Statistics Canada's Quality Assurance Framework

2002

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Preface

The Quality Assurance Framework was originally drafted in 1997 to describe the measures Statistics Canada had in place to manage the quality of the data it produced. The impetus for its preparation came from a then imminent audit by the Office of the Auditor-General (OAG) on Statistics Canada's management of the quality of statistics. That audit was subsequently carried out and published by the OAG in April 1999. A subsequent report on Statistics Canada's implementation of the recommendations of that audit was published by the OAG in December 2001.

The present version of the Quality Assurance Framework updates the 1997 version. It retains the definition of data quality, and its six dimensions, as adopted in 1997. But it links the various measures that we use for quality management more closely to each of these six dimensions. It also incorporates updated references to policies, procedures and guidelines that have changed since 1997.

The six dimensions of data quality as described in the Quality Assurance Framework have been adopted as the framework for reporting on data quality by programs in their Biennial and Quadrennial Program Reports, and by the Agency in its annual Departmental Performance Report to Parliament.

This is a descriptive document intended for reference and training purposes. It does not impose any new policies or practices on programs, but situates existing policies or practices within a common quality management framework. The various measures described in the document will not necessarily apply uniformly to every program. Outside those requirements laid down in policies, it remains a responsibility of program managers to determine which measures should be applied in their programs. In addition, the Quality Assurance Framework will need to evolve as the Agency's programs, methodology and technology evolve.

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Table of Contents

Statistics Canada's Quality Assurance Framework

1.   Introduction

Statistics Canada's product is information. Confidence in the quality of that information is key to its survival. If its information becomes suspect, the credibility of the Agency is called into question and its reputation as an independent, objective source of trustworthy information is undermined. The management of quality must therefore play a central role within the overall management of the Agency. This Quality Assurance Framework describes the approaches that Statistics Canada takes to the management of quality.

Information quality is only one of several critical issues that Statistics Canada has to manage to be effective. Of equal importance are maintaining a reputation for objectivity and impartiality, respecting privacy and confidentiality, sound financial management, and staff development and training. This document focuses on information quality and covers these other issues only to the extent that they impinge on information quality.

Statistics Canada defines the quality of information in terms of its fitness for use. This is a multidimensional concept embracing both the relevance of information to users' needs, and characteristics of the information such as accuracy, timeliness, accessibility, interpretability and coherence that affect how it can be used.

> Statistics Canada's mandate is to serve the information needs of all sectors of Canadian society, including all levels of government. In addition to meeting its legislated data obligations, the Agency strives to develop and disseminate reliable and objective information that satisfies and anticipates critical needs - information that sheds light on major public policy issues and on the processes underlying social, economic and environmental phenomena in Canada. The Agency aims to promote the economic and social well-being of the country by providing a factual basis for better decision-making by governments, businesses, institutions and individuals.

Most operations and functions of the Agency have an impact on the quality of the Agency's information. The management of quality is therefore an integral part of the management of every program, and an important component of corporate management. It is not a separate management function, but an aspect of the management of the Agency that has to be addressed across all programs in the same way as, for example, financial management, human resource management, the management of respondent relations, or the management of data holdings.

A significant feature of the management of quality is the balancing of quality objectives against the constraints of financial and human resources, the goodwill of respondents in

providing source data, and competing demands for greater quantities of information. The management of quality is not the maximization of quality at all costs, but the achievement of an appropriate balance between the quantity and quality of information yielded by the Agency's program and the resources available. Within individual programs the challenge is to make the appropriate trade-offs between the evolving needs of clients, costs, respondent burden, and the various dimensions of quality.

Success in the management of quality requires a shared concern for, and pride in, quality among employees and managers at all levels of Statistics Canada. Acceptable quality is not achieved through managerial edicts but through attention to client needs coupled with the sound application of knowledge and expertise by employees at many levels. Policies and programs aimed at ensuring the availability of a motivated and competent workforce at all times are a crucial supporting element of the Agency's management of quality.

Statistics Canada strives to build quality into all its programs and products. The quality of its official statistics is founded on the use of sound scientific methods, adapted over time to changing client needs, to budgetary circumstances, to the changing reality that the Agency aims to measure, and to the capacity of respondents to supply source data.

The next two sections expand on the definition of information quality and its six dimensions as well as the framework under which it is managed. The following six sections describe the processes in place for managing each of these dimensions. Section 10 integrates some elements of the various processes described, and adds some additional corporate processes that complete the management of quality.

2.   Defining Information Quality

Statistics Canada defines the information quality of its statistical outputs to reflect their *fitness for use* by clients. To operationalize this definition it has identified six dimensions of information quality as described in Table 1.

Table 1

The Six Dimensions of Information Quality

Relevance	The **relevance** of statistical information reflects the degree to which it meets the real needs of clients. It is concerned with whether the available information sheds light on the issues of most importance to users. Assessing relevance is a subjective matter dependent upon the varying needs of users. The Agency's challenge is to weigh and balance the conflicting needs of current and potential users to produce a program that goes as far as possible in satisfying the most important needs within given resource constraints.
Accuracy	The **accuracy** of statistical information is the degree to which the information correctly describes the phenomena it was designed to measure. It is usually characterized in terms of error in statistical estimates and is traditionally decomposed into bias (systematic error) and variance (random error) components. It may also be described in terms of the major sources of error that potentially cause inaccuracy (*e.g.*, coverage, sampling, nonresponse, response).
Timeliness	The **timeliness** of statistical information refers to the delay between the reference point (or the end of the reference period) to which the information pertains, and the date on which the information becomes available. It is typically involved in a trade-off against *accuracy*. The *timeliness* of information will influence its *relevance*.
Accessibility	The **accessibility** of statistical information refers to the ease with which it can be obtained from the Agency. This includes the ease with which the existence of information can be ascertained, as well as the suitability of the form or medium through which the information can be accessed. The cost of the information may also be an aspect of *accessibility* for some users.
Interpretability	The **interpretability** of statistical information reflects the availability of the supplementary information and metadata necessary to interpret and utilize it appropriately. This information normally covers the underlying concepts, variables and classifications used, the methodology of data collection and processing, and indications of the accuracy of the statistical information.
Coherence	The **coherence** of statistical information reflects the degree to which it can be successfully brought together with other statistical information within a broad analytic framework and over time. The use of standard concepts, classifications and target populations promotes coherence, as does the use of common methodology across surveys. *Coherence* does not necessarily imply full numerical consistency.

