

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

Making Data Meaningful

Part 4:

A guide to Improving Statistical Literacy



UNITED NATIONS
Geneva, 2011

Introduction

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More to be added.

1. Statistical literacy: To comprehend the world

Katherine K. Wallman (1993): *"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."*

Introduction

Statistical literacy is a term used to describe the ability of an individual or a group to understand and comprehend statistics. The field of statistical literacy is not new: For more than 30 years researchers have been discussing this interdisciplinary topic in fields such as mathematics, statistics, pedagogies, psychology or linguistics for instance. The discussion is based on the fact that statistical literacy requires many abilities- to name only the most important ones; those are mathematical and statistical skills, the competency to understand the figures correctly and to distinguish between valid and misrepresented data. Furthermore, it enables people to assess the information that the figures provide and finally to understand what the actual data reveals about society.

In general, official statistics has been occupied with the output figures for a long period of time, but the statisticians started only several years ago to actually reflect on it. Namely, that the ability to understand statistics is the prerequisite for a successful communication with our users. Therefore, several initiatives had been put into practice in order to increase statistical literacy in all fields of societies: For scholars and students, for journalists, for decision makers in politics and businesses and overall for the general public.

In the following chapter we will show which abilities the term "statistical literacy" comprises and who the user groups are that we need to train on different stages of statistical literacy. The task is simple as well as overarching: teaching people to comprehend the world.

Stage 1:

Statistical numeracy: How much is 20 percent?

There are numerous misunderstandings and misinterpretations of (official) data which can be observed in media reports, in daily newspaper articles and in direct contact with our users. This weakness in quantitative skills is summarized under the term statistical innumeracy. In particular among the younger generations and in developing countries there is an increasing need to understand quantitative data and facts. Nowadays it has become an inevitable requirement of contemporary societies to interpret quantitative data.

The first qualification in order to understand statistics are mathematical skills. Statistical numeracy requires a feel for numbers; an appreciation for levels of accuracy, making sense of estimates, awareness for the variety of interpretations of figures as well as a judicious understanding of widely used concepts such as the mean and percentages. Moreover, there is a fundamental need to know about statistical approaches and methods. To express it in one sentence: a common sense approach to data is needed in order to support an argument.

Statistical numeracy is what people learn in schools or at the university, it is the basic knowledge but -unfortunately- it can not be taken for granted. In the last few years statistical institutions have discovered the general public as a target group in itself. Therefore, we had to become aware of a global lack of statistical numeracy among the average population and we had to act upon it. What is our information worth -though it is mentioned in TV news and newspapers at all times--- if many people (or a vast amount) do not even understand the meaning of the figures? One main task of official statistics is to inform people about the development of economy and society. To fulfill this mission it is more than necessary to train them in understanding the figures and to open the access to the world of quantitative thinking and measurement.

The task is to increase the standard knowledge of statistical calculations. There are many options where to start: Statistical institutions improved cooperation with the education community at all stages, which is sensible and necessary; because the closer we work together the better their understanding of statistics will fit to our presentation of statistical data. Best practices of teaching statistics will be described in the following chapters.

Stage 2:

Communicating statistics

Statistical literacy is more than numeracy: it includes the ability to read and communicate in those areas. This quality makes people literate as opposed to just numerate. Wherever words (and pictures) are added to numbers and data in your communication, people need to be able to know what the words mean as well. This is the point where the statistical community put in a great amount of energy during the last years.

On the one hand our users need to have the ability to understand text, tables and graphs with statistical content. But on the other hand we as official statistics still have to come closer to our users in the way we present statistics.

Guidelines like previous publications of 'Making data meaningful' (parts I and II,III) set international standards that help to ease the understanding of statistics for an international audience of users.

Also simplification of tables and charts becomes more and more necessary as the number of quantitative information increases. We should offer comparisons, as many figures get their meaning only in relation to others. Giving additional and background information is our contribution to a successful communication.

Interpreting the figures under consideration of the context as well is another very important aspect that statisticians should keep in mind. Moreover, the statistician, implicating she or he is statistically literate, should support this interpretation process itself and also help users to do that. In particular it can be done in minor areas: For instance context explanations or links that imbed the results into a subject -not only a statistic- and the ranking or highlighting of important developments in graphs and tables.

Transparency is another keyword in how we can try to enable our users to understand the data. Because users do not only need to know about the empirical methods to assess the quality of the data, they also need to have knowledge about the legal framework of official statistics in particular in distinction to market research institutes or untrustworthy providers with unreliable data. The better people are informed about the background of the evaluation of figures, the strategies and tasks of official statistics, the easier they can assess the meaning and the quality of the data.

Stage 3:

Discovering the use of statistics for professional and personal decisions

The third stage of statistical literacy can be postulated as a short question: What can or what do we have to do with the new information? To get the worth of statistical figures appreciated is maybe the most difficult and fundamental stage of using statistics. And it is probably the most important one. Particularly decision makers in businesses and politics need our support at this stage. But also the general public, as the basis of democratic societies needs to be affected on the social dimensions of statistical results. This is challenging, because we as statisticians are not used (or not asked!) to leave the field of statistics and to comment or interpret the results. So what we have to do is to help to use the figures correctly, because we know best what the figures say and what they do not mean.

User groups

At the different stages of statistical literacy you have to address to several user groups. In order to improve statistical literacy the user groups have to be defined by their stage of knowledge and by the purpose why they use statistics. It is necessary to develop user oriented strategies, as it will be described in chapter 3. In this publication we focus on the following target groups:

- Education communities (scholars and students, teachers)
- Respondents
- Businesses
- Media
- Opinion leaders and decision makers
- General public
- Workforce/ staff of statistical institutions

The following chapters describe best practices and successful experiences in what statistical institutions can do to improve statistical literacy among their users.

2. Overview of current initiatives

2.1 International statistical literacy project

The mission of the ISLP

International statistical literacy project (ISLP) is the only international program which aim is to pro-mote statistical literacy world-wide. [The International Statistical Institute \(ISI\)](#) created it in 1991 with the name "World Numeracy Project" (WNP). Today the project is called ISLP and it has worked IASE 's guidance since the year 2000. [IASE \(International Association for Statistics Education\)](#) is one of the ISI 's sections.

The mission of the International Statistical Literacy Project (ISLP) is to support, create and participate in statistical literacy activities and promotion around the world. Now the focus has been young, teachers and schools. The aim in the future is also to develop adult's statistical literacy and the education of those occupational groups, such as media and libraries, who pass statistical information. Important target groups are equally to decision-makers and the general public. The goal is promote the statistical literacy in all walks of life.

ISLP today

The ISLP's approach is wide networking and cooperation with various actors. At the moment the ISLP has more than [80 country coordinators](#) from each continent. The main tasks of country coordinators are to improve statistical literacy and implement the ISLP plans within own country/region. With the cooperation of NSOs, statistical societies, educators and country coordinators it is possible to reach all corners of the world.

The concrete action plan will support the ISLP activities. A long-range strategy is a work in a progress. The main idea of the ISLP project is to develop operations models that can be exploited in many countries. Action in accordance with each country's infrastructure is important. Hence the operation models should be applicable to both developed and developing countries.

Project has its own web pages with useful links such as teaching materials and the ISLP project activities. The project publishes a newsletter twice a year. In addition, the project has produced a number of presentations and articles, e.g. by the Country Coordinators. In 2008, the project published a Web book "[Government Statistical Offices and Statistical Literacy](#)". The project has also organized events such as statistical literacy competitions and best cooperative awards in statistical literacy.

Statistical 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 it?

These are the kinds of questions that may come up in the International Statistical Literacy Competition aimed at school students aged 10 to 18 years. The main goal of the International Statistical Literacy Competition is to increase awareness of Statistics among students and teachers throughout the world, to promote statistical literacy resources and to bring together parties interested in statistical literacy in each country. Its objective is also to improve students' abilities in describing their environment with the help of statistics and in using statistics as a tool for making sense of their daily life. The competition is organised now three times. The competition has three phases: the first phase in students school, in the second phase the winners in each school competes nationally for a national champion and in the third phase national champions competes in the international final.

The ISLP has organized three statistical literacy competitions:

1. Pilot statistical literacy competition in Portugal 2007.
2. The very first statistical literacy competition in 2008-2009. This competition had three phases and was done in 5 languages without the use of computers.
3. The third competition is in the progress in 2010-2011. The form of the competition is a poster com-petition. Posters can be prepared in teams of two or three members. Teams are registered by teachers.

The competition is divided into two age categories: students born in 1995 and younger and students born in 1992 and younger. The aim of poster competition is:

- to work as a team
- to investigate real questions using data
- to use calculation and graphical skills
- to interpret statistical results
- to develop written communication skills.

The organization structure of the ISLP

The project is constructed entirely of volunteer activities. An operational structure for the ISLP is:

- An executive consisting of the ISLP director and two deputy directors. The executive's roles are planning, coordination, liaison with IASE (and, through IASE and the ISLP advisory board, ISI and other ISI Sections as appropriate), and overseeing implementation of plans.
- An advisory board, consisting of IASE president (chair), the ISLP director, 3 IASE representatives, an IAOS representative and an ISI council members.
- Country coordinators. Their roles are implementation of plans within their country/region, and providing information, liaison & suggestions to the ISLP executive. Country coordinators need not to be members of ISI or its sections.

2.2 Statistical dissemination and communication (DissCom)

Under the auspices of UNECE (United Nations Economic Commission for Europe) operates [Statistical dissemination and communication unit \(DissComm\)](#). Its aim is to promote good practices in dissemination and communication of information by statistical organizations. This 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.

Disscom has published a popular book series "[Making data meaningful](#)" on the web where it is freely available. The Making Data Meaningful guides are intended as a practical tool 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.

2.3 Statlit.org

The primary goal of [statlit.org](#) is to present statistical literacy as an interdisciplinary activity. As such it has overlaps with quantitative reasoning, quantitative literacy, numeracy and statistical reasoning. This site features books, papers and activities related to statistical literacy - taken broadly from a variety of disciplines. A secondary goal is to present statistical literacy as the study of statistics in everyday arguments. Milo Schield is the webmaster of this site. He is the Director of the W. M. Keck Statistical Literacy project and Vice President of the National Numeracy Network in the USA. Site is independent of any organization.

3. Defining strategies for different users

"Give a man a fish and you feed him for a day. Teach a man to fish and you feed him for a lifetime."

Chinese proverb

- Who are the different user groups?
- What are the different statistical literacy needs?
- What strategies can be used across the different groups?

Does a *'one size fits all'* approach work to developing statistical literacy amongst our different user groups? The answer is a resounding 'no'. There is a vast range of statistical awareness, ability, skill and need among the various users of statistics. This is magnified further if we consider individual differences within identified user groups along with those individuals who are currently not using statistics or who are unaware of the extent that statistics permeate their daily lives. Furthermore there are particular subsets within user groups, for example disadvantaged groups or people with a disability who require initiatives specifically focused to address their specialised needs.

3.1 Who are the different user groups?

On a daily basis we are all required to use numbers to make sense of the world around us - from soccer scores to weather reports of atmospheric humidity to productivity dividends and performance indicators, credit card interest rates and measures of social progress - statistics surround us.

National Statistical Organisations (NSOs) accommodate a range of increasingly diverse client groups with data and statistics. Therefore it is important to understand who comprise these various user and client groups and how each of these would benefit from improving their ability to access, use, understand and appraise the statistical information produced.

There are many ways that client groups can be classified however from the perspective of official statistics, five distinct client groups can be defined:

- Schools (including students and teachers);
- Tertiary institutions (vocational and academic);
- Decision makers (including government);
- Opinion leaders (including journalists and the media); and

- General community (including small business and disadvantaged populations).

Each of these groups is quite distinct in terms of their level of needs and strategies that would benefit them. The groupings are key enablers for national statistical agencies to cater to actual needs and prioritise their concentration of effort to ensure better long term national outcomes.

The extent to which NSOs can reasonably focus on developing the statistical literacy of various client groups will be dictated by many factors such as resources and opportunities and in particular, the level of impact and long term results that can be achieved.

3.1.1 Schools

The importance of developing the statistical literacy of our future generations is obvious therefore this group includes school students as the next cohort of 'data generators' and 'data users' and also school teachers as the necessary facilitators for this outcome.

Ideally all school students should be able to understand and apply basic statistical concepts and statistical reasoning and then those students with aptitude would be encouraged to undertake further statistical study.

