to:

- **Execute the survey seamlessly:** Gain clear, step-by-step guidance to ensure smooth and efficient data collection.
- **Translate valuable data into impactful reports:** Use guidelines and insights to generate reports, fact sheets and policy briefs that drive informed decision-making.
- **Contribute to national R&D progress:** Your data plays a vital role in painting a vibrant picture of the R&D landscape, informing strategic national investments and fostering innovation.

What is this toolkit about?

This toolkit offers guidelines, best practices and resources developed by CeSTII to guide you through an R&D survey journey.

Who is this toolkit for?

This toolkit is designed specifically for staff responsible for implementing an R&D survey within their organisation. This includes individuals in various roles, such as survey managers, researchers, and fieldworkers.

Whether you are new to conducting R&D surveys or have previous experience, this toolkit provides the essential knowledge and guidance to conduct the survey, including communicating the results to inform strategic decision-making.

The toolkit is designed to be accessible and user-friendly to individuals with varying levels of R&D survey experience and expertise.

How to use this toolkit

The toolkit is designed to guide you through the process of conducting an R&D survey. It covers key aspects such as understanding an R&D survey and what it measures, an R&D survey lifecycle, what R&D is (and is not), R&D survey data governance, updating and maintaining an R&D survey register, data collection and analysis strategies, and communicating the survey results.

The toolkit also includes templates for confidentiality agreements, telephone scripts and emails, as well as for writing reports, policy briefs and fact sheets. These templates can be adapted to your specific needs and priorities.

Remember, this toolkit is designed to be a valuable companion throughout your R&D survey journey. We encourage you to explore its resources, seek clarification where needed, and actively participate in contributing to the national R&D landscape.

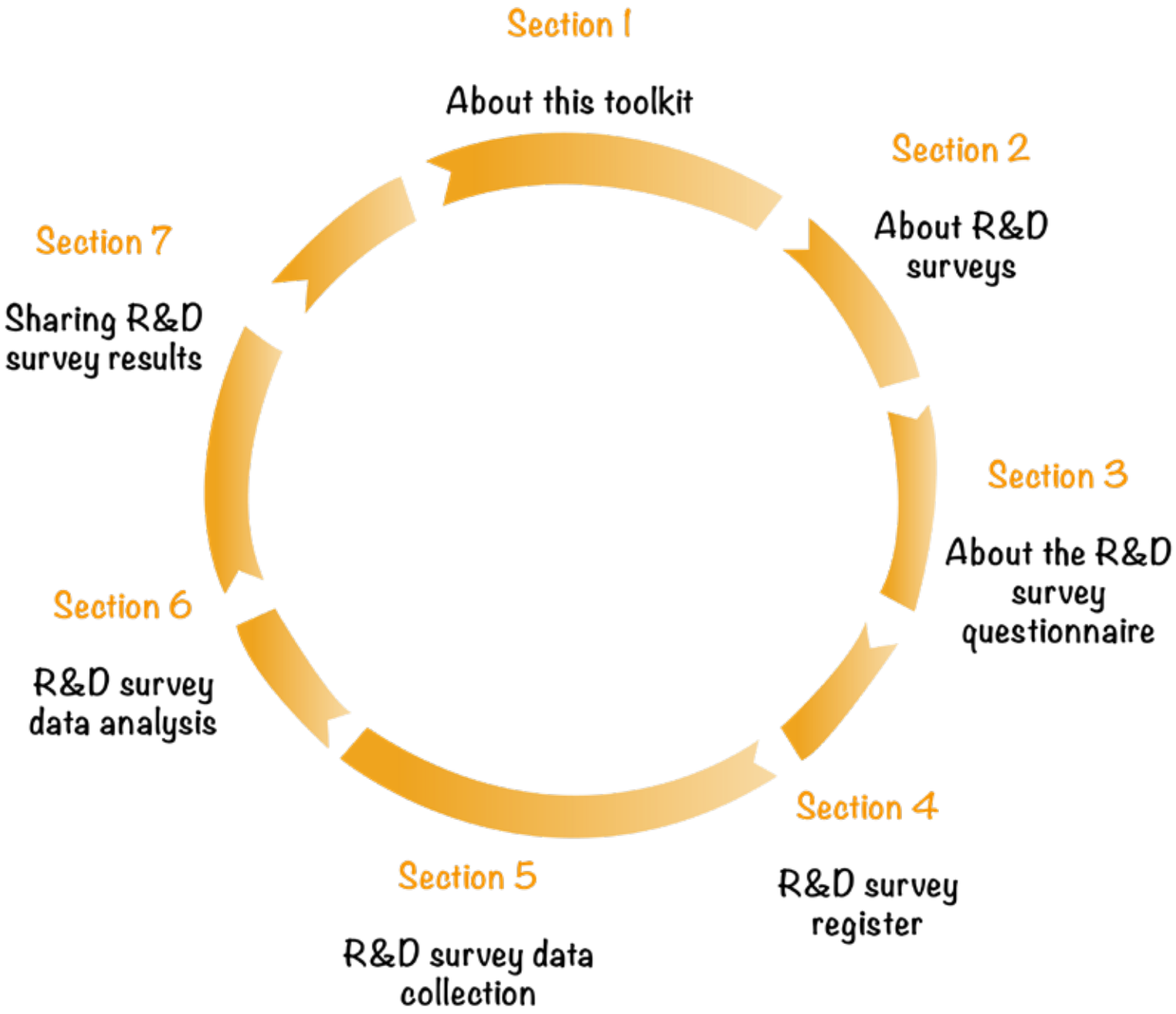

Figure 1
Overview of this toolkit

ABOUT
R&D SURVEYS

What is R&D?

R&D is the act of systematically creating new knowledge and applying it to improve our lives. The Frascati Manual offers a precise definition of R&D, which distinguishes it from other activities:

- **Research:** This involves creative and systematic exploration to acquire new knowledge across various domains, including humanity, culture, and society.
- **Experimental Development:** This entails the practical application of research findings to create or improve products, applications, or processes.

Why measure R&D?

R&D is not just about scientific exploration; it's a driving force for national progress. By measuring R&D, we gain valuable insights to:

1. **Fuel economic growth:** Studies show that increased R&D spending can lead to significant GDP growth over time.
2. **Create high-skilled jobs:** R&D-intensive industries generate employment opportunities in various sectors.
3. **Improve quality of life:** R&D advancements contribute to breakthroughs in healthcare, education, and sustainable development, benefiting society as a whole.
4. **Address global challenges:** R&D plays a crucial role in finding solutions to pressing issues like climate change and food security.
5. **Harness R&D potential:** Identify areas for improvement and optimise resource allocation for maximum impact.
6. **Benchmark competitiveness:** Compare a country's R&D performance with other countries to identify strengths and opportunities for collaboration.
7. **Optimise R&D systems:** Ensure efficient utilisation of resources and maximise the return on investment in R&D.

What is an R&D survey?

An R&D survey provides a comprehensive picture of Research and Development (R&D) expenditure across various institutional sectors. It gathers data from universities, science councils, government agencies, businesses, and non-profit organisations to track all R&D activities conducted within a country.

Data and statistics on R&D are crucial for policymakers and decision-makers. They help manage and allocate financial and human resources effectively by identifying which institutions or organisations are excelling and which need support, as well as the type of support required.

This data helps analysts understand why organizations need assistance and ensures that R&D activities align with national development goals in areas like manufacturing, energy, health, ICT, and agriculture. Additionally, it allows for the setting of long-term R&D investment targets at sector-specific, regional, or national levels, with a focus on R&D intensity.

OBJECTIVES OF AN R&D SURVEY

Investigate the financial expenditure in R&D.

Investigate the human resource investment in R&D.

Investigate the geographical allocation of financial and human resources within the country.

Help map the allocation of R&D investment into the types of R&D.

Help map the allocation of R&D investment into research fields and socio-economic objectives.

Help map the extramural (locally and abroad) allocation of financial resources for R&D.

CASE STUDY: THE SOUTH AFRICAN R&D SURVEY

The South African National Survey of Research and Experimental Development (R&D) has been conducted annually since 2002 by the Centre for Science, Technology and Innovation Indicators (CESTII) on behalf of the Department of Science and Innovation (DSI). This data adheres to international guidelines set by the OECD (Organisation for Economic Co-operation and Development) and is used for various purposes, including national planning, monitoring, and decision-making related to R&D.

Design and implementation of public policies and innovation strategies

- South Africa Ten Year Innovation Plan 2008-2018
- Department: Science & Technology (DST) Strategic Plan 2015-2020
- Revision of the White Paper on Science, Technology and Innovation (2017)
- Science, Technology and Innovation Decadal Plan 2022

Setting targets/ meeting government priorities

- GERD (Gross domestic expenditure on research and experimental development) as % of GDP (gross domestic product) to reach 1.5% by 2030
- Patents 2014-2018: More than R23 million in commercial revenue paid to over 270 intellectual property (IP) creators and enablers

Contribution to development efforts by providing information that would assist in translating the activities and outputs of STI

- National Planning Commission appointed by the President to advise on issues that impact on long-term development of South Africa.

Monitoring and evaluation, foresight studies and indicator research

- OECD Review of South Africa's National System of Innovation (NSI)
- DST Ministerial Review on the Science, Technology and Innovation Landscape in South Africa, 2012

Resource allocation

- Policy support instruments and incentives to stimulate Science, Technology and Innovation
- Private Sector R&D Tax Incentives
- The South African Research Chairs Initiative (SARChI)
- DSI-NRF Centres of Excellence

International comparisons

- South African R&D data submitted to the OECD (Organisation for Economic Co-operation and Development), New Partnership for Africa's Development (NEPAD), and United Nations Educational, Scientific and Cultural Organisation (UNESCO) for publication

Bespoke needs

- Data requests for specific needs from government departments: DSI, National Treasury, Department of Trade Industry and Competition (DTI), Department of Agriculture, Land Reform and Rural Development (DALRRD), National Advisory Council on Innovation (NACI)
- Individual stakeholders: Trade & Industrial Policy Strategies (TIPS), research programmes, students and academics

The main users of South African R&D data

National users of R&D data

- Department: Science & Innovation (DSI)
- National Treasury
- Department of Trade Industry and Competition (DTI)
- Department of Agriculture, Land Reform and Rural Development (DALRRD)
- National Advisory Council on Innovation (NACI)
- Media
- Universities
- Other national stakeholders including the private sector

International users of R&D data

- African Union Development Agency-NEPAD (AUDA-NEPAD)
- UNESCO
- OECD
- National Commission on Research, Science and Technology (NCRST)
- R&D survey data is submitted to various international bodies for publication including: UNESCO Institute of Statistics and AUDA-NEPAD African Innovation Outlook (AIO)
- Books, publications and requests for special analyses

Who completes an R&D survey?

An R&D survey may cover various institutional sectors, each playing a vital role in the R&D landscape. Here's an overview of the sectors that may be involved:

BENEFITS

- **Policy Impact:** Inform evidence-based policymaking for national R&D strategies and funding allocations.
- **Monitoring Progress:** Track the impact of R&D investments on national development goals and identify areas for further support.
- **Research Visibility:** Enhance the visibility and recognition of government-funded research initiatives, fostering collaboration and knowledge exchange.

BENEFITS

- **Strategic Planning:** Inform strategic planning efforts, guiding research priorities, resource allocation, and programs to address national challenges and promote scientific excellence.
- **Market Knowledge:** Gain insights on sector trends to adapt your R&D strategies and stay ahead of the curve.
- **Identify Emerging Trends:** Track the evolution of research focus and emerging areas of scientific inquiry, enabling proactive adjustments to support cutting-edge research.
- **Benchmarking & Insights:** Compare performance against peers, identify areas for improvement, and capitalise on trends.
- **Tax Incentives:** Participating in R&D activities may qualify for tax benefits, providing financial incentives for innovation.

BENEFITS

- **Research Funding Opportunities:** Strengthen the case for research funding allocation and attracting collaborations, enabling institutions to secure resources for research, infrastructure, and innovation projects.
- **Benchmarking & Collaboration:** Benchmark performance, identify areas for improvement, foster collaboration, and strengthen research capacity and impact.
- **Visibility & Recognition:** Showcase the institution's research strengths and contributions to the national R&D landscape.

BENEFITS

- **International Benchmarking:** Compare national R&D performance with other countries to identify areas for improvement and foster international collaboration.
- **Strategic Decision-Making:** Utilise data to optimise R&D investments, resource allocation, and strategic planning for increased innovation and competitiveness.
- **Policy Advocacy:** Contribute to shaping R&D policies that support business innovation and create a favorable environment for growth.

BENEFITS

- **Demonstrate Impact:** Quantify the value of R&D initiatives and their contributions to social challenges, attracting further support and partnerships.
- **Inform Advocacy Efforts:** Use data to advocate for policies that support R&D activities focused on social good and sustainable development.
- **Collaboration Opportunities:** Connect with other NGOs and stakeholders for knowledge sharing and collaboration on impactful projects.
- **Funding Opportunities:** Enhance visibility, increasing opportunities for funding, grants, and partnerships.

Figure 2
Overview of sectors

R&D survey lifecycle

An R&D survey lifecycle follows a well-defined process, ensuring the successful collection, analysis, and dissemination of valuable data. Here's a breakdown of the key stages involved:

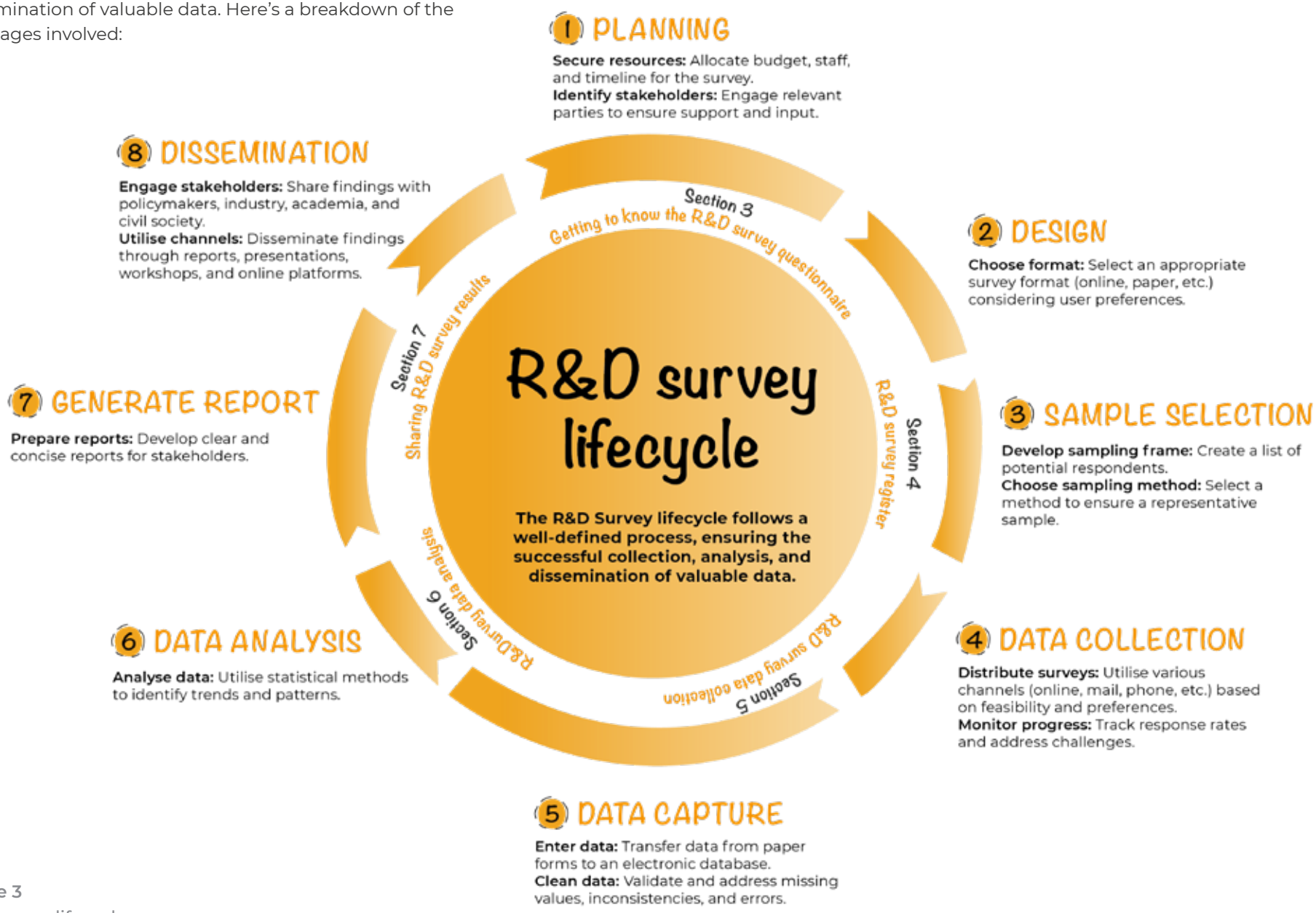

Figure 3
R&D survey lifecycle

The R&D survey team

The R&D survey team is a dedicated group of professionals working collaboratively to ensure the survey's success. Each member brings their expertise to various core areas:

- **Data Collection:** Gathering comprehensive data on R&D activities across sectors.
- **Analysis & Reporting:** Identifying trends, patterns, and areas for improvement in R&D investment and performance.
- **Stakeholder Engagement:** Promoting participation and collaboration from various stakeholders.
- **Quality Assurance:** Maintaining the accuracy, reliability, and integrity of survey data.
- **Policy Recommendations**: Providing evidence-based insights to inform R&D policy development and funding allocation.
- **Dissemination:** Sharing survey findings through various channels to foster knowledge sharing and informed decision-making.