These dimensions of quality are overlapping and interrelated. However, there is no effective model for bringing together all of these characteristics of quality into a single indicator. Every dimension has to be adequately managed if information is to be fit for use; failure in any one dimension will impair or destroy the usefulness of the information.

Achieving an acceptable level of quality is the result of addressing, managing, and balancing over time, the various dimensions of quality, with due attention to program objectives, the major uses of the information, costs, respondent burden, and other factors that may affect information quality or user expectations. Actions taken to address one dimension of quality may affect other dimensions, often in ways that cannot be fully predicted. Decisions and actions aimed at achieving an appropriate balance of quality dimensions and other factors are based on knowledge, experience, reviews, feedback, consultation and, inevitably, judgement.

3. Management Framework

The management of quality at Statistics Canada occurs within a matrix management framework – project management operating within a functional organization. The Agency is functionally organized into seven Fields. Four of these are primarily responsible for statistical programs of data production and analysis in various subject-matter areas. The other three Fields are primarily involved in the provision of infrastructure and services to be used by the statistical programs. The typical statistical program will be managed by one of the subject-matter divisions but will draw heavily on the resources of service areas for inputs to their programs, particularly for collection and processing operations, for informatics support, for statistical methodology, and for marketing and dissemination support.

The design or redesign of a statistical program normally takes place within a project management structure in which the sponsoring program area and the involved service areas all participate. It is within such a project team that the many decisions and trade-offs necessary to ensure an appropriate balance between concern for quality and considerations of cost and response burden are made. It is the responsibility of functional organizations (divisions) to ensure that project teams are adequately staffed with people able to speak with expertise and authority for their functional area while being sensitive to the need to weigh competing pressures in order to reach a project team consensus. Projects are normally guided by a more senior Steering Committee that includes managers from each of the major participating areas. This Committee provides overall guidance, broad budgetary and design parameters, and helps to ensure that appropriate resources are available to the project. It also provides a forum for resolving any issues that cannot be satisfactorily resolved at the project team level.

The use of an interdisciplinary project team approach, supported by the functional organization, is important in ensuring that quality considerations receive appropriate attention during design, implementation and assessment. Subject-matter staff bring knowledge of content, client needs, and relevance. Methodologists bring their expertise on statistical methods and data quality trade-offs, especially with respect to accuracy, timeliness and cost. Operations experts bring experience in operational methods, and concerns for practicality, efficiency, field staff and respondents. The systems expert brings a systems view, and knowledge of technology standards and tools to the design. Together they have to balance the conflicting pressures to develop an optimal design. The fact that each is a part of a specialized functional organization, from which they can call on a variety of more specialized and management resources when warranted, helps in resolving both technical challenges and conflicts arising in a project.

4.   Managing Relevance

The management of *relevance* embraces those processes that lead to the determination of what information the Agency produces and the level of resources to be devoted to each program. It deals essentially with the translation of user needs into program approval and budgetary decisions within the Agency. The processes that are used to assure relevance also permit basic monitoring of other elements of quality and correspondingly to assess user requirements in these other dimensions.

To fulfill its mandate it is paramount that the Agency's programs and outputs properly and continuously reflect the country's most important information needs. Since these needs evolve over time, a process for continuously reviewing programs in the light of client needs and making necessary adjustments is essential.

There are constraints on adjustment. It has been estimated that more than 90% of the Agency's budgetary resources are devoted to ongoing programs that are non-discretionary at a given point in time. These programs serve the information needs of a broad clientele through provision of basic information on Canadian society and the Canadian economy, and they meet the legislative and regulatory needs specified in approximately two dozen Acts of Parliament. The Agency's response to newly emerging information needs must therefore be found through savings within these non-discretionary programs that do not imperil their outputs, through redirection of resources within the discretionary component, or through persuading clients (particularly federal government clients) to finance worthy additions to the national database.

A second constraint on adjustment is the interdependency between different programs. In many cases information from one program feeds another (e.g. retail sales information feeds into GDP calculations, vital statistics are used in population estimates) so that the impact of adjustments in one program on others has to be considered.

While taking into account these constraints, the Agency has put in place processes that monitor the relevance of its existing programs, that identify new or emerging information gaps that the current program is not filling, and that lead to decisions on program change or new funding initiatives aimed at strengthening the relevance of the Agency's overall program. These processes can be described under three broad headings: **client and stakeholder feedback mechanisms**; **program review**; and **data analysis**. A fourth process, priority-setting and planning translates the information from these three processes into program and budget decisions.

4.1   Client and Stakeholder Feedback Mechanisms

Feedback mechanisms serve to maintain awareness of the issues of interest to each major client and stakeholder group, and the information needs likely to flow from these issues. They also obtain feedback from current users of our products on their level of

satisfaction, and identify potential new markets for information. The principal mechanisms include:

- the National Statistics Council - provides overall advice on policies and priorities for statistical programs;
- fifteen Professional Advisory Committees in major subject areas - regularly review statistical programs and plans to amend them;
- senior bilateral arrangements with key federal departments and agencies (e.g., Human Resources Development, Bank of Canada, Health Canada, Canadian Customs and Revenue Agency, Agriculture Canada, Transport Canada) - serve to keep abreast of emerging issues among our principal Federal government users and suppliers;
- participation of the Chief Statistician in policy and program discussions with other Deputy Ministers - keeps Agency management aware of current and emerging issues within the Federal government;
- involvement of senior Agency staff in the Policy Research initiative of the Federal government;
- the Federal-Provincial Consultative Council on Statistical Policy and its subsidiary committees - provide a means of liaising with provincial governments on their statistical requirements;
- special liaison and consultation arrangements with Federal and Provincial officials in areas of primary provincial jurisdiction (health, justice, education);
- periodic liaison with business associations and labour unions - help to understand information needs and reporting preferences in the business sector;
- ad hoc consultations with interested groups on particular programs (e.g. on Census content) - provide input to the design of these programs;
- bilateral liaison with foreign statistical agencies, and multilateral liaison through international organizations (e.g., OECD, Conference of European Statisticians, International Statistical Institute) - identify information needs emerging in other jurisdictions;
- user feedback through Advisory Services - provides information on the strengths and weaknesses of existing products and gaps in our product line;
- market research, and monitoring of product sales and requests - identify current product use and demand for new products;
- bilateral and multilateral discussions with potential clients - to identify cost-recovery projects.

