Assuring quality in the statistics production of Statistics Sweden

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1. Quality assurance – introductory comments

A brief description (from ISO 9000:2005) of quality assurance is: part of quality management focused on providing confidence that quality requirements will be fulfilled. Statistics Canada expresses quality assurance in more detail and tied to the situation with surveys and statistics production as follows. "Quality assurance refers to all planned activities necessary in providing confidence that a product or service will satisfy its purpose and the users' needs. In the context of survey conducting activities, this can take place at any of the major stages of survey development: planning, design, implementation, processing, evaluation and dissemination." Confidence among stakeholders, customers, and users is important – also internal confidence.

Quality assurance (QA) and quality control (QC) have the characters *before* and *after*, respectively. Emphasis seems in general to be moving from control to assurance. The QA statement above is tied to purpose and needs expressed through quality requirements, i.e. a quality level. A QC may be part of an evaluation, for instance with respect to the achieved quality level, followed by a feedback. Evaluation results can, especially for a recurrent survey, be utilised as input to the QA of a later round.

The European Statistics Code of Practice (CoP) defines three major areas to ensure quality in statistics: institutional environment, statistical processes, and statistical output. Statistics Sweden (SCB) has approaches in all these three areas. Even if all three will be mentioned, the focus here is on the statistical processes. Some major approaches and illustrations are given. The quality of statistical output is in the European Statistical System (ESS) described with the following main components: relevance, accuracy, timeliness and punctuality, accessibility and clarity, comparability, and coherence. The Swedish output quality components are similar.

2. Moving from a decentralised culture towards centralisation and standardisation

The current organisational structure of SCB includes two data collection departments, four subject matter departments, and a communication department. Among the further departments are a department for research and development, a process department (since 2008) and an IT department (new structure in 2011).

Dissemination is a part of the production system that has been fairly standardised for a long time; there is just one way to publish statistics. Data collection has been centralised successively, moving tasks and staff from subject matter units to data collection units. The subject matter units are responsible for statistical products; they are survey managers. They buy resources from other departments for production, maintenance, and development of the survey and its output; they buy resources for data collection and micro editing, methodology, IT etc.

The current situation differs from, say, ten years ago, when SCB was quite decentralised in both organisation and culture. Each subject-matter unit was responsible for one or a few surveys. The units had their own staff to run most of their surveys in a tailor-made way, having built their own production systems. The IT persons were fairly free to build the systems according to their own knowledge and without strong central directives. Hence, many of the large number of stove-pipes that were built were person-dependent. There is still a considerable person-dependence and variation between the ways that data are handled and statistics are produced in the stove-pipes.

SCB is not alone in having had a decentralised organisation and culture. However, this culture with much freedom for individual initiatives has perhaps been unusually strong at SCB in comparison with other

statistical institutes. Many of the stove-pipes have a character of a single long cement pipe – as opposed to a pipe built of a set of bricks in a way that makes it easy to substitute single bricks. The subject matter units are the owners of these systems. The data collection units normally neither own the collection part nor can they make changes as they wish. Moreover, the documentation has been limited in many cases.

The needs for changes towards standardisation and coordination have been obvious for some time. Different activities and steps have been taken, for instance in 2007 when there was intensive project work. The needs for changes have recently been further emphasised. There have been some mistakes in published statistics; a few of them got much attention, partly due to unfortunate timing. The Swedish National Audit Office gave SCB some directions in 2010, especially for IT. The Swedish ordinance on internal management and control has been implemented. One implication is that risks are on the agenda more visibly than previously, for example in planning. Risks are identified and assessed in a scheme that uses likelihood and consequence, each on a scale with five categories; the higher the product, the more important to introduce, or at least prepare, some action to reduce the consequences. Such procedures are a way of pro-activity, like quality assurance.

The fairly new process department was created for SCB as one of the means to work in ways where standardisation is important. Standardised methods, tools, and routines have been and are emphasised. The process department has a group of five process owners (each with a deputy) together covering the statistics production process, two units for statistical methodology, one unit for cognitive methods, and furthermore specialists working with for example documentation and register coordination. Each process owner is responsible for developing and maintaining methods, tools, and routines in his/her process area; also to give support to process users and to evaluate and improve the processes. The process department and its process owner have an important role, both in the short run and in the long run. The approach is further described below, especially in Section 3, and there are illustrations in Sections 4–8.

