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Making Data Meaningful

Part 4:

How to improve statistical literacy: A guide for statistical organizations

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Contents

Acknowledgements

Introduction

Statistical literacy: to comprehend the world

"Statistical Literacy" is the ability to understand and critically evaluate statistical results that permeate our daily lives—coupled with the ability to appreciate the contribution that statistical thinking can make in public and private, professional and personal decisions". - Katherine K. Wallman

 "Statistical literacy" is a term we use to describe the ability of a person or a group to understand statistics. For more than 30 years, researchers have been discussing this interdisciplinary topic in fields such as mathematics, statistics, education, psychology and linguistics.

It requires mainly mathematical and statistical skills, as well as the ability to interpret the figures and to distinguish between valid and invalid data. And it enables an individual to assess the information that figures provide and understand what the data reveal about the world.

What contributes to a person's ability to comprehend statistical information? The main factors would include educational background, literacy level, world knowledge and individual beliefs on mathematical and statistical issues, as well as how critical or accepting a person is of information coming from different public and media sources (Murray & Gal, 2002). Other factors could be "statistical anxiety" (Bradstreet, 1996) and "mathphobia" (Phillips, 1988), since most people associate statistical ability with mathematical ability.

Traditionally, we statisticians have been occupied with producing figures. Only recently have we started to consider that we can only communicate successfully with people who use our statistics if they can fully understand them. Statistical agencies have therefore been launching several initiatives to increase statistical literacy. The initiatives are aimed at scholars and students, journalists, decision makers in politics and businesses, and last but not least, the general public.

In this introductory chapter, we'll talk about the abilities included in the term "statistical literacy" and look at who the user groups are that need training.

Stage 1: Statistical numeracy: How much is 20 per cent?

Frequently we notice misunderstandings and misinterpretations of (official) data in media reports, in daily newspaper articles and in direct contact with our users. This weakness in quantitative skills is referred to as "statistical innumeracy".

Among the younger generations and in developing countries in particular, there's an increasing need to understand quantitative data and facts. Mathematical skills are a basic requirement for understanding statistics. Statistical numeracy requires a feel for numbers: an appreciation for levels of accuracy, the ability to make sense of estimates, awareness of the variety of interpretations of figures, and a judicious understanding of concepts such as averages and percentages. It's also basic to have a knowledge of statistical approaches and methods.

Although statistical numeracy is learned in schools or at university, it can't be taken for granted. In recent years, statistical institutions become aware of a global lack of statistical numeracy among the average population and we had to act upon it.

One main task of official statistics is to inform people about the development of the economy and society. To do this, we need to train people in interpreting the figures. We have many options for how and where to start. We could, for instance, cooperate more closely with the educational community.

In the following chapters, we'll describe best practices in teaching statistics.

Stage 2: Communicating statistics

More than statistical numeracy, statistical literacy includes the ability to read and communicate the meaning of data. Wherever you add words or pictures to numbers and data in your communications, people should be able to understand them.

Guides such as previous issues in the UNECE's *Making Data Meaningful* series (parts 1 and 2) set international standards that help to ease the understanding of statistics for an international audience.

As the volume of quantitative information increases, we need to simplify tables and charts. We should also offer comparisons, as many figures only have real meaning in relation to others. Providing additional and background information is also a useful contribution to successful communication.

Context. Good examples include context explanations or links that embed statistics into a topic of interest to the user. They rank or highlight important developments in graphs and tables.

Transparency. As well as knowing something about the quality of the data, users also need to know in particular about the legal framework of official statistics compared with, for instance, market research institutes or untrustworthy providers of "data".

Stage 3: Discovering the use of statistics for professional and personal decisions

Getting users to appreciate the value of statistics is perhaps the most difficult and most fundamental step. Decision makers in businesses and politics may need support particularly at this stage. The general public are also important, as high-quality official statistics are an essential pillar of a democratic society.

Who are our user groups?

User groups can be defined by their level of knowledge and by the purpose for which they use statistics. Just as each group has different needs, the strategies that would benefit them will also be different. Three broad levels of statistical literacy can be applied to the user groups—basic, intermediate and advanced (ABS, 2007). These groupings help our organizations cater to actual needs and prioritize our efforts to ensure better long-term outcomes.

Basic. The individual will be aware of, understand and appreciate the type of study or data source used (survey, census or administrative data set), be able to find definitions of statistical terms and understand basic statistical measures and graphic representations of data.

Intermediate. The individual will understand and appreciate the limitations of the methods used, understand the more commonly used statistical concepts and terms (e.g. labour-force-participation rate), understand variability and uncertainty, and be able to interpret probability statements associated with sample estimates.

Advanced. The individual will be able to understand the more sophisticated statistical terminology, understand sampling errors and non-sampling errors, understand what constitutes a valid statistical study, make valid statistical inferences and critically assess claims made about the data.

Schools

Developing the statistical literacy of future generations. This group includes schoolchildren as the next cohort of "data generators" and "data users", and schoolteachers as facilitators. Integrating statistical concepts and reasoning from the elementary years through to secondary school should develop a population of critical thinkers and competent consumers of information. This should ultimately ensure social progress, good governance and solid business leadership.

Schoolteachers need to be able to teach statistical concepts and convey the importance of statistics. They also need to be skilled readers and interpreters of statistical information.

Third-level institutions

The client group within third-level institutions comprises students, teachers and lecturers in vocational and technical institutions, universities and across academia and research. Increasingly, employers are requiring their staff and new recruits to be able to understand statistical concepts, as well as to be able to analyse, interpret and evaluate statistical information. The shortage of people undertaking mathematical and statistical training is further compounding the problem; and this appears to be an international phenomenon (Chinnapan et al., 2007).

Third-level institutions have a responsibility to ensure that their graduates are fully equipped to deal with a burgeoning data age—that they can access, use, understand and appraise statistical information. Regardless of the academic discipline, statistical literacy should be considered basic. Many advocate the broader integration of statistics into all courses and support the development of statistical literacy as an interdisciplinary curriculum in the liberal arts (e.g. Schield, 1999).

Decision makers

Decision makers are the key client group for the information that our organizations produce. This group includes "commercial decision makers" in industry, business and trade and "political decision makers" such as policymakers, members of parliament and staff from agencies at all levels of government.

Decision makers need to be able to define the elements of the required data, know where to access the right sources and know whether the data are "fit for purpose". They also need to be able to critically appraise the information presented and analyse and interpret data. (ABS, 2008).

All these skills are needed for developing policy, guidance, confirming progress and monitoring outcomes in this age of evidence-based decision-making. This type of decision-making is important, as governments are publically being held accountable for policy outcomes.

Likewise, commercial decision makers increasingly need to be able to interpret statistical information so that they can make strategic decisions about investments and the direction of future growth.

Opinion leaders

Opinion leaders (e.g. journalists) have a duty to ensure that statistical information is used and reported correctly. The media are a powerful agent in the dissemination of statistics and presentation of facts. In today's world, people are increasingly relying on media sources for accurate facts and interpretations of the world.

> "The overwhelming majority of the public will never directly consult a national statistical agency or communicate with it directly. For most citizens, the news media—newspapers, radio and television—provide their only exposure to official statistics. Consequently, collaboration with the news media as an agency's 'gatekeepers' to the public is of great importance". (Smith, 2005, p. 1).

General community

General community refers to the public, with a focus on selected groups, especially owners of small businesses, disadvantaged groups (who don't fit into one of the other groups) and community organizations. With the proliferation of statistics in the media and on the Internet, people's ability to critically evaluate the information is fundamental to effective citizenship (Gordon & Nicholas, 2006).

Other groups

We also need to target two other distinct groups. These are the respondents and our own staff. And although these groups aren't necessarily data users, they're critical to the production of high-quality official data.

Respondents

Every statistical organization has to ensure the willing cooperation of respondents. But the survey environment is becoming increasingly challenging. Not only are respondents more difficult to contact and more heavily bombarded by public polling and market surveys, but there also appears to be a greater sensitivity to any intrusion of privacy.

By targeting our statistical-literacy activities towards respondents so that they understand the importance of data, we can get higher response rates, and respondents are more aware of why we're collecting the data.

One of our key objectives should be to increase trust in statistics and promote understanding of the importance of data to policy- and decision-making. Results from a survey on trust in the Australian Bureau of Statistics (ABS, 2010) show that individuals with greater knowledge of the Bureau also reported greater product trust in the Bureau, a better understanding of Census and the value of national statistics for policy and planning. The increased trust also led to better response rates.

Staff of statistical organizations

A statistical organization can't operate without first-rate people. The quality and vitality of our programmes depend on engaging the finest and most talented recruits and investing in continuous learning for all our employees.

Putting it all into practice

So how can we develop the statistical literacy of the user groups with all their different needs? The following chapters will provide some answers.

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I. Overview of initiatives

A. International Statistical Literacy Project

Mission

The International Statistical Literacy Project (ISLP) promotes statistical literacy worldwide http://iase-web.org/islp/. Created by the International Statistical Institute in 1991 as the "World Numeracy Project", the mission of this unique programme is to support, create and participate in statistical literacy activities and promotion around the world.

Up to now, the focus has been on young people, teachers and schools; but a future aim is also to develop adult statistical literacy and education of occupational groups such as media and libraries who pass on statistical information. Other important target groups are decision makers and the general public. The goal is to promote statistical literacy in all walks of life.

ISLP today

The ISLP approach is to do extensive networking and cooperation with various actors. The project has more than 80 country coordinators, whose main tasks are to improve statistical literacy and implement the ISLP plans in their own country or region.

The main idea of the project is to develop operation models that can be used in many countries and that should be applicable to both developed and developing countries.

On the project's website, you'll find useful links, including to teaching materials and information about ISLP activities. The project publishes a newsletter twice a year. It has also produced several presentations and articles, e.g. by the country coordinators. In 2008, the project published an online book *Government Statistical Offices and Statistical Literacy*.

It organized several events such as international statistical literacy competitions and best cooperative awards.

Competitions

- How to interpret statistics and graphs
- How to evaluate the reliability of statistics
- How are the statistics describing society produced?
- Where can I find statistical data when I need them?

These are the kinds of question that may come up in the International Statistical Literacy Competition, aimed at schoolchildren between the ages of 10 and 18. The main goal of the competition is to increase awareness of statistics among students and teachers throughout the world, to promote statistical literacy resources and to bring together people who are interested in statistical literacy in each country. Its objective is also to help students describe their environment with the help of statistics and to use statistics as a tool for making sense of their daily lives.

The competitions have three phases: (a) within schools; (b) winners from each school compete to be national champion and (c) national champions compete in the international final.

The ISLP organized three statistical literacy competitions:

2007. Pilot statistical literacy competition in Portugal.

2008-2009. The very first statistical literacy competition. This competition had three phases and was done in five languages without the use of computers.

2010-2011. The form of the third competition was a poster, prepared in teams of two or three. Teams were registered by teachers. This competition was divided into two age categories: students born in between 1992 and 1995; and students born in 1992 and younger. The aims of this poster competition were to:

- Work as a team
- Investigate real questions using data
- Use calculation and graphical skills
- Interpret statistical results
- Develop written communication skills.

Organizational structure

The project is composed entirely of volunteer activities. The operational structure is as follows:

- An executive, consisting of the ISLP director and two deputy directors. The executive's roles are: planning, coordination, liaison with the International Association for Statistical Education (IASE) and overseeing implementation of plans.

- An advisory board, consisting of IASE president (chair), the ISLP director, three IASE representatives, a representative of the International Association for Official Statistics, and a council member of the International Statistical Institute (ISI).

- Country coordinators. Their roles are to implement plans within their country or region, and provide information, liaison and suggestions to the ISLP executive. Country coordinators don't need to be members of ISI or its sections.

B. Dissemination and communication

As part of the work programme of the Conference of European Statisticians, a Steering Group on Statistical Dissemination and Communication organizes annual work sessions, supported by the UNECE secretariat. The Steering Group aims to promote good practices in dissemination and communication of information by statistical organizations. Its work focuses on issues such as:

- Communicating with the media
- Managing customer relationships and outreach

- Gathering and analysing feedback
- Statistical literacy
- Managing the dissemination and communication functions within a statistical organization.

The Steering Group produces the UNECE "*Making Data Meaningful*" series of practical guides. The guides are intended to help managers, statisticians and media-relations officers in statistical organizations use text, tables, charts, maps and other devices to bring statistics to life for non-statisticians.