Due to resource constraints, it may not always be possible to have separate individuals for each function. In such cases, it is crucial to consider the strengths and skills of the available team members when assigning roles. Depending on the resources available, the R&D survey team may be structured as follows:

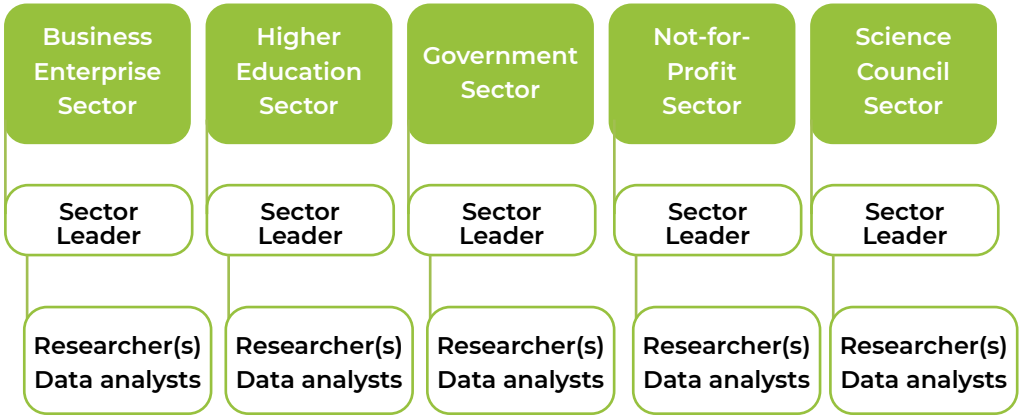

Figure 4
R&D survey team structure

By leveraging the specific strengths of your team members, you can effectively cover the essential areas of the R&D survey process, even with limited resources.

Here are some examples of how you might allocate roles based on individuals' skills:

1. **Data Collection:** Assign this task to researchers who have a strong background in inquiry and verification to ensure the accuracy of the data collected.
2. **Analysis & Reporting:** This should be handled by statisticians or data analysts who can identify trends and provide insightful interpretations of the data.
3. **Dissemination:** Choose someone with experience in media or communications to effectively share the survey findings with a wider audience.

What will the team look like in your context?
Take some time to make notes of what an R & D survey team willl look like in your context.

How will you need to adjust your planning for conducting an R&D survey depending on the size of your team? What will the team look like in your context?
For example, would you need to conduct a survey with fewer sectors?

What is R&D?

R&D is the act of systematically creating new knowledge and applying it to improve our lives. The Frascati Manual offers a precise definition of R&D, which distinguishes it from other activities:

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- **Experimental Development:** This entails the practical application of research findings to create or improve products, applications, or processes.

R&D endeavours should meet five essential criteria:

1. Novel: Aims for entirely new advancements in knowledge.
2. Creative: Explores new concepts and builds upon existing knowledge.
3. Uncertain: Inherently unpredictable outcomes, costs, and timelines.
4. Systematic: Conducted in a planned way with documented processes and dedicated resources, including records maintenance.
5. Transferable: Results should be shareable and replicable by others.

Types of R&D activities

1

Basic Research

Focuses on fundamental understanding without a specific application in mind. For example, investigating electrical conduction in crystals or studying a protein's structure.

2

Applied Research

Aims to solve specific problems or develop new applications, like using crystallography to improve alloys or developing new materials for low-energy cement production.

3

Experimental Development

Uses existing knowledge to create new or improved products or processes, like designing a new computer chip or an aircraft prototype.

WHAT ARE R&D ACTIVITIES?

- **Activities of personnel who are obviously engaged in R&D.** Include the involvement of individuals directly or indirectly supporting R&D efforts, for example professional, technical, administrative or technical support staff
- **Management activities:** Oversight of personnel engaged in R&D or providing support.
- **Software development:** When aimed at resolving scientific uncertainties systematically. For example:
  - the development of new operating systems or languages.
  - the design and implementation of new search engines based on original technologies.
  - the effort to resolve conflicts within hardware or software based on the process of re-engineering a system or a network.
  - the creation of new and original encryption or security techniques
- **Construction of unique algorithms.**
- **Research** work in the **natural sciences, engineering, medical sciences, agricultural sciences, social sciences and the humanities.**
- **Social science research** including economic, cultural, educational, psychological or sociological research.
- **R&D carried out as a participant in an unincorporated joint venture.**
- **Prototypes and pilot plants**, as long as the primary objective is to improve further.
- **R&D projects performed on contracts** for other legal entities, such as businesses.
- **Feedback R&D:** Addressing challenges arising beyond the initial R&D phase. For example, technical problems arising during the initial production run of a new product
- **Clinical trials stages 1, 2 and 3** count as R&D actvities.

WHAT ARE NOT R&D ACTIVITIES?

- **Scientific and technical information services:** collecting, coding, recording, classifying, disseminating, translating, analysing, and evaluating information, unless for R&D support or within R&D projects
- **Testing and standardisation:** routine testing and analysis of materials, components, products, processes, and maintenance of standards.
- **Feasibility studies:** investigations using existing techniques for additional information before implementation and socio-economic feasibility studies, except for research projects.
- **Specialised health care:** routine investigation and application of specialised medical knowledge.
- **Policy-related studies:** analysis and assessment of policies, programmes, and operations, along with policy advice, public relations, legal advice, and technical support.
- **Programmatic evaluations:** appraisals and evaluations supporting decision-making, typically outsourced or conducted by internal teams, which do not always meet R&D criteria.
- **Purely R&D-financing activities:** raising, managing, and distributing R&D grants by ministries, research agencies, foundations, or charities.
- **Indirect supporting activities:** transportation, storage, cleaning, repair, maintenance, security, and administrative activities not exclusively for R&D.
- **Pre-production activities**
- **General purpose or routine data collection**
- **Routine software-related activities:** development of business software and information systems using known methods and tools, adding functionality to existing programs, creating websites or software using existing tools, standard methods for encryption, security verification, data integrity testing, customising products without significantly improving the base program, and routine debugging unless done before the end of experimental development.

BORDERLINE R&D ACTIVITIES

The line between R&D and non-R&D can sometimes be blurry. For borderline activities, consider:

- Does it involve significant scientific or technological uncertainty?
- Does it aim to create new knowledge or improve existing knowledge?
- Does it have a systematic approach with documented processes?

Phase 4 clinical trials, which continue testing the drug or treatment after approval and manufacture:
- Include if they bring about further scientific or technological advances

Trial production activities can be split:
- Include if the production implies full-scale testing and subsequent further design and engineering
- Exclude all other associated activities

R&D and software development:
- Include when aimed at resolving scientific uncertainties systematically

Industrial engineering and tooling-up activities can be split:
- Include the “feedback” R&D and tooling-up industrial engineering in innovation processes
- Exclude production processes

After-sales service and troubleshooting:
- Include “feedback” to be included in R&D activities

Industrial design activities can be split:
- Include the design required during R&D in R&D activities
- Exclude the design for production processes

Pilot plants:
- Include as long as the primary objective is R&D

Patent and licence activities:
- Include if the patent work is connected directly with R&D projects

Tooling up, process development, design, and prototype construction:
- Include prototypes as long as the primary objective is to make future improvements

ABOUT THE
R&D SURVEY QUESTIONNAIRE

An R&D survey questionnaire is an instrument sent to R&D performing firms to collect information on their inhouse R&D activities.

An R&D survey questionnaire can be tailored to different sectors, for example:

- business enterprise
- government
- not-for-profit
- higher education
- science council sector

While each version addresses specific aspects relevant to the sector, they share common elements:

DO WE HAVE TO IMPLEMENT THE SURVEY FOR ALL SECTORS?

Your context and the resources you have available will guide you to decide which sector(s) to run the R&D survey for.

1. Survey purpose, scope, and deadline.
2. Contact information for assistance.
3. Clear definitions of R&D activities.
4. Guidance on completing questions and calculating metrics such as full-time equivalents (FTEs), in-house R&D expenditure, and extramural R&D expenditure.

TIP

Use the **example of the business sector survey questionnaire** to familiarise yourself with the questionnaire.

Sections in an R&D survey

The questionnaire is divided into five parts, covering various aspects of R&D activities:

General Information Data

- Organisation/ Institution/Unit Name
- Total Number of Employees
- In-house R&D Status (Yes/No)
- Additional Questions (Business Sector Only): Principal Activities, Ownership Split, Gross Sales Revenue Turnover

In-house R&D Personnel Data

- Headcounts, Qualifications, Fields of Science, Age Groups, Genders, and Nationalities of R&D Personnel
- Full-time Equivalent (FTEs) of R&D Personnel
- Average Annual Labour Cost per Person of R&D Personnel

In-house R&D Expenditure Data

- Labour cost of R&D
- Other current expenditures on R&D
- Capital expenditure on R&D
- Sources of funds for in-house R&D (this question is slightly different in the education questionnaire)
- Sources of funds percentage breakdown from the rest of the world

Categories of in-house R&D expenditure data

- Type of R&D (Basic, Applied, Experimental Development)
- Industrial Breakdown (Business Sector Only)
- Fields of Science R&D Classification with Percentages
- Socio-economic R&D Objectives Classification with Percentages
- Geographic Location of R&D Activities

Extramural R&D data

- Details of Extramural R&D locally and/or abroad

Figure 5
R&D survey Questionnaire Sections

CREATE AND MAINTAIN THE **R&D SURVEY REGISTER**

A representative and up-to-date R&D survey register is crucial for ensuring the quality, efficiency, and effectiveness of the survey process. Here's why:

1. **Data quality:** Targeting the right organisations minimises errors, duplication, and skewed data, leading to reliable insights.
2. **Efficiency:** Saves time and resources by avoiding rework due to inaccurate information or missing organisations.
3. **Effective Monitoring:** Enables accurate tracking of R&D trends and progress across sectors.

R&D survey register maintenance activities

Create the register

- Decide how the data will be stored, such as in a spreadsheet.
- Establish a comprehensive register to include all potential R&D performers using data from various sources.

Confirm R&D Status

- Regularly review the R&D status of organisations in the register.
- Mark organisations as "R&D active" or "likely R&D performers" to ensure that all organisations that are part of the sample for a specific survey cycle are confirmed R&D active or likely R&D performers.
- Where an organisation is confirmed to be out of scope or no longer an active R&D performer, mark this accordingly in the register and note the reasons.

Add new organisations

- Continuously identify new R&D performers through various sources like online searches, industry directories, and government databases.
- Regularly add newly identified organisations to the register.

Update contact details

- Regularly verify and update contact information for existing organisations.
- Update details upon confirmation from the organisation or respondent.

Figure 6
R&D survey Maintenance Activities

Methods to create and maintain an R&D survey register

Table 1 Methods to create and maintain an R&D survey register

Telephone	Email
• Fieldworkers contact organisations by telephone to verify R&D activities, collect information, and update details. • Some lists may have updated contact details while others require online searches for accurate information. • All verified information is updated and stored in the designated data management tools.	• Email communication is used to share information, request data, and obtain clarifications from respondents. • Draft an email template and then personalise emails with relevant organisational information. • Double-check email addresses and recipients to avoid errors and to assure the privacy and confidentiality of information. • Make sure all required supporting documentation is attached to the email • Consider email frequency to prevent respondent fatigue and maintain positive engagement levels.

BEFORE CONTACTING A NEW RESPONDENT

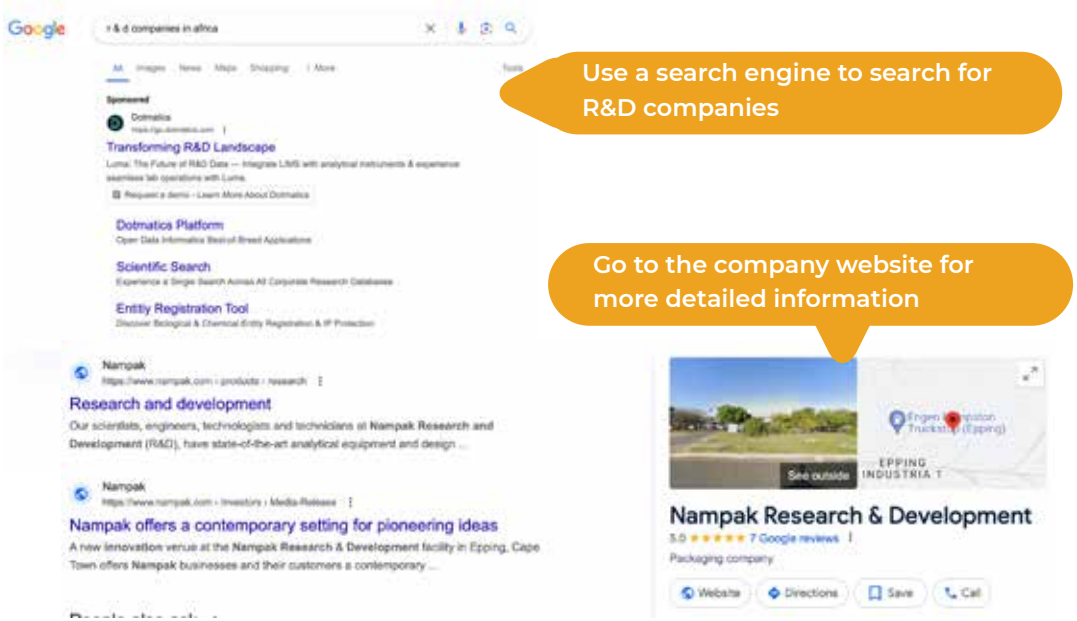
- **Research the organisation for enhanced cooperation:** Review their website, annual report and news articles to understand their mandate and values as well as any R&D projects and activities. Mentioning this to a respondent usually leaves a good impression and will likely make them more amenable to completing the survey.
- **Review internal data:** Check if the organisation is already on the register and review previous submissions and who responded.

Improving R&D survey coverage

Continuously identifying and adding new R&D performers is essential for comprehensive survey coverage. While known R&D performers are listed in survey registries, many organisations may not yet be identified and added. Public organisations are usually well-known and listed, thus requiring less systematic or continuous coverage improvement. However, NPOs and businesses primarily require this ongoing identification and addition.

Table 2 Strategies to improve survey coverage

Type	Tips and Resources
Search engines	Use targeted keywords: Use relevant keywords and phrases related to R&D activities, specific industries and technologies within your search queries.
	Use Boolean operators: Use operators like AND, OR, and NOT to refine your search and exclude irrelevant results.
Other resources	**Industry publications and reports:** Explore online publications, research reports and news articles focusing on specific sectors to identify potential R&D performers.
	Conference proceedings and event listings: Explore online databases and websites for upcoming conferences, workshops, and events related to R&D.
	Chambers of Commerce/ Industries, Trade and Professional associations
	Business directories and databases: Several commercial platforms like Brabys, Dun & Bradstreet, and Yellow Pages offer company listings with varying levels of detail. **In South Africa, the Companies and Intellectual Property Commission (CIPC)** maintains a database of registered companies in South Africa.
	Company annual reports and trade journals
	Media and social media
	Personal knowledge and observations



Updating a R&D survey register

Maintaining a high-quality R&D survey register requires careful consideration of which entities to include and exclude. Here are key guidelines to ensure its accuracy:

Adding New Entities

- Before adding new entries, exhaustively search the existing register with various search methods to establish if the organisation has already been added to the register.
- Check for full name variations (including punctuation, capitalisation, and acronyms).
- Check for partial names.

Verification

- Only add companies confirmed to be absent from the register.
- Table 3 contains inclusion and exclusion criteria to guide your updates to the R&D survey register.