A further important ingredient in the new ways of working is the maintenance model, which has been built and implemented during the last years. It is described in Section 4.

3. Process model and support

SCB is, like many other national statistical institutes, moving in a direction with standardisation and process-oriented statistics production. SCB has a Statistical Business Process Model (SBPM) that is fairly close to the Generic Statistical Business Process Model (GSBPM) of the UNECE and quite close to the earlier model from Statistics New Zealand; it is in fact an adaption from the latter.

An SBPM is a basis and a model of reference. It may cause some confusion and take some time to get used to. One reason is that the process is erroneously read as strictly sequential. There is in fact much iteration, but this is implicit in the model. Another, party related, reason for confusion is that an SBPM is read as an unduly simplification. Still – a simplification can be a useful structure for statistics production.

Similarly, standardisation may be interpreted as over-simplification, and this has happened. There are several challenges here, especially in communication. This is an experience made by SCB. Many others have also stated that the need for communication has been underestimated (see also Section 9).

SCB has a process support system based on the Swedish SBPM. Each sub-process is described in a how-to-do way with those who use the process as the major readership. The description is made with an appropriate level of detail; at least on the two-digit-level. It consists of:

- an overview of the process including the aim;
- the input to the process;
- the processing – this is the major part;
- the output from the process;
- information on contacts and date.

Methods, tools, and routines (MTRs) are described. Motivations are given in more detailed documents, reached by links. Some process areas are more standardised than others. Dissemination provides an example.

There are some major types of standardisation and description, as indicated below:

- activities on a detailed level, described step-by-step;
- tasks to be done, without /precise/ instructions;
- issues to consider.

The type depends on the character of the sub-process and on the current knowledge about the best way(s).

The description of a process is mainly important for those who use this process in their work. Others may also be interested, for example as an introductory overview. Survey managers use some sub-processes, and they can be regarded as indirect users of other sub-processes, where they are responsible.

The process support system gets more and more important when the content grows and its role as the basis for statistics production gets firmer.

4. Maintenance model, standardisation, and quality assurance

The management of a recurrent statistical survey includes production, maintenance and improvement of the methodology and the production system, documentation, plans for development etc. The maintenance model that has been developed is included in the process support system. A team with several different roles is important when working according to the model; typically the following roles with corresponding responsibilities: owner, management, methodology, IT, and data collection. The model provides templates for documentation of plans, events, actions, and follow-up. There is an annual planning round where judgements and plans are made for maintenance and improvements in the next calendar year, especially resource-consuming activities. The process support system enables a special area where there is room for a structured documentation, easy-to-find templates etc.

The model is usually implemented for a statistical product or a group of closely related products. The process areas also have maintenance objects; each process owner defines a suitable set of objects. These maintenance teams work with standardised tools, implementation support, improvements, initiatives for development projects etc.

Standardisation has several merits. Standardisation is often seen as an important means in the efforts of cost-effectiveness, for example since there will be fewer tools and systems. This reduces maintenance costs. Staff can easier move around when they are used to the basic tools and know where and how to find information. They can quicker get acquainted to a survey, and replacement with short notice is much easier. This also contributes to lower costs.

Intensive and broad use of tools leads to requirements on functionality and usefulness. There is mostly more room for maintenance, documentation, and successive development of a common tool than for each of several local tailor-made tools. Clearly, a tool with more functionality and usability makes work easier. Moreover, risks for mistakes and misunderstandings are considerably lowered.

Hence, standardisation efforts and effects as those just mentioned contribute not only to cost-effectiveness, but also to staff flexibility and to safety in statistics production. There is less dependence on key persons and a smaller variation in the ways that a sub-process will be run. This contributes also to a safer and more predictable production – and thus to ensured quality.