C. Statlit.org

The primary goal of the independent website statlit.org is to present statistical literacy as an interdisciplinary activity. As such, it overlaps with quantitative reasoning, quantitative literacy, numeracy and statistical reasoning. The site features books, papers and activities related to statistical literacy—taken from a variety of disciplines. A secondary goal is to present statistical literacy as the study of statistics in everyday arguments.

The webmaster is Milo Schield, Director of the W. M. Keck Statistical Literacy project and Vice-President of the National Numeracy Network in the United States.

Meeting the needs of different groups

Numerous initiatives are aimed at developing statistical literacy across different target groups, and most of these can be summarized into the following two types of strategies: raising awareness and developing strategic partnerships.

Raising awareness

A fundamental statistical-literacy activity is to ensure that people are aware of the extensive data and statistics held by our statistical organizations and the importance of this information for effective decision-making.

We can use many strategies to generate public awareness and interest in national statistics and their practical application to everyday life. These range from increasing exposure of statistics in daily newspapers to producing electronic newsletters, alert mechanisms and blogs for specific target groups.

This may entail a cultural change for many of us, as well as developing skills for our statisticians to market their statistics and present data in ways that are relevant, interesting and accessible.

Cultivating interest in statistics from an early age will prove strategic to future successful outcomes. We need to become involved in running competitions for schoolchildren and in developing real-life case studies and activities to illustrate the practical applications of the statistics. This includes supporting student participation in international projects that focus on developing statistical capability.

Raising awareness of the importance of statistics for sound decision-making and social progress is critical to developing positive "statistical attitudes". *Brand Awareness* (Murray & Gal, 2002) is an important consideration for statistical

organizations to ensure that citizens and decision makers access and rely on their official data and reports rather than on other sources or on anecdotal information.

Developing strategic partnerships

We must establish relationships with key stakeholders to improve the information flow between producers and clients and ensure that data users can understand and apply the information (Head, 2008).

Ultimately, each of these client groups must be viewed as partners in developing statistical literacy. We should establish networks with our key client groups to facilitate greater interaction so that we understand their needs and how they operate.

Also, by forging strategic partnerships and alliances with other associated organizations, we can address the needs of specific target groups. For example, to increase the statistical literacy of schoolchildren we need to engage the whole education community: teachers, teacher educators, researchers and curriculum developers, as well as academics and government officials.

We must look for opportunities to maximize impact. For example, an effective means of ensuring long-term and widespread outcomes would be to influence school curricula in mathematics, science and geography to increase the focus on statistical content and statistical reasoning.

We should also consider supporting initiatives such as the ISLP and work in partnership with statistical societies such as the IASE. International sharing of experiences and resources, creating opportunities for international collaboration, facilitating broader discussion and research, will all serve to promote and develop statistical capability globally.

Increasing access to information

Statistical data need to be disseminated to the widest possible audience if maximum benefits can be achieved from the investment made in collecting and compiling the data in the first instance. Caricom (2004)

Making data accessible and relevant is the key to improving and promoting their use across target groups. Dissemination mechanisms and systems need to make it easy for users (e.g. practitioners, managers, policymakers and consumers) to access information. Effective dissemination depends on understanding the needs of the diverse user groups and then matching this with the appropriate medium and level of detail.

In disseminating our information, we need to ensure that it's clear and unambiguous. Reducing the "noise to signal" ratio—i.e. the amount of caveats and qualifications as opposed to the key messages and implications of the findings—would help governments make greater use of evidence in policy and decision-making (Davies, 2004).

Visualization is one means of presenting complex data in ways that are both engaging and easily understood. In this, the work of someone like Hans Rosling is exemplary. He developed Gapminder, which has changed the way data can be

presented. Documentary *The Joy of Stats*, (Rosling, 2010) demonstrates the creative and dynamic use of statistics to make sense of the world and explore changes over time and into the future.

To promote awareness of data and what they mean, we can now use an array of mechanisms and social media platforms such as YouTube, Twitter, blogs and wikis to communicate across different target groups and demographic profiles.

Developing and delivering statistical training

By providing training, information seminars on data sources and other didactic techniques, we can help our key client groups to better understand statistical concepts, processes and data applications for key client groups. Training for specific groups such as teachers or journalists can be an effective way to improve community levels of statistical literacy through their intermediary roles within other target groups.

Training can be presenter-based in a face-to-face setting, or short self-help online tutorials or e-learning course modules. But to be effective, it must match user requirements. "Just in time" training can also be built into online data access tools to provide users with key information at critical points in time.

Offering support services

Another mechanism we can employ to promote the statistical literacy of data users is to develop resources and materials, either online or hardcopy, to support the informed use of statistics. These materials can range from posters to information brochures or technical notes that accompany statistical reports. We can also produce information, guides, fact sheets and other learning resources to support the better understanding of statistics across a range of topics, statistical concepts, processes and purposes. Needless to say, we should tailor them to meet the specific needs of each client group.

Evaluating outcomes

To ensure that our strategies to improve statistical literacy across key target groups are achieving the desired outcomes, we need to be able to evaluate the impact of these strategies. So, how can we quantify an increase in the public's appreciation of the value of statistics?

To promote the uptake of knowledge and changes in behaviour and attitudes, we have to interact with the client groups to obtain insights into how effective our dissemination strategies are, and we must continuously modify the strategies to suit their purpose.

Summary

Our role as a statistical organization has been changing. It's no longer enough just to collect and produce statistics. To stay relevant and responsive, we need to understand the needs of our diverse user community, improve our dissemination processes, raise awareness of the value of these statistics and actively encourage their informed use.

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II. Educating the opinion leaders

We can find "opinion leaders" or "strategic information users" in the following sectors: media, world of politics, private sector, non-governmental organizations and academia.

Media

The media are high-impact distribution channels for the information we generate. Opinion leaders here use the following communication channels to share their ideas and opinions with their audiences: television, radio, printed media, and web services.

World of politics

The opinion leaders in the public sector have a direct impact on the public policymaking process and serve as a model to different groups in society. These users might also be producers of statistical information.

Private sector

The opinion leaders in the private sector are those large enterprises and business organizations that have a large impact on the economy of their countries.

Non-governmental organizations

The opinion leaders in this group are represented by trade unions of different sectors, political parties, civil associations, religious organizations, etc.

Academia

We also find strategic information users in research institutions, universities and think tanks.

After identifying the opinion leaders or strategic information users in all of these sectors, we should maintain an updated database that individually identifies the leaders in each sector as an action field.

A. Reasons for educating the opinion leaders

- To have direct contact and close interaction with them, and therefore have a better and dynamic process of crafting statistical information.

- To make them, as drivers of public opinion, channels of communication for the information we generate.

- To improve their decision-making by having quality, timely and relevant information.

- To get their feedback so we can provide better products and services to satisfy their needs.

- To position our organization as the provider of official statistical information as opposed to non-official data sources.

- To help them interpret and present data correctly.

B. How can we educate the opinion leaders?

Develop a free Strategic Information Users Training Programme to meet their information needs and familiarize them with the products and services that we offer.

Step 1. Design an ad hoc training programme by identifying and registering their general and particular needs by means of:

> Web services
> A call centre
> Information requests by email and letters
> Face-to-face communication

The Programme should be divided into basic and advanced programmes, based on these users' needs.

Example of topics that could be included in a Strategic Information Users Training Programme

Basic Programme:

> Statistical information available

> Handling the statistical organization's website

> Using the statistical organization's interactive data consulting tools

> Economic information database

Advanced Programme:

> Digital maps

> Data warehouse

> Business directory

> Industry classification system

Step 2. Select the people inside your statistical organization who have the right capabilities to educate the opinion leaders in each topic.

Step 3. Define the optimal format for the training programme (e.g. online or face to face).

Step 4. Create an annual training programme by scheduling these courses periodically, starting from the basic programme, moving on to more complex

topics that could include other products and services provided by your statistical organization.

Once you've developed the Strategic Information Users Training Programme, you should encourage these opinion leaders to participate by offering personalized presentations.

To formalize your relationship with the opinion leaders, you might consider signing a cooperation agreement with them.

Tools

Your website will serve as your main tool for training. It should therefore be kept up to date and take into account the feedback from the strategic information users.

You could also offer specialized opinion leaders direct access to their data warehouses, and possible access to microdata.

Other tools that you could offer as a service to opinion leaders include various platforms that you've developed to make data meaningful. For example:

- **Geo-referencing tools:**

Virtual Private Network, Internet, Web services
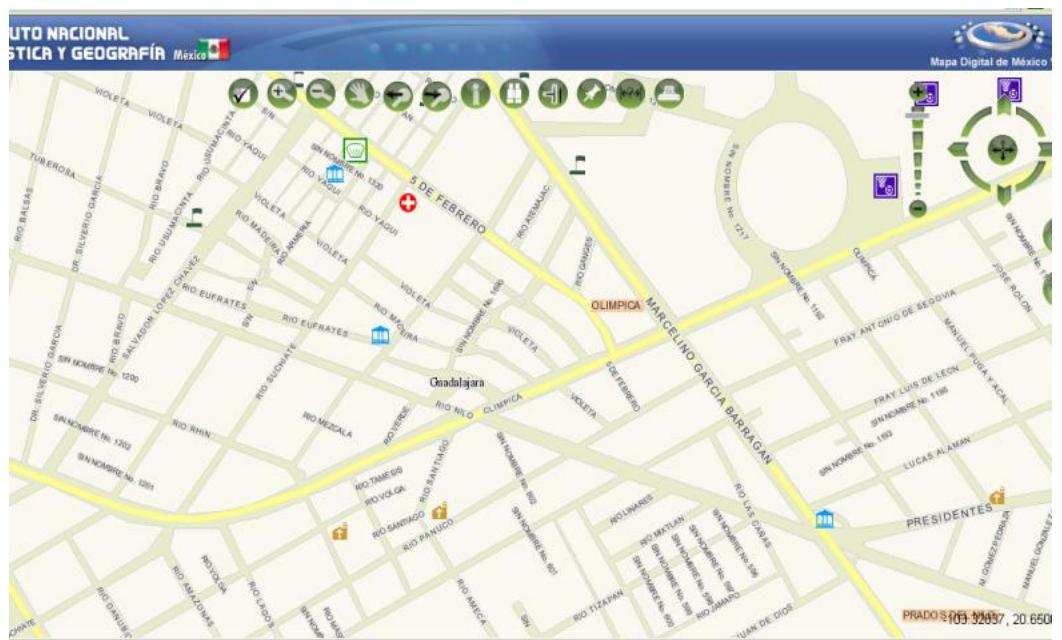
- Statistical data cubes (allowing multidimensional data analysis with multiple factors crafted for the requirements and needs of strategic information users).