Integrating statistical concepts and reasoning from the elementary years through to secondary school should develop a nation of critical thinkers and savvy consumers of information that would ultimately benefit social progress - from our future government leaders to our future business operators.

To teach our school students to understand and effectively utilise statistical information we also need to ensure that our teachers are able to teach statistical concepts. It is fundamental that teachers are skilled readers and interpreters of statistical information, especially with teachers of mathematics, science and geography.

There is also a need to increase teacher awareness of the importance of statistics and enhance skills, competence and confidence to teach statistical reasoning. The development of pedagogy to support the teaching of statistics is fundamental to the successful implementation of a statistics stream in the school curriculum. Hence NSOs cannot ignore the need to involve teacher educators and address the professional development of teachers.

3.1.2 Tertiary Institutions

The client group within tertiary institutions is comprised of students, teachers and lecturers in both vocational and technical institutions at university and across academia and research.

Increasingly employers are requiring their staff and new recruits to be able to understand statistical concepts and be able to analyze, interpret and evaluate statistical information. The shortage of people undertaking mathematical and statistical studies is further compounding the problem and this appears to be an international phenomena. (Chinnapan, et al, 2007).

Our tertiary institutions have a responsibility to ensure that their graduates are equipped to deal with a burgeoning data age with the ability to access, use, understand and appraise statistical information. Irrespective of academic discipline, the development of statistical literacy should be considered foundational. 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 (Schield, 1999).

3.1.3 Decision Makers

The group entitled 'decision makers' is the key client group for the information produced by NSOs and is comprised of '*commercial decision makers*' in industry, business and trade and '*political decision makers*' such as policy makers, members of parliaments and staff from agencies at all levels of government. However whilst data and information has never been more readily available, decision making has never been more difficult.

Decision makers need to know where to access the right data sources and whether it is 'fit for purpose' (NSS, 2008); be able to critically appraise information presented; analyse and interpret data. These are all skills that have become increasingly important to develop policy, guide directions, confirm progress, and monitor outcomes in this age of evidence based decision making. Evidence based decision making is becoming increasingly important as governments are publicly held accountable for policy outcomes. Likewise there is an increasing need for commercial decision makers to be able to interpret statistical information in order to make strategic decisions about investments and the direction of future growth.

Decision makers require an understanding of what data is available, how it is collected and how it can be used and most importantly, how it can also be misused. Numerous individuals and organisations conduct research and publish findings, however, "*not all research is of sufficient quality to form the basis of sound policy making*" (Davies, 2004 p3) and not all decision makers have the necessary capability to critically assess and use statistical information.

3.1.4 Opinion Leaders

Opinion leaders (notably journalists) have a responsibility to ensure that statistical information is correctly used and reported in the media. The media is a powerful agent in the dissemination of statistics and presentation of facts and there is an increasing reliance on media sources to provide facts and interpretations of the world.

For NSOs, interest in opinion leaders is two-fold - whilst the media is an important vehicle for the broader distribution of national statistics to the masses (which can serve to demonstrate the importance and relevance of statistical agencies to the public), it also necessitates the accurate interpretation and reporting of these statistics by journalists (the development of appropriate levels of statistical literacy for reporting and minimise the damaging misuse of statistics).

The media plays a critical role in demonstrating the relevance of national statistics to the general public. *"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). Therefore it is important that journalists are equipped with the skills and knowledge to accurately interpret and present these statistics.

Data is the basis of news stories and journalists are expected to 'digest' data and transform it into accessible and interesting stories within short time frames - this depends on the ability of the journalist to access and understand quantitative data, statistical concepts and processes.

There is a benefit for NSOs to increase journalists' interest in national statistics along with their capability to use this data. Developing the statistical literacy of journalists will facilitate greater use of national statistics which in turn can serve to demonstrate the importance and relevance of statistical agencies to the public.

NSOs need to increase public awareness of the value of the information they produce and they need to demonstrate its relevance to public and private decision making and this can be achieved through the media. Greater exposure of the value of national statistics will help ensure that NSOs gain greater public support for its programs and more willing participation in its surveys which in turn contributes to the quality and timeliness of its output. (Crompton & Flanders, 2006 p1)

3.1.5 General Community

General community refers to the public with a focus on selected groups especially small business owners and disadvantaged groups (who do not fit into one of the above four groups) and community organisations.

The proliferation of statistics in the media and on the internet means that we are increasingly becoming consumers of information. The ability to critically evaluate the information presented to us is fundamental to effective citizenship (Gordon &

Nicholas, 2006). Without these skills we exclude citizens from being able to fully participate in society and the judicious consumption of information presented.

Increasing trust in statistics and understanding of the importance of data to policy and decision making is a key statistical literacy objective for the general public. The marketing of work done by NSOs is imperative - people need to know and understand the value of national statistics - it is just not good enough to collect data, there is a real need to advocate their importance. Results from the survey *Trust in ABS and ABS Statistics*, (ABS, 2010) shows that individuals with greater knowledge of the ABS also reported greater product trust in the ABS. Therefore, there is a role for NSOs to increase public awareness of products and services which in turn leads to better response rates, better understanding of Census and the value of national statistics to policy and planning.

3.2 What are the different statistical literacy needs?

So what level of statistical literacy is needed for us to actively and capably participate in society? Consider the local grocer reading a newspaper article on inflation rates; the journalist trawling through national statistics to report the latest crime figures; or the government official who is measuring the outcome of policy initiatives through data on unemployment. The need for some level of statistical literacy is apparent, however, the degree of skills and understanding required varies considerably.

Not only are there varying levels of statistical need, there are also many factors which affect an individual's ability to comprehend statistical information. According to Murray & Gal, 2002, these comprise person-related factors such as educational background, literacy skills, world knowledge and individual beliefs on mathematical and statistical issues including how critical or accepting they are of information coming from different public and media sources, as well as *statistical anxiety* (Bradstreet, 1996) and *mathphobia* (Phillips, 1988) as most people associate statistical ability with math ability.

There are a considerable number of views as to what constitutes statistical literacy and what competencies are required. However there appears to be consensus about the need to develop statistical reasoning (concepts and ways of thinking) before statistical methods (computations) (Bradstreet, 1996 page 69).

Furthermore, these competencies can be broadly summarised under three broad dimensions which have been adapted from the statistical literacy objectives identified by Bradstreet (1996) and include:

- ***Statistical Knowledge*** which comprises data awareness and the ability to understand statistical concepts, definitions, statistical methods and strategies - ***or what do each of the client groups need to know?***;
- ***Statistical Skills*** including the ability to read graphs and tables and to analyse, interpret and critically evaluate statistical information; and the ability to communicate statistical information and understandings and correctly report results - ***what do each of the client groups need to be able to do?***; and

- **Statistical Attitudes** relates to general perceptions, interest in and opinion of statistics and the need to develop an appreciation and valuing of what statistics can contribute; understanding broad statistical premises; and having the skills and confidence to question and critically appraise statistical messages - **what do we want each of the client groups to understand?**

These broad dimensions of statistical literacy can be applied to all client groups and can range considerably in depth and breadth of coverage from basic knowledge and skill bases to more advanced and sophisticated understanding and analytical abilities.

For the purpose of official statistics, three broad levels of statistical literacy can be applied to the five client groups: these are basic, intermediate and advanced. (ABS, 2006). For example:

- An individual with **Basic** statistical literacy will have an awareness 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.
- An individual with **Intermediate** statistical literacy will understand and have appreciation of the limitations of the methods used; understand the more commonly used statistical concepts and terms (eg labour force participation rate); understand variability and uncertainty; and be able to interpret probability statements associated with sample estimates.
- An individual with **Advanced** statistical literacy 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 that are made about the data.

The matrix illustrates the range of statistical literacy need across the different user groups.

	School Students and Teachers*	Tertiary Institutions	Opinion Leaders	Decision Makers	General Community
Basic	X	X	X	X	X
Intermediate	X	X	X	X	X
Advanced		X		X	

*NB: Some teachers will require advanced statistical skills.

3.3 What strategies can be used across the different groups?

The problem is that while statistical organisations acknowledge the importance of having statistically literate data users and the social and political benefits this confers, the development of statistical capability is not their primary function. So how do we manage this with limited resources?

The role of an NSO in developing statistical literacy across key client groups is not to develop a batch of statisticians but to ensure that clients (especially priority groups such as government and journalists), know what data is available and are able to understand simple statistical analyses and know when to seek assistance from a statistician. (Bradstreet, 1996 p 70).

NSOs need to "proactively plan 'client education' processes to increase the chance that their diverse users can extract maximum value from the reports and information products offered to them" (Murray & Gal, 2002..p. 7).

There are numerous initiatives that are aimed at developing statistical literacy across different target groups but most of these can be summarised into the following strategies:

Raising awareness

Ensuring that people are aware of the extensive data and statistics held by NSOs and the importance of this information to effective decision making is fundamentally a statistical literacy activity.

There are many strategies that NSOs can employ to generate awareness and interest in national statistics and their practical application to everyday life. From increasing exposure of statistics in daily newspapers to producing electronic newsletters, alert mechanisms and blogs for specific target groups, this entails a cultural change for many NSOs along with the development of skills for statisticians to market their statistics and present data in ways that are interesting, relevant and accessible.

Cultivating interest in national statistics from an early age will prove strategic to future successful outcomes. NSOs need to become involved in running statistical competitions for school students and in developing real life case studies and activities to illustrate the practical application of national statistics. This includes supporting student participation in international projects that focus on the development of statistical capability such as *Census At School* which enables students to participate in a range of important statistical processes.

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

Establishing relationships with key stakeholders is a vital means of improving the information flow between producers and clients and ensuring that data users can understand and apply the information (Head, 2008).

Ultimately each of these client groups must be viewed as partners in the process of developing statistical literacy. NSOs need to ensure that networks are established with key client groups to facilitate greater interaction in order to understand their needs and how they operate and to evaluate the impact of the strategies employed.

Furthermore, strategic partnerships and alliances with other associated organizations can facilitate the development of statistical literacy amongst specific target groups. For example, the ability to increase the statistical literacy of school students requires the engagement of the whole education community: teachers, teacher educators, researchers and curriculum developers as well as academics and government.

NSOs must look for opportunities to maximise impact in the development of statistical literacy. For example, influencing the national curriculum in math, science and geography to increase the focus on statistical content and statistical reasoning is an effective means of ensuring long term and widespread outcomes.

Supporting initiatives such as the International Statistical Literacy Project (ISLP) and working in partnership with statistical societies such as the International Association for Statistical Education (IASE) are also important avenues for NSOs to pursue. 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

The importance of data dissemination cannot be overemphasized. 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 its use across target groups. Dissemination mechanisms and systems need to make it easy for users (practitioners, managers, policy makers 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.

Another important consideration for the dissemination of statistical information is the way it is presented. NSOs need to improve the way information is presented to ensure that it is clear and unambiguous. Reducing '*noise*' to '*signal*' ratio i.e. the amount of caveats, and qualifications as opposed to the key messages and implications of the findings) would assist the greater use of evidence in policy and decision making by government (Davies, 2004).

Data visualisation is one means of presenting complex data in ways that are both engaging and easily understood. The work of Hans Rosling is exemplary in this field with the development of Gapminder which has changed the way data can be presented. The recent 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.

Using other mechanisms and social media platforms such as YouTube, Twitter, Blogs and Wikis to communicate across different target groups and demographic profiles is the key to promoting awareness of data and what they mean.

Developing and delivering training

Providing statistical training, information seminars on data sources and other didactic techniques are tangible means for NSOs to facilitate better understanding of statistical concepts, processes and data applications for key client groups.

Training for specific groups such as teachers or journalists can be effective ways 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, short self help online tutorials or e-learning course modules but need to match user requirements to be effective. 'Just in time' training can also be built into online data access tools to provide users with key information at critical points in time.

Providing support services

Developing resources and materials, either online or hardcopy, to support the informed use of statistics is another mechanism employed to promote the statistical literacy of data users. These materials can range from posters to information brochures or technical notes that accompany statistical reports.

Information, guides, fact sheets and other learning resources can be produced by NSOs to support the better understanding of statistics across a range of topics, statistical concepts, processes and purposes and can be tailored for each client

group.

Evaluating Outcomes

Making sure that strategies to improve statistical literacy across key target groups are achieving the desired outcomes requires some way of evaluating impact. With such broad and often indirect strategies, this is not an easy task. How can we quantify an increase in the public's appreciation of the value of national statistics?