Table 3 Inclusion and Exclusion criteria for the R&D Survey register

Inclusion criteria	Exclusion criteria
• **Large companies:** Include all large companies due to their potential for R&D activities and public visibility. • **Likely R&D performers:** Include companies with a reasonable possibility of conducting R&D, even if confirmation is pending. These companies are likely to be revisited. • **R&D survey relevant companies:** Selectively add companies from industry lists based on their potential relevance to an R&D survey.	• **R&D Irrelevant Subsidiaries:** Avoid including non-R&D subsidiaries of large companies. Instead, contact the head office of the company to inquire about the subsidiaries that are likely to conduct R&D and then only add relevant subsidiaries to the register. • **R&D Irrelevant Lists:** Carefully evaluate new company lists (e.g. Trade Association Member lists) before adding entries. Only include companies with a high likelihood of conducting R&D.

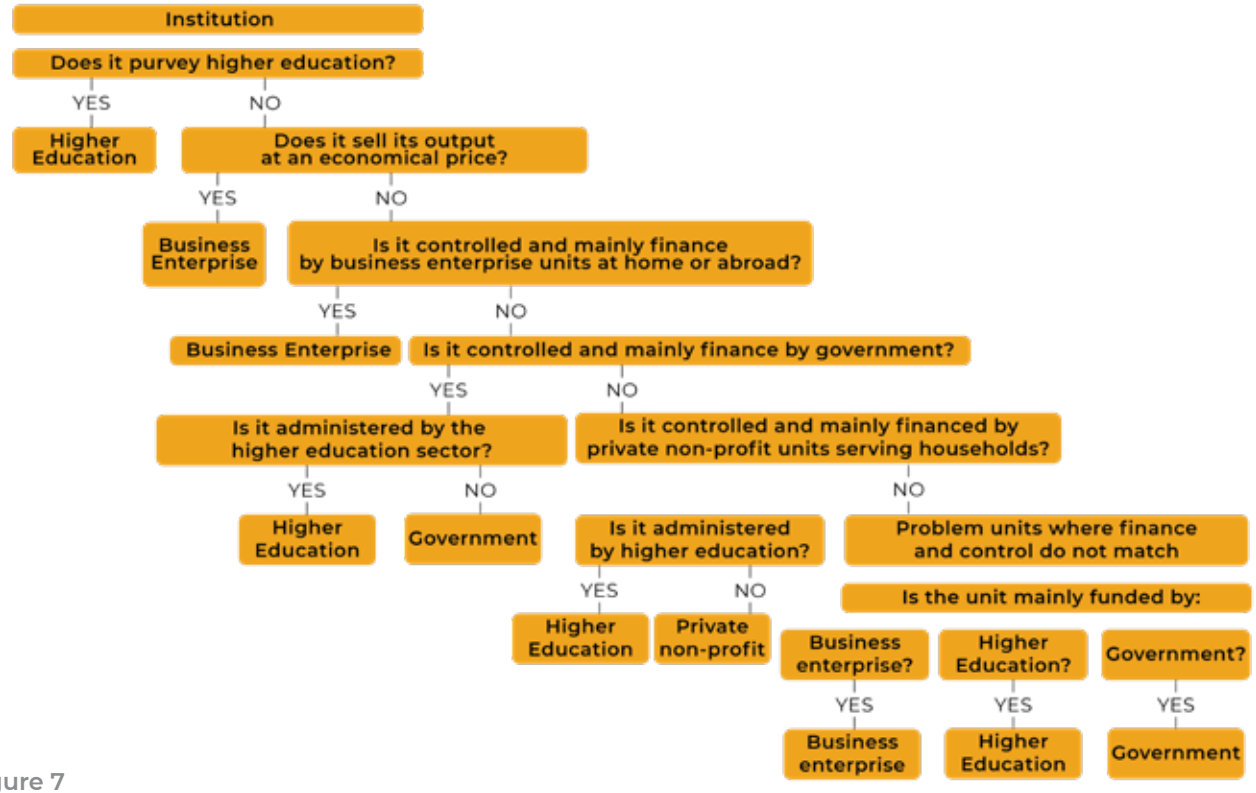


Figure 7
Decison Tree for Sectoring R&D Units. *Source: Frascati Manual (2015)*

R&D survey register naming conventions

Why are naming conventions important?

A

1. **Prevent duplicates:** Ensures consistent naming to avoid adding duplicate information.
2. **Improve search efficiency:** Enables staff to easily find organisations in the register.
3. **Maintain professionalism:** Presents a professional image to respondents and stakeholders.

Enhance data quality: Accurate naming facilitates efficient data management and analysis.

Coding and naming

- **Estimated Main Income SIC Code:** Assign a provisional code based on industry sector for efficient fieldwork assignment.
- **Classification:** Refer to the Decision tree for sectoring R&D Units in Figure 7 to classify an organisation.
- **Source reference**: Record the source where you found the organisation name.
- **Duplicate check:** Before adding a new entry, thoroughly search the register for existing entries with similar names or variations (e.g., “South African Steel” is the same as “SA Steel”). If a duplicate is found, transfer the reference and delete the duplicate.

Naming guidelines

Organisation name

- Use the official business name displayed on the company's website. Correct any inaccuracies found in the register.
- Write out the full organisation name as per their registered name, including abbreviations like "(Pty) Ltd." or "Ltd.".
- Include popular abbreviations in brackets after the full name for easier searching (e.g., "Green Energy Solutions (Pty) Ltd. (GES)").
- Use the correct legal ending based on the company type (e.g., "Inc." for incorporated, "(Pty) Ltd." for private companies). Avoid guessing; use "unknown" if unsure.
- A company name can end with one of the following expressions, as appropriate for the category of the particular company:
- In the case of a personal liability company, the name must end in "Incorporated" or "Inc."
- In the case of a private company, the name must end in "Proprietary Limited" or "(Pty) Ltd."
- In the case of a public company, the name must end in "Limited" or "Ltd."
- In the case of a state-owned company, the name must end in "SOC Ltd."
- In the case of a non-profit company, the name must end in "NPC"
- Do not guess the legal type of a company. If you do not know the full legal name of an organisation, enter what you do know but don't guess the rest.
- Verify and correct spelling errors from referral lists or sources.
- Choose the most appropriate name if multiple variations exist for the same organisation. For example, Virtual Reality Ventures, Virtual Reality Ventures Corporation or Virtual Reality Ventures South Africa (Pty) Ltd.

Holding companies and group structures:

- **Identify group structures:** Recognise holding companies with subsidiaries or universities with departments.
- **R&D measurement location:** Researchers need to determine if companies form part of a larger group for fieldwork purposes.

Naming guidelines

- **Unit of Measure (UOM):** The fieldworker marks the appropriate entity (head office or subsidiary) as the UOM for R&D measurement to avoid double counting.
- **Fieldwork assignment:** Preferably assign one fieldworker to survey all companies or organisations within the same group structure. One person will survey the various subsidiaries or facilities within an enterprise or organisation group unless otherwise agreed by the team.
- **Sector variations:** In exceptional cases, sector-specific fieldworkers might split the group company for surveying purposes. Ensure proper communication and confirmation within the survey team.
- Mergers and acquisitions:
- **New entity:** Create a new entry for mergers resulting in a completely new organisation name.
- **Name change:** Update the name for acquired companies if their operations and R&D activities continue under the new ownership. The key questions to ask are:
- **Is the company being purchased by a bigger company and being absorbed?** In this case, the unit name will change as well as the parent company.
- **Is the company that was purchased still doing the same type of work, products, sales, R&D, etc?** Then the unit name must change.
- Subsidiaries measured centrally might appear on referral lists even if not directly surveyed. Mark them as not to be surveyed on the register to avoid confusion. Be aware that subsidiaries of organisations that are measured centrally often appear on referral lists. For example, Advanced Biotech Research and Advanced Biotech Solutions are all on the register even though all R&D is measured through Advanced Biotech Research Limited.
- The others are on the register because they are frequently referred to as R&D performers even though they are measured through Advanced Biotech Research Limited.
- Document the rationale behind any decisions made during the process for future reference.

Sampling frame evaluation

A robust sampling frame is a crucial component of an R&D survey process, as it serves as the foundation for selecting the representative sample of organisations to be included in the survey. Evaluating the sampling frame ensures that it accurately represents the target population and facilitates the selection of a representative sample.

Benefits of regular sampling frame evaluation

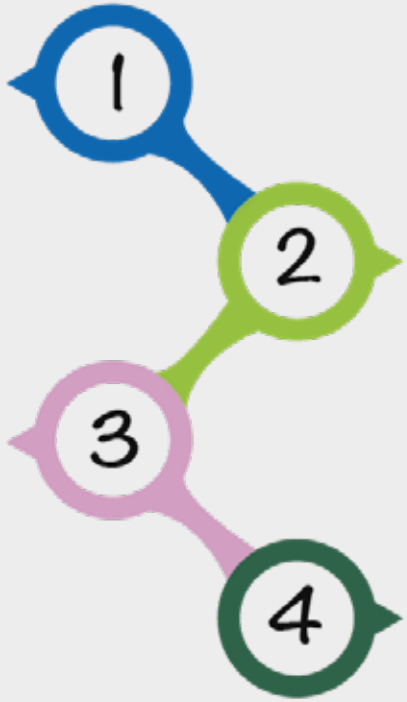
1. **Enhanced data quality:** Ensures accurate and reliable data collection, leading to more robust and generalisable findings.
2. **Improved efficiency:** Reduces the risk of sampling errors and wasted resources due to inaccurate or outdated information.
3. **Increased confidence in results:** Provides greater confidence in the validity and representativeness of survey findings.

1. **Assessing Coverage:** Assess whether the frame captures the entire target population of potential R&D performers within the target sectors. Identify any exclusions or biases in coverage that may limit the representativeness of the sample.
2. **Accuracy:** Evaluate the accuracy and completeness of information within the frame.
3. **Timeliness:** Regularly update the frame to reflect changes in the population.
4. **Assessing Representativeness:** Evaluate the representativeness of the sampling frame in terms of sectoral distribution, organisational size, geographic location, and other relevant characteristics.
5. **Documenting Findings:** Document the findings of the sampling frame evaluation.

Key aspects of sampling frame evaluation

Comparison with external sources
Compare the frame with established databases, industry directories, or other relevant sources to identify potential gaps or inconsistencies.

Fieldwork feedback
Collect feedback from fieldworkers regarding their experience using the frame, including challenges encountered and suggestions for improvement.



Data quality checks
Conduct data quality checks within the frame to assess the accuracy and completeness of information, identifying duplicate and missing values or inconsistencies..

Statistical analysis
Analyse the representativeness of the sample drawn from the frame compared to the target population by comparing the sample characteristics to the population characteristics, analysing non-response bias, evaluating coverage bias, and statistical testing.

Figure 8
Methods for sampling frame evaluation

Methods for sampling frame evaluation

Addressing sampling bias

Sampling bias occurs when the selection process used to draw a sample from a population systematically favours certain groups over others, leading to a sample that is not representative of the entire population. Addressing sampling bias is important to ensure the reliability and validity of R&D survey findings.

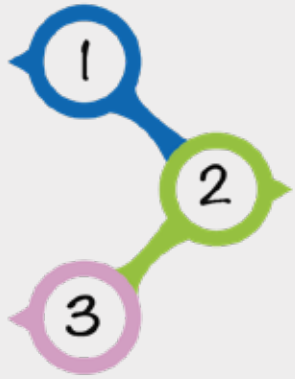
Strategies to mitigate sampling bias include:

1. Maintain an accurate and current sampling frame.
2. Employ random sampling techniques.
3. Implement weighting adjustments to compensate for the underrepresentation of certain groups.
4. Stratify the sample and sample from subgroups.
5. Document your sampling methods and adjustments clearly so that readers can critically assess the reliability and validity of the survey results.

R&D SURVEY DATA COLLECTION

Effective data collection is a cornerstone of robust research and development (R&D) surveys. This section outlines the fieldwork methods employed to gather high-quality data. The primary methods include telephone and email communication, with selective use of face-to-face interviews for specific cases.

We detail the process of sending an R&D survey, including methods of contact, survey response options, and guidelines for survey invitations. Emphasis is placed on maintaining clear communication and follow-ups to ensure high response rates. This is followed by best practices related to data checking and capturing, followed by data quality measures.



Fieldwork

During this phase, fieldworkers collect and manage R&D survey data.

Data checking and capturing

Data is checked for accuracy and captured.

Data quality

Data is checked according to quality principles.

Figure 9
Data collection steps

Fieldwork

Fieldwork methods

Email
Survey and participant communication takes place by email.

Telephone
Survey and participant communication takes place by telephone.

Face-to-face
Used selectively by researchers for specific cases.

Fieldworker training

Fieldworkers should be able to explain the purpose and meaning of each question, including any specific instructions or considerations.

Sending the R&D invitations and questionnaires

Survey invitations and questionnaires can be sent by **email**.

Send a formal invitation email containing the survey link or attachment, clear instructions, and a deadline for completion.

Personalise the email by addressing the recipient by name and mentioning their organisation.

Emphasise the importance of their participation and the confidentiality of their responses.

Postal mail can be used to send out survey invitations and questionnaires.

Remember to include a self-addressed, paid envelope.

Field workers can **phone** respondents to invite organisations and to complete the questionnaire.

Survey response options

Depending on the available resources, participants can be informed to complete an R&D survey as follows:

1. **Interactive PDF**
Questionnaires are created in software such as Adobe Acrobat and respondents will complete the questionnaire in the PDF document.

2. **Electronic spreadsheets**
Questionnaires are created in software such as Microsoft Excel or Google Sheets and respondents will complete the questionnaire in the spreadsheet.

3. **Printed document**
Questionnaires are created in software such as Microsoft Word or Microsoft Excel and then printed. Respondents will complete the answers to the questionnaire bin writing.

4. **Online platform**
Questionnaires are created in bespoke or commercially available survey research platforms. Respondents will complete the questionnaire online.

Table 4 Survey response options

Method	Considerations
Interactive PDF: Attached to the email invitation, submitted electronically or via postal service.	Returned data will need to be linked to a database, or be captured manually.
Excel Spreadsheet: Attached to email, submitted electronically or via postal service.	Returned data will need to be linked to a database, or be captured manually.
Printed Copy: In specific cases, organisations may complete a printed copy independently, by phone, or during a face-to-face visit.	Returned data will need to be captured manually.
Online Platform: for example RDI (**https://rdisurveys.hsrc.ac.za/**) or other commercially available survey platforms.	This method allows for full automation. Bespoke online platforms are expensive to build. Commercially available platforms need to be vetted for functionality, privacy and security.

DATA STORAGE AND CURATION

Considering how all data related to the R&D survey will be stored is crucial for data preservation and curation. Effective storage methods ensure that valuable information collected from various sources remains accessible, organised, and secure over time.

Proper data curation practices not only facilitate easy retrieval and analysis but also enhance the reliability and integrity of survey outcomes. This systematic approach helps maintain the accuracy and relevance of the data, supporting informed decision-making and future research efforts in the field of research and development.

Record-keeping

Effective record-keeping is essential for successful R&D survey fieldwork. Detailed notes and reports documenting key activities, updates, changes, and feedback are crucial for several reasons:

1. **Auditing:** Comprehensive records serve as an audit trail, enabling verification of fieldwork procedures.
2. **Data Quality:** Detailed notes on respondent interactions, observations, and challenges encountered can help identify potential data quality issues and inform data cleaning and validation processes.
3. **Reporting:** Accurate records provide valuable information for generating comprehensive reports on fieldwork progress, challenges encountered, and lessons learned.
4. **Management and Support:** Regular progress reports shared with sector leaders allow for:
5. **Assessment:** Timely evaluation of fieldwork performance and resource allocation.
6. **Informed decision-making:** Adjustments to strategies or resource allocation when needed based on reliable information.
7. **Support:** Prompt intervention and provision of necessary support to fieldworkers based on reported challenges.

Record Keeping Practices

It is important to keep records of key information throughout the survey process.

Capture key information including:

- Dates and tTimes
- Locations
- Respondent details
- Conversation summaries

- Observations
- Actions taken
- Regular Reporting: Provide regular reports to sector leaders on:
  - Fieldwork progress
  - Challenges encountered
  - Recommendations for improvement
  - Secure Storage: Save all notes and reports on a shared drive, ensuring:
  - Accessibility for authorised personnel
  - Adherence to data security protocols

Data management

Registers are maintained for each sector, storing key organisational information.