Together these mechanisms provide a flow of information on satisfaction with current products, gaps in our current set of products, and information needs likely to emerge in the future.

4.2   Program Review

In addition to the regular flow of information coming from liaison mechanisms, programs are periodically reviewed to assess whether they are meeting user needs. Every

two years each program is required to produce a program report documenting its performance and laying out its future direction and proposals for change. These reports follow the structure of this Framework in reporting on the management of quality.

Every fourth year, each program must supplement its biennial report with a more strategic review of its relevance and direction, including the results of consultation with its clients and stakeholders. These quadrennial reports consolidate and analyse the feedback obtained from clients and may present proposals for addressing any identified program weaknesses.

Both the biennial and quadrennial reports are reviewed by senior management, with written feedback being provided to the programs. The quadrennial reports are presented and discussed at the Agency's Corporate Planning Committee, and any proposals put forward are considered in the context of the Agency's planning process (see 4.4 below).

In addition to these regular reviews, ad hoc reviews or audits may be undertaken on particular programs or issues in response to feedback arising from key users, problems identified within programs, proposals for program change, or sudden changes in the external environment.

4.3   Data Analysis

Data analysis serves several purposes in the management of quality, including an important role in maintaining relevance. While its primary purposes may be to advance understanding and to discover further insights from existing outputs, it also provides a valuable source of feedback on the adequacy and completeness of our own data. By identifying questions the data cannot answer it pinpoints gaps and weaknesses in our data holdings. The development of certain longitudinal surveys, several record linkage activities, the creation of a metadata base, harmonized calibration, and attention to data integration and standardization of concepts are among the initiatives that can be attributed, at least in part, in response to obstacles faced in undertaking analysis.

The peer review mechanisms for analytical work, including articles published in the Agency's flagship publications - Perspectives on Labour and Income, Canadian Social Trends and Canadian Economic Observer, provide critical and expert review of analytical work and another source of feedback on our programs.

The use of analytic frameworks such as the System of National Accounts to integrate and reconcile data coming from different sources is an important element in identifying gaps and weaknesses in our data. The development of other analytic frameworks, that would allow similar integration and reconciliation for other domains of subject-matter, continues.

Specific issues of relevance identified through data analysis may lead to content changes in existing programs. Findings related to other dimensions of quality (especially accuracy and coherence) may also emerge from analysis (see section 10.3)

An active program of analysis is encouraged and nurtured through several mechanisms:

- the centralized analytical programs in the Analytical Studies Branch;
- decentralized analysis in subject-matter divisions;
- the Doctoral and Post-doctoral Fellowship programs for external analysts;
- joint analytic work with external authors, often academics;
- subject-matter data review and reconciliation committees (e.g., the Economic Forum for the System of National Accounts and its "feeder" surveys);
- the Research Data Centres, where academic researchers produce reports for Statistics Canada;
- contracts with external analysts to produce analytical reports for Statistics Canada.

4.4 The Planning Process

Statistics Canada's long-term planning process (LTP) provides the framework for deciding what changes will be made to the Agency's program from one year to the next. The process involves all managers in the Agency and takes as one of its major inputs the information and intelligence on user needs, program weaknesses, and information gaps that managers at various levels have gleaned through the mechanisms described above, or by other means. The process is described in detail in other documents (Statistics Canada, 1998b). The features of the process that are particularly important to managing *relevance* are the following:

- an annual strategic planning conference to identify major corporate priorities to be addressed in the coming LTP round;
- a requirement for program managers to identify their lowest priority program activities for possible reduction or cancellation and to propose efficiencies;
- an invitation to program managers to submit new initiatives that would respond to user needs, especially in areas identified as corporate priorities;
- a review and screening of proposals by program Syndicates headed by Assistant Chief Statisticians;
- an independent review of major systems proposals to ensure that they follow appropriate project management and design principles;
- a senior management meeting of Directors General and above to review and critique all proposals presented by Syndicates;
- Corporate Planning Committee decisions on all proposals based on their relevance to corporate priorities, the results of previous Program reviews, and the funds available.

Requests to fund improvements to other aspects of quality are also submitted by program managers. Such opportunities can usually be undertaken with parallel gains in efficiency. Indeed there is a clear link between efficiency and *relevance* of the Agency's overall program, as improvements in efficiency can be redirected to broadening the scope and of this program. Significant improvement in efficiency, of course, may involve program redesign initiated through the planning process.

Given the limited room to maneuver within the Agency's budget, the annual LTP process cannot cover full funding of all major new data collection initiatives and program proposals. Its funding tends to go towards non-discretionary redesigns, feasibility studies, seed money to evaluate new approaches to data development, and investment in efficiency. In some cases partial funding may be granted on the understanding that a key client (usually a federal department) will also contribute. For major new program initiatives that are clearly beyond the financial means of the Agency to fund from its existing budget, external avenues of funding are pursued. Successful ventures of this kind require strong expressions of support, if not funding itself, from influential users - so success implies relevance in this case.

In summary, the Agency uses a variety of mechanisms to keep abreast of clients' information requirements, to obtain users' views on its existing products and services, to seek professional advice on issues and priorities, and to identify weaknesses and gaps in its own data. This information provides a basis for the management judgements that have to be made on revising the Agency's program. In addition to user needs and costs, respondent burden, public sensitivities, and the Agency's capacity and expertise have to be taken into account. Judgements have to be made in the light of current public policy priorities as to which statistical programs are in most need of redevelopment or further investment.

While decisions on program funding are the major determinant of relevance, many subsequent decisions during the design of programs also have an impact on the eventual relevance of information products. For example, questionnaire design, accuracy-timeliness trade-offs, and the design of statistical outputs all affect relevance. These considerations are dealt with in subsequent sections.

5.   Managing Accuracy

Processes described under relevance determine which programs are going to be carried out, their broad objectives, and the resource parameters within which they must operate. Within those "program parameters" the management of accuracy requires particular attention during three key stages of a survey process: design, implementation, and assessment. These stages typically take place in a project management environment, outlined in Section 3, which is crucial to a proper balancing of conflicting considerations in the development of a statistical program.

5.1   Program Design

The collection, processing and compilation of data require the use of sound statistical, and analytical methods and models, effective designs, instruments, operational methods and procedures, and efficient systems and algorithms. The accuracy achieved - as well as the degree of *timeliness* and *coherence* - will depend on the explicit methods put in place and the quality assurance processes built in to identify and control potential errors at the various stages of the program. While individual program managers have considerable flexibility in implementing specific practices and methods, standards and guidelines exist for some functions. Eight primary aspects of design that need to be addressed in every program to ensure that accuracy considerations are given due attention during design have been identified.