Promoting the uptake of knowledge and changes in behaviour and attitudes relies on interacting with the client groups to gather insights into the effectiveness of dissemination strategies and continuously modifying strategies to suit purpose.

3.4 Summary

The role of the NSO is changing - it is no longer enough to merely collect and produce national statistics.

The need for NSOs to understand diverse data user needs, improve dissemination processes, raise awareness of the value of these statistics and to actively encourage their informed use is imperative to staying relevant and responsive.

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4. Educating the opinion leader (strategic information users, politicians and journalists)

What is an opinion leader?

Are those agents whose ideas and opinions serve as a model to others. Opinion leaders communicate messages to different groups, influencing the attitudes and behavior change of their followers.

How to identify an opinion leader?

We can find the opinion leaders or strategic information users in the following segments:

- Media

The media constitutes a high impact distribution channel of the statistical information generated by the NSO. Opinion leaders in this segment use the following communication channels to share their ideas and opinions to their audience: TV, radio, printed media, and web services (i.e. websites, blogs, social networks).

- Politicians

The *strategic information users* in the public sector are those that have a direct impact in the public policy making process, and serve as a model to different groups of the society. These users are, in some cases, statistical information producers.

- Private Sector

The *strategic information users* in the private sector are those large enterprises and business organizations that have a significant impact on the economy of their countries.

- NGOs

Strategic information users in this group are represented by Unions (workers, employees) of different sectors, political parties, civil associations, religious organizations and NGOs.

- Academia

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

After identifying the *strategic information users* in all of the above mentioned segments, the NSO should maintain an updated database that individually identifies the opinion leaders in each sector as an action field.

Educating the opinion leaders

Why is important to educate the opinion leaders?

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

- To make them communication channels of the information generated by the NSO, as drivers of the public opinion.
- To improve their decision making process by having quality, on time and sufficient information inputs.
- To get feedback in order to provide better products and services according to their needs.
- To contribute the positioning of the NSO as provider of the official statistical information against the non NSO data sources.
- To help the strategic users in the correctly interpretation and presentation of the data.

How to educate the opinion leaders?

It is important to develop a **Strategic Information Users Training Program**, which will attend their information requirements and needs and allow them to familiarize with the products and services that the NSO offers.

In the process of developing the training program, it is advisable to keep in mind the following steps:

- 1) Designing an *ad hoc* training program by identifying and registering the general and particular needs of the opinion leaders by means of:
 - a. Web services.
 - b. Call center.
 - c. Information petitions by email and letters, among others.
 - d. Face to face.

Direct communication with the opinion leaders will facilitate and enhance this part of the process.

The Strategic Information Users Training Program should be divided in a Basic and Advanced Program, based in the strategic user's needs, in order to facilitate the understanding of the statistical concepts, data analysis and data communication.

Example of some topics that a *Strategic Information Users Training Program* could include:

Basic Program

Statistical information available

Handling the NSO website

Using the NSO Interactive Data Consulting tool

Economic Information **Database**

Advanced program

Digital Maps

Data Warehouse

Business Directory

Industry Classification System

- 2) Identifying the human resources inside the NSO that have the capabilities to educate the opinion leaders in each topic.
- 3) Defining the optimal format that the training program should be imparted:
 - a. Online.
 - b. Face to face.

This should depend on the infrastructure and resources (human and financial) of each particular NSO and the geographical situation of the opinion leaders.

- 4) Creating an annual training program by scheduling these courses periodically, starting from the basic program, moving forward to more complex topics that could include several products and services provided by the NSO.

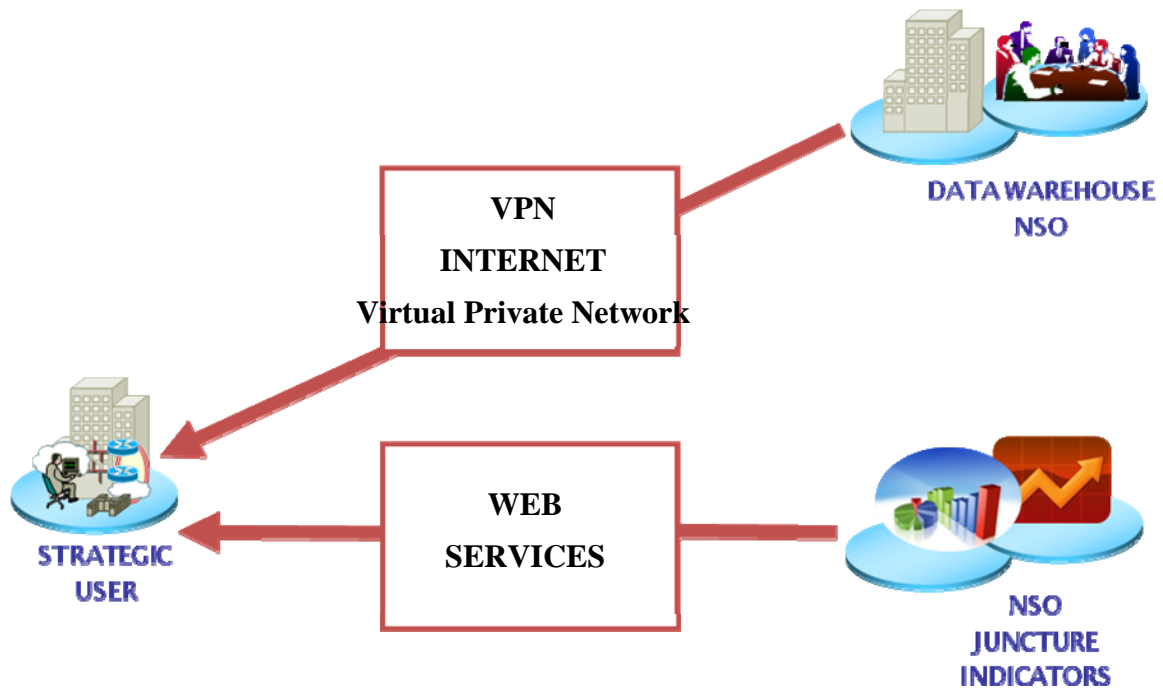
Once the development of the *Strategic Information Users Training Program* has been concluded, the NSO should motivate the opinion leaders' participation in this non-cost program by giving personalized presentations to each of them.

The relationship built with the opinion leaders should be permanent and dynamic in order to keep a continuous dialogue and fluid communication with each one. To formalize this relationship, the NSO could consider signing a cooperation agreement with the strategic information users.

Tools that can be used to educate the opinion leaders

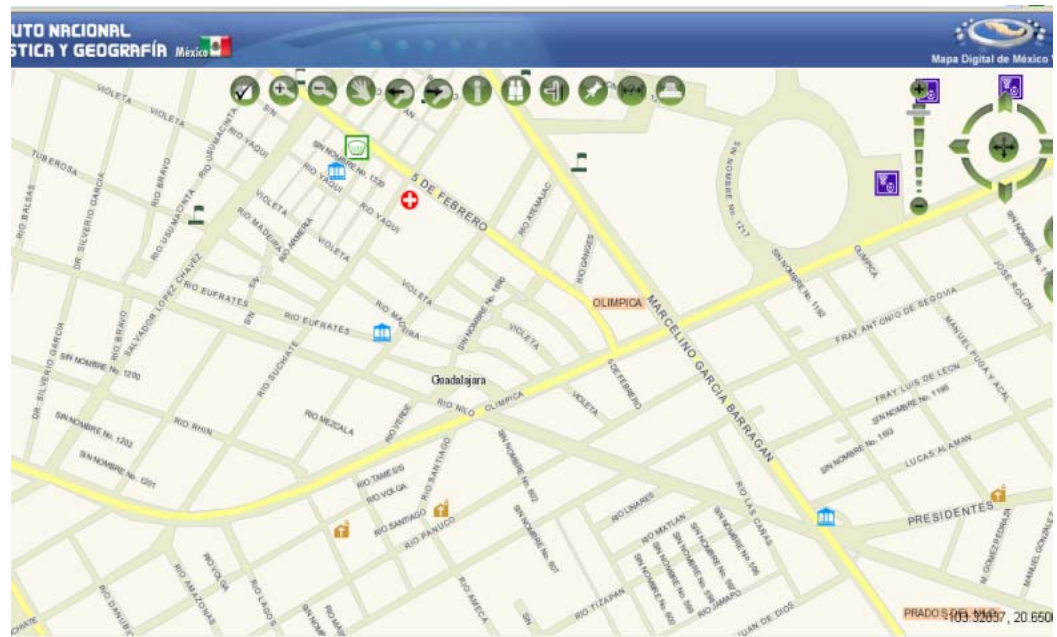
The NSO's website is the main tool for training the opinion leaders. Therefore, the website should be constantly maintained and updated in a dynamic improvement process, considering the feedback from the strategic information users.

Also the NSO could offer to the specialized opinion leaders a direct access to its Data Warehouse through a Virtual Personal Network (VPN), considering the limited or unlimited access to microdata ensuring its confidentiality or classification; this service to the strategic information users will improve, enhance and make more effective their decision making process based on statistical information.



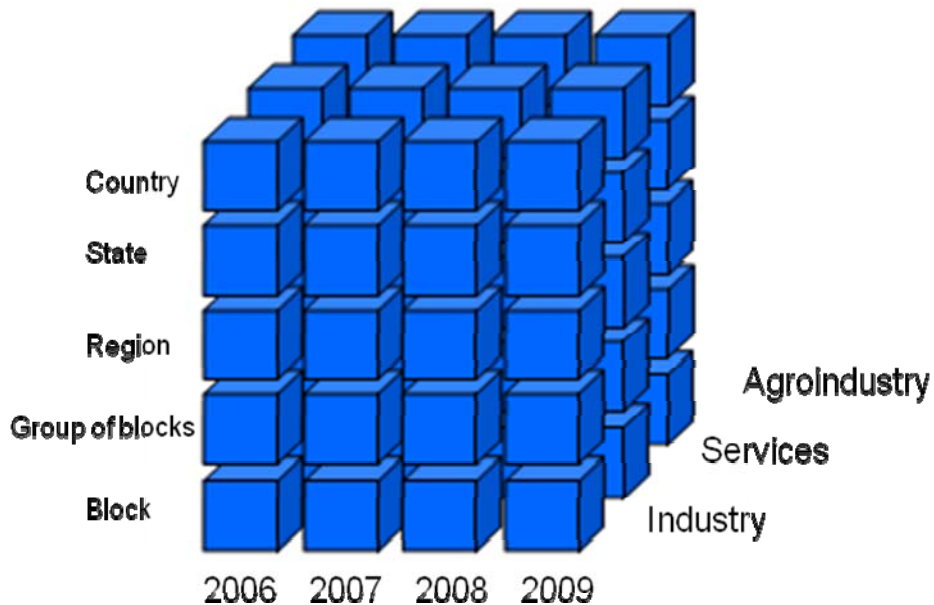
Other tools that could be offer as a service to the opinion leaders are the different platforms developed by the NSO that make data meaningful. For example:

- Geo-referencing tools.





- Statistical Data Cubes (allow multidimensional data analysis with multiple factors crafted for the requirements and needs of strategic information users).



The return of investment of this program clearly justifies its development, and will result in the creation of a network of opinion leaders, repositioning the value of official statistics, making data meaningful and improving statistical literacy.

5. Improving the Statistical Literacy of Decision Makers (Government agencies)

"Government is a contrivance of human wisdom to provide for human want" Edmund Burke

- Who are the decision makers and why are they important?
- What statistical capabilities do decision makers need to be able to effectively use official statistics?
- How can NSOs support evidence based policy making?

5.1 Who are the decision makers and why are they important?

Whilst decision making is necessary at every level of society, this chapter will focus on 'political decision makers' such as policy makers, members of parliaments and staff from agencies at all levels of government.

Governments are required to make decisions for public policy which determine the location of schools and medical services, the allocation of resources, the implementation of programs and interventions, the direction of trade investments and so forth. The decisions that we make today will affect us tomorrow hence the importance of basing these decisions on reliable, high-quality information sources. Therefore the role of national statistical agencies is to lead a responsive statistical service that supports the evidence required by governments to identify issues, evaluate programs, plan for the future and make informed decisions.

Governments are increasingly committed to basing their policy on recognised and accepted evidence and high quality official statistics are an important form of evidence.

Worldwide there is an increasing emphasis on the need for evidence-informed policy as a '...rigorous approach that gathers, critically appraises and uses high quality research evidence to inform policy making and professional practice.' (Davies, 2004).