Multiple data management systems are utilised, including:

1. **Excel spreadsheets** for data storage and organisation.
2. **Shared drive** for centralised file sharing and collaboration.
3. **Digital platforms** for example, Research and Development Survey Management System (RDSMS) or commercial survey solutions.
4. **Microsoft Access** for specific data needs.

Data management protocols

Fieldworkers are required to adhere to established data management protocols to ensure consistent data recording, storage, and accessibility for all R&D team members.

R&D survey questionnaire checking

Once R&D survey responses start arriving, it's crucial to implement a robust checking process to ensure data quality and completeness. The following checklist will help you with this process.

Table 5 R&D survey questionnaire checking checklist

Checklist item		Self-assessment questions	✓
1	Initial Screening	Reviewed surveys to ensure all sections are completed.	
2		Reviewed specific sections of the survey to identify missing information.	
3		Checked for responses that deviate significantly from the norm.	
4		Utilised automated checks provided (if applicable).	
5	Consistency Checks	Manually reviewed flagged responses for inconsistencies or errors.	
6		Checked for illogical or contradictory answers.	
7		Checked for internal coherence and logical flow of responses across related questions.	
8		Contacted respondents for clarification or offer completion options for incomplete surveys.	

R&D survey data capturing

Manual data capture is necessary when respondents submit surveys via:

- Adobe Acrobat PDF
- Spreadsheet
- Postal service

TIP

It is recommended that survey data is captured in digital format, for example in a spreadsheet.

Digital survey management tools such as the Research and Development Survey Management System (RDSMS) and RDI system (online R&D digital dashboard) as well as commercial survey software automates processes but is very expensive to implement and careful consideration must be given to privacy and security aspects.

Fieldworker training

Fieldworkers need to be equipped with the skills necessary to use the chosen data capture tool effectively to ensure that they are comfortable navigating the questionnaire and managing challenging situations.

Handling Challenging Situations

Fieldwork for an R&D survey often presents various challenges that need to be addressed promptly and effectively to ensure the smooth execution of data collection activities. Table 6 provides an overview of possible challenges and strategies to mitigate these:

Table 6 Common fieldwork challenges and mitigation strategies

Common challenges	Strategies
Respondent availability and engagement	• Develop positive working relationships with gatekeepers like secretaries or assistants who can facilitate contact with the desired respondent. • Be persistent in attempts to reach the respondent while remaining flexible and respectful of their time constraints • If necessary, discuss alternative strategies with a project leader, such as suggesting meetings or involving senior personnel to facilitate contact.
Respondent resistance or reluctance Respondents can exhibit resistance or reluctance to participate in the survey due to various reasons, such as concerns about data privacy or time constraints.	• Address concerns transparently and emphasise the importance of their participation in contributing to valuable research insights. • Building rapport and trust with respondents can help alleviate their concerns and increase their willingness to participate. • Tailor communication to resonate with the target audience, highlighting the survey's relevance and potential benefits. • Provide clear and transparent information about data collection procedures, data usage policies, and how respondent anonymity will be maintained.
Data Quality Issues	Fieldworkers should be trained to adhere to standardised data collection protocols and procedures to minimise errors and inconsistencies. Implement regular quality checks and validation procedures to identify and rectify any data quality issues promptly.
Adapting to Changing Circumstances	It's essential to stay flexible and adaptable in response to changing circumstances such as regulatory changes, economic shifts, or public health crises. Adjust fieldwork strategies and protocols as needed to accommodate evolving conditions.
Technical difficulties	Train fieldworkers on basic troubleshooting steps for common technical issues encountered during data entry and establish clear procedures for reporting and seeking assistance with more complex technical problems.
Conflicting information	Fieldworkers should seek clarification and document the discrepancies.
Incomplete responses	Equip fieldworkers with strategies to politely encourage respondents to complete missing information or clarify ambiguous answers without leading or pressuring them.

REMINDERS AND FOLLOW-UPS

- Send gentle reminder emails to non-respondents after a reasonable timeframe.
- Offer alternative methods for completing the survey if needed (e.g., phone interview).
- Maintain a professional and respectful tone throughout all communication.

Quality checks

Operational standards and guidelines provide several ways to perform quality checks on your data.

Self-assessment

Use the guidelines for each quality dimension (relevance, accuracy, etc.) to evaluate data against the specified criteria. This helps identify areas for improvement before external evaluation.

Documentation review

Assess documentation on data collection, processing, and dissemination methodologies against the operational guidelines. This ensures transparency and adherence to sound practices.

User feedback

Gather feedback from data users on the relevance, accessibility, and interpretability of your data. This helps ensure data meets the needs of its intended audience.

External assessment

Share data and documentation with independent assessors who can apply the operational standards and guidelines to evaluate its quality objectively.

Data comparison

Compare data with similar data from other sources to check for coherence and consistency. This helps identify potential errors or outliers in your data.

Statistical analysis

Apply appropriate statistical tests to assess the accuracy, reliability, and completeness of your data. This provides quantitative evidence of data quality.

Figure 10
Data quality checks

Reporting incidents

To ensure any potential issues are addressed promptly and effectively, a clear and accessible process for reporting incidents is essential.

What constitutes an incident?

An incident in the context of R&D surveys may include:

1. **Ethical concerns:** Potential breaches of ethical principles, such as mishandling of sensitive data.
2. **Data quality issues:** Errors or inconsistencies in data collection, such as misunderstandings, missing information, or technical malfunctions.
3. **Respondent concerns:** Complaints or concerns raised by participants regarding the survey process, data privacy, or their treatment during data collection.
4. **Fieldworker misconduct:** Instances of unprofessional or unethical behaviour by fieldworkers, including breaches of confidentiality, coercion, or disregard for established protocols.

Reporting procedures

All incidents must be reported to the sector leader.

The sector leader will acknowledge and address reported incidents promptly and effectively.

SOUTH AFRICAN EXAMPLE

Within the context of the South African Statistical Quality Assessment Framework (SASQAF), Stats SA defines data quality in terms of "fitness for use." This means that data is considered high quality if it:

- is suitable for the intended purpose and
- can be used to make informed decisions.

SASQAF further breaks down data quality into two key aspects:

1. **Prerequisites:** These are the institutional and organisational conditions that enable the production of high-quality data. They include factors like having a clear mandate, adequate resources, and qualified staff.

2. **Eight Dimensions of Quality:** These dimensions assess the specific characteristics of the data itself.

By evaluating data against these prerequisites and dimensions data producers have a clear understanding of what constitutes high-quality data and how to achieve it. It also ensures a consistent and transparent approach to evaluating data quality.

FURTHER RESOURCES

South African Statistical Quality Assessment Framework (SASQAF)

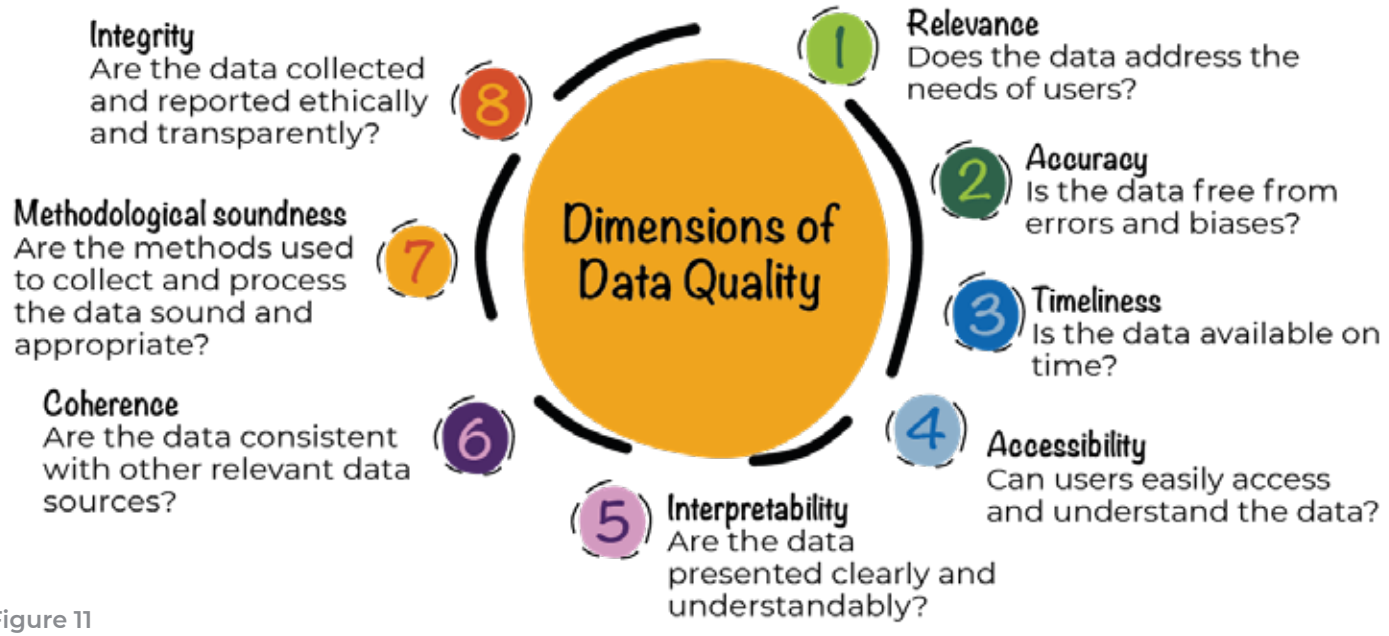
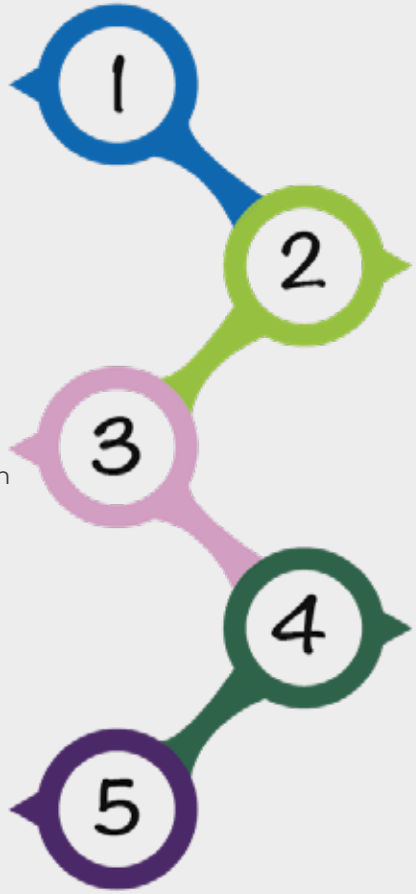


Figure 11
Eight dimensions of quality

Closing fieldwork

Once you've successfully collected data from your target audience, it's crucial to properly conclude the fieldwork phase of your R&D survey. Here are key steps to ensure a smooth and efficient closure:



Finalise data collection

Ensure completion of all scheduled surveys and data capture.

Finalise respondent engagement

Fieldworkers should check that all planned interactions with respondents have been conducted.

Finalise fieldwork reports

Accurate and comprehensive fieldwork reports summarising key findings, observations, and challenges encountered during data collection should be prepared.

Conduct final data quality checks

Review data for completeness, consistency, and any potential errors or inconsistencies that may require further clarification or correction.

Debrief fieldworkers

Conduct a debriefing session with fieldworkers to gather feedback on their experiences, identify any challenges encountered, and share insights for future research.

Figure 12
Closing fieldwork activities

R&D Survey respondent support

Building rapport and trust

The foundation of successful R&D survey fieldwork lies in effective communication with respondents. Clear and respectful communication ensures respondents understand the survey's purpose and feel comfortable providing accurate information. Conversely, unclear or unprofessional communication can lead to confusion, frustration, and ultimately, unreliable data.

Guidelines for positive interactions

1. **Clarity and Conciseness:** Communicate information clearly and concisely, avoiding jargon or technical terms.
2. **Respect and Courtesy:** Maintain a respectful and professional tone throughout all interactions, both verbal and written.
3. **Transparency and Honesty:** Be honest and truthful in all communication, avoiding misleading or false information.
4. **Completeness:** Provide all necessary details about the survey, including its purpose, confidentiality measures, and expected time commitment.

Table 7 Telephone communication with respondents checklist

Checklist item		Self-assessment questions	✓
1	Professional introduction	State your name, organisation, and purpose of your call politely.	
2	Be brief and informative	Briefly explain the purpose of your call and the information you seek.	
3	Finding the right contact	Politely inquire if you don't know the contact person, aiming for specific roles such as research manager, HR manager, or program manager.	
4		Make multiple calls if necessary to confirm contact information and reach the correct respondent.	
5	Respect respondent availability	If the respondent is unavailable, inquire politely about alternative contact options or suitable follow-up times.	
6	Explanation of survey mandate	Briefly explain the purpose and mandate of the survey once speaking to the right person.	
7	Highlight confidentiality	Emphasize the confidentiality of the data and address any concerns about data storage and safety.	
8	Use supporting documentation	Refer to the script and other supporting documents to guide your responses.	
9	Active listening	Listen attentively to the respondent's questions and concerns, addressing them promptly and respectfully.	
10	Express gratitude	Always thank the person you were speaking to for their assistance.	

Example telephone script

Good morning/afternoon, my name is [Your Full Name] from [Your organisation Name].

We are conducting a research survey on behalf of [Mandating organisation] to understand R&D activities in South African companies.

Based on your website, your company appears to be involved in R&D. We would like to speak with someone knowledgeable about your R&D activities, such as a research manager, director, or HR manager. Could you please direct me to the appropriate person to connect with?

The data that we collect is mainly on human resource information, financial data and the type of research activities undertaken in R&D and all data are kept confidential.

We assure you that all data collected is kept confidential.

If the contact person is unavailable, when would be a good time for me to call back? Could you provide an email address so I can follow up electronically?

Table 8 Email communication with respondents checklist

Checklist item		Self-assessment questions	✓
1	Professional Tone and Language	Maintain a professional and respectful tone, addressing the recipient by name and title.	
2	Clear Subject Line	Use a clear and concise subject line that accurately reflects the email's purpose.	
3	Proofreading and Accuracy	Carefully proofread the email for any errors in spelling or grammar before sending.	
5	Organised Communication	Structure the email clearly for easy understanding, using paragraphs and bullet points if necessary.	
6	Professional Signature	Include your email signature at the end of each email, including your name, position, organisation, and contact information.	
7	Target the Right Recipient	Ensure that only relevant recipients are copied in the email, avoiding unnecessary recipients.	
8	Check After Sending	Verify that the email has been sent to the intended recipient(s) by checking your sent items folder or using the email platform's confirmation feature.	
9	Stay Organised	Create sub-folders in your email inbox to categorise and store email communication with respondents, helping to keep your inbox organised and easily searchable.	

Example email script

Subject: DSI/CeSTII National R&D survey 2020/21 - BO International Pty Ltd

Dear Mr Khumalo

This is a friendly reminder about the 2020/21 R&D survey questionnaire sent to you on 21 February 2022. Your participation is crucial in helping us understand the R&D landscape in South Africa.

If you haven't already, we encourage you to complete the online survey by 30 April 2024.

Click here to access the survey: [Link to survey]

If you have any questions or require assistance completing the survey, please don't hesitate to contact me by email or at 021 555 4444.

Thank you for your time and contribution.

Regards

Mrs Kate Monroe

Ethical Conduct

It is imperative that everyone involved in an R&D survey process upholds ethical standards. Two key principles guide ethical conduct:

1. **Maintaining confidentiality:** Uphold the highest standards of ethical conduct, ensuring the confidentiality of all respondent information.
2. **No coercion:** Never pressure or coerce respondents into participating or providing specific answers.

Example Oath of Confidentiality

OATH OF CONFIDENTIALITY: [Insert name of Act, for example, STATISTICS ACT No. 13 OF 2018]

The [Insert the name of Science Council] is a [insert description of Council, for example, "statutory body]] established by the [Insert Act, for example, Science and Technology Act No. 26 of 1997]. The main function or mandate of the Council as prescribed in the Act is to [Insert mandate, for example, "promote science and technology to improve the quality of life in Zambia"]. The mission of the [Insert Council name, for example, NSTC] is the commitment to the promotion of science, technology and innovation for industrial development, while the vision is [Insert vision, for example, "to be a smart and value-centred science, technology and innovation (STI) council"]. To this end, the [Insert name of Council, for example, NSTC] is mandated to perform surveys on the national system of innovation, including regular National R&D Surveys. The [Insert name of Council, for example, NSTC] works with the [Insert name of National statistics agency, for example, Zambia Statistics Agency].

Respondents have the right to expect that the information given will be used for the purpose it was intended for and that it will not be disclosed to others without the respondents' explicit permission. All parties are bound by the provisions of the [Insert name of Act, for example, Statistics Act No.13 of 2018], insofar as the collection of Official Statistics is concerned.