Country

State

Region

Group of blocks

Block

2006   2007   2008   2009

Agroindustry

Services

Industry
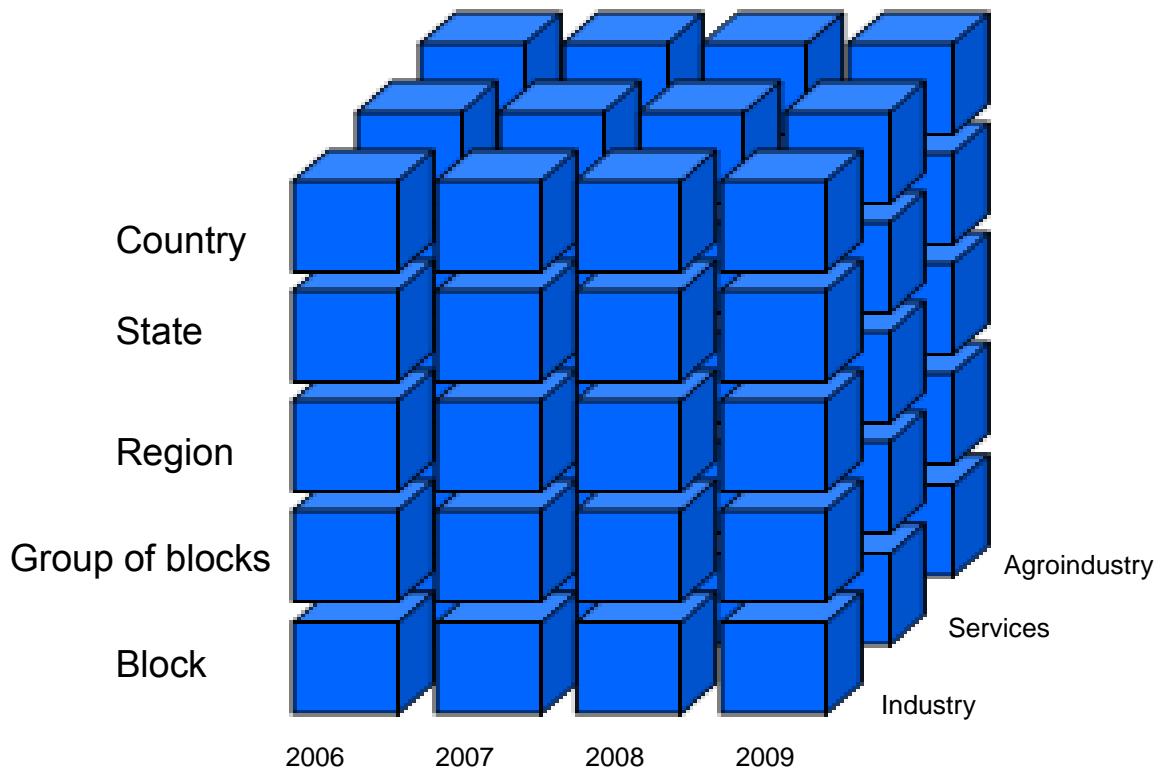
III. Improving the statistical literacy of decision makers

A. Who are the decision makers?

In this chapter we'll focus on "political decision makers" such as policymakers, members of parliament and staff of agencies at all levels of government.

Governments make decisions for public policy, and public policy determines the location of schools and medical services, the allocation of resources, the implementation of programmes and interventions, the direction of trade investments and so forth. As the decisions made today will affect our children tomorrow, those decisions should be based on reliable, high-quality information sources.

Our role, therefore, is to provide a responsive statistical service that supports the evidence required by governments for identifying issues, evaluating programmes, planning for the future and making informed decisions.

Political decision makers need to be able to access, use and understand statistics:

- **To identify and understand the issues**. Statistics are critical for accurately identifying economic, social or environmental problems and for developing a better understanding of these by analysing patterns in the data or trends over time.

- **To set the agenda.** Statistics provide a vital source of evidence to support decisions for new or altered directions and to establish the urgency of action.

- **To formulate a response.** Once an issue has been identified and recognized as important, a rigorous statistical analysis can help to formulate a response and assess the cost benefits and effectiveness of alternative response options. At this point it is necessary to define aims and goals clearly with quantifiable indicators for measuring success.

- **To set benchmarks**. Benchmarks are needed to measure progress.

- **To monitor and evaluate results**. Finally, statistical evidence in terms of quantifiable outcomes against established benchmarks is critical to the effective monitoring and evaluation of results.

The policymaking cycle (below) illustrates that information comes from many sources (government and non-government) and concerns all aspects of the decision-making cycle: from obtaining recognition of an issue to the design of policy, then monitoring implementation and evaluating impact.
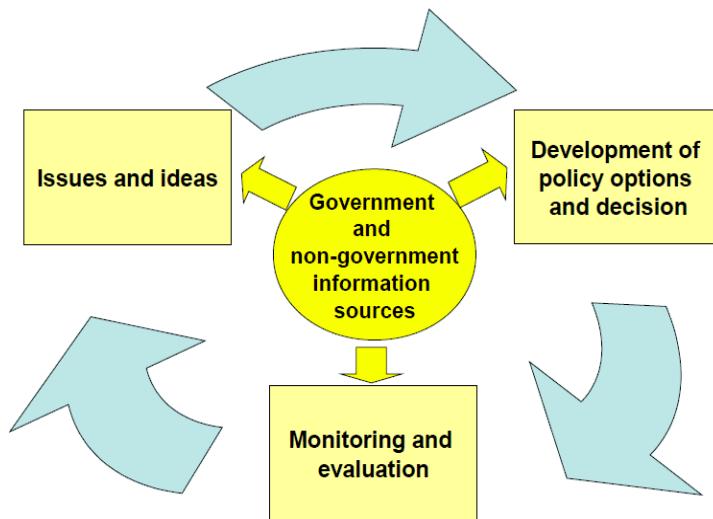
B. What decision makers need for using official statistics effectively

Although it has support, the application of evidence-based policy may be difficult. For instance, sources of evidence can come in many forms, both qualitative and quantitative, the required data may not exist, or there may be conflicting information from a range of sources. So, while statistics can provide clear, unbiased and undisputed numerical facts on an issue, alone they do not form evidence. They must be analysed and interpreted effectively.

Statistical literacy skills are vital for the informed use of statistics in decision-making. They can be summarized in terms of four broad criteria:

- Data awareness
- Ability to understand statistical concepts
- Ability to analyse, interpret and evaluate statistical information
- Ability to communicate statistical information.

Data awareness

By offering our expertise and working with government agencies, understanding their policy drivers and helping them to define their data needs, we can ultimately improve the decision-making process.

Defining data needs

Helping decision makers define the elements of **data need** before identifying **data sources** ensures a much better process for getting the right data.

Starting with the available data source and then using this as a basis to determine data need is a data-informed decision. But it risks missing key important points and is less likely to create innovative policy.

To define data need, you need to:

- Articulate the issue or area of investigation
- Identify the key population (i.e. demographic and geographic)
- Specify particular time frames being investigated.

Ability to assess data quality and "fit for purpose"
After their data needs have been defined, decision makers must then be able to identify suitable data and information sources to address that need.

Political decision makers must be able to assess the data to ensure these are suitable and of sufficient quality for the issue under investigation. Ensuring the **objectivity of evidence and its rigorous application** is essential to good use and ultimately good decision-making and policy.

From the perspective of official statistics, a number of criteria determine "fitness for purpose" (ABS, 2008) and decision makers need to be made aware of these. They include:

- Institutional environment
- Relevance
- Accuracy
- Timeliness
- Accessibility
- Interpretability

Coherence

Providing tools, resources and frameworks to assist decision makers assess data quality and fitness for purpose will facilitate evidence-informed policy. Resources such as the Australian Bureau of Statistics (ABS) Data Quality Framework: www.abs.gov.au/ausstats/abs@.nsf/mf/1520.0, which has been based on other international data quality initiatives, and the Data Quality Online Tool: www.nss.gov.au/dataquality/ are being actively promoted across government agencies in Australia as resources to help decision makers better understand the quality of available data.

Understanding statistical concepts

Fundamental to the ability to use statistics effectively in decision-making is the need to understand a number of statistical premises—including differences between a random sample and a census population, whether data collected are observational or experimental and if analysis is descriptive or inferential.

Another essential for data analysis and effective decision-making is the ability to read information presented in tables, graphs and maps and interpret the meaning and implications of statistical concepts such as percentage, ratio and variability.

Analysing, interpreting and evaluating statistical information

The ability to critically evaluate the statistical information presented, determine appropriate analytical techniques and identify when concepts have been applied

without proper statistical foundation are essential to using statistics in effective decision-making.

Decision makers need to be able to monitor and evaluate policy outcomes and options using statistical evidence as well as define reasonable and meaningful benchmarks to measure success.

Communicating statistical information

They also need to be able to communicate statistical information and understanding in a way that makes it real, relevant and meaningful to the audience and gives the data context and credibility. This involves drawing out the main relationships, causations and trends in the data and being able to report on progress towards the set benchmarks.

IV. How can a statistical organization support evidence-based policymaking?

We can help government clients make better use of official statistics for informed decision-making. We can, for instance, increase access to data and metadata; provide tools to assist in interpreting statistical information; develop statistical capability and work collaboratively to enhance understanding of needs and identify opportunities.

Increase access to statistical information

An important step in being able to use statistics to make informed decisions is being able to access data sets, metadata and information relating to the statistical context in which data are collected.

Making data freely available online greatly facilitates access to statistical information. Too often, however, data and statistical information are hard to find or are not presented clearly. Best-practice principles for accessibility include:

- Storing data in an open format that's not restricted to any particular product or technology

- Having a permissible copyright licence such as Creative Commons

- Ensuring strategies for keeping the data set up-to-date

- Having a website that's intuitive and easy to navigate, and that includes effective search tools to improve both data visibility and accessibility.

Develop communication channels

Government agencies need to be aware of the data that are available, and to have information on the uses and limitations of those data. Mechanisms for achieving this could include:

- Regular newsletters tailored to client needs and providing information about new statistical developments, publications, seminars, training and reviews; current and future statistical releases and feature articles illustrating the use of statistics.

- Web 2.0 technologies such as tweets, blogs, wikis and mash-ups that allow government clients to interact with information and keep up to date with national and international statistical releases.

- Specialized government web portal—allowing for a tailored approach to government clients for finding urgent and relevant information and resources.

- "Road show" presentations designed to raise awareness of the data and services that are available. These sessions can target client groups and their specific data needs, as well as enabling discussion.

Build statistical capability

Government client groups are increasingly asking for basic statistical training. Many statistical organizations provide courses on a range of statistical literacy skills and specialist learning opportunities. By offering training and resources that help decision makers understand the statistical process—from data collection through to data analysis, testing of assumptions and evaluation of results—we promote the use of statistical evidence in decision-making.

And where government agencies are also data custodians, there may be opportunities to develop capability in metadata management practices, improve data quality, capitalize on administrative data sources and facilitate data sharing within and across agencies. This is becoming increasingly important for addressing the range of multidimensional issues that are facing society.

Establish consultative forums

Our statistical organizations must stay relevant to government needs. One mechanism for demonstrating statistical leadership to achieve better outcomes is through establishing advisory or consultative forums. These should be chosen to represent a broad cross-section of perspectives across government, business and academia in order to provide advice on key policies likely to affect statistical priorities.

They can also help assess the relative merit of statistical programmes, the adequacy of statistical services, and external pressures that might affect statistical activities.

Establishing collaborative forums for consultation between government agencies and statistical organizations encourages dialogue within and between agencies on strategic statistical issues, operations and processes.

Provide outpostings to government agencies

A tangible way to help bridge the gap between policy and research is by out-posting statistical staff to government agencies. The outposted officer can provide statistical leadership in the host organizations, promote wider awareness, understanding, access and use of official statistics, and also increase the capability for research and analysis within departments.

These outpostings can help statistical organizations to better understand emerging policy issues and statistical requirements of government, promote and implement statistical frameworks and standards that allow comparisons across agencies, and help maintain professional relationships and engagement with other agencies.

Organize conferences

We can also promote understanding of the statistical landscape by holding regular conferences that bring together key statistical partners, both nationally and internationally. Such forums help promote mutual understanding and enable decision makers to develop effective policies and strategies, as they:

- Increase awareness of the importance of statistics
- Demonstrate the effective use of data
- Strengthen the infrastructure and use of data
- Promote better collaboration for sharing and maximizing the use of statistics.

Provide statistical leadership

We can work closely with government decision makers to promote the value of data as a "statistical resource" and develop mechanisms that maximize the potential of data to explore complex issues. We can offer the expertise necessary to initiate dialogue and investigate opportunities to increase the potential for using statistical information for evidence-based policy and decision-making, such as:

- Statistical data integration—linking social, economic and environmental data sets
- Identifying and developing nationally important data sets
- Coordinating agreement on high level principles for improved data use and outcomes
- Improving access to domestic and international statistical information.

The strategies already discussed also offer us opportunities to continually build a strategic relationship with government decision makers, and to help position our organization in the minds of the government as the first organization they'll consult with when considering developing their statistical capability.

To position ourselves as a strategic partner with government in relation to statistical issues (with government being both a data producer/custodian and data user), we need to have a strategy in place where government officials can understand how we can support them in their strategic data-driven initiatives. We also need to have in place resources and expertise to respond to those strategic opportunities to provide statistical leadership.

Conclusion

Increasing opportunities for communication, collaboration and consultation are the most effective means for us to understand political drivers and provide the necessary advice, assistance and support for evidence-based decision-making.

We need to leverage these opportunities to be involved from the onset in important discussions relating to statistical infrastructure or capability issues rather than be perceived as an online shopping catalogue of data sources.