Importantly evidence based decision making differs from the alternative. Opinion based policy '...relies heavily on either the selective use of evidence (e.g. on single studies irrespective of quality) or untested views and can be inspired by ideological standpoints, prejudices, or speculative conjecture.' (Davies, 2004)

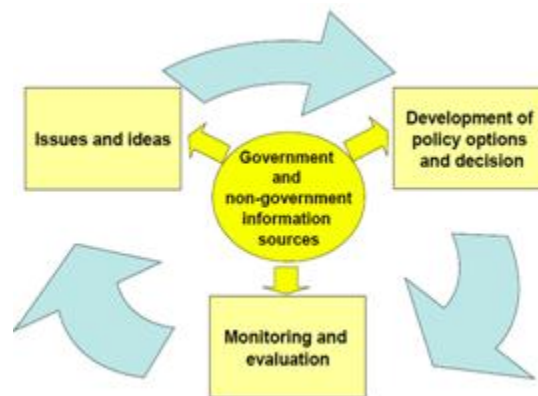
The advantages of an evidence informed approach to policy making are that it:

- Helps ensure policies respond to the real needs of the community;
- Can highlight the urgency of an issue or problem which requires immediate attention;
- Enables information sharing amongst other members of the public sector, in regard to what policies have or haven't worked;
- Can reduce government expenditure which may otherwise be directed into ineffective policies or programmes;
- Ensures that decisions are made in a way that is consistent with our democratic and political processes which are characterised by transparency and accountability. So it is the evidence that provides the grounds for believing that certain conditions exist or that certain actions lead to particular outcomes.

The need for political decision makers to be able to access, use and understand statistics is paramount as information and data is required at all stages of the decision making process:

- Firstly in **identifying and understanding the issues at hand**. Statistics are critical for the accurate identification of existing economic, social or environmental problems and for developing a better understanding of the issue by analysing trends over time, or patterns in the data.
- Then in **setting the agenda**, statistics provide a valuable source of evidence to support decisions for new or altered directions and to establish the urgency of action.
- Once an issue has been identified and recognised as important then rigorous statistical analysis can assist in **formulating a response** and assessing the cost benefits and effectiveness of alternative response options. At this point it is necessary to clearly define aims and goals with quantifiable indicators for measuring success. Benchmarks should also be established to ensure that progress is measurable following the implementation of the initiative, policy or programme.
- Finally statistical evidence in terms of quantifiable outcomes against established benchmarks is critical to the effective **monitoring and evaluation of results** and to the re-assessment of the issues.

The policy making cycle (below) illustrates the information comes from many sources (government and non government) and should inform all aspects of the decision making cycle: from getting recognition of an issue to informing the design of policy, then monitoring implementation and evaluating impact.



5.2 What statistical capabilities do decision makers need to be able to effectively use official statistics?

While there is support for evidence based policy, its application can be difficult. Rarely does there exist the perfect piece of evidence that clearly dictates policy. 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 whilst statistics can form powerful evidence as they can provide clear, unbiased, and undisputed numerical facts on an issue, statistics alone do not form evidence,

they're just numbers - they need to be analysed and interpreted effectively and accurately to ensure that they form actual 'evidence'.

Furthermore, the growing number of private and commercial sources providing information has increased the need for political decision makers to be able to critically evaluate and appraise data sources.

Banks (2009) laments the loss of a quantitatively skilled Australian public service '... at a time when it has been called upon to provide an evidence based approach.' (Banks, 2009, p.13). It would be fair to say that this is an international phenomenon with many governments experiencing difficulty attracting prospective employees with mathematical or statistical backgrounds into their workforces. Yet ironically there has never been greater emphasis on the need for statistical evidence in political decision making.

Statistical literacy skills are vital for the informed use of statistics in decision making and can be summarised in terms of four broad criteria, these are:

- data awareness,
- the ability to understand statistical concepts;
- the ability to analyse, interpret and evaluate statistical information; and
- the ability to communicate statistical information and understandings

5.2.1 Data awareness

Data awareness involves knowing what types of data are available, how that data is collected and how it can be used in order to decide if it is appropriate for a particular need.

Defining data needs

Effective policy making requires awareness of the data characteristics necessary to inform and make decisions - therefore decision makers need to first be clear on the issue they are attempting to address. Assisting decision makers to define the elements of **data need** before identifying **data sources** ensures a much better process to get the right data for making a decision

Starting with the available data source and then using this as a basis to determine data need is still a data informed decision however it risks missing key important points and it is less likely to create innovative policy, as the analysis is likely to head down the same path as previously.

Defining data need entails:

- articulating the issue or area of investigation
- identifying the key population (demographic and geographic)
- specifying any particular time frames being investigated

NSOs offering their statistical expertise and working with government agencies, understanding their policy drivers and helping them to define their data needs will ultimately improve the decision making process.

Ability to assess data quality and 'fit for purpose'

Once data needs have been defined, decision makers must then be able to identify suitable data and information sources to address that need.

Whilst data is increasingly available from variety of sources, its quality can vary considerably. Using data that is of poor quality or that is not fit for the purpose which it is intended, can lead to inappropriate conclusions and ineffective decision making. It is therefore important that political decision makers are able to make an assessment of data to ensure it is 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 there are a number of criteria that determine 'fitness for purpose' (ABS, 2008) which decision makers need be made aware of. These include:

- **Institutional Environment:** The institutional environment within which the data are collected and processed;
- **Relevance:** The degree to which data meets real needs;
- **Accuracy:** How well data correctly describes the phenomena it was designed to measure;
- **Timeliness:** The delay between reference point and when data info becomes available;
- **Accessibility:** The ease with which data can be referenced, including suitability of form through which info can be accessed;
- **Interpretability:** The availability of supplementary information and metadata and the appropriate presentation of data such that it aids in correct interpretation of data;
- **Coherence:** The degree to which data can be successfully brought together with other statistical information within a broad analytical framework and over time.

Providing tools, resources and frameworks to assist decision makers assess data quality and fitness for purpose will facilitate evidence informed policy.

5.2.2 Understanding statistical concepts

Fundamental to the ability to effectively use statistics 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 is observational or experimental and if analysis is descriptive or inferential.

Furthermore, 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 is an essential skill for data analysis and ultimately effective decision making.

5.2.3 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.

This is particularly important to the ability to formulate appropriate policy options and responses. 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.

5.2.4 Communicating statistical information and understandings

Decision makers need to be able to communicate statistical information and understandings 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 toward set benchmarks.

5.3 How can NSOs support evidence based policy making?

There are a number of ways that NSOs can assist their government clients to make better use of official statistics for informed decision making. These relate to increasing access to data and metadata; providing tools to assist in interpreting statistical information; developing statistical capability and working collaboratively to enhance understanding of needs and identify opportunities.

5.3.1 Improving access to statistical information

The first step to 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 is collected.

Making data freely available online is the first step to enabling access to statistical information. However, too often, data and statistical information is challenging to find or it is presented in ways that make it difficult to be understood. Following best practice principles for accessibility include:

- Storing data in an open format which is not restricted to any particular product or technology;
- Having a permissible copyright license such as Creative Commons; and
- Ensuring strategies for keeping the data set up-to-date.

5.3.2 Developing Communication Channels

An important role for NSOs is to ensure that government agencies are aware of available data, as well as have the relevant information on the data's uses and limitations. There are many mechanisms for achieving this, including:

- 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 recent national and international statistical releases;
- Specialised government web-portal - allowing for a tailored approach to government clients in finding urgent and relevant information and resources;

- 'Road show' presentations designed to raise awareness of the data and services available and which are presented across the country. These sessions target client groups and their specific data needs but also enables discussion which facilitates mutual understanding of statistical priorities and future directions.

5.3.3 Building Statistical Capability

There is a growing demand among government client groups for statistical training at a basic level. Many NSOs provide training courses aimed at developing a range of statistical literacy skills and specialist learning opportunities. Offering training and resources that assist decision makers understand the statistical process, from data collection through to data analysis, testing of assumptions and evaluation of results will assist in promoting use of statistical evidence in decision making.

Furthermore, where government agencies are also data custodians there may be opportunity to develop capability in metadata management practices, improving data quality, capitalize on administrative data sources and facilitating data sharing within and across agencies. This is becoming increasingly important to being able to address the range of complex multidimensional issues or 'wicked problems' that are facing society.

5.3.4 Establishing Consultative Forums

Staying relevant to government needs is important for NSOs and one mechanism for demonstrating statistical leadership to achieving better national outcomes is through the establishment of advisory or consultative forums. These forums can 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 assist in assessing the relative merit of statistical programs; the adequacy of statistical services; and external pressures that might affect statistical activities. Establishing collaborative forums for consultation between government agencies and NSOs encourages and informs dialogue within and between agencies on strategic statistical issues, operations and processes.

5.3.5 Providing Out-postings to Government Agencies

A tangible way that NSOs can attempt to bridge the gap between policy and research is through out-posting statistical staff within government agencies. The role of the out-posted officer is to provide statistical leadership in their host organisations, promote wider awareness, understanding, access and use of official statistics, and also to increase the capability for research and analysis within departments. These out-postings can assist NSOs to develop a better understanding of emerging policy issues and statistical requirements of government; promote and implement statistical frameworks and standards that allow comparisons across agencies; and assist in maintaining professional relationships and engagement with other agencies.

5.3.6 Coordinating National Conferences

Organising regular statistical conferences that bring together key statistical partners, both nationally and internationally, is another means that NSOs can promote understanding of the statistical landscape. These forums serve to develop mutual

understandings and enable decision makers to develop effective policies and strategies for the future by:

- Increasing awareness of the importance of statistics;
- Demonstrating the effective use of data;
- Strengthening the infrastructure and use of data; and
- Promoting better collaboration for sharing and maximising use of statistics.

5.3.7 Providing Statistical Leadership

NSOs have a role in providing the statistical leadership necessary to improve national outcomes. These are opportunities to work closely with government decision makers to promote the value of data as a 'statistical resource' and develop mechanisms that maximise the potential of data to explore complex issues. NSOs 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: and
- Improving access to domestic and international statistical information.

Conclusion

Political decision makers are a diverse group with interests across a broad range of statistical outputs and with varying degrees of statistical and analytical capability. Developing initiatives to improve the statistical literacy of decision makers is a challenging task.

Ultimately increasing opportunities for communication, collaboration and consultation are the most effective means for NSOs to understand political drivers and provide the necessary advice, assistance and support for evidence based decision making. NSOs need to 'get a seat at the table' and be involved in discussions of national importance from the onset rather than be treated as an online shopping catalogue of data sources.

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

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6. Statistical Literacy for the Education Community, including how to influence curriculum development

6.1 Introduction

The teaching of statistics is one of the most important instruments to achieve the goal of improving statistical literacy. In the curriculum of the Primary and Secondary Schools in many countries, the teaching of statistics is included in the several levels ("O" level - 7th, 8th and 9th year and A-level - 10th and 11th year) of the Mathematics syllabus. Initial topics (the gathering and organisation of data, data representation and interpretation, measures of central tendency and probability calculation) are taught at the primary school level while, in secondary school, students are introduced to more elaborate concepts such as (in certain situations), inductive statistics. Recent reflexions on the usual introductory courses in Statistics lead us to the introduction of projects, which 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 the heart of statistical thinking. Data collection promotes learning by experience and links the learning process to reality (Snee, 1993). Developing the statistical reasoning of students consists of incorporating active learning strategies that make it possible to complement what they have 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 it replaces passive lessons with lessons in which the students take an active part (Smith, 1998). This allows demonstrating the power, elegance and beauty of the 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. The work is structured as follows: in section 6.2 we start by comparing different approaches concerning the teaching of Statistics and make a short review of the curricula in three different countries - USA, England and Portugal. We also bring in the paradigms of the teaching of Statistics. In section 6.3 we present the power of statistical projects as the basis for the statistical thinking and reasoning. Section 6.4 introduces an idea about who should influence the development of the curriculum in statistics. We explore the importance of training in statistics for teachers, as well as tools and materials for the education community. Conclusions are presented in Section 6.5.

6.2 An overview of Statistics education

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 50s, closely linked to the study of Probability and oriented to the theory (with special emphasis on the study of hypothesis testing). Later, Statistics was included in the curricula of primary education, focusing on graphical forms of representation and on central location measures, (Holmes, 2000).

In the late 70s, a major curriculum development project appeared in England, where statistics was essentially viewed as "working with data". The guidelines of 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. This approach, later, also became notable in the curricula of other countries.