1.   Explicit consideration of overall trade-offs between accuracy, cost, timeliness and respondent burden during the design stage. The extent and sophistication of these considerations will depend on the size of the program, and the scope for different options in light of the program parameters. But evidence that proper consideration was given to these trade-offs should be visible.

2.   Explicit consideration of alternative sources of data, including the availability of existing survey data or administrative records, to minimize new data collection. This issue focuses on the minimization of respondent burden and the avoidance of unnecessary collection.

3.   Adequate justification for each question asked, and appropriate pre-testing of questions and questionnaires in each mode of collection, while also assuring that the set of questions asked is sufficient to achieve the descriptive and analytical aims of the survey.

4.   Assessment of the coverage of the target population by the proposed survey frames.

5.   Within overall trade-offs, proper consideration of sampling and estimation options and their impact on accuracy, timeliness, cost, response burden, and comparisons of data over time and across programs.

6.   Adequate measures in place for encouraging accurate response, following up nonresponse, and dealing with missing data.

7.   Proper consideration of the need for quality control and other quality assurance processes for all stages of collection and processing.

8.   Appropriate internal and external consistency checking of data with corresponding correction or adjustment strategies.

While these eight areas do not cover all aspects of survey design, and consideration of issues does not necessarily result in the "optimum" decision, evidence that these aspects have been seriously considered will be strongly suggestive of sound survey design. In the end, the strength of the survey methodology will depend on the judgements of survey design teams.

Decisions on what constitutes acceptable accuracy are left to the individual program to determine and justify in light of its knowledge of user requirements and the circumstances, constraints, opportunities and objectives within which it has to work. The Agency's Draft Policy on Data Quality Criteria (Statistics Canada, 1994) provides some guidance on the definition of acceptable accuracy levels and their implications for the dissemination of data.

Whatever specific methods are applied must be within the realm of commonly accepted and defendable statistical practices under the given circumstances. The use of new technologies and innovations to improve quality and efficiency is encouraged, but must be adequately tested to minimize risk. Questionnaires, in particular, must be tested to ensure that respondents can and will be willing to provide input data of acceptable quality (Policy 2.8). It must be possible to monitor quality, to react effectively to unanticipated problems and to be able to verify or support the credibility of the results, as well as to understand their limitations.

The Agency's Quality Guidelines (Statistics Canada, 1998a) describe specific practices, methods and considerations that should be taken into account in designing programs, and indicate where formal standards or guidelines exist.

In order to ensure that the design of statistical programs efficiently meet the objectives set for them a variety of means have been put in place to provide guidance and information. The effectiveness of these is largely a matter of their overall impact rather than of any one item individually:

- the use of specialized staff for subject-matter, methodology, operations and systems to participate in program design;
- Quality Guidelines to list considerations and provide guidance in design decisions;
- centralized headquarters operations staff, and a regional network of field staff for conducting collection and processing;
- a software use policy that identifies recommended and supported software for key functions;
- specialized resource and support centres for certain functions (e.g., questionnaire design and testing, seasonal adjustment, data analysis);
- standard survey frames for major populations (e.g., the Business Register, the LFS area sample, the Address Register);

- specific Agency policies and guidelines, e.g., Policy on the Development, Testing and Evaluation of Questionnaires (Policy 2.8), Guidelines for Seasonal Adjustment and Trend-Cycle Estimation (Statistics Canada, 2000), Policy on Estimates with Future Reference Dates (Policy 2.2);
- standard definitions of concepts, variables and classifications for common subject-matter areas (Policy 2.10);
- Peer and Institutional Reviews (Policy 2.5);
- internal cost recovery in order to reflect real costs of alternative approaches in making design decisions.

While each of these mechanisms influence accuracy, they will also have an impact on other dimensions of quality, especially timeliness and coherence.

5.2   Implementation

A good design can be negated in implementation. Though a good design will contain built-in protection against implementation errors (through quality assurance processes, for example), still things can go wrong. The results of implementation depend not only on the specific design, but also on the instruments of implementation. These instruments will include the resource and material plans, the supervisory structure, the schedules, the operations, procedures and checks, the training, the publicity, etc., developed and specified during the design phase. Mechanisms for monitoring implementation should be built into survey processes as part of design. Two types of information are required. The first is information to monitor and correct, in real time, any problems arising during implementation. This requires a timely information system that provides managers with the information they need to adjust or correct problems while the survey is in progress. The second need is for information to assess, after the event, whether the design was carried out as planned, whether some aspects of the design were problematic in operation, and what lessons were learned from the operational standpoint to aid design in the future. This too requires information to be recorded during implementation (though not necessarily with the same fast feedback as for the first need), but it can also include information gleaned from post-implementation studies and debriefings of staff involved in implementation.

Information pertaining directly to accuracy itself may only be a small subset of the information required by operational managers. But information related to costs and efficiency of operations is equally important to the consideration of accuracy for future designs.

Statistics Canada's management information systems form the framework that provides these kinds of information. In addition, the following are examples of activities that could be undertaken to manage and monitor implementation:

- regular reporting and analysis of response rates and completion rates during the collection phase;

- monitoring refusal and conversion rates;
- monitoring interviewer and respondent feedback;
- monitoring of edit failure rates and the progress of corrective actions;
- monitoring the results of quality control procedures during collection and processing;
- monitoring of expenditures against progress;
- development, implementation and monitoring of contingency plans.

Where applicable, monitoring should be at various geographic levels or aggregations useful for each level of management, including levels suitable for supervising and correcting the actions of groups or individuals involved.

5.3   Accuracy Assessment

The third key stage of the survey process is the assessment of accuracy – what level of accuracy has actually been achieved? Though described last, it needs to be a consideration at the design stage since the measurement of accuracy often requires information to be recorded as the survey is taking place.

As indicated earlier, accuracy is multidimensional and choices have to be made as to what are the most important indicators for each individual survey. Also each survey produces thousands of different estimates, so either generic methods of indicating the accuracy of large numbers of estimates have to be developed, or the indicators are restricted to certain key estimates.