We can play a vital role in providing a responsive statistical service and supporting the statistical needs of political decision makers. This includes not only developing an understanding of available information and how it can be used, but also working towards a coordinated and integrated statistical system that promotes evidence-based decision-making.

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V. Statistical literacy for the education community, including how to influence curriculum development

The teaching of statistics is one of the most important instruments for improving statistical literacy. In many countries, it's included in the mathematics curricula of primary and secondary schools.

Initial topics (gathering and organization of data, data representation and interpretation, measures of central tendency and probability calculation) are taught in primary school. In secondary school, students might be introduced to more elaborate concepts such as inductive statistics.

Recent reflexions on the usual introductory courses in statistics lead us to the introduction of projects that take advantage of the complementarity in relation to the classic concept of the lesson, satisfying the new paradigms of teaching statistics.

Data collection and analysis is at the heart of statistical thinking. Data collection promotes learning by experience and links the learning process to reality (Snee, 1993). Developing the students' statistical reasoning consists in incorporating active-learning strategies that make it possible to complement what they have already heard and read on statistics.

One of the main advantages of using data and projects (with oral and written reports) as a supplement to theoretical lessons is that students take an active part (Smith, 1998). It also allows you to show them the power, elegance and beauty of statistical reasoning and involves making interpretations based on sets of data, graphical representations and statistical summaries. Much of statistical reasoning combines ideas about data and chance, which leads to making inferences and interpreting statistical results.

In this chapter, we analyse the importance of statistical literacy for the education community and suggest improvements for curriculum development. We compare different approaches to teaching and make a short review of the curricula in three different countries—the United States of America, England and Portugal. We also bring in the paradigms of the teaching of statistics.

We then present the power of statistical projects as the basis for statistical thinking and reasoning. After that, we introduce an idea about who should influence the development of the curriculum in statistics. We explore the importance of statistical training for teachers, as well as tools and materials for the education community. We then present the conclusions.

A. Statistics education: an overview

Statistics education has been seen in a variety of perspectives. Ponte and Fonseca (2001) recall that in England, statistics was included in the curricula of secondary school mathematics in the late 1950s, closely linked to the study of probability and oriented to the theory (with special emphasis on the study of hypothesis testing). Later, it was included in primary-school curricula, focusing on graphical forms of representation and on central location measures (Holmes, 2000).

In the late 1970s, a major curriculum-development project appeared in England, where statistics was essentially viewed as "working with data". The guidelines for this project were to be fully considered in the so-called "Cockcroft report" (Cockcroft, 1982) which, in turn, came to constitute a decisive influence on the English National Curriculum. Later, this approach also became notable in the curricula of other countries.

Several countries made changes in their curricula to adapt mathematics to meet statistical literacy. Ponte and Fonseca compared different approaches to the teaching of statistics in Europe and highlighted three major trends:

- Emphasis on the process of data analysis from the perspective that this science is used in society, taking into account that the use of data is part of everyday life (mainstream in countries such as England).

- As a chapter of mathematics, sometimes referred to as "stochastic analysis", emphasizing conceptual or computational approaches (for example, in France).

- As an auxiliary tool for the study of various topics and school subjects, including geography and biology (this trend is visible in Sweden, for example).

In their work, Ponte and Fonseca focused on the curricula of the United States, England and Portugal, and saw the following as the main similarities and differences:

Exploratory data analysis

- American and English curricula point to the importance of understanding the characteristics of a global data set, whereas the Portuguese focuses much on measures of central tendency (mean, mode, median) by the end of the third cycle.

- Comparisons between two or more sets of data are emphasized by the National Council of Teachers in Mathematics (comprising the United States and Canada) starting from the second stage of elementary school curricula, whereas Portuguese and English do that in the third cycle.

- In secondary education, the National Council calls for a more or less in-depth study of bivariate data (including linear, exponential, quadratic functions -

that best fit a given data set), whereas Portugal only suggests an intuitive graphical approach of two-dimensional distributions.

Inference

American and English documents emphasize the need to draw conclusions from the second phase of the elementary school and "key stage" 2, while other countries refer to it in the third cycle. The curriculum of many countries makes no reference to the development of inferences (although the National Council and the English programme advocate the development of concepts of statistical inference in some phases of the elementary school and later).

There's a lack of consensus about introducing inferential aspects in the curricula of elementary and secondary schools. This is because the teaching of statistical inference is usually preceded by the introduction of essential concepts (e.g. random samples, estimator theory, hypothesis testing), for which some mathematical background is needed. However, students should understand, from middle school, the use of samples in order to draw conclusions to populations.

Roiter and Petrocz (1996) also analysed the curricula of several introductory courses in statistics. They claim that there are four paradigms in teaching statistics: statistics as a branch of mathematics; as data analysis; as experience planning and as a problem-based matter.

Ben-Zvi and Garfield (2004) note some challenges that teachers face in teaching introductory courses in statistics. Therefore, if data aren't structured, this may hamper the interpretations based on different assumptions.

B. Main challenges

It's essential to adopt the paradigm of "statistics as a problem-based matter". This perspective allows one to organize the course as a series of applied problems that could be taken from the news or problems with a statistical content found in the mass media.

The Curriculum and Evaluation Standards for School Mathematics of the USA, published in 1989 (NCTM, 1989) introduced rules on probability and statistics for all levels of education. On the basis of these, the current guidelines on teaching mathematics recommend a strong development of content, concepts and procedures which should acquire a greater degree of development, so that at the end of secondary school, students have a sound knowledge of basic statistics.

To understand the fundamental ideas of statistics, students should work directly with data (Campos and Oliveira, 2010). Analysing the data and studying probabilities will provide them with a natural environment to set up connections between mathematics and other subjects and their everyday experience.

Happily, in recent years, the teaching and learning of statistics has become more practical and interactive. One reason for this is that the paradigm of statistics pedagogy has changed in the last two decades. Statistics is more than a branch of mathematics supported by data analysis: it involves experience planning and

problem-based matters that need careful thinking and reasoning (Garfield, 2002, Garfield and Gal, 1999, Moore, 1992, 1998).

The failure of many introductory courses in statistics has led certain authors to the belief that the courses should be redirected—from mathematical technique to data analysis (Oliveira *et al*, 1999). There are also those who defend changes in teaching methods, replacing passive lessons with lessons in which the students take an active part.

As a supplement to theoretical lessons, the use of a sequence of collaborative projects with oral and written reports on the results obtained is one of the solutions tested (Smith, 1998). To demonstrate the power, elegance and beauty of statistical reasoning, if you use a wide variety of realistic examples, you can persuade students that they're using critical thinking skills that may be applied on a daily basis and in any profession.

Many authors have discussed the advantages and disadvantages of comparing the data produced by the students with the analysis of data produced by others. The problem with examples produced by others is that the students remain passive and don't experience firsthand the questions and problems that arise from collecting and analysing data.

It's better, therefore, to let the students manage their own data. Activities in the form of a project give them experience in formulating questions, defining problems, and formulating hypotheses and operational definitions. The students also learn how to plan experiments and surveys, collect data and, how to best deal with measurement errors, draw up data summaries, analyse them, communicate results, plan experiments and correlate the ideas suggested by the discoveries.

Learning by doing should be supplemented by the written and oral presentation of results. Writing about a subject can reinforce understanding. Presentations should include the goals, details about data collection, inferential processes and questions or reservations concerning the conclusions.

We believe that projects create the conditions necessary to improve statistical literacy, as they enable the interaction and proactively reinforce the understanding of statistical concepts.

C. Ideas, tools and materials to influence curriculum development

Who takes part?

Curriculum means different things to different people. Andy Begg (2004) argues that there are situations where it means the official curriculum, the planned curriculum, the school scheme, individual teacher's lesson plans, or textbooks. He presents an idea about who should influence the development of the curriculum in statistics. He includes statisticians, teachers, employers, socials scientists and students as possible "voices" that contribute to curriculum development.

Table 1. Interested groups and their possible contributions[1]

Statisticians	Ensure school statistics accurately reflects professional practice
Employers	Ensure that future workers will be statistically literate
Parents	Address needs of citizenship in an information-filled age
Other teachers	Ensure that statistical needs in other subjects are met
Social scientists	Ensure the cultural acceptability of curriculum ideas
Learners	Ascertain whether the curriculum is meaningful for them

We suggest two additional voices in this set: the employees and ourselves, the statistical organizations. Former students that are now our employees constitute active voices by suggesting new ideas for curriculum development. They probably know what statistical concepts they need to manage in their actual tasks. As statistical organizations, we can also act as contributors, since we already offer tools and materials to encourage the improvement of statistical literacy, as we'll see later in this chapter.

Among all these voices, teachers play a very important role. It is therefore essential to reflect on how they should be taught.

Teaching teachers

According to Branco (2000), we need to be aware of the difficulties and successes that teachers and students experience in teaching and learning statistics.

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[1] Begg, 2004

Quintas, et al (2009) conducted a survey where it was found that teachers recognize the need for training in statistics, especially with regard to the realm of didactic knowledge.

Example

Several educational courses were subsequently created (Peck and Gould, 2005). INSPIRE (Insight into Statistical Practice, Instruction and Reasoning), comprising both a face-to-face component and a significant online component, was a year-long course for secondary school teachers of statistics. It was designed jointly by the American Statistical Association and two universities (California Polytechnic State University and University of California, Los Angeles). A grant from the National Science Foundation supported course development and course delivery for the first two years.

The main goal of the project was to create a unique professional-development experience for secondary-school teachers that would:

- provide them with the necessary background to teach introductory statistics

- help them to incorporate real data, active learning and technology in teaching introductory statistics

- provide access to a variety of resources for teaching statistics

- create a community of learners who would advise and support each other in matters of classroom practices, pedagogy and understanding of statistical concepts.

Tools and materials

Nowadays, resources are available worldwide at the click of a mouse. Many statistical organizations have developed clear educational strategies. Statistics Canada, for instance, developed several resources such as access to a selection of electronic data, and a page with the statistical profile of Canadian communities. They also provide learning resources for teachers and students, and have a "Kids' zone" in their web page.

Other organizations, such as the Australian Bureau of Statistics also have web pages intended for secondary-school teachers and students. Statistics New Zealand includes the "Schools corner", where you can find applications built to provide a flexible way of visualizing the complex tables that result from the Census of Population.

In the United Kingdom, the Office for National Statistics has an education strategy that includes the creation of a group made up of people from the Office, teachers, assistants, students and trade associations with a view to contributing towards bringing the Office and schools closer together.

In Portugal, a project called ALEA (Local Action of Applied Statistics) aims at providing both teachers and secondary-school students with teaching materials for the study of statistics.

Conclusions

The teaching of statistics in elementary and secondary schools is one means of improving statistical literacy. The paradigms of teaching statistics have been changing over the years.

Statistics is now being seen as a problem-based matter, which implies that statistical methods are used to organize the course as a series of applied problems that could very well be taken from news items with a statistical content found in the mass media. Therefore, data collection and analysis is the heart of statistical thinking and reasoning because it promotes learning by experience.

In order to contribute to and influence curriculum development, we suggest that employees and statistical organizations, as well as statisticians, teachers, employers, social scientists and students, should get involved.

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VI. Statistical literacy for respondents, businesses and the general public

General public

For a better society, citizens need to be literate. And numeracy is now considered a key element of literacy. After arithmetic, which is used for regular financial transactions, statistics is the component of functional numeracy with which the general public has the most contact. Every day, adults receive political, commercial, financial and ethical messages that are connected to statistics. We, the national statistical organizations, produce many of those statistics.

We tend to rely heavily on journalists as intermediaries to capture the attention of the public and to popularize statistical studies, making our facts and figures relevant and understandable by incorporating them into human-interest stories. The duty to acquire the skills to evaluate media stories critically, however, rests directly with our citizens. Author H.G. Wells noted over 70 years ago: "Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write." This prediction has become true in our time.

Responsible citizens shouldn't be afraid of numbers or statistical terms. But they should be able to understand clearly why statistical information is needed, how reliable statistics are gathered, what's meant by basic statistical ideas such as averages and how to interpret graphs and charts that appear in the media.

Citizens need to be statistically literate so they can think critically, challenge the veracity of numbers in the media and correctly interpret an article or debate that is based on statistics. Some of these skills are being taught at school, as statistics has become integrated into the mathematics curriculum from the earliest grades. School training, however, has long-term outcomes, as the students of today become the citizens of tomorrow. Educators should not be expected to shoulder alone the statistical literacy development of future citizens.