Several countries implemented changes in their curricula in order to adapt Maths to meet statistical literacy. Ponte and Fonseca (2001) have compared different approaches concerning the teaching of Statistics and concluded that three major trends are related to the teaching of statistics in Europe:

- (i) 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);
- (ii) As a chapter of mathematics, sometimes referred to as Stochastic Analysis, emphasizing conceptual and / or computational approaches (for example, in France);
- (iii) As 'state' istics, i.e., as an auxiliary tool for the study of various topics and school subjects, such as Geography, Biology, etc. (a trend visible, for example, in Sweden).

The work of Ponte and Fonseca (2001) focused on the curricula of USA, England and Portugal. The main similarities and differences resulting from comparing the three documents are the following:

Exploratory data analysis

- American and English curricula point to the importance of understanding the characteristics of a global data set, while Portuguese focuses much on measures of central tendency (mean, mode, median), by the end of the 3rd cycle;
- comparisons between two or more sets of data are emphasized in NCTM starting from the second stage of elementary school curricula, while Portuguese and English do that in 3rd cycle;

- at the level of secondary education, NCTM calls for a more or less deep study of bivariate data (including linear, exponential, quadratic functions - that best fit a given data set) while 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 KS 2, while other countries refer to it in the 3rd cycle. In the curriculum of many countries there is no reference to the development of inferences, (although the American NCTM and the English program advocate the development of concepts of statistical inference in some phases of the elementary school an later).

There is a lack of consensus in the introduction of inferential aspects in the curricula of elementary and secondary schools. This is due to the fact that the teaching of statistical inference is usually preceded by the introduction of essential concepts (such as random samples, estimator theory, hypothesis testing, etc.), for what some mathematical background is needed. However, it is important that students understand, since middle school, the use of samples in order to draw conclusions to populations.

In a similar perspective, Roiter and Petrocz, (1996), analysed the curricula of several introductory courses in Statistics and 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. As students consider that the focus is on numbers and calculations, the basic math (fractions, decimals, and algebraic formulas) can interfere with learning involving these topics in mathematics. Therefore, when data is not structured it may hamper the interpretations based on different assumptions and also with the written communication skills that are required.

6.3 The main challenges

Adopting the paradigm of Statistics as a problem-based matter is essential. This perspective would make it possible to organise the course as a series of applied problems that could very well be taken from the news or 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 the Probability and Statistics for all levels of education. On this basis, the current guidelines for the teaching of 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. In order to understand the fundamental ideas of statistics, students should work directly with data, (Campos and Oliveira, 2010). Data analysis and the study of probabilities

provide a natural environment for students to set up connections between mathematics and other subjects and their everyday experiences. In fact, in recent years, the teaching and learning of statistics has become more practical, and interactive. One of the main causes that contributed to this improvement 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 needs 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 they 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. The use, as a supplement to theoretical lessons of a sequence of collaborative projects with oral and written reports on the results obtained is one of the solutions tested (Smith, 1998). In order to demonstrate the power, elegance and beauty of the statistical reasoning, the use of realistic examples of a great variety persuades students that they are using critical thinking skills which may be applied on a daily basis and in any profession. In this aspect, many people have discussed the advantages and disadvantages of comparing the data produced by the students with the analysis of data produced by others. The problem of the examples produced by others is that the students remain passive and do not experiment in first hand the many questions and problems which arise from the collection and analysis of data.

Thus, it is preferable to let the students manage their own data. Activities which take on the form of a project provide the students with experience in formulating questions, defining problems, formulating hypotheses and operational definitions, planning experiments and surveys, collecting data and, regarding the best way to deal with measurement errors, draw up data summaries, analyse them, communicate results, plan experiments and correlate the ideas suggested by the discoveries.

Experiential learning ('learning by doing') must be supplemented by the written and oral presentation of results. The process of writing about a subject may reinforce and clarify its understanding. It is useful for the projects to be presented by the students. Presentations must the goals, details about data collection, inferential processes and questions or reserves concerning the conclusions found. 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.

6.4 Ideas, Tools and materials to influence curriculum development

6.4.1 Who takes part?

Curriculum means different things to different people. Begg (2004) refers that there are situations where it means the official curriculum, the planned curriculum, the school scheme, individual teacher's lesson plans, or textbooks. In that work, Andy Begg presents an idea about who should influence the development of the curriculum

in statistics. He includes statisticians, teachers, employers, social scientists and students as possible "voices" that contribute to the curriculum development.

Voices	Contributions
Statisticians	to ensure school statistics accurately reflects professional practice
Employers	to ensure that future workers will be statistically literate
Parents	to address needs of citizenship in an information-filled age
Other Teachers	to ensure that statistical needs in other subjects are met
Social Scientists	to ensure the cultural acceptability of curriculum ideas
Learners	to ascertain whether the curriculum is meaningful for them

Table 1. Interested Groups and Possible Contributions (Begg, 2004)

We suggest two additional voices in this set: the employees and the statistical offices. Former students that are now 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. Statistical offices can also act as contributors, since they already offer tools and materials to encourage the improvement of statistical literacy, as we can see later in this chapter.

Among all these voices, teachers play an important role as possible contributors. Therefore, it is essential to reflect on how they should be taught.

6.4.2 Teaching teachers to teach statistics

According to Branco (2000) it is essential to have an awareness of the difficulties and successes teachers and students experience in the teaching and learning of statistics. Therefore, Quintas, et. al (2009), implemented a survey where it was found that teachers recognize the need for training in statistics especially with regard to the realm of didactic knowledge.

Several initiatives were created to accomplish this goal (Peck and Gould, 2005). The INSPIRE (Insight into Statistical Practice, Instruction and Reasoning), consisting of both a face-to-face component and a significant online component, was a yearlong course for secondary school teachers of statistics designed in a joint effort by two universities (California Polytechnic State University and University of California, Los Angeles) and the American Statistical Association. The endeavor was funded by a grant from the National Science Foundation which supported course development and course delivery for the first two years of the project. The primary goal of the project was to create a unique professional development experience for secondary school teachers that would (i) provide teachers with the necessary background to teach introductory statistics; (ii) help teachers to incorporate real data, active learning and technology in teaching introductory statistics; (iii) provide access to a

variety of resources for teaching statistics and (iv) create a community of learners who would advise and support each other in matters of classroom practices, pedagogy and understanding of statistical concepts.

6.4.3 Tools and materials from Statistical offices

Nowadays, resources are available worldwide, at the distance of a click. Many statistical offices have developed clear educational strategies. Statistics Canada developed several resources such as access to a selection of electronic data, a page with the statistical profile of Canadian communities, etc. Other countries, such as the Australian Bureau of Statistics have a number of pages on the Internet intended for secondary school teachers and students. Statistics New Zealand includes the "Schools corner" where applications built to provide a flexible way of visualising the complex tables that result from the Census of Population are available. Statistics Canada provides learning resources for Teachers and Students and includes a "Kids' zone" in the web page.

In Europe, the Office for National Statistics (ONS) in the United Kingdom has its education strategy that includes the creation of a group made up of people from the ONS, teachers, assistants, students and trade associations with a view to contributing towards bringing the ONS and schools closer together. In Portugal, ALEA is to be viewed as a project which aims at providing both teachers and students of secondary education with teaching materials for the study of Statistics.

6.5 Conclusions

The teaching of statistics in elementary and secondary schools is one of the means to improve 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 organise 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 influence the curriculum development, we suggest that employees and statistical offices as well as statisticians, teachers, employers, social scientists and students get involved. All of them can act as possible "voices" that shall contribute to the curriculum development.

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

General Public

The literacy of citizens is of fundamental importance in building a better society. 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. On a daily basis, adults receive political, commercial, financial, and ethical messages that are connected to statistics. Many of those statistics are produced by government statistical organizations.

Statistical agencies rely heavily on journalists as intermediaries to capture the attention of the public and to popularize statistical studies, making their facts and figures relevant and understandable by incorporating them into human interest stories. The duty to acquire the skills to critically evaluate media stories, 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 is true in our time.

Responsible citizens should not be afraid of numbers or statistical terms. They should understand why statistical information is needed, how reliable statistics are gathered, what is meant by basic statistical ideas such as averages and how to effectively interpret graphs and charts that appear in the media. In other words, citizens need to be more 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 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. Moreover, today's adult public may have missed out on a statistical education previously not provided in public school. They need to know more about how studies are conducted and data are analyzed in order to comprehend the terms that media use in describing study outcomes. Statistical agencies can lend timely support to this public education.

Promoting statistical literacy

A national statistical institution's mandate is to provide official statistics that are trusted by governments, businesses, communities and individuals to make informed, evidence-based decisions. This is done by offering access to reliable, relevant data. Most statistical agencies 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 now has direct access to massive amounts of official information online. While media continue to be a key and trusted distributor of our data, statistical agencies can proactively share their considerable statistical expertise directly with the general public. They can improve public

statistical literacy by enabling a better understanding of statistical concepts so that citizens may get more value out of the data they collect and distribute and be better informed and fuller participants 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 need 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 person.

Explain why statistics are needed

Statistical organizations 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. Statistics are used to design, evaluate and improve government programs and policies. For example, the government needs to know the number of seniors and children in order to plan financial assistance programs and services such as senior citizens' homes, schools and day-care centers.

Informed decision-making depends on the accurate and objective information that is collected and disseminated by statistical agencies.

In practice, informed decision-making can save a country millions of dollars, for example, by helping to accurately target government spending. 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 better understand the numbers produced by statistical agencies.

Encourage public understanding of numbers

Every major data release, published 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.

You can gently introduce the public to basic terms and concepts used in the world of data by pointing them to definitions and supporting resources. Several international statistical agencies have sections of their websites that support public statistical literacy and explain statistics.

An excellent example is Australia Bureau of Statistics (ABS) section called *Understanding Statistics*.

<http://www.abs.gov.au/websitedbs/a3121120.nsf/home/Understanding%20statistics?opendocument#from-banner=LN>

Here one 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 the basic concepts and principles of statistics.

The first World Statistics Day in October 2010 was the driver for other statistical agencies 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. http://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 U.S. 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
<http://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 increase their capacity to understand and use data, they also provide informed feedback about data collection activities in their community. Their feedback helps in understanding the context within which data are collected and disseminated.

Statistical agencies are now using technology to do online consultations with the public. They network and have interactive discussions through listservs, blogs and social media like Facebook.

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 programs and to promote the collaboration of survey respondents.

As mentioned earlier in this chapter, every national statistical agency has an interest in creating an appetite for their data and helping to develop citizens' understanding of how to 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 programs 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 statistical organizations would not 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:

<http://www.statcan.gc.ca/survey-enquete/index-eng.htm>.

The survey environment, however, is becoming increasingly difficult. Not only are respondents more difficult to contact and more heavily bombarded by public polling and market surveys, but there appears to be a greater sensitivity to any intrusion of privacy. For this reason, it is important to explain privacy and confidentiality practices in detail. Response rates can be heightened when respondents are assured of privacy and of the confidentiality of collection activities and are fully informed of the reasons for collecting the data---especially for surveys that are likely to directly impact their lives or their community's well-being. 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.

Considerable goodwill is elicited from respondents when associations publicly support and justify the statistical organization's 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 program, 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 is very good practice (and in many statistical agencies, it's the policy) to provide all respondents with information, prior to or at the time of collection, about:

- The purpose of the survey (including the expected uses and users of the statistics to be produced from the survey)
- The authority under which the survey is taken

- The collection registration details
- The 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 (questionnaire or computer- or telephone-assisted interview script), the respondent would be provided 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, it is recommended that it appear directly on the questionnaire as well; or, in the case of 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 agencies 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?*
- *How interest rates, salaries, prices, and other key financial indicators will be calculated?*

There are a few ways he (or she) could do it....

...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.

So next time, think about the influence and the impact you and your information can have!

Other activities which can help support respondent relations and statistical learning include:

- Returning the results or numbers to survey respondents in a way which makes them easy to understand, such as in analysis which highlights nuggets of information from among the mass of data collected.
- Giving people information they can use, while helping them know what statistical agencies do. Some agencies distribute copies of press articles using data that was collected through previous surveys. Typically, figures reported in the press are analytical. Repeated reference to the statistical agency as the source of this analytical information keeps us in the public mind. During collection activities, people understand almost instinctively that the information being collected is important if they see it used in a media article. Provide a copy of real articles.
- Developing and distributing 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 <http://www.statcan.gc.ca/pub/12-581-x/12-581-x2010000-eng.htm> presents current Canadian statistics on demographics, education, health and aging, justice, housing, income, labor market, households, travel, national economy and finances, agriculture, international trade and the environment. Used as a respondent relations tool, this envelope-sized booklet serves as a reference for people who want quick access to current Canadian statistics and key international comparisons. This brochure is included with paper questionnaires provided to respondents and more than a million additional copies are printed every 5 years to support the collection of the Census of Canada.