The Oath of Confidentiality Principles

Data Protection: I recognise that the statistical data I have access to is an important national asset. I will take every reasonable precaution to ensure its physical and digital security, as well as to prevent unauthorised access, disclosure, alteration, or destruction.

Respect for Privacy: I understand that the information gathered represents individuals, businesses, and other entities in society. I will treat this information with the utmost regard for their privacy and ensure that no personal or sensitive information is released in any way that could jeopardise any individual's or entity's identity or interests.

Professionalism: In all encounters with statistical data, I pledge to maintain a professional tone and approach. I will not use the information for personal advantage or disclose it to unauthorised persons or organisations.

Non-Discrimination: I pledge to treat all statistics data objectively, without bias, discrimination, or prejudice. I will not disclose information that could be used to identify specific groups, individuals, or organisations, and I will help to disseminate fair, accurate, and reliable statistical information.

Legal and Ethical Obligations: I recognise that my obligations go beyond this oath and include adhering to all applicable laws, regulations, and ethical standards regulating the collection, storage, analysis, and dissemination of statistical data.

Data Use for the Public Benefit: I recognise that the goal of collecting and maintaining national statistical data is to serve the public benefit, promote evidence-based decision-making, and facilitate policy formation. I will contribute to these goals by guaranteeing the accuracy, dependability, and accessibility of the data.

Accountability: As a curator of national statistics data, I hold myself accountable for my activities. If I become aware of any data confidentiality breaches, discrepancies, or wrongdoing, I will report such instances to the appropriate authorities and take all required steps to address the issue.

Oath of Confidentiality

I, [Your Full Name], solemnly swear to uphold the highest standards of confidentiality and integrity as a custodian of this national statistical data. Recognising the critical importance of preserving the trust bestowed upon me by the citizens and institutions of Zambia, I hereby pledge to abide by the principles outlined in this oath.

I take this oath freely and without hesitation, knowing the gravity of my commitment and the potential consequences of breaking it. By declaring my steadfast commitment to the aforementioned principles, I affirm my responsibility to maintain the confidence, credibility, and usability of national statistics data for the welfare of society and the progress of knowledge.

I, [Your Full Name] with ID/Passport number [Insert number] of [Insert organisation name] do affirm that I will faithfully and honestly fulfil my duties as a person accessing the national statistical data of the [Name of Agency in conformity with the requirements of the Statistics Act, and of all rules and instructions thereunder and that I will not without due authority disclose or make known any matter, data or information that comes to my knowledge because of my access to the data.

Signed: At: Date:

R&D SURVEY ANALYSIS

Data cleaning

The initial stage of data analysis involves data cleaning, which prepares the data for further analysis by addressing any inconsistencies or errors.

Data cleaning procedures

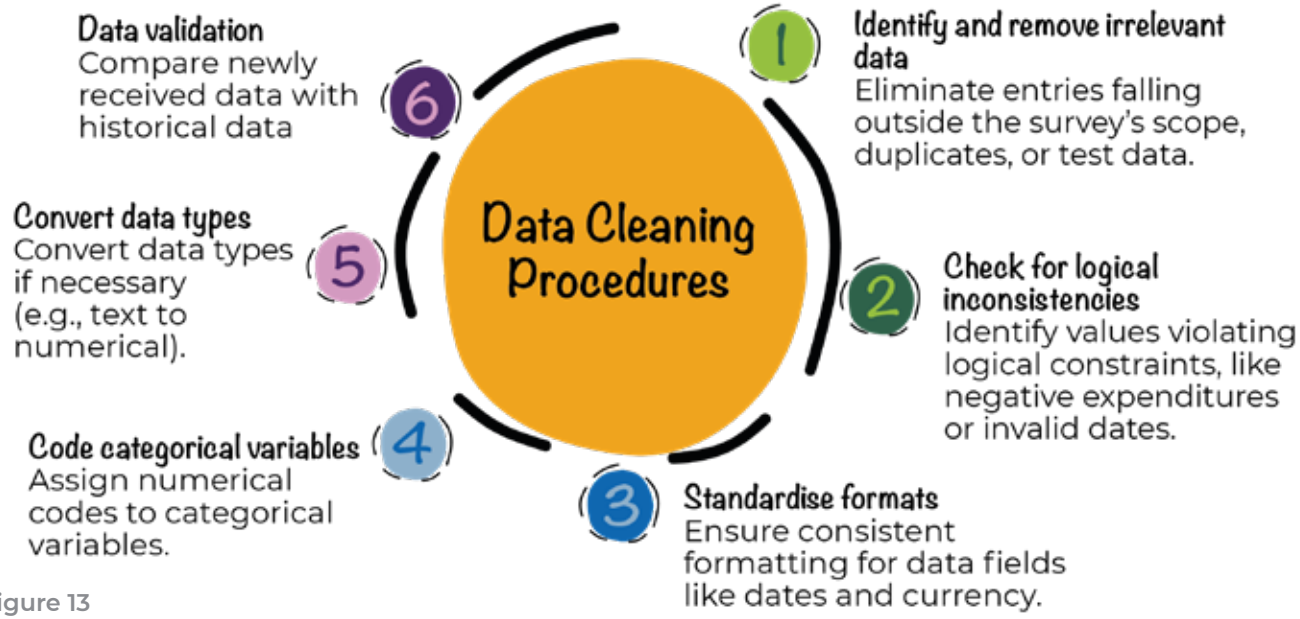


Figure 13
Data cleaning procedures

Documentation of data cleaning steps

Maintain a detailed record of all cleaning steps, including:

1. **Rationale:** Reasons behind each step.
2. **Methods:** Tools and methods used.
3. **Transformations:** Any modifications applied to the data.
4. **Document the impact** of cleaning, quantifying changes made (e.g., number of entries removed, missing values imputed).

Data validation

Compare newly received data with historical data to identify:

- **Large indicator shifts:** Significant changes over time.
- **New indicators:** Newly emerging research fields.
- **Investigate discrepancies:** The researcher analyses reasons for large differences, often by contacting respondents for clarification.

The researcher compares the data with fieldwork records.

Handling missing data

Identify missing values: Locate and document missing entries to understand their extent and patterns.

Imputation techniques: Use techniques like mean, median, or regression imputation to estimate and replace missing values with plausible substitutes.

Outlier identification and treatment

1. **Outlier detection:** Identify data points significantly deviating from expected or typical values using statistical methods, visual inspection, or domain knowledge.
2. **Investigate the cause:** Analyse potential reasons for outliers, such as data entry errors, genuine extreme cases, or specific contexts requiring further exploration.
3. **Outlier treatment:** Decide whether to remove, transform, or adjust outlier values based on the impact on analysis and underlying research objectives.

SHARING R&D SURVEY RESULTS

R&D survey data serves as a valuable resource for informing stakeholders, policymakers, and researchers. Sharing findings and insights effectively is crucial to maximising the impact of the survey.

Dissemination Methods

1 Reports

Comprehensive documents presenting key findings, trends, and analysis.

2 Fact Sheets

Concise summaries of key information and statistics in an easy-to-understand format.

3 Policy Briefs

Action-oriented documents summarising a specific policy issue, presenting evidence-based recommendations, and advocating for specific solutions.

Why share R&D data?

R&D survey data is instrumental in informing decisions pertaining to research and development by offering valuable insights into the R&D landscape. Key applications of this data include:

1. **Identifying Trends and Patterns:**
   - Monitoring overall R&D expenditure as a percentage of GDP across different sectors.
   - Assessing R&D intensity to pinpoint sectors or regions for potential investment.
   - Tracking trends in R&D personnel to evaluate workforce capacity and identify skills gaps.
2. **Evaluating Policy Effectiveness:**
   - Analysing changes in R&D activity, funding sources, or human resources post-policy implementation.
   - Identifying areas for policy improvement based on data analysis.
3. **Informing Policy Decisions:**
   - Strategically allocating R&D funding by leveraging data-driven insights into promising research areas and emerging technologies.
   - Designing targeted support programs, such as skills development initiatives, based on identified needs.
4. **Benchmarking against Other Countries:**
   - Comparing R&D performance indicators with international counterparts to identify areas for improvement and adopt best practices.

Writing reports

Writing reports

The purpose of an R&D Statistical Report is to:

1. present key findings for the latest R&D results,
2. summarise commentary on key developments, and
3. present trends for the ten most recent years of selected variables.

Table 9 Report writing checklist

Checklist item		Self-assessment questions	✓
1	Clarity and Transparency	Is my language clear and understandable to someone who is not an expert in the field?	
2		Have I avoided using technical jargon or overly complex terms?	
3	Consistency	Is the formatting of the report consistent throughout, including font styles, sizes, headings, and spacing?	
4		Have I used consistent terminology and language across different sections of the report?	
5		Are charts, graphs, and tables presented in a consistent style and format?	
6		Is the report prescribing to the same definitions and have these been updated, if yes, include in Methodology section	
7	Objectivity	Have I presented data, findings, and interpretations objectively, without bias or personal opinions?	
8		Have I avoided language that could imply bias or subjective interpretations?	
9		Did I critically evaluate sources of information to ensure credibility and accuracy?	
10	Accessibility	Have I made the report accessible through various channels, such as online platforms and hard copies?	
11		Is the report designed to be easily navigable and readable, both in digital and print formats?	
11		Have I considered accessibility features for individuals with disabilities, such as screen readers or alternative formats?	

Table 10 Report writing checklist: survey report sections

Checklist item		✓
I have included the following sections in this order:		
1	Front Cover Page with the publication name and the reference period; appropriate logos	
2	Back of front cover page with the publication date	
3	Notifications (publication date, dissemination, User feedback survey invitation, data extractions, revisions, project team)	
4	Foreword from statistical agency (for example Stats SA)	
5	Preface from the government department responsible for R&D (for example, Department of Science and Innovation)	
6	Acknowledgements	
7	List of Abbreviations in alphabetical order	
8	Definitions and Descriptions of terms in alphabetical order	
9	Table of contents	
10	List of tables	
11	List of figures	
12	Introduction	
13	Key findings for survey reference year (Statistical report only). Briefly summarised: The overall GERD (GERD as a percentage of Gross Domestic Product (GDP); Key indicators table (most recent three years); Distribution of GERD within the surveyed sectors; and Factors that either contributed to the increase of decrease of GERD) and R&D sources of funds (Human resources devoted to R&D (including students); Distribution of human resources among the sectors; Full-time-equivalent; and Doctoral students and post-doctoral fellows)	

Checklist item		✓
I have included the following sections in this order:		
14	Content of the report (Tables)	
15	Description of Survey Methodology (Annexure I)	
16	References	
17	User Satisfaction Questionnaire (Annexure II)	
18	Back cover page with appropriate logos	

Report Writing Style Guide

Fonts and Formatting

- Font type: Arial
- Chapter heading font size and caps: 11 pt upper caps
- Body of report font size: 11 pt
- Table heading font size: 11 pt
- Table contents font size: 8 pt
- Table and graph headings font size: 10pt
- Numbers in tables should be right-adjusted
- Bold / different the colour of total and subtotal of the tables

Significant digits

When a number is expressed in scientific notation, the number of significant digits (or significant figures) is the number of digits needed to express the number to within the uncertainty of calculation. The surveys produce numbers in the form of currency, headcounts, full-time-equivalent, percentages and years, the presentation of each number type is described below.

Currency

- In the body of the report, all numbers should be 3 significant digits when expressed in billions of currency: R5.346 billion and not R5.35 billion.
- In tables, the level of detail required is higher. Numbers will be reported to six significant digits in billions of currency, or nought when expressed in millions of currency: 257 235 in units of a thousand or 257.235 million.
- The currency presented in a table should include the unit of measure in the second table header: R'000.

Headcounts

- No rounding in the body and the tables of the report: 9 283 (not 9300) or 4 449 (not 4450).

Full time equivalents (FTEs)

- All numbers to be rounded to one decimal point, in both the body of the report and in the tables: 9 283.1 (not 9283) or 4 449.9 (not 4449.87).

Percentages

- Round to one decimal point (except for R&D intensity indicators): 12.5% (not 12.54%) or 94.9% (not 95%).
- R&D intensity indicators must be reported to two decimal points: 0.94% (not 0.9%)
- The percentage presented in a table should include percentage symbol (%) as a second table header.

Years

- Table columns and rows should present trend years in the same ascending order in all tables: 2007/08 to 2011/12
- Reference periods are to be presented as the financial year for all tables and figures, for example 2011/12 not 2011.

Writing policy briefs

The purpose of a policy brief is to provide a clear and concise overview of a policy issue, problem, or solution, bridging the gap between research and policy. Policy briefs are typically written by researchers, analysts, or advocacy organisations to inform decision-makers about the evidence-based implications of various policy options.

Common Uses of policy briefs

- Informing policymakers about critical issues and potential solutions.
- Influencing decision-making on policy matters.
- Raising awareness about important issues among stakeholders.
- Promoting specific policy recommendations based on research and evidence.
- Facilitating communication between researchers, policymakers, and the public.


POLICY BRIEF

Policy levers to **boost innovation and productivity** in South African manufacturing firms

Summary

This policy brief shares key evidence-based insights on boosting innovation and productivity in manufacturing firms. Current policy instruments to promote innovation do not consider all of the drivers of innovation investment and success, and there is a need for a mix of tools – known as policy levers – that explicitly consider the differential impact of these drivers on product versus process innovation. New empirical evidence shows that both product and process innovations improve productivity, and strengthen the relationship between innovation and productivity to inform the design of such instruments for the manufacturing sector?

This policy brief showcases new insights into the drivers of innovation and productivity in manufacturing firms, and proposes several ways to translate this evidence into effective policymaking that targets the relevant firms in the most efficient manner. Concerned with modernising and growing the manufacturing sector towards building a stronger economy, the findings presented in this brief

FURTHER RESOURCES

R&D survey Policy Briefs

Table 11 Policy briefs writing checklist

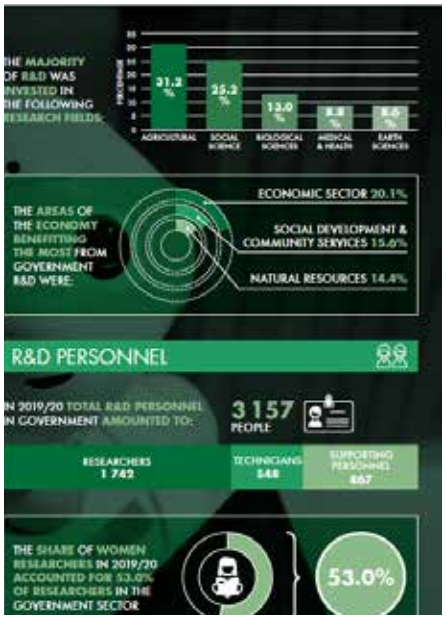
Checklist item		Self-assessment questions	✓
1	Clarity and Accessibility	Is my language clear and understandable to someone who is not an expert in the field?	
2		Have I avoided using technical jargon or overly complex terms?	
3	Focus and Structure	Does my brief address a specific issue with a clear focus?	
4		Have I prominently presented key findings and policy implications?	
5		Have I provided analysis, potential solutions, and recommendations concisely?	
6	Evidence-based Argumentation	Have I supported my arguments with credible evidence, such as research findings, data, and expert opinions?	
7		Have I cited relevant sources to strengthen the credibility of my claims?	
8	Relevance and Timeliness	Does my brief address timely and pressing policy issues?	
9		Have I connected the content to current policy challenges or goals?	
10	Action Orientation	Have I provided actionable recommendations for policymakers?	
11		Are my recommendations based on the analysis and evidence presented in the brief?	
12	Length and Visual Enhancement	Is my brief concise, typically 1-6 pages?	
13		Have I included visuals such as graphs and charts to enhance comprehension and illustrate key points?	
14	Stakeholder Engagement	Have I sought input from relevant stakeholders, including policymakers and researchers, to address their needs?	

Writing fact sheets

The purpose of a fact sheet is to provide key information, data, or statistics about a specific topic in an easy-to-understand format. It is designed to provide readers with a quick overview of the subject matter without overwhelming them with excessive detail.

Common Uses of fact sheets

- Fact sheets are used to communicate survey results to stakeholders, such as executives, investors, and partners, ensuring they have a clear understanding of the research outcomes without reading the full report.
- Fact sheets are shared with the public or specific audiences to inform them about the R&D survey results, enhancing transparency and public awareness.