Also, today's adult public may have missed out on a statistical education when they were at school. They need to know more about how studies are conducted and data are analysed in order to comprehend the terms that media use in describing the results of studies. We, as statistical organizations, can lend timely support to this public education.

Promote statistical literacy

Our mandate is to provide official statistics that so that governments, businesses, communities and individuals can make informed, evidence-based decisions. We provide this service by offering access to reliable, relevant data. Most of our organizations have made their websites their primary distribution mechanism.

With new technologies—including robust search engines, dynamic publishing, animated data display and data visualization, and with hyperlinks to metadata, paradata and definitions—the public has direct access to massive amounts of official information online. While media continue to be a key and trusted distributor of our data, we can also proactively share our considerable statistical

expertise directly with the general public. We can improve public statistical literacy by enabling a better understanding of statistical concepts so that citizens may get more value out of the data we collect and distribute and be better informed and participate more fully in societal debates.

Helping people develop an awareness of the importance of statistics and how they can be applied to their advantage is the first step in statistical literacy. Citizens should be able to understand how official information is used to monitor the tremendous changes happening, the challenges our world is facing and the impact those changes have on each and every one of us.

Explain why statistics are needed

We should build awareness through materials that explain how timely statistics help citizens understand their country. Many groups depend on statistical information. Unions negotiate collective agreements using statistics on average salaries of various occupations in different industries. Advocacy groups arm themselves with statistics to press for change and to keep business and governments accountable, for example, in the area of greenhouse gas emissions and international commitments. Educators follow the latest statistics on topics in their field to shed light on emerging trends.

Governments monitor the changing picture of the country's economy, society and environment. They use statistics to design, evaluate and improve their programmes and policies. For example, a government needs to know the number of seniors and children in order to plan financial assistance programmes and services such as senior citizens' homes, schools and day-care centres.

Informed decision-making depends on the accurate and objective information that we collect and disseminate.

In practice, informed decision-making can save a lot of money—for example, by helping to target government spending accurately. It can also lead to lifesaving breakthroughs in medicine, and can help conserve the earth's natural environment. By becoming aware of the importance of statistics to their daily lives and able to access relevant information in an understandable format, people will come to understand better the numbers that statistical organizations produce.

Encourage public understanding of numbers

Every major data release we publish should include analysis, charts and tables that tell the story in the numbers, as well as information on methodology that explains how the data were collected. Data releases should explore relationships, causes and effects, and place significant findings in the context of long- and short-term trends and of the broader economic or social environment.

We can gently introduce the public to the basic terms and concepts used in the world of data by pointing them to definitions and supporting resources. Several statistical organizations have sections of their websites that support public statistical literacy and explain statistics: an excellent example is the Australian Bureau of Statistics (ABS) section called *Understanding Statistics.*

www.abs.gov.au/websitedbs/a3121120.nsf/home/Understanding%20statistics?op
endocument#from-banner=LN

Here you can find information on *Why Statistics Matter*, *Frequently Asked Questions*, a *Blog* about statistics, *Statistical Language* definitions, *Video Tutorials* that explain how to use ABS information and an online course *An Introduction to Statistics,* which covers basic concepts and principles.

The first World Statistics Day in October 2010 was the driver for other organizations to produce online products that make the public more aware of statistics. Here are some examples:

From Statistics Canada, *Statistics are Important!* is produced primarily for the student market. www.statcan.gc.ca/edu/edu06/edu06f/edu06f_0003-eng.htm

Through interviews with international statistical experts, answers are given to questions such as "What's the use of statistics?", "Why learn with statistics?" and "What is statistical literacy?" Information about Careers in statistics is offered, as well as links to Statistics: Power from Data, an online resource that explains the steps in producing data—from collection to analysis to display—with examples and lessons.

From the United States Bureau of the Census, an animation *The Great Apportionment Machine* explains how Census data are important and used in the apportionment formula to ensure equal representation for all citizens in their political system.   http://2010.census.gov/mediacenter/census-data/census-apportionment-machine.php

Products that explain statistics

From Finland: E-Course in Statistics:

http://tilastokeskus.fi/tup/verkkokoulu/index_en.html

From Italy: *The Worth of Data* http://www.istat.it/servizi/studenti/valoredati/

From Japan: *Welcome to the World of Statistics*, a video

www.stat.go.jp/kids/teacher/video/html2/video.htm

From Eurostat: *Statistics Explained,* a guide to European statistics

http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Main_Page

As people learn to better understand and use data, they can also provide informed feedback about data-collection activities in their community. Their feedback helps in understanding the context in which data are collected and disseminated.

Many if not most of our statistical organizations are using technology to do online consultations with the public. We network and have interactive discussions through blogs and social media.

Respondents

A positive public image is created through the broad dissemination and analysis of "official" statistics, provided they are relevant, accurate, neutral and easy to use. This positive image helps to secure stakeholder support for the continuation of statistical programmes and to promote the collaboration of survey respondents.

As statistical organizations, we have an interest in creating an appetite for our data and helping citizens learn how to interpret and use data. Statistically literate citizens will recognize that timely and accurate survey responses are linked to more relevant data outputs, which in turn support the policies and programmes that affect their daily lives.

Public statistical education promotes a better understanding of the statistical system so that people will become more willing to respond to surveys. Many of our statistical organizations wouldn't be in the business of producing and distributing data without the cooperation of survey respondents and other partners.

When an agency collects information from the public, its website should include a section that tells survey respondents about the importance of their participation. An example from Statistics Canada, including a very friendly video explaining the importance of survey participation, can be found at:

www.statcan.gc.ca/survey-enquete/index-eng.htm.

But the survey environment is becoming increasingly complex. Not only are respondents more difficult to contact and more heavily inundated by public polling and market surveys, but there appears to be a greater sensitivity to any intrusion of privacy. For this reason, we must explain privacy and confidentiality practices in detail. We can get higher response rates if we assure respondents of privacy and confidentiality and if we inform them fully about why we're collecting the data—especially for surveys that are likely to have a direct impact on their lives or the well-being of their community.

For example, surveys with high response rates, such as those about health, literacy and child development, typically have good respondent relations materials and are supported by community groups and associations.

We can often obtain considerable goodwill from respondents when associations publicly support and justify our surveys and help disseminate their findings. This active support is crucial, given the privacy-sensitive environment and the requirement that the information be relevant to a significant programme, policy or research issue. Outreach and relationship-building with associations or cultural groups can be undertaken through providing seminars, talks, and workshops and tailored communication materials.

Explain the why and how of data collection

Explaining to survey respondents why they should participate is the first step in their statistical awareness and can lead to more advanced statistical understanding.

It's good practice, and in many of our statistical organizations it's the policy, to provide all respondents with the following information before or at the time of collection:

- Purpose of the survey (including the expected uses and users of the statistics to be produced from the survey)

- Authority under which the survey is made

- Collection registration details

- Mandatory or voluntary nature of the survey

- Confidentiality and protection, any record linkage plans and the identity of the parties to any agreements to share the information provided by respondents.

In addition to the survey instrument (i.e. questionnaire or computer- or telephone-assisted interview script), you should provide the respondent with such materials as a letter of introduction, brochure, newsletter, questions and answers or online survey documentation.

The following is an example of a survey's statement of purpose for respondents. While this information may be provided in a letter of introduction or brochure, we recommend that you include it directly on the questionnaire as well; or, for telephone and personal interviews, that it be given verbally at the time of the interview.

> "This survey collects essential data to produce statistics on the construction industry and on the national economy. Aggregated industry information is used by private industry participants and trade associations for performance measurement and market development and, in addition, is required by governments for national and regional economic programs and policy planning.

> "While participation in this survey is voluntary, your cooperation is important to ensure that the information collected in this survey is as accurate and as comprehensive as possible".

Statistical organizations should also highlight in a friendly way in all communications with respondents the availability of more information that explains the "big" statistics picture. For example:

You're sitting at home, or at the office.

It's quiet, it's calm, it's - perfect.

Suddenly - the doorbell rings, the phone sounds, or an email arrives out of the blue.

In fact, it's the statistical agency and we're going to spend the next few minutes helping you understand why this is good news.

Imagine being the person who has to decide these things:

- *Where to put that new school?*
- *Whether that new road should be two lanes or four lanes?*
- *How many police cars, ambulances, or park benches do we need?*
- *How will interest rates, salaries, prices, and other key financial indicators be calculated?*

Here are some suggestions for approaching this:

 ...We want a little of your time and a little of your information.

We need it so the government can make good decisions about you, your family, your community, and your work life as well.

We respect and value the time you give us, and we won't waste it.

We can also help support respondent relations and statistical learning if we:

- Return the results or numbers to survey respondents in a way that makes them easy to understand, such as in an analysis that highlights nuggets of information from among the mass of data collected.

- Give people information they can use, while letting them know what statistical organizations do. Some of our organizations distribute copies of press articles using data that they collected through previous surveys. Typically, figures reported in the press are analytical. By making repeated reference to the statistical organization as the source of this analytical information, we keep it in the public mind. During collection activities, people understand almost instinctively that this information is important if they see it used in a media article. Give them a copy of real articles.

- Develop and distribute good respondent materials that explain the importance of data and of respondent participation, on topics such as "The Why of Business Statistics", "The Fair Collection Practices" and "The History of the Census".

Example

The *Canada at a Glance* brochure [www.statcan.gc.ca/pub/12-581-x/12-581-x2010000-eng.htmpresents](http://www.statcan.gc.ca/pub/12-581-x/12-581-x2010000-eng.htm) contains current Canadian statistics on demographics, education, health and ageing, justice, housing, income, labour market, households, travel, national economy and finances, agriculture, international trade and the environment.

Used as a respondent-relations tool, this envelope-sized brochure serves as a reference for people who want quick access to current Canadian statistics and key international comparisons. It's included with paper questionnaires sent to respondents, and more than a million additional copies are printed every five years to support the collection of the Census.

To assist in reaching respondents, to develop their statistical literacy and to help them understand the statistical process, survey-support materials should clearly communicate the benefits of completing the surveys.

And when respondents use electronic reporting options, they should be linked directly to previously gathered data. In this way, they could compare themselves to the national or community-level summary results and see themselves as relevant to the data and data-collection activities and as part of the whole. Respondents who have an interest in knowing more about statistics could link to online learning materials developed for the general public.

As a statistical organization, our prime assets are our credibility, relevance and visibility. High visibility and positive media coverage reinforce credibility, which in turn motivates respondent participation. Consider every communication directed to survey respondents as an opportunity to encourage a better understanding of the statistical system and its outputs, and to highlight the importance of statistical programmes.

Business

In today's global economy, data are increasingly the lifeblood of business. They're used for strategic planning, new market exploration and expansion. Business people need up-to-date statistics on how industries work and on the goods and services they produce. They need demographic statistics to determine the right location for a new business and to help reach the right market.

When preparing a business plan, entrepreneurs consult statistics on the sales of their type of product or service, and evaluate the competition using statistics on similar businesses in the same geographic area.

Businesses are also major contributors to the different data that statistical organizations collect to feed the gross domestic product—an international measurement of a country's economic well-being.

Since businesses are involved in both the supply and demand side of data, there's good reason to invest in statistical-literacy activities that invite accurate business reporting and that build awareness and effective use of statistical information among the business community.

Outreach to business

To provide a deeper understanding of data for non-experts, many of our statistical organizations (e.g. Australia, Canada and New Zealand) offer workshops. The workshops typically vary in length from one to three days. They're targeted at business, market researchers, analysts, advisors and scientists or anyone who conducts a survey, is a data user or needs to develop the ability to assess and interpret survey results.

Workshops include titles such as "Know your region", "Surveys from start to finish", "Turning statistics into stories", "Understanding and interpreting data" and "Introduction to basic statistics".

From Australia:
www.abs.gov.au/websitedbs/d3310114.nsf/web_pages/23E69B515C586A7ECA25
7188001D2EA5

From Canada: www.statcan.gc.ca/cgi-bin/workshop/wst.cgi

From New Zealand: www.stats.govt.nz/tools_and_services/services/outreach-
and-liaison/outreach.aspx

By collaborating and building relationships with stakeholders within the business sector (including those that service the business sector, such as statistical societies) you can increase the exposure of your data and services on various business websites. These websites redistribute relevant information to their members and clients and provide a seal of approval for your activities. Stakeholders include the federation of independent business, chambers of commerce, manufacturers and exporters, bankers associations, investment industry associations, institutes of actuaries, and retail councils.