To assist in reaching respondents, to develop their statistical literacy and to help respondents understand the statistical process, survey support materials should clearly communicate the benefits of completing individual surveys. In addition, when respondents use electronic reporting options, they should be linked directly to previously gathered data. They could then 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 that have an interest in knowing more about statistics could link to online learning materials developed for the general public.

A statistical agency's prime assets are its credibility, relevance and visibility. High visibility and positive media coverage reinforce credibility, which is essential in motivating respondent participation. Every communication directed to survey

respondents should be considered an opportunity to encourage a better understanding of the statistical system and its outputs, and to highlight the importance of statistical programs.

Business

In this global economy, data is increasingly the lifeblood of business and used for strategic planning, new market exploration and expansion.

Business people need up-to-date statistics on how industries work and the goods and services they produce. They use demographic statistics to determine the right location for a new business and to help reach the right market for their products or services. 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 important contributors to the different data collected by statistical organizations to feed the gross domestic product which is an international measurement of a country's economic well being.

Since businesses are involved in both the supply and demand side of data, there is 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

Outreach activities can provide business clients and respondents with better access to data and with training on their use.

- To provide a more in-depth understanding of data for non-experts, many statistical agencies (including Australia, New Zealand and Canada) offer workshops in different cities. These workshops typically vary in length from 1 to 3 days and are targeted at business, market researchers, analysts, advisors and scientists or anyone who conducts a survey, is a data user or needs to develop their 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 Canada: <http://www.statcan.gc.ca/cgi-bin/workshop/wst.cgi>

From Australia: http://www.abs.gov.au/websitedbs/d3310114.nsf/web_pages/23E69B515C586A7ECA257188001D2EA5

From New Zealand: http://www.stats.govt.nz/tools_and_services/services/outreach-

[and-liaison/outreach.aspx](#)

Other activities in business outreach are described below:

- By collaborating and building relationships with stakeholders within the business sector, (including those that service the business sector such as statistical societies or brotherhoods) a statistical agency can increase the exposure of their data and services on various business websites. These websites redistribute relevant information to their members and clients and provide a seal of approval to the agency's activities. Stakeholders include the federation of independent business, chambers of commerce, manufacturers and exporters, bankers associations, investment industry associations, institutes of actuaries, retail councils, etc.
- Attending major conferences or events organized by national business groups helps to raise awareness about statistical programs and develops business leads or ideas for partnerships. Being visible, interacting with business and understanding the environment in which they work are the best ways to produce products and services that will assist them. Brochures that explain the importance of statistics to the economy and how businesses can use these statistics to their advantage can also be included in conference registration packages.
- A Speakers Program can be set up to send expert speakers to Executive Masters of Business classes (E-MBA), business courses at the university level or conferences. 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. The agency should develop specific and relevant cases studies and examples for this purpose. A very 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.
<http://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 more apparent. Dynamic visualizations of data prepared for business can tell a story at a glance and are useful in helping people understand economic indicators, for example.

More data, enhanced skills required

Besides responding to client questions, statistical agencies should look for opportunities to explain their products and services to existing or potential users, respondents, business and the general public. This can be done through education programs for specific communities which include targeted talks, workshops, communication or training materials or through an enhanced website that makes available data, metadata and analysis, case studies and tutorials. We 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 their development of data interpretation skills. In this way, the agency can grow a more knowledgeable stakeholder base: people that understand the statistical system, the application of data to benefit the workplace and their daily lives, and the importance of data to our society and economy.

There is a surge of open government data initiatives around the world: more and more 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. Statistical agencies must change the way they approach the public to 'enable the layman to better understand the results obtained by statisticians'. This will support the viability of statistical programs in the long term and reward the global community by enhancing the statistical literacy its citizens. Statistical literacy is an important ingredient of democracy.

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Australian Bureau of Statistics website, Planning for Business brochure online
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Eurostat website, *Statistics Explained*, a guide to European statistics

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

8. Improving statistical literacy within statistical organisations - training the workforce

The true capacity and 'strength' of any organization are its human resources or staff.

An efficient statistical organization cannot operate without first rate people. The quality and vitality of our statistical programs is reliant on engaging the finest and most talented recruits and investing in continuous learning for employees to build capacity at all levels of our 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 the collection, processing and distribution of statistical data and have at least a fundamental level of statistical literacy. To foster the recruitment, retention and growth of our 'strength', a broad spectrum of statistical learning opportunities must be made available, from basic statistical skills to advanced methodologies.

This chapter will cover the different aspects of capacity building within statistical organizations including training:

- The **future** workforce in 'official' statistics concepts
- **new recruits** through a structured developmental program
- **current employees** to upgrade and strengthen statistical skills
- **by retirees** to implement a knowledge transfer of statistical expertise
- staff in other countries and **international** organizations

8.1 Training the future workforce

Of the many purposes that education serves, one of the most important 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. In some countries, government statistical agencies are experiencing challenges in finding skilled professionals from the education system to directly fill these roles. Why? Because there is a difference in preparing a post secondary student for a role in government or 'official' statistics as opposed to the 'general' statistics that is most often learned through the education system.

The traditional mathematics and statistics departments in major universities often do not offer a full suite of courses in sampling, methodology or survey statistics. Add to this the fact that much of the course work in math and statistics is abstract and is not really applied to real world issues. University professors often make their academic reputations in statistical theory and not applied statistics so the academic training of statisticians is not always relevant to the skills required by 'official' statistical agencies that look for recruits who:

- are technology literate and are comfortable with computer programs
- have a blend of training both in the theory and the application of statistics
- have the statistical skills to produce analysis of real world issues
- can effectively communicate their results in written text

To remedy this skill gap, students in statistical courses at the post secondary level should get more involved in hands-on statistical consulting. Students should also be encouraged to work during school breaks at statistical agencies to acquire a cooperative experience. If found to be productive then students may be integrated directly after graduation to full time work in areas of the statistical organization where they have had experience during their studies.

Interaction should be fostered between academics and government statisticians with perhaps 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, better access to government statistics should be provided 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 can be awarded to get students interested in the broad range of data collected. Similarly, prizes for the best data visualization or modelling project can 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. The statistical organization must find ways to network with academics to implement pre-determined courses that might lead to a certificate in 'official' statistics.

Useful courses for government statistics should include topics on:

- Data relevance, the need for new data for policy making
- confidentiality and privacy in collection practises
- 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 the university level 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 Statistics New Zealand and the University of Auckland.

Example of 'official' statistics course from University of Auckland: Course 705- Topics in Official Statistics

8.2 Training new recruits

Statistical agencies 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. It should be recognized that it will be almost impossible for an academic institution to produce exactly the correct skills in a graduate that a statistical organization desires. It is therefore up to the statistical organization to mould the new hire into the employee it wants. This can be done 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. Left alone without direction a new employee will find it more difficult to reach their full potential and gain the self-confidence and skills required to provide optimum service while achieving their career aspirations.

A mentor or coach should be assigned to each new recruit to provide guidance, share their statistical 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 program

New recruits should be placed in a structured developmental program that helps them rapidly acquire the skills and a broad experience within the statistics organization. Development programs can include work assignments interspersed with periods of statistical training. The best programs are based on action learning. An example of action learning is a rotational assignment. These assignments are collaborative in nature and enable applied training and expose recruits to some main statistical functions - such as research, surveying, modeling, analysis, compilation of the national accounts, etc., as well as some subject matter areas: such as labor, 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. The end result of rotational assignments is the integration of skill and knowledge. They allow a new recruit to explore different aspects of the organization's work which often helps the new employee to choose a career path.

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 their 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. A new recruit can use the career path document as a baseline for helping to develop a learning plan http://icn-rci.statcan.ca/07/07m/07m_078_e.htm that addresses their current job needs and future aspirations.

For example, if the new recruit wanted to be involved in business statistics then they should ensure that they get some experience in the development, collection,

processing, analysis and dissemination of 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, business survey methodology etc.

8.3 Training our current workforce

To realize the important role in making our data relevant, understandable, and useful, we need a dedicated workforce that makes 'quality' a core value that is applied in day-to-day activities, processes and standards. In order to uphold a reputation of relevance and to remain reliable and trusted by a broad range of stakeholders, we must invest heavily in our employees' continuous statistical learning to elicit quality in our output.

Re-engineering, changes in the workplace and the emergence of new and better technologies have fuelled the need for lifelong learning in statistical agencies. 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.

It should be noted that employees acquire and assimilate knowledge through diverse learning experiences. Therefore, a blend of formal and informal learning activities should be offered to enhance employee competencies. They may include:

- Formal training such as structured in-class courses either provided by trainers at the statistical organization or in partnership with academic institutions, computer assisted courses or e-learning, external learning through university diploma or certificate programs some of which can be financially sponsored or education leave provided.
- Informal training such as networking opportunities, conferences in specific subject areas, information sessions, presentations and workshops

8.3.1 Statistical training for general staff

In the realm of statistical training, one size does not fit all. Different sections and different employees within the organization have different needs. Staff in subject areas for example, must have a higher level skill and statistical competency than those in general administration. Nonetheless, all staff should have some level of statistical training in order to understand the basics of processes in a statistical organization. Everyone is not expected to understand the in- depth daily activities of statisticians but there are some elements in statistical knowledge which are universal. For example, to be an informed citizen, basic statistic concepts are necessary. In this information age, every employee that has come through the school system with at least some secondary school learning should already have a good understanding of:

- knowing why data are needed and how data are produced
- familiarity with basic terms and concepts related to data such as averages

- how to interpret a table or graph
- how statistical conclusions and inferences and analysis are reached

Courses to review this information or train general staff can be offered in either a formal or informal environment, in groups in a classroom, or asynchronous learning on computers done at the pace of the employee in their own time in their own environment.

Everyone approaches learning differently with their own personal learning style. Perhaps a blended approach of statistical training can be used such as a combination of classroom training, workplace learning, computer-based learning, conferences, special events, roundtables and seminars.

Computer based training or E-Learning is also highly recommended for general staff where technology is available. It involves using a computer to share information and support learning. E-learning provides a timely and 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 web site lists examples, among them:

Finland- E-course in Statistics - import URL

Australia- Introduction to Statistics-

Canada: Statistics: Power from Data! -

A best case example of an applied course prepared for general staff and provided in the classroom is the Survey Skills Development course at Statistics Canada.

Example: Survey Skills Development Course

This 6 week course is designed to provide participants with knowledge and the skills in survey-taking. The course targets employees who have little training or experience in the design and implementation of surveys. It is 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 inter-relationships 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 an awareness of how these methods and procedures are applied by the major survey-taking areas of the department.
- Learn how to work with others in an interdependent framework toward a common objective.
- Build a network of friends and colleagues at different levels within the organization.

8.3.2 When new or special skills are required

A challenge for any statistical office is to maintain a high level statistical capability within the organization. Competing careers, international portability of skills and the

global marketplace mean that many statistical organizations are losing knowledge workers to other countries or organizations. Rapid and significant changes in technology have dramatically increased the need for most statistical organizations to retrain 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.

Statistical 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
- theory and application of raking
- using paradata in applied operational and methodological research

As well, for countries that undertake a census, 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.

E-Learning courses on census roles, duties and explaining census variables and geographies are available from many statistical agencies. Special courseware packages standardize the training provided for the different roles involved in a census. For the dissemination of census data, subject-matter specialized courses, census related tool courses, advanced tool courses and, edit and imputation courses are given by dedicated census training staff, with a focus on hands-on exercises using actual Census data. Advanced courses address more complex functionality, such as the programming of derived variables and multiple response variables.

Insert: U.S. Bureau of the Census list of training courses and videos available

8.3.3 Education leave

Statistical organizations typically do not teach the science of statistics. That is left to the academics and teachers. We do facilitate the learning of the processes and knowledge that goes into the production of 'official' statistics.

Education leave is another program which, while subject to the mission and operational requirements of the organization offers the opportunity to facilitate employee statistical competency development. 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 the development of employee skills and qualifications which are beneficial to the statistical organization.