As with design, the extent and sophistication of accuracy assessment measures will depend on the size of the program, and on the significance of the uses of the estimates. Statistics Canada's Policy on Informing Users of Data Quality and Methodology (Policy 2.3) requires at least the following four primary areas of accuracy assessment to be considered in all surveys.

1.   Assessment of the coverage of the survey in comparison to a target population, for the population as a whole and for significant sub-populations. This may mean assessing the coverage of a list frame (*e.g.*, a business register by industry), the coverage of a census that seeks to create a list of a population (*e.g.*, the coverage of a census of population by province or by age and sex), or the coverage of an area sample survey in comparison to independent estimates of the target population (*e.g.*, the difference between sample based population estimates from a household survey and official population estimates).

2.   Assessment of sampling error where sampling was used. Standard errors, or coefficients of variation, should be provided for key estimates. Methods

of deriving or approximating standard errors should be indicated for estimates not provided with explicit standard errors.

3.   Nonresponse rates, or percentages of estimates imputed. The objective is to indicate the extent to which estimates are composed of "reported" data. For skewed populations (such as most business populations), nonresponse or imputation rates weighted by a measure of size are usually more informative than unweighted ones.

4.   Any other serious accuracy or consistency problems with the survey results. This heading allows for the possibility that problems were experienced with a particular aspect of a survey causing a need for caution in using results. For example, a widely misunderstood question might lead to misleading estimates for a particular variable. It also allows any serious inconsistencies between the results and other comparable series to be flagged.

In addition, depending on the nature of the survey, attention may be needed on particular sources of measurement or processing error.

The choice of how much effort to invest in measuring accuracy is a management decision that has to be made in the context of the usual trade-offs in survey design. But requiring that, at a minimum, information on the four primary aspects of accuracy be available for all programs ensures that attention is paid to accuracy assessment, and also provides a basis for monitoring some key accuracy indicators corporately. Regular measures of the coverage of major survey frames such as a business register or an address register also provide information that is important both to individual programs using these frames, and to Agency management.

Measures of accuracy are an important input for Program Review (section 4.2) for assessing whether user requirements are being met, and for allowing appropriate analytic use of the data. They are also a crucial input to the management of *interpretability* as elaborated in section 8 below.

5.4   Independent Review

In light of the high technical content of many design issues, programs are encouraged to incorporate independent technical review into their design, implementation and accuracy assessment plans. Among options available are:

- internal technical review committees for major programs;
- referral of issues of technical standards, or general methods or approaches to the Methods and Standards Committee;

- referral of technical issues to the Advisory Committee on Statistical Methods (or to other advisory committees on specific programs);
- review of the practices of other national statistical agencies and the exchange of experiences with them;
- participation in working groups of multilateral international organizations addressing particular technical problems;
- presentation of technical issues and proposed solutions for review at Symposia and other professional meetings;
- use of Work-in-Progress reviews subject to the procedures laid out in the Policy on Statistics Canada's Daily (Policy 3.3).

Reviews of practices, within or across programs, may be imposed from time to time as a result of external or internal audits, Methods and Standards Committee initiatives, or other managerial decisions.

6. Managing Timeliness

Timeliness of information refers to the length of time between the reference point, or the end of the reference period, to which the information relates, and its availability to users. The desired timeliness of information derives from considerations of relevance – for what period does the information remain useful for its main purposes? The answer to this question varies with the rate of change of the phenomena being measured, with the frequency of measurement, and with the immediacy of response that users might make to the latest data.

Planned timeliness is a design decision, often based on trade-offs with accuracy - are later but more accurate data preferable to earlier less accurate data? – and cost. Improved timeliness is not, therefore, an unconditional objective. However, timeliness is an important characteristic that should be monitored over time to warn of deterioration. It should be monitored across programs, to recognize extremes of tardiness, and to identify good practices. User expectations of timeliness are likely to heighten as they become accustomed to immediacy in all forms of service delivery thanks to the pervasive impact of technology. Unlike accuracy, timeliness can be directly observed by users who, one can be sure, will be monitoring it.

To the extent that timeliness is a factor in the design and implementation of programs, the factors and considerations described in Section 5 apply equally here. But there are further measures that can be pursued for managing timeliness.

Major information releases should have release dates announced well in advance. This not only helps users plan, but it also provides internal discipline and, importantly, undermines any potential effort by interested parties to influence or delay any particular release for their benefit. The achievement of planned release dates should be monitored

as a timeliness performance measure. Changes in planned release dates should also be monitored over longer periods.

For some programs, the release of preliminary data followed by revised and final figures is used as a strategy for making data more timely. In such cases, the tracking of the size and direction of revisions can serve to assess the appropriateness of the chosen timeliness-accuracy trade-off. It also provides a basis for recognizing any persistent or predictable biases in preliminary data that could be removed through estimation.

For ad hoc surveys and new surveys, another possible indicator of timeliness is the elapsed time between the commitment to undertake the survey and the release date. This measure reflects the responsiveness of the Agency in planning and setting up a survey as well as its execution after the reference date. But its interpretation must take account of other factors that help to determine how quickly a new survey should be in place – faster is not necessarily better.

For programs that offer customized data retrieval services, the appropriate timeliness measure is the elapsed time between the receipt of a clear request and the delivery of the information to the client. Service standards should be in place for such services, and achievement of them monitored.

Improvements in timeliness might be expected as new technologies are developed and as uses of data change. There may be an ongoing need to assess current practices through operational evaluations, experimentation, testing and process measurement. The nature of operations and how operations are organized, the quantity and mix of resources, and the role of manual versus automated operations require periodic review and assessment. Improvements in timeliness and the ability to inform users on timeliness constraints should lead to better management of timeliness as a key quality factor.

7.   Managing Accessibility

Statistical information that users don't know about, can't locate, can't access or can't afford, is of no value to them. Accessibility of information refers to the ease with which users can learn of its existence, locate it, and import it into their own working environment. Corporate-wide dissemination policies and delivery systems determine most aspects of accessibility. Program managers are responsible for designing statistical products, choosing appropriate delivery systems and ensuring that statistical products are properly included within corporate catalogue systems.

Statistics Canada's dissemination objective is to maximize the use of the information it produces while ensuring that dissemination costs do not reduce the Agency's ability to collect and process data in the first place. Its strategy is to make 'public good' information of broad interest available free of charge through several media (including

the press, the internet, research data centres and libraries) while charging for products and services that go beyond satisfying a broad public demand for basic information (Policy 3.6).