If you attend major conferences or events organized by national business groups, you help raise awareness about statistical programmes and you may develop business leads or ideas for partnerships. Being visible, interacting with business and understanding the environment in which they work are the best ways for you to produce products and services that will assist them. You could also include in conference registration packages brochures that explain the importance of statistics to the economy and how businesses can use these statistics to their advantage.

Another useful thing to do is to set up a speakers programme, whereby you send expert speakers to Executive Masters of Business Administrationclasses (E-MBA), business courses at university level or conferences. You should develop consistent messages to include in communication materials for these speakers.

Making statistical information accessible helps business users understand it and use it to inform debate, research and make decisions. Your organization should develop specific and relevant cases studies and examples for this purpose.

A good example of case studies that show business how to use data can be found on a new section of the Australian Bureau of Statistics (ABS) website called *For Small Business. An online brochure _Planning for Business* provides tips on how to use ABS information in order to know your market, locate potential clients, target promotions, grow your business, support your business case and more. www.abs.gov.au/ausstats/abs@.nsf/mf/1391.0.55.001

Use new technology to reach business people who want to receive relevant information and services "just-in-time". This demands more involvement in push distribution, social networks and more frequent information updates. New services from statistical agencies such as RSS feeds, Twitter, Linked-In, Widgets and Apps for mobile devices are becoming increasingly common. Dynamic visualizations of data prepared for business can tell a story at a glance and are useful, for example, in helping people understand economic indicators.

More data, enhanced skills required

Besides responding to client questions, you should look for opportunities to explain your products and services to existing or potential users, respondents, business and the general public. This can be done through educational programmes for specific communities which include targeted talks, workshops, and communication or training materials. Or it could be done through an enhanced website that includes data, metadata and analysis, case studies and tutorials.

You should also think about the power of social networks and their ability to build informed user communities. Part of the mandate of a statistical organization should be to help citizens understand issues and to actively support the development of their data interpretation skills. In this way, you can grow a more knowledgeable stakeholder base.

More and more government data are being made available free online. This enhanced access will encourage the construction of new and useful data products and further dissemination of official statistics to a broader segment of society. As a statistical organization, therefore, you must change the way you approach the public to enable the layperson to better understand the results obtained by statisticians. This will support the viability of your statistical programmes in the long term and reward the global community by enhancing its statistical literacy. Statistical literacy is an important ingredient of democracy.

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VII. Improving statistical literacy within statistical organizations—training your workforce

The true strength of any organization is its staff. An efficient statistical organization cannot operate without first-rate people. The quality and vitality of our statistical programmes rely on engaging the finest and most talented recruits and investing in continuous learning for employees to build capacity at all levels of the organization.

Because it takes more than just statisticians to make a statistical organization function, all employees, including administrative and support staff, should be sensitized to the activities connected with collecting, processing and distributing f the data and have at least a basic level of statistical literacy.

To foster the recruitment, retention and growth of our "strength", a broad spectrum of learning opportunities must be made available, from basic statistical skills to advanced methodologies. This chapter covers the different aspects of capacity-building within statistical organizations. It includes training current staff, new recruits, the future workforce. It also deals with training by retirees and training by staff in other countries and international organizations.

A. Train your future workforce

Of the many purposes that education serves, an important one is to prepare people for work. Most statistical organizations attempt to recruit the best and the brightest graduates from post-secondary education institutions to fill the important jobs of analyst, statistician and methodologist.

Some countries' organizations find it hard to get skilled professionals from the educational system to fill these roles directly. Why? Because there's a difference in preparing a post-secondary student for a role in government or "official" statistics as opposed to the "general" statistics that's most often learned through the educational system. The traditional mathematics and statistics department in major universities doesn't always offer a full suite of courses in sampling, methodology or survey statistics.

Also, much of the course work in mathematics and statistics is abstract. And since university professors often make their academic reputations in statistical theory and not applied statistics, the academic training of statisticians isn't always relevant to the skills required by our organizations. We look for recruits who:

• are technology literate and can use computer programs

• have a blend of training in both the theory and the application of statistics

• have the statistical skills to produce analysis of real world issues

• can communicate their results effectively in written text.

To close this skill gap, students in statistical courses at the post-secondary level should get more involved in hands-on statistical consulting. They should also be encouraged to work during school breaks at a statistical organization. If found to be productive, they may be integrated directly after graduation to full-time work in the areas of the organization where they have already gained experience.

Interaction should be encouraged between academics and government statisticians, including with temporary exchanges of personnel between government agencies and universities. Course lectures and public speakers can be provided in specific topics by government statistical experts.

To foster the use of official statistics and to enable applied research and analysis while students are in university, you could provide better access to government statistics through university libraries. New products designed for the university market can be jointly developed and made available. Prizes for the best paper by a student in statistical analysis using official data could be awarded to get students interested in the broad range of data collected.

Similarly, prizes for the best data visualization or modelling project could be offered to encourage innovation in prospective statisticians and to demonstrate the use of new technology for real statistical applications.

In the best-case scenario, specific training would be provided by the university to help prepare students for careers in government statistics. For this, you must find ways to network with academics to implement pre-determined courses that might lead to a certificate in official statistics.

In your courses on government statistics, you should include topics on:

• Data relevance, the need for new data for policymaking

• Confidentiality and privacy in collection practices

• Dissemination and metadata compilation

• Longitudinal surveys for data comparability across time

• Burden on respondents

• Data access and control and cross analysis.

An example of a country that has set up an "official statistics" stream at a university is New Zealand. An adjunct professor has been appointed who works part-time at Statistics New Zealand and manages the official statistics courses at the University of Auckland. The preparation of statistical students for careers in government then is a shared responsibility and the salary and activities of the adjunct professor are supported both by the university and Statistics New Zealand.

B. Train new recruits

Our organizations are learning organizations just by the nature of the work we do. We employ highly skilled labour generally recruited from other government departments, research organizations and for the most part from post-secondary institutions. We recognize that it's impossible for an academic institution to produce exactly the correct skills in a graduate that a statistical organization desires. It's therefore up to us to mould the new recruit into the employee we want. This we can do in three steps.

Step1: Assign a mentor

A new employee should not be left to flounder, not knowing his or her role or what to do. A mentor or coach should therefore be assigned to each new recruit to provide guidance, share their knowledge and offer advice and assistance when needed and to help choose the correct training required for the recruit to achieve success.

Step 2: Provide a structured development programme

New recruits should be placed in a structured developmental programme that helps them rapidly acquire the skills and broad experience within the statistical organization. Development programmes can include work assignments interspersed with periods of statistical training. The best programmes are based on action learning.

An example of action learning is a rotational assignment. These are collaborative in nature and enable applied training and expose recruits to some main statistical functions.

Functions include research, surveying, modelling, analysis, compilation of the national accounts, etc., as well as some subject matter areas: such as labour, demography and population, international trade, business statistics, service industries, national accounts, health or crime statistics, income statistics.

Rotational assignments stress the importance of actually doing the work and provide the opportunity to solve real problems. They result in the integration of skill and knowledge.

Step 3: Offer a career path and learning plan

Every new recruit has their own unique mix of professional, career and personal goals and priorities. Recruits should be guided to explore a career path. A statistical career path lays out the opportunities that may present themselves as the recruit work towards his or her career goal. It provides a general sense of the skills that could be required at various levels in a career in statistics in the organization. A career path document is a career planning reference tool that outlines the experience, knowledge, abilities and training that is needed to have to progress within a specific statistical domain.

New recruits can use the career path document as a baseline for helping to develop a learning plan that addresses their current job needs and future aspirations. For example, if new recruits wanted to be involved in business

statistics, they should ensure that they get some experience in developing, collecting, processing, analysing and disseminating statistical business information such as trade data, price indexes, transportation and service industry data.

Beyond the generic statistical training such as survey-process training, a new recruit interested in the business domain would choose relevant courses such as business financial accounting, basic concepts of the business register system and business survey methodology.

C. Train your current workforce

To make our data relevant, understandable and useful, we need a dedicated workforce that makes "quality" a core value that's applied in day-to-day activities, processes and standards. And to uphold a reputation of relevance and remain trusted by a wide range of stakeholders, we must invest heavily in our employees' continuous statistical learning.

Re-engineering, changes in the workplace and the emergence of new and better technologies have fuelled the need for lifelong learning in statistical organizations. Through continuous learning, employees gain a wider and deeper understanding of the core business of statistical organizations and can upgrade the skills that are required to implement new practises, standards and processes. It is important then that employees are offered work related learning for vitality and competitiveness of both the individual and the organization.

Since employees acquire and assimilate knowledge through diverse learning experiences, you should offer a blend of formal and informal learning activities. These could include:

• Structured in-class courses either provided by trainers at your organization or in partnership with academic institutions, computer-assisted courses or e-learning, external learning through university diploma or certificate programmes, some of which can be financially sponsored, or education leave provided.

• Networking opportunities, conferences in specific subject areas, information sessions, presentations and workshops.

D. Training your general staff

Different sections and different employees within the organization have different needs. Staff in subject matter areas, for example, must have a higher level of skill and statistical competency than those in general administration. Nonetheless, all staff should have some level of statistical training so that they can understand the basics of the processes in a statistical organization.

Not everyone is expected to understand the in-depth daily activities of statisticians but some elements in statistical knowledge which are universal. For example, to be an informed citizen, you need basic statistical concepts. In this information age, every employee who has come through the school system with at least some secondary school learning should already have a good understanding of:

- Why data are needed and how they are produced

- Basic terms and concepts related to data such as averages

- How to interpret a table or graph

- How statistical conclusions are reached, and how inferences and analyses are made.

You can offer courses to review this information or to train general staff either formally or informally, in groups in a classroom, or through asynchronous learning on computers done at the pace of the employees in their own time in their own environment.

Everyone has their own personal learning style. We recommend a blended approach of statistical training such as a combination of classroom training, workplace learning, computer-based learning, conferences, special events, roundtables and seminars.

We also highly recommend computer-based training or e-learning for general staff where the technology is available. This kind of training involves using a computer to share information and to support learning. E-learning is an effective means of transferring knowledge by combining visual effects, hand-on practice exercises, audio, simulations of the actual application being learned.

Several statistical organizations have developed e-learning or online learning courses about statistics and surveys which can be used by general staff to revisit or upgrade their learning.

The International Statistical Literacy Project website lists examples, among them:

Finland - E-course in Statistics

Australia - Introduction to Statistics

Canada - Statistics: Power from Data!

An excellent example of an applied course prepared for general staff and provided in the classroom is Statistics Canada's Survey Skills Development course.

Example: Survey Skills Development course

This six-week course is designed to provide participants with knowledge and the skills in survey-taking. It targets employees who have little training or experience in the design and implementation of surveys. It's based on action learning principles: participants design and conduct an actual survey under real-life conditions. The final two weeks of the course are off-site where the survey is run.

Through this action learning, participants:

- Develop an awareness of the policies, principles, issues, complexities, and interrelationships inherent in the design and implementation of a statistical survey

- Develop basic skills of survey-taking through practical experience

- Acquire knowledge of survey methods and procedures and of how these are applied by the major survey-taking areas of the department

- Learn how to work with others in an interdependent framework towards a common objective

- Build a network of friends and colleagues at different levels within the organization.

When new or special skills are required

A challenge for any statistical organization is to maintain a high-level statistical capability within the organization. Competing careers, international portability of skills and the global marketplace mean that many of our organizations are losing knowledge workers to other countries or organizations. Rapid and significant changes in technology have dramatically increased the need for most of us to retrain our existing employees or to renew and adapt previously acquired skills.

Classroom courses and workshops that run from half a day to several weeks can provide basic and advanced training on generic topics such as:

- Survey design and development

- Questionnaire design

- Sampling

- Data analysis

- Time series methods

- Non-response

- Imputation

- Quality assurance

- Interpretation and presentation of data.

Courses that are job specific could include topics like:

- Collection entity customization

- Seasonal adjustment

- Small area estimation

- Introduction to record linkage

- Modelling and forecasting of time series

- Indirect sampling for difficult to reach populations.