FURTHER RESOURCES

R&D survey Fact Sheets

Table 12 Fact sheets writing checklist

Checklist item		Self-assessment questions	✓
1	Conciseness	Have I presented information briefly and avoided technical jargon?	
2		Are the key points communicated succinctly using bullet points and short sentences?	
3	Clarity and Structure	Have I used clear headings and subheadings to organise the information?	
4		Do the headings/subheadings accurately reflect the content they introduce?	
6	Visual Enhancement	Have I included visuals such as bullet lists, key figures, charts, or tables to enhance comprehension?	
7		Do the visuals support and reinforce the key points presented in the fact sheet?	
9	Consistent Formatting	Is the formatting consistent throughout the fact sheet (font styles, sizes, and spacing)?	
10		Have I maintained consistency in the layout and design elements?	
11	Source credibility	Have I cited credible and relevant sources for the information presented, if necessary?	
12	Contact Information and Additional Resources	Have I included contact information for further inquiries or follow-up questions?	
13		Are additional resources provided for readers who want to delve deeper into the topic?	
14	Accessibility	Have I ensured that the fact sheet is accessible to diverse audiences, including those with disabilities?	
15		Is the language used inclusive and easy to understand for all readers?	
16		Have I considered providing alternative formats or accessibility features for those who may need them?	

ADDITIONAL RESOURCES

ANNEXURE

EXAMPLE BUSINESS SECTOR R&D SURVEY QUESTIONNAIRE

Cover page, mandate and respondent info

STRICTLY CONFIDENTIAL

LOGOS OF INSTITUTIONS IN CHARGE OF R&D SURVEYS

NATIONAL SURVEY OF RESEARCH AND EXPERIMENTAL DEVELOPMENT (R&D) INPUTS BUSINESS ENTERPRISES SECTOR	
BUSINESS ENTERPRISE SECTOR *Private and Foreign-controlled Business Enterprises, Public Enterprises, Non-profit institutions serving business enterprises (Trade associations, industry-controlled research institutes) and parents/members of a domestic or foreign group.* *. [FM 200-205]* **FINANCIAL YEAR :** MM/AAAA MM/AAAA or AAAA	
Organisation	**Please modify address label (only if there is one)**

AUTHORITY: [Institutions serving as ASTII Focal Point ……] is/are mandated to carry out the survey of Research and Experimental Development (R&D) inputs on behalf of the Ministry (s) [……] under the supervision of [National Institute of Statistics …… ……] in [country……..].

All data gathered for this survey are confidential under the Statistical Law no……..of DD/MM/YYY. Only the survey team sees individual organisation data. Raw data gathered for this survey is confidential except when an organisation gives written permission for its data to be disclosed to other parties.

PURPOSE AND SCOPE OF SURVEY: The R&D survey collects data on the inputs into R&D activities performed IN-HOUSE by all organisations (including **Business Enterprises,** Government, Higher Education, and Private Non-Profit). The data are used for planning and monitoring purposes and for measuring international competitiveness.

This survey covers the Financial Year: DD/MM/YYY to DD/MM/YYYY (or your nearest complete financial year).

DUE DATE: Kindly complete and return this questionnaire by ..... to: R&D Survey, [full address]

ASSISTANCE: To assist you in completing this form one of the surveyors mentioned below will be contacting you to complete this form on an appointed date/time. For any clarifications, please do not hesitate to contact the staff below for assistance:

Name	Phone number	e-mail

PERSON COMPLETING THE QUESTIONNAIRE: Name of Head or Admin/Finance Manager:

Organization		**Tel**	
Name (with title)		**Fax**	
Designation		**Cell**	
Date		**e-mail**	
Signature		**Website**	

TIP

Use the example of the business sector survey questionnaire to familiarise yourself with the questionnaire.

Copies of all the questionnaires for the other sectors are available as MSWord and Excel documents on the CeSTII website at Alternatively, you can access these tools by visiting the CeSTII webpages at **https://hsrc.ac.za/divisions/centre-for-science-technology-and-innovation-indicators/**, or the HSRCs Research Output Repository at **https://repository.hsrc.ac.za**.

What is R&D definitions

THE FOLLOWING DEFINITIONS ARE IMPORTANT IN THE COMPLETION OF THIS QUESTIONNAIRE:

Definition of R&D:
This survey follows the 'Frascati Manual' guidelines for conducting surveys on the inputs to R&D (OECD, 2015).
Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge –including knowledge of humankind, culture and society – and to devise new applications of available knowledge.

- **Basic research is** experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.
- **Applied research** is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective.
  Experimental development is systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, which is directed to producing new products or processes or to improving existing products or processes.

For an activity to be an R&D activity, it must satisfy five core criteria. The activity must be (i) novel, (ii) creative, (iii) uncertain, (iv) systematic, and (v) transferable and/or reproducible.

Scope of survey:

- The survey requests data on **R&D performed IN-HOUSE by your organisation** on the national territory.
- Part five asks some questions on "out-sourced R&D".

R&D in business:
Any activity classified as R&D is characterised by originality; it should have investigation as a primary objective and should have the potential to produce results that are sufficiently general for humanity's stock of knowledge (theoretical and/or practical) to be recognisably increased.

R&D includes – but is not limited to:
Activities of personnel who are obviously engaged in R&D. In addition, research activity includes:

- The provision of professional, technical, administrative or clerical support and/or assistance to personnel directly engaged in R&D.
- The management of personnel who are either directly engaged in R&D or are providing professional, technical or clerical support or assistance to those R&D activities of students undertaking postgraduate research courses.
- Software development where the aim of the project is the systematic resolution of a scientific uncertainty.
- Research work in the natural sciences, engineering, medical sciences, agricultural sciences, social sciences and the humanities.
- R&D carried out as a participant in any unincorporated joint venture.
- Prototypes and pilot plants, as long as long as the primary objective is to make further improvements. arising during initial production runs.
- Industrial design and drawing but only if required for R&D.
- R&D projects performed on contract for other legal entities, such as businesses.

"Feedback R&D" directed at solving problems occurring beyond the original R&D phase – for example, technical problems

R&D excludes:
The following specific activities are excluded except where they are used primarily for the support of or as part of R&D activities performed in this reporting unit:

- Scientific and technical information services.
- Engineering and technical services.
- General purpose or routine data collection.
- Standardisation and routine testing.
- Feasibility studies (except into R&D projects).
- Specialised routine medical care, for example routine pathology services.
- The commercial, legal and administrative aspects of patenting, copyrighting or licensing activities.
- Routine computer programming, systems work or software maintenance where there are no technological uncertainties to be resolved.

Examples:

- Investigating electrical conduction in crystals is basic research; application of crystallography to the properties of alloys is applied research.
- New chip designs involve development.
- Investigating the limiting factors in chip element placement lies at the border between basic and applied research, and increasingly involves nanotechnology.
- Much service R&D involves software development where the completion of the project is dependent on a scientific or technological advance and the aim of the project is the systematic resolution of a scientific or technological uncertainty.

Borderline cases:

- The greatest source of error in measuring R&D is the difficulty of locating the cut-off point between experimental development and the related activities required to realise an innovation.
- Care must be taken to exclude activities that although undoubtedly a part of the innovation process, rarely involve any R&D, e.g. patent filing and licensing, market research, manufacturing start-up, tooling up and redesign for the manufacturing process.

It is also difficult to define precisely the cut-off point between experimental development and pre-production development, such as producing user demonstration models and testing, and production that is applicable to all industrial situations. If the primary objective is to make further technical improvements on the product or process, then the work falls within the definition of R&D. If, on the other hand, the product, process or approach is substantially set and the primary objective is to develop markets, to do pre-production planning or to get a production or control system working smoothly, the work is no longer R&D.

General info

SECTION 1
GENERAL INFORMATION

1.1	Registered name of Company	
1.2	Trading as (if applicable)	

2	If you are reporting R&D for subsidiary companies (e.g. as a head office with several subsidiary companies), please list the companies below (append a page if required).

3	List the principal activities and/or National Classification/International Standard Industrial Classification (ISIC) code (see Appendix A in code book) from which your company derives its main income.	
Activities	**ISIC**	**Company Income Obtained (%)**

4	Parent Company (if applicable) with % ownership	
Parent Company		**% de participation**

General info

5	**Approximate foreign/local ownership split** (By ultimate ownership if complex holding structures exist.)				
	African Union Member States				%
	European Union				%
	United States of America				%
	China				%
	Others				%
	Domestic/National				%
	TOTAL				**%**

6	**Financial year (dd/mm/yyyy) for which you are reporting in this survey**	From **dd/mm/yyyy** to **dd/mm/yyyy** …… ……
7	**Total number of all employees** (include staffers on **a 6-month contract or longer**)	
8	**Gross Sales Revenue or Turnover (Local currency'000 Excl. VAT[1])**	X X X X X X

9	**During the financial year** MM/AAAA-MM/AAAA or AAAA **did the reporting unit perform any IN-HOUSE R&D, including received contracts to perform R&D within the institution for one of the following tasks:** - Creative and systematic work undertaken in order to increase the stock of knowledge - Knowledge creation/production of humankind, culture and society ; - creation of new device or applications of available knowledge.	
No		**Please move to Question 17 in the last section (5) of the questionnaire**
Yes		**Tick the Socio-economic objective (SEO) your reporting unit was planning to achieve while performing R&D before moving to Question 10.**
		1) Exploration and exploitation of the earth
		2) Environment
		3) Exploration and exploitation of space
		4) Transport, telecommunication and other infrastructures
		5) Energy
		6) Industrial production and technology
		7) Health
		8) Agriculture
		9) Education
		10) Culture, recreation, religion and mass media
		11) Political and social systems, structures and processes
		12) General advancement of knowledge : R&D financed from general university funds (GUF)
		13) General advancement of knowledge : R&D financed from other sources than GUF
		14) Defence

[1] VAT = Value-added tax

R&D personnel definitions

SECTION 2
IN-HOUSE R&D PERSONNEL

R&D PERSONNEL

Report against the categories listed below for all personnel employed directly in R&D or providing direct R&D services/support for at least 10% of their time. Do not count any staff NOT supporting research. Please report the average number of persons engaged in R&D during the reference year and kindly include permanent, temporary, full-time, part-time and contract staff.

1) Researchers

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

Researchers include managers and administrators engaged in the planning and management of the scientific and technical aspects of a researcher's work. Their rank is usually equal or superior to that of persons directly employed as researchers and they are often former or part-time researchers.

Excluded are managers and directors concerned primarily with budgets and human resources rather than project management or content (include in other personnel directly supporting R&D).

2) Technicians directly supporting R&D

Persons performing technical tasks in support of R&D, normally under the direction and supervision of a researcher.

3) Other personnel directly supporting R&D

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

Included are executives and directors concerned primarily with budgets and human resources in support of research rather than project management.

Note: Do not include personnel indirectly supporting R&D. Typical examples are transportation, storage, cleaning, repair, maintenance and security activities, as well as administration and clerical activities undertaken not exclusively for R&D (such as the activities of central finance and personnel departments). Allowance for these should be made under "overheads in R&D expenditure" ("other current expenditure" in Question 11.1.2) but such persons should not be included as R&D personnel.

Headcount and FTE of R&D personnel

10 HEADCOUNT & FULL-TIME EQUIVALENTS OF R&D PERSONNEL

CALCULATING 'HEADCOUNT' (HC) DATA

HC data cover the total number of persons who are mainly or partially employed in R&D. This includes staff employed both "full-time" and "part-time" on R&D activities.

CALCULATING 'FULL TIME EQUIVALENT' (FTE) PERSONS

Note: FTE data measure the volume of human resources in R&D. One FTE may be thought of as one person-year. That is 1 FTE is equal to 1 person working full-time on R&D for a period of 1 year, or more persons working part-time or for a shorter period, corresponding to one person-year.

For the purpose of this survey, an employee can work a maximum of 1 FTE in a year.

The following equation could be used to calculate person years of effort on R&D:

FTE: (Dedication to the employment: Full-time/Part-time) x (Portion of the year active on R&D) x (Time or portion spent on R&D)

- A full time employee spending 100% of time on R&D during a year: (1 x 1 x 1) = 1 FTE
- A full time employee spending 30% of time on R&D during a year: (1 x 1 x 0.3) = 0.3 FTE
- A full time R&D worker who is spending 100% of time on R&D, is employed at an R&D institution only for six months: (1 x 0.5 x 1) = 0.5 FTE
- A full time employee spending 40% of time on R&D during half of the year (person is only active for 6 months per year): (1 x 0.5 x 0.4) = 0.2 FTE
- A part-time employee (working 40% of a full time year) engaged only in R&D (spending 100% of time on R&D) during a year: (0.4 x 1 x 1) = 0.4 FTE
- A part-time employee (working 40% of a full time year) spending 60% of time on R&D during half of the year (person is only active for 6 months per year): (0.4 x 0.5 x 0.6) = 0.12 FTE
- 20 full time employees spending 40% of time on R&D during a year: 20 x (1 x 1 x 0.4) = 8 FTE

NOTE: please calculate FTEs for all R&D personnel

Headcount and FTE of R&D personnel

10.1 Headcount and Full-Time Equivalents (estimate of person-years of effort on R&D) by Function and Highest Level of Formal Qualification

10.1.1 RESEARCHERS *(Degree/Diploma Holder of)*	HEADCOUNT			FULL-TIME EQUIVALENT (For Official Use Only)		
	M	F	Total	M	F	Total
Doctoral or equivalent level (ISCED 8)						
Master's or equivalent level (ISCED 7)						
Bachelor's or equivalent level (ISCED 6)						
Other tertiary level diplomas or Short-cycle tertiary education (ISCED 5)						
All other degrees (ISCED 1 to 4): including post-secondary non-tertiary programmes and upper secondary programmes						
TOTAL RESEARCHERS (1)						

10.1.2 TECHNICIANS *(Degree/Diploma Holder of)*	HEADCOUNT			FULL-TIME EQUIVALENT (For Official Use Only)		
	M	F	Total	F	M	Total
Doctoral or equivalent level (ISCED 8)						
Master's or equivalent level (ISCED 7)						
Bachelor's or equivalent level (ISCED 6)						
Other tertiary level diplomas or Short-cycle tertiary education (ISCED 5)						
All other degrees (ISCED 1 to 4): including post-secondary non-tertiary programmes and upper secondary programmes						
TOTAL TECHNICIANS (2)						

10.1.3 OTHER SUPPORT STAFF *(Degree/Diploma Holder of)*	HEADCOUNT			FULL-TIME EQUIVALENT (For Official Use Only)		
	M	F	Total	F	M	Total
Doctoral or equivalent level (ISCED 8)						
Master's or equivalent level (ISCED 7)						
Bachelor's or equivalent level (ISCED 6)						
Other tertiary level diplomas or Short-cycle tertiary education (ISCED 5)						
All other degrees (ISCED 1 to 4): including post-secondary non-tertiary programmes and upper secondary programmes						
TOTAL OTHER SUPPORT STAFF (3)						

Headcount and FTE of R&D personnel

10.2	Total labour costs based calculated based on Full-Time Equivalents (FTEs) and Average annual labour cost of each R&D function .

Using the full-time equivalents of all R&D personnel reported for in Question 10.1, calculate the total labour costs of R&D using the average annual full cost-to-company for full-time staff (including annual wages and salaries and all associated costs or fringe benefits such as: bonus payments, contributions to pension and medical aid funds, payroll tax, unemployment insurance fund and all other statutory payments) per category below

10.2.1 FTE by Personnel Categories and Labour Costs	Full Time Equivalent (FTE) (From Q 10.1) (A)	Average annual labour cost per person Local Currency Unit'000 (Excl. VAT) (B)	Calculated labour cost of R&D Local Currency Unit '000 (Excl. VAT) (A x B)
Total researchers (From 10.1.1)			
Total technicians (From 10.1.2)			
Total other support staff (From 10.1.3)			
TOTAL LABOUR COST (1+2+3)			

Carry subtotal over to 11.1.1

10.2.2 can only be filled if your statistical unit still involves external RESEARCHERS (not Technicians or Support Staff) to support R&D activities.