8.4 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 very important to continuity of some statistical programs. 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 can directly fill a knowledge gap. New retirees can also write relevant materials to train current employees. New retirees can help to optimize a project, develop programs, facilitate the transfer of skills and expertise and increase the statistical organization's flexibility to handle peak workload periods.

8.5 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 any country effectively carry out its responsibilities in the United Nations Statistical Commission and similar international bodies. Sharing a well-designed statistical training and assistance program will strengthen the international statistical community.

Statistical education and training courses can be provided to developing countries and shared among 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, self-reliance and ingenuity among the assisted organisation's staff. The best training prepares 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 several years. For example, from 1996-2001, Statistics Canada assisted China's National Bureau of Statistics in its efforts to reform the statistical system to meet the needs of a socialist market economy. The cooperative project promoted improved collection, analysis, use and dissemination of statistical information in China and addressed organizational development, market economy measurement, technical capacity building and management. Employees from both national agencies participated in statistical training courses and were provided with material. One of the documents prepared to transfer information and used in the workshops was:

Survey Methods and Practises, catalogue 12-587-X

<http://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 is aimed at those involved in planning, conducting or managing a survey and at students of survey design courses and 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;
- the 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; and
- disclosure control and data dissemination.

9. Making our numbers better understood: Improving dissemination activities of statistical organisations, including good practices for metadata and geo-referencing

9.1 Introduction

In a globalized world in which information technology and computers support the use of statistical information, it is necessary to have high-quality data that can be easily understood by all users with different levels of expertise: There is a need to make more efficient searches in a universe of data which increase every day in quantity and detail. Thus, it is necessary to improve data understanding and availability of them by using tools for documentation, dissemination and reporting. No one can speak of good practice in the generation of statistical information if data is not combined with its metadata and these are not constructed according to standards used by agencies worldwide.

Significant advances have been made over recent years in making statistical metadata available to the users of our data. Most organizations now have some sort of on-line glossary, and many provide links to electronic versions of methodological manuals and texts. However, these documents have not been, sufficiently adapted to the purpose of providing information to, and improving the statistical literacy of the majority of data users. They tend to be written in a way that is only really understandable to subject-matter experts, and are therefore often not sufficiently user-friendly to have any real benefit.

Metadata provides detailed information about one or more characteristics of the data and enable understanding of their scope and limitations; also it encourages 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 make use of available automated software tools to facilitate its integration and management.

The increasing prevalence and importance of statistical and geospatial metadata intended to be interpreted and actioned by computer applications (to make the end user's life easier and save them having to manually transform between formats etc.) it places more emphasis than ever on the importance and value of using common standards for metadata.

Today, information technologies allow representation of statistical information in formats which go beyond charts and graphs by enabling creation of 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.

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

1. "Traditional" metadata intended to be read, and understood, by humans. Such metadata helps the user to understand the nature of the data in depth including assisting them in assessing its quality – where quality can be understood as "fitness for purpose" (eg relevance) for the specific research/analysis/decision making or purposes that the particular user has in mind. In other words, "quality" is to some degree based on the context of use – data that is 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 in order to determine quality in the context of a particular purpose. For example, one user's purpose may require the data is very up to date but not be dependent on extreme statistical precision/accuracy in estimates – eg very narrow confidence intervals. A second user's purpose might place opposite relative priorities on timeliness and accuracy. (Similarly different users/uses may place different emphases on statistical precision vs geospatial precision in regard to the data – with metadata to support judgements in regard to both being important.)
2. "Processing" metadata, constitutes another form of assistance to end users, is metadata intended to be interpreted and actioned by applications, an end user may wish to use to work with the data. The example of geospatial metadata which allows data of interest to the user to be interpreted and displayed by a GIS is a strong example of the latter. Sufficient structural metadata to support, eg, an automated SDMX-> Data Visualisation (eg Adobe Flex based components), SDMX->Google DSPL (DataSet Publishing Language), SDMX->Excel, SDMX->FAME, SDMX->SAS, etc; transform – if the end user wants to visualise and explore, in a simple automated manner, data they have selected - or happen to prefer to work with that data in Excel, or FAME, or SAS etc – is another example.

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, eg "geo-enabled" (i) data discovery – what data do you have related to this place? – (ii) data visualisation – eg mapping – (iii) data analysis – eg how many businesses of a particular type are located within 1km of a particular highway (which might itself, eg, stretch for 100km)?

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 contravene the principle of confidentiality, as the values are presented by shades of colours and provides the potential to allow (i) data discovery and (ii) data analysis.

There are several international initiatives to generate metadata for the statistical and geographical areas; both are necessary to assess usefulness of statistical information per se, as well as its outcome after being subjected to certain processes to be georeferenced.

In this context, the dissemination considers mechanisms 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. There are different standards to do this job, and some of them are discussed in the next section.

9.2 Metadata Standards

Due to the importance of proper use of statistical information; several international agencies have been given to the task of establishing guidelines and standards for documenting and exchanging metadata. They have been establishing reference frameworks for the enrichment of statistical data sets with additional 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 existing metadata standards are:

A) Statistical Metadata: “DDI”, “ISO/IEC 11179” and “SDMX”.

This section has a summary of some experiences in the generation of metadata using standards that have been important to document different stages in the process of generating, processing and disseminating statistical information.

Data Documentation Initiative (DDI): DDI is a standard for documenting basic statistical information projects, i.e. of censuses, surveys and administrative records. One of the important features of DDI is that it describes variables of statistical projects one by one and so that is stored in a database, it provides users with details of different aspects of statistical data.

DDI specification, written in XML provides a format for integration, dissemination exchange and preservation of information; indeed the entire data lifecycle can be described. Due to the good results obtained, it has begun to be used for documenting economic data.

Standard ISO/IEC 11179: Establishes a register of metadata which focuses on managing semantics of data, as well as its representation and its description. Through this description a precise understanding of the semantics and a useful description of the data is achieved.

The standard for data and metadata exchange (SDMX): It is a set of technical standards providing technical specifications for exchanging data and metadata based on a common information model. The purpose of this effort is to define formats for the exchange of aggregated statistical data and its metadata, which is needed to understand how data is structured. The focus of the standard is on data presented as time series, although cross-sectional XML formats are supported too.

Using SDMX improves several aspects of information quality such as: opportunity, accessibility, interoperability, consistency and cost efficiency.

B) Geographic Metadata: FGDC, ISO 19115 and the individual profiles that derive from it.

Geospatial metadata commonly document geographic digital data such as Geographic Information System (GIS) files, geospatial databases, and earth imagery

but can also be used to document geospatial resources including data catalogs, mapping applications, data models and related websites. Metadata records include core library catalogue elements such as Title, Abstract, and Publication Data; geographic elements such as Geographic Extent and Projection Information; and database elements such as Attribute Label Definitions and Attribute Domain Values.

The standard of Federal Geographic Data Committee (FGDC): The FGDC is tasked to develop procedures and assist in the implementation of 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).

The objective of CSDGM is to provide a common set of terminology and definitions for documenting digital geospatial data. The standard establishes names of data elements, information about its possible values, and descriptions of compound elements (groups of data elements) to be used for these purposes.

The standard ISO 19115: This standard allows generating regional, national and institutional profiles, as examples of them we can mention the ones for: European Union, Colombia, Australia and New Zealand, Valencia, the Navarra, the Catalonia, Spain and Mexico. The last one was formalized on December 24th 2010 as a Technical Standard for the National System of Statistical and Geographical Information.

Each one of those standards provides a structured way to generate metadata, as well as specifications to ensure its completeness and consistency; but it is important to note that they do not describe how software applications must operate with them; for this reason, they must be combined with other standards.

9.3 Metadata dissemination

Main purpose of metadata dissemination is to provide formal mechanisms to access characteristics of some statistical or geographic information resource, so users can evaluate its usefulness to meet specific needs. Statistics and geography fields have always maintained a close relationship and working with them in a holistic way producing better quality elements for decision makers.

In the present days, the Web is a natural dissemination scheme where geographically dispersed information can be integrated; but metadata providers must implement schemas to clarify concepts and attend users to solve their doubts.

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 offer, then user can access directly to information resources through metadata.

Metadata describe concepts from the time in which a project was conceptually designed; for example, 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.

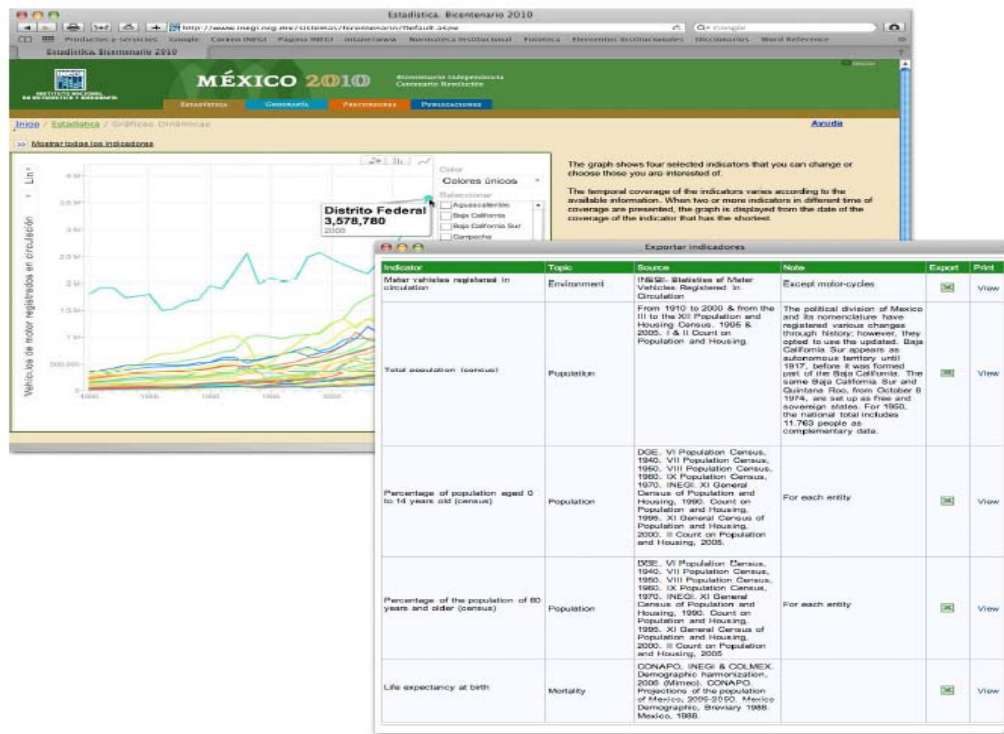
Build a story from statistical information requires a structure according to the intended purpose and audience. American journalism school says that at least it should answer the following questions: Who did? What happened? When did it happen? Where did it happen? Why did it happen?

The answers to above questions are that we call metadata, and in order to build interesting and complete information, they must always be presented along with the figures. The way in which metadata is showed depends, as mentioned above, of the audience to which we turn, but it always must be clear and highly relevant to data they are related.

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

In this sense, the 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, they can easily find projects related to a topic of their interest and also learn methodological aspects about how information was obtained.

Example 1: Historical Statistics of Mexico. - Information by state since 1910



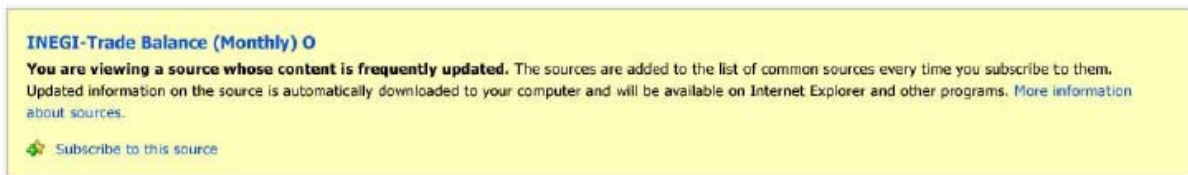
In the Australian context, some examples of how metadata can be linked to data include Census Quickstats (<http://www.censusdata.abs.gov.au/>) and National Regional Profiles (<http://www.abs.gov.au/>). Census products that use published metadata such as the Census dictionary to provide descriptions and definitions of data items. Contextual links are provided within the tables to the metadata. National Regional Profiles (NRP) featured a map interface using Google Maps. The NRP provides summary data from a number of ABS collections for geographic regions

within Australia. Additionally, a set of seven on line videos have been produced to show how to use and understand the NRP.