7.1   Product Definition and Design

In determining what information products to offer, program managers must take careful account of client demands and decide whether pre-specified catalogued products or the provision of information on demand is justified from a cost-revenue perspective.

Program managers are responsible for conducting market research and liaison with their clients to establish what products will best meet their client needs. They are also responsible for collecting and monitoring client feedback on the content of their products and on the mode of dissemination with a view to future improvement.

Marketing Division assists these processes by:

- making client and user profiles, as well as reports of product sales and distribution from the Business Information Reporting System (BIRS), available to program managers;
- conducting market research studies for Statistics Canada products and services, and client satisfaction measurements required in divisional program reviews; and
- providing assessments of electronic products, and support to end-users. The Electronic Products Help Line also captures and monitors client satisfaction, and provides feedback to product managers. Informing managers about the strengths and weaknesses of their products ensures that electronic products meet the needs of clients and are constantly improving.

In the internal design of products, program managers must also ensure that the following policies and standards are addressed:
- Policy 2.1 - Highlights in Publications;
- Policy 2.3 - Informing Users of Data Quality and Methodology;
- Standards and Guidelines on the Presentation of Data in Statistical Tables (Statistics Canada, 2002); and
- Policy 2.5 - Review of Information Products.

7.2   Dissemination

At the corporate level, the primary dissemination vehicles include:

- The Daily for the initial release of all data;
- CANSIM as the repository of all publicly available data;
- the Statistics Canada website as a primary entry point for those seeking data; and

- an extensive program of publications and analytical reports for specific client groups.

The Internet site is to be a virtual library of all information that Statistics Canada can provide to the public. It should include the data released as well as information about the data (metadata) such as data quality statements and descriptions of the surveys underlying the data. The site offers extensive hyperlinks between these complementary data and information, which assist clients in navigating the site.

The Government's depository libraries program ensures that all our products are available to libraries across the country. The Data Liberation Initiative makes sure that universities have access at reasonable cost to an array of Agency products for educational and research purposes. A growing number of public and private-sector organizations are licensed to use our data to provide businesses and specialized communities with value added services which Statistics Canada cannot respond to directly.

Program managers must ensure that their products are included in corporate dissemination vehicles as appropriate:
- The availability of all new data sets and publications are to be announced in The Daily (Policy 3.3);
- All published or publishable data should be made available through CANSIM;
- All products and services must be registered in the Corporate Database of Products and Services before release (Policy 3.10); and
- Information about data released are to be stored in the Integrated Metadata Base (IMDB) - see Section 8 for more on metadata.

In addition, programs must supply data as required for corporate information products and services including the Statistics Canada website, the Canada Year Book, and other compendia.

7.3 Needs of Analysts

The information needs of the analytical community present some particular needs that have generated additional approaches to making data accessible. Analysts often require access to individual data records so that they can apply analytical techniques that cannot be performed when only pre-aggregated summaries of information are available. But the Statistics Act prevents the Agency from making individual records available in any form that might identify individuals. The following options are open to program managers to make their data files more accessible for analytical purposes:

- The production of public-use microdata files that have been screened to protect confidentiality. Such products must be approved by the Microdata Release Committee;

- The provision of a custom retrieval service through which external analysts can submit special requests for retrievals from the confidential microdata base. Such retrievals must be screened for confidentiality before release;
- Contracting with an external analyst to perform statistical analysis for the Agency under the Statistics Act. Such analysts must be sworn in under the Act; and
- Referral of an external analyst to the Research Data Centres program (or equivalent) administered by the Social Sciences and Humanities Research Council of Canada (SSHRC). Under this program, analysts with approved projects may be sworn in under the Statistics Act and have access to certain files in a Research Data Centre (see the Guide for Researchers under Agreement with Statistics Canada for more information about this option);
- Use of Sections 11 or 12 of the Statistics Act for sharing of micro-data with other organizations under prescribed conditions;
- Use of Section 17 of the Statistics Act for discretionary release of certain types of data under prescribed conditions.

7.4   Finding What You Want

A major component of ensuring accessibility is providing efficient search mechanisms to help users find what they need. Statistics Canada provides services and tools to help its users in this respect. Regional Reference Centres answer client inquiries by phone, letter and e-mail.

The Internet site offers an array of search and navigation tools and features that permit users to discover our information:

- data and product browsers and search, by theme and subject;
- catalogue search;
- key word search (supported by a terminology Thesaurus);
- The Daily;
- CANSIM search;
- search of the Statistics Canada's library (BiblioCat);
- guides to data, to search tools and to methods; and
- index of reference documents.

Advisory Services provides a single point of access to Statistics Canada information and services through a network of offices across the country. This service promotes the increased effective use of Statistics Canada's data products and services. In response to contacts, staff:

- help define the information requirements of the client;
- provide data and information on the Agency's products and services;
- develop customized, cost-efficient data solutions; and

- facilitate and serve as the direct link to the rest of Statistics Canada researchers, analysts, consultants and other technical experts.

The quality of this service to the public is measured on a regular service by Advisory Services Division.

8.   Managing Interpretability

Statistical information that users cannot understand - or can easily misunderstand - has no value and may be a liability . Providing sufficient information to allow users to properly interpret statistical information is therefore a responsibility of the Agency. 'Information about information' has come to be known as meta-information or metadata. Managing interpretability is primarily concerned with the provision of metadata.

The information needed to understand statistical data falls under three broad headings:
(a)   the concepts and classifications that underlie the data;
(b)   the methodology used to collect and compile the data; and
(c)   measures of accuracy of the data.

These three headings cover what has been measured, how it was measured, and how well it was measured. Users clearly need to know what has been measured (to assess its relevance to their needs), how it was measured (to allow appropriate analytic methods to be used), and how well it was measured (to have confidence in the results). Since we can rarely provide a profile of all dimensions of accuracy, the description of methodology also serves as a surrogate indicator of accuracy: it allows the user the option of assessing whether the methods used were scientific, objective and carefully implemented.

In the case of public-use micro-data files, information regarding the record layout and the coding/classification system to code the data on the file is an essential tool to allow users to understand and use the data files. Wherever possible, these files should be provided in a generic format, which can be read by the most popular statistical packages (SAS and SPSS).

Statistics Canada's standards and guidelines for the provision of metadata derive from the Policy on Informing Users of Data Quality and Methodology (Policy 2.3). It lays out requirements and guidelines for the provision of information on data quality and methodology with every statistical product. The Integrated Metadata Base (IMDB) is the repository used to store this information for each survey, in addition to other related metadata.