As well, for countries that undertake a census, the relevant training needs to be developed and offered to staff. Often, employees working on a census are hired for a definite time period and require a special skill set, especially those working in the field.

Many statistical agencies offer e-learning courses on census roles, duties and explaining census variables and geographies. Special courseware packages standardize the training provided for the different roles involved in a census. For the dissemination of census data, dedicated census training staff give subject-matter specialized courses, census-related tool courses and advanced tool courses.

Education leave

Our organizations typically do not teach the science of statistics. We leave that to schools and universities. But we do facilitate the learning of the processes and knowledge that go into the production of official statistics.

Education leave is another programme that offers an opportunity to help with developing the statistical competencies of our employees. Statistical organizations that commit to strengthening and broadening the skills and expertise of employees to meet future needs can actively encourage and support the efforts of employees to improve and enhance their professional qualifications and accreditation through formal education.

To encourage and assist employees who are prepared to invest in their own development, the reimbursement of tuition fees and related course costs, in whole or in part, should be considered for courses taken by employees outside working hours when these courses contribute to developing employee skills and qualifications that are beneficial to your organization.

E. Training by retirees

Economists like Paul Romer believe that knowledge and human capital can yield infinite outputs. How we capture, nurture and value the abundant knowledge and human capital of the experienced employees who have recently retired is important to the continuity of some statistical programmes.

Knowledge gaps can be directly filled by hiring recent retirees to work on a contract basis to pass along their historical knowledge and specialized experience through workshops and training to current and new employees. New retirees can also write training materials for current employees. They can also help to optimize a project, develop programmes, help transfer skills and expertise and improve our organization's flexibility to handle peak-workload periods.

F. Statistical training of staff in international organizations

With steadily increasing interdependence among countries, improvements to any one country's statistical system benefit the world community. A deeper understanding of the statistical problems of developing countries also helps a country effectively carry out its responsibilities in the United Nations Statistical Commission and similar international bodies. Sharing a well-designed statistical training and assistance programme will strengthen the international statistical community.

We can provide statistical education and training courses to developing countries and to international organizations. The purpose is to transfer expertise and provide lasting capacities in specific target areas.

Some examples of statistical training assistance include:

- Project missions abroad

- Study tours

- Training manuals and workshops created for another country

- Providing statistical e-courses and software training to developing countries.

These activities contribute to increased knowledge and self-reliance among the assisted organizations' staff. The training courses prepare staff to continue performing the work required by the project, on their own, after the assistance ends.

Some bilateral agreements between statistical agencies can last for several years. For example, from 1996-2001, Statistics Canada assisted China's National Bureau of Statistics in reforming their statistical system to meet the needs of a socialist market economy. The cooperative project improved the collection, analysis, use and dissemination of statistical information in China. It also addressed organizational development, market economy measurement, technical capacity-building and management. Employees from both of these national statistical organizations participated in the training courses. One of the texts used in the

workshops was *Survey Methods and Practices*, catalogue 12-587-X.
www.statcan.gc.ca/pub/12-587-x/12-587-x2003001-eng.pdf

This publication shows how to design and conduct a census or sample survey. It explains basic survey concepts and provides information on how to create efficient and high quality surveys. It's aimed at persons involved in planning, conducting or managing a survey and at students of survey-design courses. It contains the following information:

- How to plan and manage a survey

- How to formulate the survey objectives and design a questionnaire

- Things to consider when determining a sample design (choosing between a sample or a census, defining the survey population, choosing a survey frame, identifying possible sources of survey error)

- Choosing a method of collection (self-enumeration, personal interviews or telephone interviews; computer-assisted versus paper-based questionnaires)

- Organizing and conducting data-collection operations

- Determining the sample size, allocating the sample across strata and selecting the sample

- Methods of point estimation and variance estimation, and data analysis

- Use of administrative data, particularly during the design and estimation phases

- How to process the data (which consists of all data handling activities between collection and estimation) and use quality control and quality assurance measures to minimize and control errors during various survey steps

- Disclosure control and data dissemination.

VIII. Making numbers better understood: Improving dissemination activities, including good practices for metadata and geo-referencing

In a globalized world in which information technology and computers support the use of statistical information, users need high-quality data that they can understand. They also need to be able to make efficient searches in a universe of data that's increasing every day in quantity and detail.

We must therefore improve data understanding and availability by using tools for documentation, dissemination and reporting. No one can speak of good practice in generating statistical information unless data are combined with their metadata and these metadata are constructed according to international standards.

Our organizations have made huge advances over recent years in making metadata available to users. Most of us now have some sort of online glossary, and many provide links to electronic versions of methodological manuals and texts. A problem, however, is that these documents are often not well adapted to the level and needs of the majority of data users.

Metadata provide detailed information about one or more characteristics of data, thus explaining their scope and limitations. They also encourage proper use of information. By standardizing metadata structures, we provide information about how components of an object are defined and organized. And in some cases we can use automated software tools for better metadata integration and management.

The increasing importance of statistical and geospatial metadata intended to be interpreted by computer applications (to make the end user's life easier) places more emphasis than ever on the value of using common standards for the metadata.

Today, information technologies allow representation of statistical information in formats that go beyond charts and graphs by enabling us to create online geospatial tools including thematic maps. Geographical references are part of information metadata and can be used to build these maps. Disseminating information in these new ways enables analysis of relations among statistical variables and geographical objects within the context in which a phenomenon occurs.

To build a story from statistical information requires a structure according to the intended purpose and audience. Our story should answer the following questions: Who did it? What happened? When did it happen? Where did it happen? Why did it happen?

The answers to these questions are what we call metadata, and in order to build interesting and complete information, they must always be presented along with

the figures. How we present metadata will depend on our audience, but the metadata must always be clear and relevant to the data they're linked to.

In this way, perhaps we need to consider two approaches to how metadata could be used: "traditional" metadata and "processing" metadata:

1. "Traditional" metadata are intended to be read and understood by humans. These metadata help users understand the nature of the data in depth, including assisting them in assessing data quality—where quality can be understood as "fitness for purpose" for the specific research/analysis/decision-making or other purposes that the particular user has in mind. "Quality" is to some degree based on the context of use—data that are of adequate quality for one purpose may not be of adequate quality for a different purpose. Different users/uses may need to focus on different aspects of the metadata to determine quality in the context of a particular purpose. For example, one user's purpose may require the data to be very up to date but not necessarily perfectly accurate. A second user's purpose might place the priorities on timeliness and accuracy. Different users/uses may place different emphases on statistical precision versus geospatial precision—with metadata to support judgements in regard to both being important.

2. "Processing" metadata constitutes another form of assistance to end-users. These metadata are intended to be interpreted and used by the applications that an end user may wish to use to work with the data. A good example is geospatial metadata, which allow data of interest to be interpreted and displayed by a geographical information system.

The ability to support geospatial data analysis comprises more than just an ability to produce and interpret maps. It is possible to think in terms of, e.g. "geo-enabled":

- Data discovery—what data do you have related to this place?
- Data visualization—e.g. mapping
- Data analysis—e.g. how many businesses of a particular type are located within 1km of a particular highway?

Geospatially enabled data can create new connections and meaning through merging different datasets (with some common dimensions) within a particular region. Also, cartographic visualization of statistical information allows its dissemination with geographical disaggregation without contravening the principle of confidentiality, as the values are presented by shades of colours and offers the potential to allow data discovery and data analysis.

Several international initiatives generate metadata for the statistical and geographical areas; both are necessary to assess usefulness of statistical information per se, as well as allowing it to be geo-referenced.

Statistical dissemination includes mechanisms not only to make information known, but also to expose it through statistical and geographical metadata. Good statistical presentation involves making it easy for readers to understand and interpret the data, and identify any key patterns or trends. Different standards do this job, and we'll be looking at some of them in the next section.

A. Metadata standards

Several international organizations draw up guidelines and standards for documenting and exchanging metadata. They establish reference frameworks for enriching statistical data sets with information that contributes to a better understanding of these data. The aim is to take advantage of the statistical and geographical information.

Some examples of metadata standards are:

Statistical metadata

- Data Documentation Initiative (DDI): A standard for documenting statistical data sets to facilitate re-use.

- ISO/IEC 11179: Establishes a register of metadata which focuses on managing semantics of data, as well as their representation and description.

- Statistical data and metadata exchange (SDMX): A set of technical standards and content-oriented guidelines to facilitate the exchange of data and metadata between organizations and computer systems.

Geographic metadata

- Mexico's Federal Geographic Data Committee (FGDC) standard. The Committee develops procedures and assists in implementing a distributed discovery mechanism for national digital geospatial data. The current Federal standard for geospatial data is the Content Standard for Digital Geospatial Metadata (CSDGM).

- ISO 19115: This standard allows generating regional, national and institutional profiles, for example, for the European Union, Colombia, Australia and New Zealand, Catalonia (Spain), Navarra (Spain), Valencia (Spain), Spain and Mexico.

Each standard provides a structured way to generate metadata, as well as specifications to ensure completeness and consistency. They do not, however, describe how software applications must operate with them, and must therefore be combined with other standards.

B. Metadata dissemination

Metadata dissemination provides formal mechanisms to access characteristics of some statistical or geographic information resource, so that users can evaluate its usefulness to meet their specific needs. The statistics and geography fields have always maintained a close relationship and work holistically to produce better data for decision makers.

The Internet is a natural dissemination scheme where geographically dispersed information can be integrated. With a single word or a geographic reference, users can be referred to geographic or statistical resources according to search criteria. If producer policies enable online access, users can access information resources directly through metadata.

Metadata describe concepts from the time in which a project was conceptually designed. For instance, objectives and constructs from collection instruments are valuable tools for understanding data and must be documented and disseminated to enhance interpretability—and transparency—of published information.

We can disseminate information in several dynamic ways using electronic devices. Each application, however, has characteristics that make it more or less suitable for presenting information to users with different backgrounds and skills. We must therefore look for tools that can be easily adapted to different needs in order to simplify our dissemination efforts.

In this sense, the Data Documentation Initiative (DDI) developed a web tool called the National Data Archive (NADA) that allows querying metadata of the projects documented in the DDI standard.

Queries based on keywords are useful for users with no previous knowledge about metadata use. In this way, the users can easily find projects related to a topic of their interest and also the methodological aspects of how the information was obtained.

Example 1: Historical statistics of Mexico - Information by State since 1910
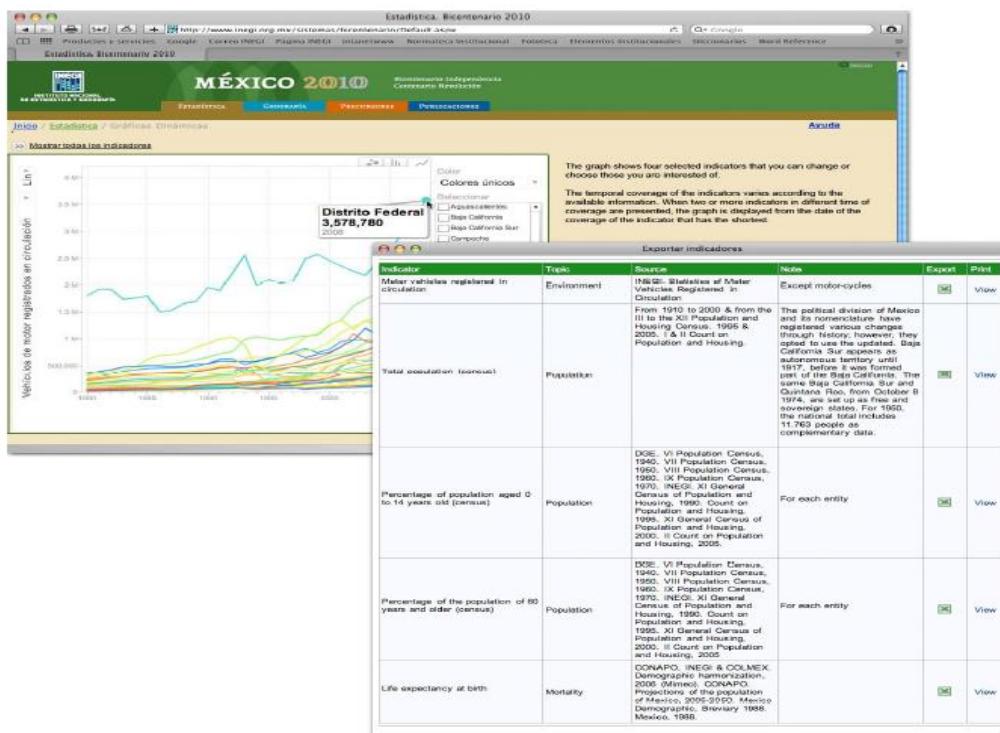
In Australia, some examples of how metadata can be linked to data include Census Quickstats (www.censusdata.abs.gov.au/) and National Regional Profiles (NRP) (www.abs.gov.au/). Census products that use published metadata such as the Census dictionary to provide descriptions and definitions of data items. Contextual links to the metadata are provided within the tables.