10.2.2 Total RESEARCHERS by employment status	Headcount		Full Time Equivalent (FTE)		Calculated labour cost of R&D Local Currency Unit '000 (Excl. VAT)
	M	F	M	F	
Internal Researchers from 10.1.1 (*) (i.e. employed researchers)					
Remunerated External Researchers (**) Researchers whose costs are reported as "other current costs – external R&D personnel" 1) Self-employed professionals acting as intramural R&D consultants and 2) Leased employees involved for R&D activities but in payroll of an employment agency) 3) Professionals and technical employees acting as intramural R&D consultants in fulfilment of the provision of a scientific or technical service by their employer(s) to the statistical unit reporting intramural R&D (FM 154-156, 5.15-24)					
Unpaid external Researchers (Unpaid family members and people involved for planned intramural R&D activities based on their expected research skills (Clinical trials, lend computer processing support, etc.) (FM 154-156, 5.15-24)					

(*) Internal researchers is already in Question 11.1.1
(**) Carry over total of external researchers to Question 11.1.2

Headcount and FTE of R&D personnel

10.3	Headcount and Full-Time Equivalents and Full-Time Equivalents of all R&D personnel according to three professional categories and fields of R&D

10.3.1 RESEARCHERS (Field of R&D)	HEADCOUNT			FULL-TIME EQUIVALENT (For Official Use Only)		
	M	F	Total	M	F	Total
Natural sciences						
Engineering & technology						
Medical & health sciences						
Agricultural & Veterinary sciences						
Social sciences						
Humanities and Arts	3			1		
Not specified elsewhere (Inter or multi-disciplinary)						
TOTAL RESEARCHERS (1)						

10.3.2 TECHNICIANS (Field of R&D)	HEADCOUNT			FULL-TIME EQUIVALENT (For Official Use Only)		
	M	F	Total	F	M	Total
Natural sciences						
Engineering & technology						
Medical & health sciences						
Agricultural & Veterinary sciences						
Social sciences						
Humanities and Arts						
Not specified elsewhere (Inter or multi-disciplinary)						
TOTAL TECHNICIANS (2)						

10.3.3 OTHER SUPPORT STAFF (Field of R&D)	HEADCOUNT			FULL-TIME EQUIVALENT (For Official Use Only)		
	M	F	Total	F	M	Total
Natural sciences						
Engineering & technology						
Medical & health sciences						
Agricultural & Veterinary sciences						
Social sciences						
Humanities and Arts						
Not specified elsewhere (Inter or multi-disciplinary)						
TOTAL OTHER SUPPORT STAFF (3)						

Headcount of R&D personnel

10.4 Headcount of all R&D personnel according to three categories and age

10.4.1 RESEARCHERS	HEADCOUNT			OPTIONAL FULL-TIME EQUIVALENT (For Official Use Only)		
	M	F	Total	F	M	Total
Under 25 years						
25-34 years						
35-44 years						
45-54 years						
55-64 years						
65 years and more						
Unknown						
TOTAL RESEARCHERS (1)						

10.4.2 TECHNICIANS : AGE	HEADCOUNT			OPTIONAL FULL-TIME EQUIVALENT (For Official Use Only)		
	M	F	Total	F	M	Total
Under 25 years						
25-34 years						
35-44 years						
45-54 years						
55-64 years						
65 years and more						
Unkown						
TOTAL TECHNICIANS (2)						

10.4.3 OTHER SUPPORT STAFF: AGE	HEADCOUNT			OPTIONAL FULL-TIME EQUIVALENT (For Official Use Only)		
	M	F	Total	F	M	Total
Under 25 years						
25-34 years						
35-44 years						
45-54 years						
55-64 years						
65 years and more						
Unkown						
TOTAL OTHER SUPPORT STAFF (3)						

In-house R&D expenditure

SECTION 3
IN-HOUSE EXPENDITURE

THE DEFINITION AND CALCULATION OF IN-HOUSE R&D EXPENDITURE

OTHER CURRENT EXPENDITURE

Including – but not limited to:

- Direct project costs, project consumables and running costs linked to research such as materials, fuels and other inputs, including telephone and printing
- Subsistence and travel expenses
- Repair and maintenance expenses
- Payments to outside organisations for use of specialised testing facilities, analytical work, engineering or other specialised services in support of R&D projects carried out by this reporting unit
- Commission/consultant expenses for research projects carried out by this reporting unit
- The relevant % of indirect and institutional costs and utility costs such as rent, space charge, leasing and hiring expenses, furniture, water, electricity any other overhead costs
- The relevant % of labour costs of persons providing indirect services such as the Head Office, HR, Finances, security and maintenance personnel, staff of central libraries, IT departments

Excluding:

- Contract R&D expenses where the research project is carried out elsewhere by others on behalf of this reporting unit
- Payments for purchases of technical know-how (goodwill)
- Licence fees
- Depreciation provisions

- Where current expenses such as direct project costs and consumables are used solely for R&D, allocate the full cost of the items
- If these current expenses are used for more than one activity, include only an estimate of the portion used for R&D
- Only where such an estimate of the portion used for R&D is not available, such as indirect and utility costs, and labour costs of staff providing indirect services, it is advised that respondents apply the percentage time that researchers in the reporting unit spent on R&D to the total of these current expenditures.
- So if a Faculty income and expenditure statement shows that the current expenditure for indirect and utility costs and labour costs of staff providing indirect services for the year was say USD 1,700,000 and that researchers on average spent 22% of their time to R&D, then this component of R&D current expenditure may be estimated as 0.22 x USD 1,700,000 = USD 374,000

CAPITAL EXPENDITURE

The full cost of capital expenses must be reported in the year of purchase (do not depreciate).

Including – but not limited to:

- Expenditure on fixed assets used in the R&D projects of this reporting unit
- Acquisition of software, including license fees, expected to be used for more than one year
- Purchase of databases expected to be used for more than one year
- Major repairs, improvements and modifications on land and buildings

Excluding:

- Other repairs and maintenance expenses
- Depreciation provisions
- Proceeds from the sale of R&D assets

- Where a capital item is used solely for R&D, allocate the full cost of the item
- If the capital item is used for more than one activity, include only an estimate of the portion used for R&D. For example, a new equipment that will be used for R&D (included), testing (excluded) and quality control (excluded). For instance, if the intended use of this new equipment for R&D purposes maybe 40% of the total usage (i.e. the other 60% for other activities), only 40% of the total equipment cost should be considered as the relevant R&D expenditure.
- Only where such an estimate of the portion used for R&D is not available, apply the percentage time that Researchers in the reporting unit spent on R&D, to the cost of the item.

In-house R&D expenditure

Sources of funds

11 IN-HOUSE R&D EXPENDITURE

Compile expenditure on IN-HOUSE R&D during the Financial year MM/AAAA-MM/AAAA or AAAA.
Include expenditure funded from all sources: internal and external (contracts and grants) and undertaken by the reporting unit on its own behalf or for other parties.

PLEASE NOTE: Outsourced R&D should be reported under **Section 5**.

Purchase of equipment can, in theory, be classified as either capital or current expenditure. A distinction can therefore be made between "major" and "minor" equipment (to be included in "capital" and "current" expenditures respectively) by establishing monetary limitation. Another distinction may be the duration of intended use: e.g. current if consumed within one year. Please provide us with this limitation as used by your institution (FM 113-119, para 4.15 to 4.44):

INTRAMURAL COSTS *Depreciation should not be included in intramural expenditure totals, but should be reported separate*		**Local Unit Currency'000 Excluding VAT**	
11.1	**CURRENT COSTS**	**X = A + B**	.....
11.1.1	**Labour costs for internal R&D personnel** *From Question 10.2.1 From 10.2.2 if the funding arrangements require to put them under Labour costs*	**A**	.....
11.1.2	**Other current costs** *1. External R&D personnel from 10.2.2 2. Purchase of services, excluding external R&D personnel 3. Purchase of materials 4. Other, not elsewhere classified (e.g., general administration costs)*	B	.....
11.2	**CAPITAL COSTS** (See definition of capital expenditure and how to calculate R&D capital expenditure in previous paragraphs)	**Y = C + D + E + F**	.....
11.2.1	**Land and buildings**	**C**	.....
11.2.2	**Machinery and equipment:** Information and communications equipment, Transportation equipment, and Other machinery and equipment	**D**	.....
11.2.3	**Capitalised computer software** (costs of computer software used in the performance of R&D for more than one year, long-term licences included)	**E**	.....
11.2.4	**Other intellectual property products**	**F**	.....
11.3	**TOTAL INTRAMURAL COSTS (A + B + C + D + E + F)**	**Z = X + Y**	.....

Carry **Total Intramural Costs (11.3) over to Question 12**

12 SOURCES OF FUNDS FOR IN-HOUSE R&D

Based on funds used within your statistical unit to perform R&D during the reference period (financial year) of the survey, with internal budget or external financial interventions (contracts or outsourced by another organisation to realisation in your unit), it is important to fill the table with R&D Funding from the source below based on the breakdown of the total R&D expenditure - (FM 133) (NOTE: Only the proportion of the money actually SPENT is required, not the total income per source)

OWN AND EXTERNAL SOURCES SPENT ON R&D		**Local Currency Unit'000 Excluding VAT**	
12.1	**RECEIVED FROM BUSINESS SECTOR**	**A1**	.....
12.1.1	Own enterprise (internal funds)	**A11**	
12.1.2	Other enterprises in the same group	**A12**	
12.1.3	Other unaffiliated enterprises	**A13**	
12.2	**RECEIVED FROM THE GOVERNMENT SECTOR**	**B1**	
12.2.1	Federal/Provincial Government	**B11**	
12.2.2	State/Central Government	**B12**	
12.2.3	Other government sector bodies	**B13**	
12.3	**RECEIVED FROM HIGHER EDUCATION**	**C1**	
12.4	**RECEIVED FROM THE PRIVATE NON-PROFIT SECTOR**	**D1**	
12.5	**ABROAD or FOREIGN**	**E1**	
12.5.1	Business enterprises in the same group	**E11**	
12.5.2	Other unaffiliated enterprises	**E12**	
12.5.3	Government sector	**E13**	
12.5.4	Higher education sector	**E14**	
12.5.5	Private non-profit sector	**E15**	
12.5.6	International organisations	**E16**	
12.6	**SUBTOTAL OWN AND EXTERNAL SOURCES**	**F1**	

SECTION 4
CATEGORIES OF IN-HOUSE R&D EXPENDITURE

13 IN-HOUSE R&D EXPENDITURE BY TYPE OF R&D

Specify the percentage of:

a) **IN-HOUSE TOTAL R&D expenditure (both current costs and capital expenditure) by type of R&D, and**

b) **Total IN-HOUSE R&D CURRENT expenditure (labour costs and other current cost) by type of R&D.**

		a). Based on **Total Intramural expenditure** (Percentage)	b). Based on **only Current expenditure** (Percentage)
Basic Research	• Work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without a specific application in view • Analyses of properties, structures and relationships with a view to formulating and testing hypotheses, theories or laws. • The results of basic research are usually published in peer-reviewed scientific journals		
Applied Research	• Original investigation to acquire new knowledge with a specific application in view. • Activities that determine the possible uses for the findings of basic research. • 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 develops ideas into operational form. • Information or knowledge derived from applied research may be published in peer-reviewed journals or subjected to other forms of intellectual property protection.		
Experimental Development	• Systematic work using existing knowledge for creating new or improved materials, products, processes or services, or improving substantially those already produced or installed.		
TOTAL		1 0 0	1 0 0

Distribution of R&D expenditure

14 DETAILED FIELDS OF R&D (FoRD)

Classify R&D according to 2-digit Field of R&D with associated percentage expenditure (see Appendix A)

- The FoRD Codes are based on recognised disciplines and emerging areas of study.

FoRD Codes			Percentage	
FoRD				
FoRD				
FoRD				
FoRD				
FoRD				
FoRD				

FoRD Codes			Percentage		
FoRD					
FoRD					
FoRD					
FoRD					
FoRD					
FoRD					
Total			1	0	0

15 MULTI-DISCIPLINARY R&D

This item allows for the collection of R&D expenditure in multidisciplinary fields that are of special interest in your country.

- Multi-disciplinary R&D combines several research fields or disciplines. If your organisation performs such R&D, as described below, please provide the applicable percentage of total R&D Expenditure.
- Note that the percentages will most likely not total 100%.

Examples:
Biotechnology is application of science and technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.
Artificial Intelligence: Artificial intelligence (AI): simulation of human intelligence in machines programmed to think like humans with the ability of a computer or controlled robot to perform tasks associated with intelligent beings for further actions.

Multidisciplinary Area of R&D	Percentage of R&D expenditure
Biotechnology	
Blue Economy	
Artificial Intelligence	
Covid-19	

No Multidisciplinary R&D in these areas	☐	← TICK if no such R&D is done

SEO codes

16	SOCIO-ECONOMIC OBJECTIVES(SEO)

Making reference to Question 9 on the selected Socio-Economic Objective(s) followed by your unit in performing R&D, please associate the right percentage of R&D expenditure.

The SEO classification provides an indication of the main beneficiary of your R&D activities.

#	**Objectifs socio-économiques (OSE)** (FM 335)
1	Exploration and exploitation of the earth
2	Environment
3	Exploration and exploitation of space
4	Transport, telecommunication and other infrastructures
5	Energy
6	Industrial production and technology
7	Health
8	Agriculture
9	Education
10	Culture, recreation, religion and mass media
11	Political and social systems, structures and processes
12	General advancement of knowledge: R&D financed from general university funds (GUF 12.1 R&D related to Natural Sciences 12.2 R&D related to Engineering Sciences 12.3 R&D related to Medical Sciences 12.4 R&D related to Agricultural Sciences 12.5 R&D related to Social Sciences 12.6 R&D related to Humanities1
13	General advancement of knowledge: R&D financed from other sources than GUF 13.1 R&D related to Natural Sciences 13.2 R&D related to Engineering Sciences 13.3 R&D related to Medical Sciences 13.4 R&D related to Agricultural Sciences 13.5 R&D related to Social Sciences 13.6 R&D related to Humanities1
14	Defence

SEO Codes			Percentage	
SEO				
SEO				
SEO				
SEO				
SEO				
SEO				

SEO Codes				Percentage	
SEO					
SEO					
SEO					
SEO					
SEO					
SEO					
Total			1	0	0

Extramural R&D

SECTION 5
R&D OUTSOURCED / CONTRACTED OUT

17	R&D OUTSOURCED OR CONTRACTED OUT

17.1	During the reference Financial year of this survey, had you had at least allowed one R&D activity to be carried out on your behalf outside of your unit?	
Yes		**Please go to question 17.2**
No		**Please return the questionnaire.**

Outsourced R&D refers to:

- Outsourced or extramural expenditures being the amounts a reporting unit paid or committed to pay to another organisation for the performance of R&D during a specific period.
- This includes acquisition of R&D performed by and/or grants given to other organisations for performing R&D.

		Approximate Value LCU'000 (excl. VAT)
17.2	State details of R&D outsourced **locally**	
17.3	State details of R&D outsourced **abroad**	

THANK YOU FOR YOUR EFFORT AND TIME

Please make any suggestion that will help us to better understand the challenges you might have gone through in filling this questionnaire

THANK YOU FOR YOUR TIME AND EFFORT

Kindly provide your contact details in case we need to follow up with any specific issues

Postal address:
e-mail:
Phone:
Website:

Annexure: 2-digit Field of R&D (FoRD)

Annex A **Two Digit Field of R&D (FoRD)**

1 NATURAL SCIENCES

1.1 Mathematics
- Pure mathematics, Applied mathematics; Statistics and probability (Includes research on statistical methodologies, but excludes research on applied statistics which should be classified under the relevant field of application (*e.g.* Economics, Sociology, etc.)