Program managers are responsible for ensuring that their products meet the requirements of the Policy on Informing Users of Data Quality and Methodology, and for documenting their programs within IMDB. Particular effort is required to ensure that the information

provided to users is comprehensible and not obscured by our internal jargon, and to ensure that the information is always up-to-date. Periodic user liaison to assess the usefulness and adequacy of metadata is recommended.

A further aid to Statistics Canada's clients is interpretation of data as they are released. Commentary in The Daily and in associated materials focuses on the primary messages that the new information contains. Directed particularly at the media, such commentary increases the chance that at least the first level of interpretation to the public will be clear and correct. Conversely, Statistics Canada publicly answers or refutes serious misinterpretation of its data (Policy 1.2). Highlights of Publications (Policy 2.1) requires that all statistical publications contain a section that highlights the principal findings in the publication.

9. Managing Coherence

Coherence of statistical data includes coherence between different data items pertaining to the same point in time, coherence between the same data items for different points in time, and international coherence. Three complementary approaches are used for managing coherence in Statistics Canada.

The first approach element is the development and use of standard frameworks, concepts, variables and classifications for all the subject-matter topics that are measured. This aims to ensure that the target of measurement is consistent across programs, that consistent terminology is used across programs (so that, for example, "educational level" means the same thing whether measured in a Census of population or from school records), and that the quantities being estimated bear known relationships to each other. The realization of this element is normally through the adoption and use of frameworks such as the System of National Accounts and standard classification systems for all major variables. The issue of international comparability is addressed by considering the adherence of the standards adopted to international standards where these exist.

The Policy on Standards (Policy 2.10) provides the umbrella under which standards are approved and disseminated. At present this policy covers only a subset of the subject-matter areas and variables which the Agency measures. It is an ongoing objective to extend the coverage of this policy to other subject-matter areas as the need for common standards becomes apparent in each area.

Where standards exist, programs are responsible for adhering to them or, in exceptional cases, seeking an exemption. Where they do not exist, programs are encouraged to propose the appropriate concepts and definitions that might be adopted as standards.

The second approach aims to ensure that the process of measurement does not introduce inconsistency between data sources even when the quantities being measured are defined

in a consistent way. The development and use of common frames, methodologies and systems for data collection and processing contribute to this aim. Examples of ways in which this approach is implemented in Statistics Canada include the following:

- the use of a common business register as the frame for all business surveys;
- the use of commonly formulated questions when the same variables are being collected in different surveys;
- the application of "harmonized" methodologies and the embodiment of common methodology for survey functions (e.g. sampling, editing, seasonal adjustment) into software included in the Agency's software toolbox (Policy 5.12);
- the Quality Guidelines document to encourage consistent consideration of design issues across surveys;
- the establishment of centres of expertise in certain methodologies and technologies to exchange experience, identify best practice, develop standards, and provide training;
- reference to international codes of best practice such as the European Current Best Methods, or the U.N.'s Good Practices in Official Statistics.

These first two approaches attempt to ensure that we do not build into the design or implementation of statistical programs any unjustified inconsistency. They do not guarantee perfect agreement between data coming from different sources, or eliminate random variations due to sampling or measurement error.

The third approach analyses the data themselves and focuses on the comparison and integration of data from different sources or over time. This kind of analysis attempts to recognize situations where variation or inconsistency exceeds levels implied by the expected accuracy of the data.   Such situations need to be explained by other factors and, where possible, corrected. Conceptual frameworks covering particular subject-matter areas play an important role by providing a basis for establishing coherence or recognizing incoherence. Some integration activities are regular and routine, *e.g.*, the integration of data in the national accounts, benchmarking or calibration of sub-annual and annual estimates, reconciliation of survey data with administrative sources. Other activities are more exploratory or ad hoc. The confrontation of data from different sources, and their subsequent reconciliation or explanation of differences, is an activity that is often needed as part of pre-release review or certification of data to be published. Feedback from external users and analysts of data that point out coherence problems with current data is also an important component of coherence analysis. Some incoherence issues only become apparent with the passage of time and may lead to historical revisions of data.

10. Environmental Factors

The management of the six dimensions of quality takes place in an organizational environment. While all aspects of that environment influence how effectively quality management can be carried out, some are critical to its success and deserve explicit mention in this Quality Assurance Framework. Program managers are helped in fulfilling their program objectives through a series of measures aimed at creating an environment and culture within the Agency that recognizes the importance of quality to the Agency's effectiveness. These measures include the recruitment of talented staff and their development to appreciate quality issues and an open and effective network of internal communications. They include explicit measures to develop partnerships and understandings with the Agency's suppliers (especially respondents). Finally, they also include programs of data analysis and methodological research that encourage a search for improvement.

10.1 Partnership with Suppliers

Suppliers of the raw data upon which all Statistics Canada products are based are fundamental contributors to the quality of data and information. Particular attention is paid in following-up on respondent complaints. Questionnaires are tested to ensure minimal intrusion on privacy, and to respect public sensitivities and overall social acceptability.

Cooperative arrangements with suppliers (for example households, businesses, holders of administrative records) are pursued through:

- a respondent relations program
- a response burden management program
- bilateral committees (e.g., with Canada Customs and Revenue Agency)
- engagement with the small business community
- a small business ombudsman
- electronic reporting initiatives
- recognition of respondents in publications

These are supported by the Policy on Informing Survey Respondents (Policy 1.1), and through the activities of Data Access and Control Division, effective use of administrative data, effective questionnaire design as prescribed by the Guidelines for Questionnaire Testing and Evaluation, and a tradition of acute awareness of and respect for the confidentiality of data.

10.2 Recruitment and Training

The primary means by which Statistics Canada meets its objectives is through the knowledge, experience and motivation of its staff. Staff must not only be technically expert but also aware of quality issues, and able to develop and implement practices and methods to meet quality objectives. The availability of qualified and talented staff to programs and projects is therefore critical. The recruitment and development of such staff is carried out with the aid of the following initiatives:

- entry level recruitment and development programs for major occupational groups;
- generic competitions for all management levels;
- mentoring programs;
- comprehensive career stream plans for major groups;
- a training policy and framework;
- the Statistics Canada Training Institute offering flagship and specialized courses;
- Certificate programs/University Certificate programs;
- a corporate assignment program;
- development programs for managers;
- an Awards and Recognition program.