NRPs featured a map interface using Google Maps. They provide summary data from various data collections for geographic regions within Australia. Additionally, a set of seven online videos have been produced to show how to use and understand the NRPs.

Standards like SDMX can help us improve the exchange of data and metadata. Flows of complete information go from producers to consumers without distortion, and we (and the users) can build new stories in a clearer context.

Another advantage of using standards is that as they become more widely used, it's easier to find tools that can understand them, reducing time and costs to create software architectures to process and publish information in an easy and attractive way.

C. Geo-referencing information

If you're conducting a deep analysis of statistical information, you should also consider the territory in which a particular fact was generated or that it relates to. Linking statistical and geographical information takes us to a geo-referencing process.

Geo-referencing is locating information in a geographic environment to represent it through geographical names or codes to delimit areas. Examples of geographical codes are zip codes and electoral districts; and names serve to refer to boundaries of provinces, states, regions or municipalities.

Geographical coordinates expressed in terms of latitude and longitude form the base for geo-referencing. They're essential for generating maps and for taking advantage of information integrated in a geographical information system.

It's now possible to develop cartography with high precision and combine geographical and statistical information to answer complex questions, such as: How do the dynamics of earth and tectonic movements affect life in different regions of the world? What are the consequences of the inappropriate use of natural resources in terms of migration, lack of availability and pollution?

Increasing the level of spatial detail applied to the geo-referencing process opens more possibilities for spatial analysis of statistical data. Suppose that you have a variable that can be referred at a street level, or even better, at a block level. A set of data can be bounded and analysed by natural criteria, for example, blocks at the margins of a river or a lake, or within a distance from it.

The benefits of combining statistical and geographical data and metadata can be perceived through an example, like generating plans to define land use and to mitigate the impact of a natural phenomenon. In this case, we need to answer several questions:

- Where is the population at the point?
- What is the level of risk to which that population is exposed?
- What is the vulnerability?
- What is the terrain like?
- What are the options for evacuation and routes available for that purpose?

- Which infrastructure works are required to reduce levels of risk and vulnerability?

Projects to capture information from administrative records, as well as through censuses and surveys, also should consider geographic coordinates of the observation units beyond the codes that relate the clusters considered in the design of the collection instruments. One option for doing this is to store the geographic coordinates of external and internal numbers of houses that exist in communities.

Example: Geo-referencing of business units in Mexico at block level

Mexico's Instituto Nacional de Estadística y Geografía (INEGI) has created a web system to represent statistical information from business units into a digital map. Addresses of business units were geo-referenced and placed on the borders of polygons representing blocks. Users can build queries of activity sectors delimiting the geographical area up to locality level. The system replies to the user requests with a geo-referenced representation of the data.

Example: Geo-referencing of homes at the level of external number

It's possible to geo-reference dwellings maintaining the confidentiality of statistical data. The versatility that this provides for spatial analysis is very large and useful. To do this, we need to integrate houses' structures provided by different sources in a harmonized way; so Mexico has generated a technical standard on homes' geography to standardize these data.

TYPE: STREET
NAME: TABACHÍN
NUMBER ON STREET: 131
TYPE OF NEIGHBOURHOOD: FRACCIONAMIENTO
NAME OF NEIGHBOURHOOD: LAS ARBOLEDAS
POSTAL CODE: 20020
LOCALITY NAME: AGUASCALIENTES
MUNICIPALITY: AGUASCALIENTES
STATE: AGUASCALIENTES

Application example: Geo-referencing of beneficiaries of social programmes

To increase transparency and certainty in the application of resources provided by social programmes in Mexico, sites of beneficiaries from one of the programmes were geo-referenced at the time the registry was updated.
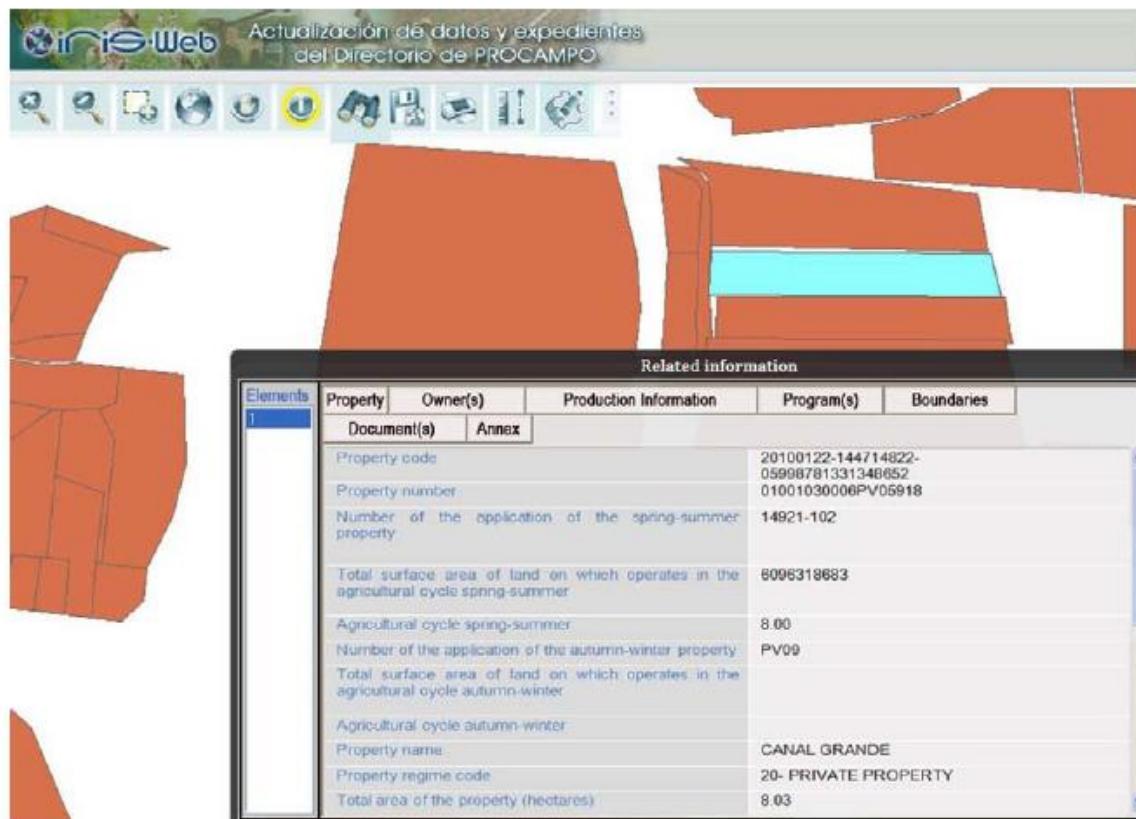
Final comments

Metadata do not appear spontaneously. They should be documented as the project progresses in order not to lose the wealth of knowledge we can gain from them. A good database to store statistical information should be designed taking account of which metadata will be provided.

The decision about which metadata to include isn't that simple. It requires experience to know what information is useful and what's not.

When generalist users come across metadata they don't understand, few will take the time and effort to try to develop that understanding. So, if we make metadata more understandable, users are more likely to take note of the messages in the metadata, thereby improving their understanding of the data, and helping to improve their statistical literacy.

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IX. Evaluating the impact of statistical literacy activities

A good understanding of statistical concepts and methodologies and proper interpretation of statistics are essential for the effective application of statistics. Statistical organizations have developed a range of activities for promoting statistical literacy to meet the needs of different users of statistics in society (or in the community). It seems reasonable, then, that each organization, which invests in increasing the awareness of official statistics and promotes the proper use of official statistics in the community, should be able to reap the benefits of this activity.

It's hard to measure the short-term paybacks of statistical-literacy activities, as the real return on investment will be long term. So, if your organization invests in statistical literacy, you'll need to be aware that the results of your investment will only be visible years after finishing the programme. It's useful, therefore, before starting your literacy programme to define both the evaluation strategy and the measurement criteria.

The most widely used and recommended measurement criteria include:

- Number of students and teachers trained, workshops provided, classes visited
- Number of access hits (monthly) to the learning resources website
- Number of educational websites linked to your organization's site
- Number and relevance of conferences and exhibits undertaken
- Number of new courses and textbooks that highlight data from statistical organizations
- Number of hours contributed to local schools by statisticians
- Number of statistical publications distributed to educators
- Amount of media coverage on educational activities
- Number of new lessons submitted by educators
- Requests for copyright or redistribution of data for the education community
- Number of telephone calls and Internet requests for information
- Numbers of communications materials distributed
- Letters, opinions, comments and testimonials received.

The team responsible for measuring the success of the literacy projects should produce annual measurement reports, which you should use as the basis for deciding on future activities.

Another way to measure the success of literacy activities is to make an evaluation strategy of literacy projects, including:

- An online survey of registered schools to assess the literacy project in general (website, registration process, questionnaire, teacher resources and data usage in the classroom)
- Teacher evaluation at conferences and training sessions
- Focus groups of teachers and students to explore more deeply issues raised by the online survey
- Telephone survey to identify issues preventing schools from continuing past the registration process

- Monitoring the use of the literacy part of your organization's website.

All improvements made as a result of the feedback received should be analysed and implemented.

The above activities for evaluating statistical literacy are country-oriented, i.e. they provide information only for the results within the country. However, globalization is raising the need for international comparability. This means that the success of a project should be evaluated using international standards, too.

Two projects: IALS and PISA

The Organisation for Economic Co-operation and Development (OECD), in cooperation with several international organizations, intergovernmental agencies and national governments, has launched two projects for evaluating literacy. The first is the International Adult Literacy Survey (IALS)—a comparative survey of adults designed to profile and explore the literacy distributions among participating countries.

As explained in the OECD publication *Literacy in the information age*,[2] literacy is measured using a sophisticated methodology:

- The IALS employed a sophisticated methodology developed and applied by the Educational Testing Service to measure literacy proficiency for each domain on a scale ranging from 0 to 500 points. Literacy ability in each domain is expressed by a score, defined as the point at which a person has an 80 per cent chance of successful performance from among the set of tasks of varying difficulty included in the assessment. Five levels of literacy that correspond to measured ranges of scores are used in the third report for analytical purposes.

- Level 1 indicates persons with very poor skills, where the individual may, for example, be unable to determine the correct amount of medicine to give a child from the information printed on the package.

- Level 2 respondents can deal only with material that is simple, clearly laid out, and in which the tasks involved are not too complex. It denotes a weak level of skill, but more hidden than Level 1. It identifies people who can read, but test poorly. They may have developed coping skills to manage everyday literacy demands, but their low level of proficiency makes it difficult for them to face novel demands, such as learning new job skills.

- Level 3 is considered a suitable minimum for coping with the demands of everyday life and work in a complex, advanced society. It denotes roughly the skill level required for successful secondary school completion and college entry. Like higher levels, it requires the ability to integrate several sources of information and solve more complex problems.

- Levels 4 and 5 describe respondents who demonstrate command of higher-order information processing skills.

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[2] www.oecd.org/education/country-studies/39437980.pdf

The second project is called PISA (Programme for International Student Assessment). This is an internationally standardized assessment jointly developed by OECD and participating countries and administered to 15-year-olds in schools. Four assessments have so far been carried out (in 2000, 2003, 2006 and 2009). Tests are typically administered to between 4,500 and 10,000 students in each country.

PISA assesses how far students near the end of compulsory education have acquired some of the knowledge and skills that are essential for full participation in society. The results of the assessment should be used for:

- Creating a solid basis for developing national policy decisions on literacy.
- Defining the programmes in statistical offices for improving statistical literacy for target population groups.