1.2 Computer and information sciences
- Computer sciences, information science and bioinformatics (hardware development to 2.2, social aspect to 5.8);

1.3 Physical sciences
- Atomic, molecular and chemical physics (physics of atoms and molecules including collisions, interaction with radiation; magnetic resonances; Moessbauer effect); Condensed matter physics (including formerly solid state physics, superconductivity); Particles and fields physics; Nuclear physics; Fluids and plasma physics (including surface physics); Optics (including laser optics and quantum optics), Acoustics; Astronomy (including astrophysics, space science);

1.4 Chemical sciences
- Organic chemistry; Inorganic and nuclear chemistry; Physical chemistry, Polymer science, Electrochemistry (dry cells, batteries, fuel cells, corrosion metals, electrolysis); Colloid chemistry; Analytical chemistry;

1.5 Earth and related Environmental sciences
- Geosciences, multidisciplinary; Mineralogy; Palaeontology; Geochemistry and geophysics; Physical geography; Geology; Volcanology; Environmental sciences (social aspects to 5.7);
- Meteorology and atmospheric sciences; climatic research;
- Oceanography, Hydrology, Water resources;

1.6 Biological sciences (Medical to be 3, and Agricultural to be 4)
- Cell biology, Microbiology; Virology; Biochemistry and molecular biology; Biochemical research methods; Mycology; Biophysics;
- Genetics and heredity (medical genetics to be 3); reproductive biology (medical aspects to be 3); developmental biology;
- Plant sciences, botany;
- Zoology, Ornithology, Entomology, Behavioural sciences biology;
- Marine biology, freshwater biology, limnology; Ecology; Biodiversity conservation;
- Biology (theoretical, mathematical, thermal, cryobiology, biological rhythm), Evolutionary biology; other biological topics;

1.7 Other natural sciences

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering
- Civil engineering; Architecture engineering; Construction engineering, Municipal and structural engineering; Transport engineering;

2.2 Electrical engineering, Electronic engineering, Information engineering
- Electrical and electronic engineering; Robotics and automatic control; Automation and control systems; Communication engineering and systems; telecommunications; Computer hardware and architecture;

2.3 Mechanical engineering
- Mechanical engineering; Applied mechanics; Thermodynamics;
- Aerospace engineering;
- Nuclear related engineering; (nuclear physics to be 1.3);
- Audio engineering, reliability analysis;

2.4 Chemical engineering
- Chemical engineering (plants, products); Chemical process engineering;

Annexure: 2-digit Field of R&D (FoRD)

2.5 Materials engineering
- Materials engineering; Ceramics; Coating and films; Composites (including laminates, reinforced plastics, cermets, combined natural and synthetic fibre fabrics; filled composites); Paper and wood; textiles; including synthetic dyes, colours, fibres; (nanoscale materials to 2.10; biomaterials to be 2.9);

2.6 Medical engineering
- Medical engineering; Medical laboratory technology (including laboratory samples analysis; diagnostic technologies); (Biomaterials to be 2.9 [physical characteristics of living material as related to medical implants, devices, sensors]);

2.7 Environmental engineering
- Environmental and geological engineering, geotechnics; Petroleum engineering, (fuel, oils),Energy and fuels; Remote sensing; Mining and mineral processing; Marine engineering, sea vessels; Ocean engineering;

2.8 Environmental biotechnology
- Environmental biotechnology; Bioremediation, diagnostic biotechnologies (DNA chips and biosensing devices) in environmental management; environmental biotechnology related ethics;

2.9 Industrial biotechnology
- Industrial biotechnology; Bioprocessing technologies (industrial processes relying on biological agents to drive the process) biocatalysis, fermentation; bioproducts (products that are manufactured using biological material as feedstock) biomaterials, bioplastics, biofuels, bioderived bulk and fine chemicals, bio-derived novel materials;

2.10 Nano-technology
- Nano-materials [production and properties];
- Nano-processes [applications on nano-scale]; (biomaterials to be 2.9);

2.11 Other engineering and technologies
- Food and beverages;
- Other engineering and technologies;

3 MEDICAL & HEALTH SCIENCES

3.1 Basic medicine
- Anatomy and morphology (plant science to be 1.6); Human genetics; Immunology; Neurosciences (including psychophysiology); Pharmacology and pharmacy; Medicinal chemistry; Toxicology; Physiology (including cytology); Pathology;

3.2 Clinical medicine
- Andrology; Obstetrics and gynaecology; Paediatrics; Cardiac and Cardiovascular systems; Peripheral vascular disease; Hematology; Respiratory systems; Critical care medicine and Emergency medicine; Anaesthesiology; Orthopaedics; Surgery; Radiology, nuclear medicine and medical imaging; Transplantation; Dentistry, oral surgery and medicine; Dermatology and venereal diseases; Allergy; Rheumatology; Endocrinology and metabolism (including diabetes, hormones); Gastroenterology and hepatology; Urology and nephrology; Oncology; Ophthalmology; Otorhinolaryngology; Psychiatry; Clinical neurology; Geriatrics and gerontology; General and internal medicine; other clinical medicine subjects; Integrative and complementary medicine (alternative practice systems);

3.3 Health sciences
- Health care sciences and services (including hospital administration, health care financing); Health policy and services;
- Nursing; Nutrition, Dietetics;
- Public and environmental health; Tropical medicine; Parasitology; Infectious diseases; epidemiology;
- Occupational health; Sport and fitness sciences;
- Social biomedical sciences (includes family planning, sexual health, psycho-oncology, political and social effects of biomedical research); Medical ethics; Substance abuse;

3.4 Medical biotechnology
- Health-related biotechnology; Technologies involving the manipulation of cells, tissues, organs or the whole organism (assisted reproduction); Technologies involving identifying the functioning of DNA, proteins and enzymes and how they influence the onset of disease and maintenance of well-

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Annexure: 2-digit Field of R&D (FoRD)

being (gene-based diagnostics and therapeutic interventions (pharmacogenomics, gene-based therapeutics); Biomaterials (as related to medical implants, devices, sensors); Medical biotechnology related ethics;

3.5 Other medical sciences

- Forensic science
- Other medical sciences

4 AGRICULTURAL & VETERINARY SCIENCES

4.1 Agriculture, Forestry, and Fisheries

- Agriculture; Forestry; Fishery; Soil science; Horticulture, viticulture; Agronomy, plant breeding and plant protection; (Agricultural biotechnology to be 4.4)

4.2 Animal and Dairy science

- Animal and dairy science; (Animal biotechnology to be 4.4)
- Husbandry; Pets;

4.3 Veterinary science

4.4 Agricultural biotechnology

- Agricultural biotechnology and food biotechnology; GM technology (crops and livestock),livestock cloning, marker assisted selection, diagnostics (DNA chips and biosensing devices for the early/accurate detection of diseases) biomass feedstock production technologies, biopharming; agricultural biotechnology related ethics;

4.5 Other agricultural sciences

5 SOCIAL SCIENCES

5.1 Psychology

- Psychology (including human - machine relations);
- Psychology, special (including therapy for learning, speech, hearing, visual and other physical and mental disabilities);

5.2 Economics and Business

- Economics, Econometrics; Industrial relations;
- Business and Management;

5.3 Educational sciences

- Education, general; including training, pedagogy, didactics;
- Education, special (to gifted persons, those with learning disabilities);

5.4 Sociology

- Sociology; Demography; Anthropology, ethnology,
- Social topics (Women's and gender studies; Social issues; Family studies, Social work);

5.5 Law

- Law, criminology, penology;

5.6 Political science

- Political science; public administration; organisation theory;

5.7 Social and economic geography

- Environmental sciences (social aspects); Cultural and economic geography; Urban studies (Planning and development); Transport planning and social aspects of transport (transport engineering to 2.1);

5.8 Media and communications

- Journalism; Information science (social aspects); Library science; Media and socio-cultural communication;

5.9 Other social sciences

- Social sciences, interdisciplinary;
- Other social sciences

Annexure: 2-digit Field of R&D (FoRD)

6 HUMANITIES & ARTS

6.1 History and Archaeology

- History (history of science and technology to be 6.3, history of specific sciences to be under the respective headings); Archaeology;

6.2 Languages and Literature

- General language studies; Specific languages; General literature studies; Literary theory; Specific literatures; Linguistics;

6.3 Philosophy, Ethics and Religion

- Philosophy, History and philosophy of science and technology;
- Ethics (except ethics related to specific subfields); Theology; Religious studies;

6.4 Arts (arts, history of arts, performing arts, music)

- Arts, Art history; Architectural design; Performing arts studies (Musicology, Theater science, Dramaturgy); Folklore studies;
- Studies on Film, Radio and Television;

6.5 Other humanities

Source : OECD (2007 :6-11) & OCDE (2015 : 63)
https://www.oecd.org/science/inno/38235147.pdf

Annexure: International Standards Industrial Classification (ISIC) of All Economic Activities

Annex B	International Standard Industrial Classification (ISIC) of All Economic Activities

Nota Bene: Two versions of ISIC are included in this Appendix: first ISIC Rev. 3.1 followed by ISIC Rev. 4. However, each country can only use one based on the recommendation of its National Statistics Office.

Option 1	ISIC rev. 3.1

A AGRICULTURE, HUNTING AND FORESTRY
- 01 - Agriculture, hunting and related service activities
- 02 - Forestry, logging and related service activities

B FISHING
- 05 - Fishing, aquaculture and service activities incidental to fishing

C MINING AND QUARRYING
- 10 - Mining of coal and lignite; extraction of peat
- 11 - Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying
- 12 - Mining of uranium and thorium ores
- 13 - Mining of metal ores
- 14 - Other mining and quarrying

D MANUFACTURING
- 15 - Manufacture of food products and beverages
- 16 - Manufacture of tobacco products
- 17 - Manufacture of textiles
- 18 - Manufacture of wearing apparel; dressing and dyeing of fur
- 19 - Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
- 20 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
- 21 - Manufacture of paper and paper products
- 22 - Publishing, printing and reproduction of recorded media
- 23 - Manufacture of coke, refined petroleum products and nuclear fuel
- 24 - Manufacture of chemicals and chemical products
- 25 - Manufacture of rubber and plastics products
- 26 - Manufacture of other non-metallic mineral products
- 27 - Manufacture of basic metals
- 28 - Manufacture of fabricated metal products, except machinery and equipment
- 29 - Manufacture of machinery and equipment n.e.c.
- 30 - Manufacture of office, accounting and computing machinery
- 31 - Manufacture of electrical machinery and apparatus n.e.c.
- 32 - Manufacture of radio, television and communication equipment and apparatus
- 33 - Manufacture of medical, precision and optical instruments, watches and clocks
- 34 - Manufacture of motor vehicles, trailers and semi-trailers
- 35 - Manufacture of other transport equipment
- 36 - Manufacture of furniture; manufacturing n.e.c.
- 37 - Recycling

E ELECTRICITY, GAS AND WATER SUPPLY
- 40 - Electricity, gas, steam and hot water supply
- 41 - Collection, purification and distribution of water

F CONSTRUCTION
- 45 - Construction

G WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES, MOTORCYCLES AND PERSONAL AND HOUSEHOLD GOODS
- 50 - Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
- 51 - Wholesale trade and commission trade, except of motor vehicles and motorcycles
- 52 - Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods

Annexure: International Standards Industrial Classification (ISIC) of All Economic Activities

H HOTELS AND RESTAURANTS
- 55 - Hotels and restaurants

I TRANSPORT, STORAGE AND COMMUNICATIONS
- 60 - Land transport; transport via pipelines
- 61 - Water transport
- 62 - Air transport
- 63 - Supporting and auxiliary transport activities; activities of travel agencies
- 64 - Post and telecommunications

J FINANCIAL INTERMEDIATION
- 65 - Financial intermediation, except insurance and pension funding
- 66 - Insurance and pension funding, except compulsory social security
- 67 - Activities auxiliary to financial intermediation

K REAL ESTATE, RENTING AND BUSINESS ACTIVITIES
- 70 - Real estate activities
- 71 - Renting of machinery and equipment without operator and of personal and household goods
- 72 - Computer and related activities
- 73 - Research and development
- 74 - Other business activities

L PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY
- 75 - Public administration and defence; compulsory social security

M EDUCATION
- 80 - Education

N HEALTH AND SOCIAL WORK
- 85 - Health and social work

O WORK OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICE ACTIVITIES
- 90 - Sewage and refuse disposal, sanitation and similar activities
- 91 - Activities of membership organizations n.e.c.
- 92 - Recreational, cultural and sporting activities
- 93 - Other service activities

P ACTIVITIES OF PRIVATE HOUSEHOLDS AS EMPLOYERS AND UNDIFFERENTIATED PRODUCTION ACTIVITIES OF PRIVATE HOUSEHOLDS
- 95 - Activities of private households as employers of domestic staff
- 96 - Undifferentiated goods-producing activities of private households for own use
- 97 - Undifferentiated service-producing activities of private households for own use

Q EXTRATERRITORIAL ORGANIZATIONS AND BODIES
- 99 - Extraterritorial organizations and bodies

***Source*: https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev3_1e.pdf**

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Annexure: International Standards Industrial Classification (ISIC) of All Economic Activities

B2	ISIC rev. 4

A AGRICULTURE, FORESTRY AND FISHING
- 01 - Crop and animal production, hunting and related service activities
- 02 - Forestry and logging
- 03 - Fishing and aquaculture

B MINING AND QUARRYING
- 05 - Mining of coal and lignite
- 06 - Extraction of crude petroleum and natural gas
- 07 - Mining of metal ores
- 08 - Other mining and quarrying
- 09 - Mining support service activities

C MANUFACTURING
- 10 - Manufacture of food products
- 11 - Manufacture of beverages
- 12 - Manufacture of tobacco products
- 13 - Manufacture of textiles
- 14 - Manufacture of wearing apparel
- 15 - Manufacture of leather and related products
- 16 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
- 17 - Manufacture of paper and paper products
- 18 - Printing and reproduction of recorded media
- 19 - Manufacture of coke and refined petroleum products
- 20 - Manufacture of chemicals and chemical products
- 21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations
- 22 - Manufacture of rubber and plastics products
- 23 - Manufacture of other non-metallic mineral products
- 24 - Manufacture of basic metals
- 25 - Manufacture of fabricated metal products, except machinery and equipment
- 26 - Manufacture of computer, electronic and optical products
- 27 - Manufacture of electrical equipment
- 28 - Manufacture of machinery and equipment n.e.c.
- 29 - Manufacture of motor vehicles, trailers and semi-trailers
- 30 - Manufacture of other transport equipment
- 31 - Manufacture of furniture
- 32 - Other manufacturing
- 33 - Repair and installation of machinery and equipment

D ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY
- 35 - Electricity, gas, steam and air conditioning supply

E WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES
- 36 - Water collection, treatment and supply
- 37 - Sewerage
- 38 - Waste collection, treatment and disposal activities; materials recovery
- 39 - Remediation activities and other waste management services

F CONSTRUCTION
- 41 - Construction of buildings
- 42 - Civil engineering
- 43 - Specialized construction activities

G WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES
- 45 - Wholesale and retail trade and repair of motor vehicles and motorcycles
- 46 - Wholesale trade, except of motor vehicles and motorcycles
- 47 - Retail trade, except of motor vehicles and motorcycles

H TRANSPORTATION AND STORAGE
- 49 - Land transport and transport via pipelines
- 50 - Water transport
- 51 - Air transport
- 52 - Warehousing and support activities for transportation
- 53 - Postal and courier activities

I ACCOMMODATION AND FOOD SERVICE ACTIVITIES
- 55 - Accommodation
- 56 - Food and beverage service activities

Annexure: International Standards Industrial Classification (ISIC) of All Economic Activities

J INFORMATION AND COMMUNICATION
- 58 - Publishing activities
- 59 - Motion picture, video and television programme production, sound recording and music publishing activities
- 60 - Programming and broadcasting activities
- 61 - Telecommunications
- 62 - Computer programming, consultancy and related activities
- 63 - Information service activities

K FINANCIAL AND INSURANCE ACTIVITIES
- 64 - Financial service activities, except insurance and pension funding
- 65 - Insurance, reinsurance and pension funding, except compulsory social security
- 66 - Activities auxiliary to financial service and insurance activities

L REAL ESTATE ACTIVITIES
- 68 - Real estate activities

M PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES
- 69 - Legal and accounting activities
- 70 - Activities of head offices; management consultancy activities
- 71 - Architectural and engineering activities; technical testing and analysis
- 72 - Scientific research and development
- 73 - Advertising and market research
- 74 - Other professional, scientific and technical activities
- 75 - Veterinary activities

N ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES
- 77 - Rental and leasing activities
- 78 - Employment activities
- 79 - Travel agency, tour operator, reservation service and related activities
- 80 - Security and investigation activities
- 81 - Services to buildings and landscape activities
- 82 - Office administrative, office support and other business support activities

O PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY
- 84 - Public administration and defence; compulsory social security

P EDUCATION
- 85 - Education

Q HUMAN HEALTH AND SOCIAL WORK ACTIVITIES
- 86 - Human health activities
- 87 - Residential care activities
- 88 - Social work activities without accommodation

R ARTS, ENTERTAINMENT AND RECREATION
- 90 - Creative, arts and entertainment activities
- 91 - Libraries, archives, museums and other cultural activities
- 92 - Gambling and betting activities
- 93 - Sports activities and amusement and recreation activities

S OTHER SERVICE ACTIVITIES
- 94 - Activities of membership organizations
- 95 - Repair of computers and personal and household goods
- 96 - Other personal service activities

T ACTIVITIES OF HOUSEHOLDS AS EMPLOYERS; UNDIFFERENTIATED GOODS- AND SERVICES-PRODUCING ACTIVITIES OF HOUSEHOLDS FOR OWN USE
- 97 - Activities of households as employers of domestic personnel
- 98 - Undifferentiated goods- and services-producing activities of private households for own use

U ACTIVITIES OF EXTRATERRITORIAL ORGANIZATIONS AND BODIES
- 99 - Activities of extraterritorial organizations and bodies

Source: https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev4e.pdf

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Link to editable templates and tools that may be customised to purpose

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