A full description of the Agency's Human Resources Management framework can be found in Human Resources Development at Statistics Canada (1997).

Internal communications are also an important means for maintaining staff awareness of quality issues, initiatives and requirements. A variety of communication vehicles are in place to provide employees with information and to seek employee feedback on how to improve programs and the organization environment.

10.3 Data Analysis and Research and Development

Statistical agencies exist to provide current statistical information, but their long term survival depends on their ability to adapt and evolve. To do this, they need to continue support of analysis, innovation and experimentation as one means of maintaining their professional and operational infrastructure.

Statistics Canada conducts and promotes data analysis to engender an awareness of data quality issues from both a developer's and a user's perspective. Through analysis the Agency not only adds to the information value of its outputs but also promotes pride in the **relevance, accuracy** and **coherence** of its statistical data. Conducting data analysis allows staff to obtain broader contacts and experience. It allows staff to enhance or broaden their skills and enhances opportunities for recruiting talented, creative staff.
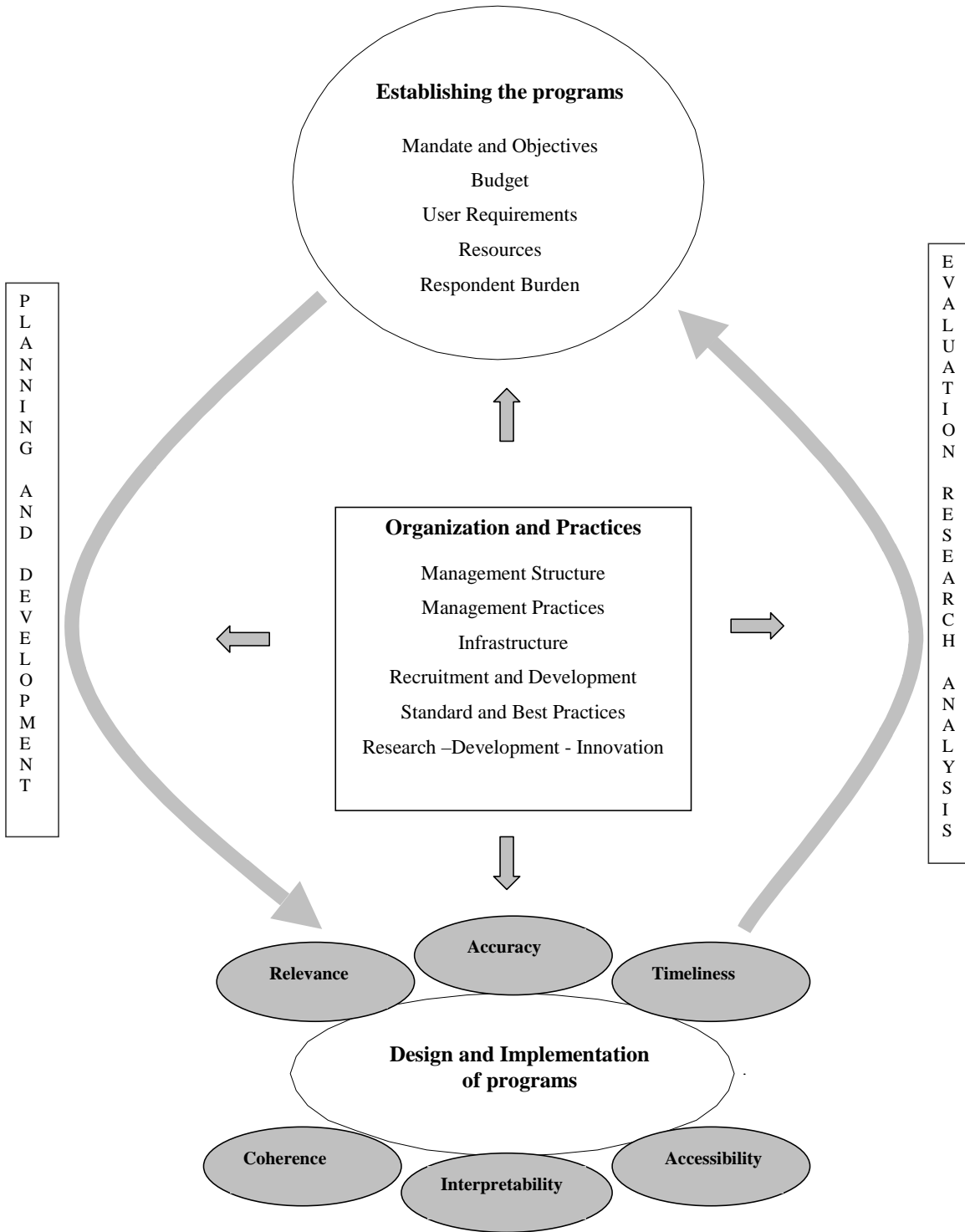
Research and development of a statistical, subject matter, informatics or operational nature helps to achieve high quality and to create a culture of quality improvement, in addition to yielding efficiency gains. Research and development is carried out by program and infrastructure staffs and through collaboration with external consultants and researchers.

11. Conclusion

Statistics Canada's quality assurance framework consists of a wide variety of mechanisms and processes, acting at various levels throughout the Agency's programs and across its organization. The effectiveness of this framework depends not on any one mechanism or process but on the collective effect of many interdependent measures. These build on the professional interests and motivation of the staff. They reinforce each other as means to serve client needs. They emphasize the Agency's objective professionalism, and reflect a concern for data quality. While the overall framework is inevitably presented in this paper as a set of separate components, the important feature of the regime is the synergy resulting from the many players in the Agency's programs, operating within a framework of coherent processes and consistent messages.

The following diagram on the next page attempts to encapsulate this quality assurance framework, "at a glance", as a unified entity, while reminding the reader of the ultimate objects of the framework, the continuity and interconnectedness of its processes, and the ongoing need for development and improvement within the framework.

Quality Assurance Framework

Establishing the programs

Mandate and Objectives

Budget

User Requirements

Resources

Respondent Burden

Organization and Practices

Management Structure

Management Practices

Infrastructure

Recruitment and Development

Standard and Best Practices

Research –Development - Innovation

P L A N N I N G   A N D   D E V E L O P M E N T

E V A L U A T I O N   R E S E A R C H   A N A L Y S I S

Relevance

Accuracy

Timeliness

Design and Implementation of programs

Coherence

Interpretability

Accessibility

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