On the other hand, statistics that has to be sent using protocols like RSS must be synthesized in order to present only the most relevant aspects and move readers to follow the links to more detailed information; however, the reader may decide not to visit the page, so information he received must have been clear and completely understood.

Example: INEGI RSS Feed of the Trade Balance in Mexico.

Indicator contains timely figures and it is published on a monthly basis. RSS message shows a summary of the data and provides a link to more information.



Timely Information on the trade balance in Mexico during December 2010

Tuesday, 25th January 2011, 08:00 a.m. [Go to the complete article](#)

According to the timely information of foreign trade in December 2010, the trade balance showed a deficit of (-) \$218 million dollars

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

Another advantage of using standards is that as they expands its use, is easier to find tools which can understand them, reducing time and costs to create software architectures to process and publish information in an easier and attractive way.

9.4 Geo-referencing of information

A deep analysis of statistical information not only lies on the detail or opportunity of data. We should consider the territory in which a fact was generated and represent it. Association of statistical and geographical information takes us to a geo-referencing process.

Geo-referencing is the process of locating information in a geographic environment, which can be analog or digital, 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, longitude are the base for geo-referencing; they are essential to generate maps and take advantage of information integrated in a geographical information system (GIS).

Historically, maps have allowed us to locate ourselves in a geographical environment. At the beginning, stars and other celestial bodies were used as means for referencing. Today, technological advances have created easier, accurate and quicker

ways to locate an object on the earth's surface represented by points, lines or areas within a map or information system. Global Positioning System (GPS) and of the Global Navigation Satellite System (GNSS) devices are good examples of this kind of tools that are broadly used to generate geo-referencing coordinates and locate ourselves in digital maps.

It is possible to develop cartography with high precision and locate geographical and statistical information into a territorial scope to answer complex questions, like: how dynamic of earth and tectonic movements affect the live in different regions of the world?, or which are the consequences of an inappropriate use of natural resources in terms of migration, lack of availability and pollution?

Geo-reference is one of several elements needed to represent statistics on maps and provide clear and precise elements for decision-making to users.

According to Haining (2003), all events have two attributes associated with them: space and time, since they occur or represent the situation somewhere in a given time. In fact when thematic maps are generated, as those which appear in the volume 2 of this series of publications, to show the behaviour of a variable or an indicator, we are geo-referring information and we need to make use of both attributes.

Location, the product of geo-referencing take account of both attributes: location and time context. Variability in time can provide descriptive information of causes and evolution of a fact. Consider air pollution levels at a large region where several urban areas with different levels of wealth development. Geo-referenced data of this type combined with population data can be used to carry out an environmental review of relationship between pollution levels and respiratory disease among the population.

Time context creates an effect that can operate at different scales and levels, for example, house prices can be influenced by the quality of the neighbourhood but so are on the quality of adjacent neighbourhoods.

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

This principle could also be applied for analysing areas inside a regular extension in the form of mesh (grid), an example of that is the grid of cells representing zones of 100 square kilometres used by Eurostat to analyse statistical information integrated from the European Union Countries. They have plans to increase resolution in order to have cells of 1 square kilometre, but in complement statistical information need to have a similar level of geo-reference.

The benefits of the potential that might bring the combination of statistical and geographical data and metadata can be perceived with 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 to several questions:

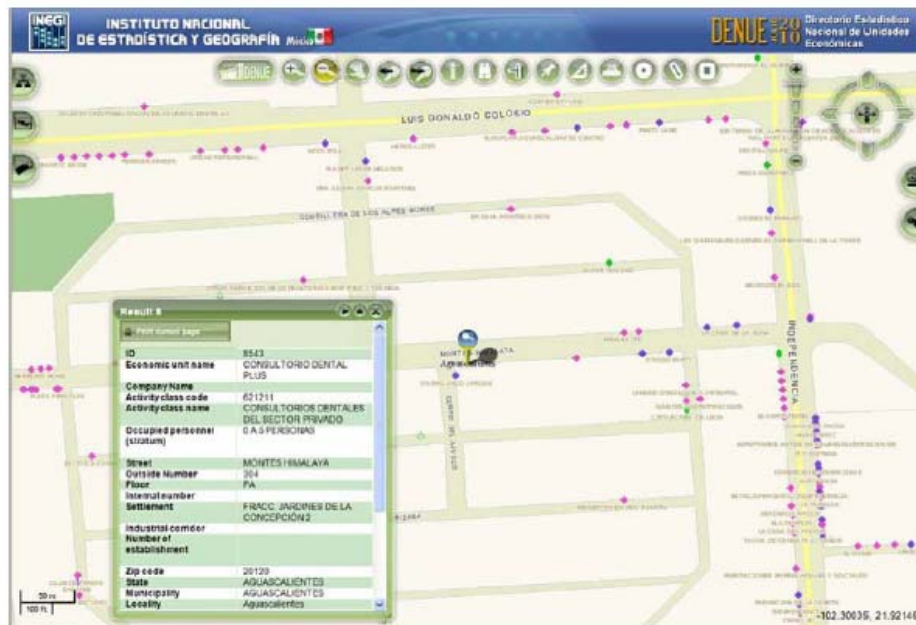
1. Where is the population at the point (maintaining confidentiality)?
2. Which is the level of risk that population is exposed?

3. What is the vulnerability?
4. What are the conditions of relief?
5. What are the options for evacuation and detail of the routes available for that purpose?
6. Which works of infrastructure 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 to do this is to store geographic coordinates of external and internal number of houses which exist in communities.

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

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 answers to the user's request with a geo-referenced representation of the data.



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

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

Geographic Address

House on Tabachín St



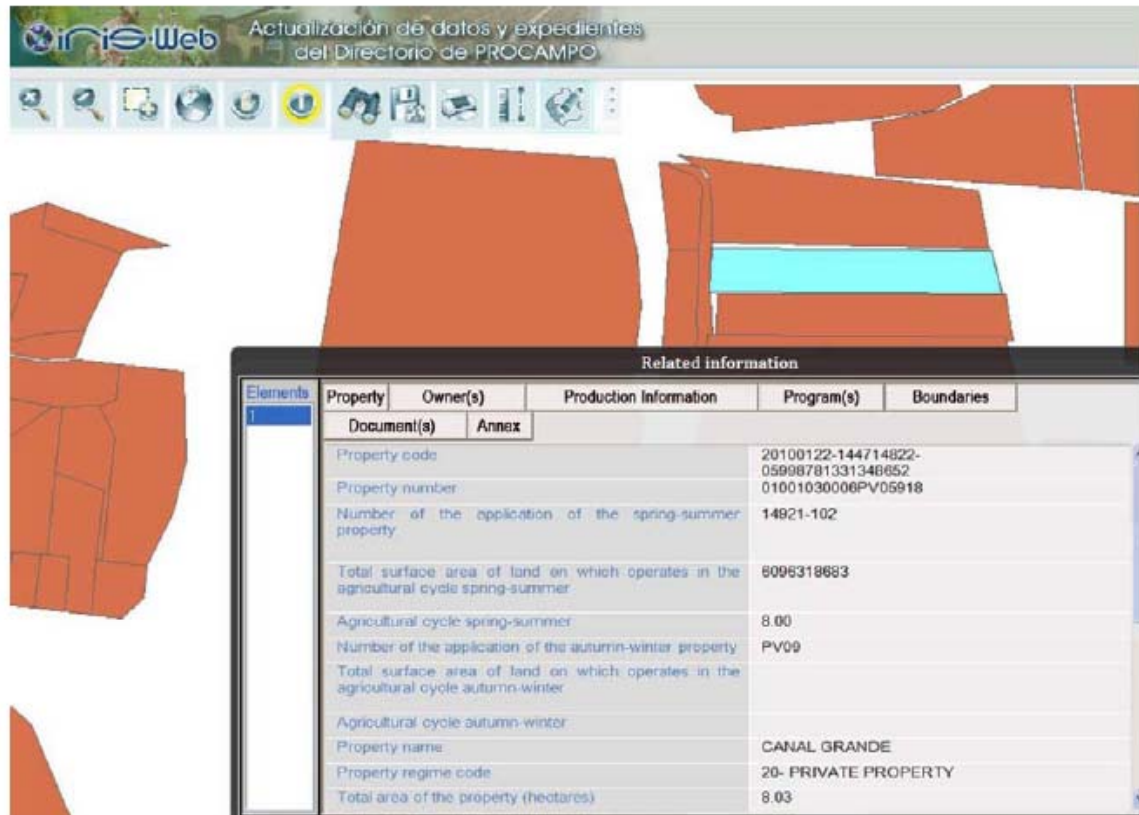
House



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 programs

To increase transparency and certainty in the application of resources provided by social programs in Mexico, sites of beneficiaries from one of those programs were geo-referenced at the time the registry was updated. Detection of duplication in assigned resources was done in an effective way.



9.5 Final Comments

Metadata do not appear spontaneously, must go to document 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 which metadata will be provided.

Decision of which metadata are going to be included is not a trivial task, requires the collegiate work in various areas and the experience to know what information is useful and what is not. Among the advantages offered by some standards like DDI or Dublin Core, one is that they provide guidance to facilitate the decision on what we should document.

A strategy for providing tools to the metadata generators is to develop them or hire their development. INEGI of Mexico has adopted the use of the IHSN Toolkit to capture and validate the metadata and has developed a platform in Java, which greatly facilitates its distribution, at the same time that it promotes an organized collaborative environment for their improvement in accordance with the technical standard for statistical metadata generation, which will be made available to the members of a National Statistical and Geographic Information System in 2011.

When generalist users of statistics are faced with metadata that they do not understand, few will take the time and effort to try to develop that understanding. This results in an increased misuse and mistrust of statistics. By making metadata more understandable, users are more likely to take note of the messages in the

metadata, improving their understanding of the data, and helping to improve their statistical literacy.

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10. Evaluating the impact of statistical literacy activities

Good understanding of statistical concepts and methodologies and proper interpretation of statistics are essential for effective application of statistics.

Statistical offices organize a range of activities for promoting statistical literacy in order to meet the needs of different users of statistics in the society (or community). It seems reasonable that each institution, which invests in increasing the awareness of official statistics and promotes the proper use of official statistics in the community, is willing to see the results of this activity. It is difficult to measure the short-term paybacks of undertaking this kind of activity. The real return on investment will be on long term. Therefore, statistical offices, which invest in literacy, have to know that the results of this investment will be visible years after finishing the programme. However, it is useful before the starting the literacy program to define the evaluation strategy and to define the measurement criteria.

The most widely used and recommended measurement criteria include:

- Number of students and teachers trained, workshops provided, classes visited,
- Number of teacher practicum's and internships provided,
- Number of access hits (monthly) to the Learning resources website,
- Number of educational websites linked to the national statistical office site,
- Number and relevance of conferences and exhibits undertaken,
- Number of new courses and textbooks that highlight data from national statistical offices,
- Number of hours contributed to local schools by statisticians,
- Number of statistical publications distributed to educators,
- Number media coverage on education 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 success of literacy project should produce annual measurement report, which should be discussed; on Board of Experts meeting and the decision for future activities should be done.

The other mode for the measurement of the success of activities on literacy is to make evaluation strategy of Literacy project with outsource organization, which will include:

- An online survey of registered schools to assess the Literacy project in general (the 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, and
- Examination of Web Server logs for the Literacy part of the national statistical office website.

All improvements done as a result of the feedback received should be analyzed and implemented appropriately.

The above mentioned activities for evaluation of statistical literacy are country-oriented, i.e. they provide information only for the results within the country. However, the globalisation and internalisation lay on the need for international comparability.

This means that the success of a project for statistical literacy should be evaluated using international standards, too.

Therefore, OECD in cooperation with several international organisations, intergovernmental agencies and national governments, has launched two projects for evaluating literacy.

The first one is International Adult Literacy Survey (IALS), which is comparative survey of adults designed to profile and explore the literacy distributions among participating countries.

As explained in OECD document about Adult Literacy, the measurement of Literacy is done, using the 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 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."

The second one is called PISA. The Programme for International Student Assessment (PISA) is an internationally standardised assessment that was jointly developed by OECD and participating economies 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. In all cycles, the domains of reading, mathematical and scientific literacy are covered not merely in terms of mastery of the school curriculum, but in terms of important knowledge and skills needed in adult life.

The results of this international assessment should be used for:

- creating a solid bases upon which the national policy decisions on literacy should be developed;
- Defining the programs in statistical offices for improving statistical literacy for target population group.