SCB has tied its standardisation of the statistics production to the SBPM and the process support system. Standardised MTRs (methods, tools, and routines) are decided and added to the process support system and the maintenance objects. The process owners are responsible for the development of their MTRs. This development is, naturally, in line with the priorities of SCB and the decisions made on a high level, for example the budget for development and its use through project applications.

To decide on a method, tool, or routine to be standard is mostly a procedure in many steps. A development project is often an important step, and some improvement is possible within the maintenance resources of the process area. Results are presented to a broad group, invited by the responsible process owner. The discussion and, more important, the suggestions for the future are documented. When a method, tool, or routine has been prepared, there is often a formal consulting procedure on department level. There

have been fruitful discussions and improvements during such consultations. Finally, there is a formal decision. Such a decision is made by the Director-General or delegated to the process organisation. Especially the details are delegated and can then be refined by the process department. The standard is, of course, put into the process support system with appropriate descriptions.

The consultations have several advantages: improvements, more knowledge in the organisation about new MTRs and their motivations, and quicker implementation. Overall, there is a successive standardisation that is planned by the process department, especially the group of process owners.

Quality assurance has during the last few years become a frequently used term within SCB. Sometimes it is somewhat of a buzzword. It is not surprising that the term is much used, since many such activities are needed and also considerable time. The standardised MTRs and the process support system are important in quality assurance. As process characteristics and their effects on quality become better known, with increasing use, it will gradually be easier to ensure a specified quality level.

It is well known that manual activities under time pressure are error-prone. It is desirable to turn to more automatic procedures and to have support for the necessarily manual activities. Some checklists to this end have been developed, at least a first version. They are in the process support system. During the last few years testing of new and modified IT-systems has become more of a routine, including allocation of time and resources. This provides another example of changing approaches and routines that have quality assurance as an important motivational factor.

5. Priorities in 2011

The five areas below have priority in SCB in 2011:

- data collection and editing;
- increase response rates and decrease non-response biases;
- disseminate and communicate;
- a structured data warehouse and register coordination;
- household and living statistics including the census.

This list shows several things. Focus is put on areas that are likely to improve efficiency and to reduce costs, on areas that are important for customers, and on areas with both a short and a long time perspective. Even if a list with five bullets may seem short, much has priority, since the areas listed are broad.

Data collection and editing have had priority for some years, which is much due to expected improvements in cost-effectiveness. Parts of the development are described in Section 6, mainly with the aim to illustrate quality assurance. Response rate is obviously an issue, due to declining interest to respond and increasing difficulties to get a contact, in spite of greater efforts. Different experiments and tests are done, and there is work with responsive design. Improvement work on dissemination and communication is left out here; there are needs to modernise old IT-systems and to improve and renew ways of presentation.

There will be a census in 2011, like in many countries around the world. For Sweden it will be purely register-based for the first time. A dwelling register (sometimes the translation is apartment register) is created and will be added to the register system (as indicated in Section 7). The prioritised area with a structured data warehouse and register coordination is partly, but only partly, related to the census. This long term goal is described below in Section 7.

Even if design is not in a priority area it is discussed below in Section 8 in the quality assurance setting.

6. Data collection and editing – two examples

The Triton project is an ongoing project with the goal of building a general and flexible production environment for data collection and micro editing. The aim is to cover most kinds of surveys, but in a first stage it is directed at surveys with direct data collection through questionnaires, web, and paper. A version of the platform is already in use, and a new and significantly improved version is under development. There will be a release at the end of June 2011. The aim is that the platform will replace many of the old survey

specific IT-systems, be usable for a majority of the surveys at SCB, integrate the common tools already in place, and eliminate as much manual work as possible. Some of the most important expected gains of the platform will be that metadata have an actual effect on the production process, that quality assuring activities will be built into the production process, and that there will be much in common for the production of many surveys, facilitating resource pooling. Besides integrating existing common tools such as the web collection tool and the scanning system, the platform will have three main new parts: an administration/design tool for setting parameters for a specific survey and monitoring the survey progress, a tool for working with individual objects, and a communication platform that connects the different parts of the platform. The approach here enables much of QA. Possibilities to have automatic sending of letters rather than separate and manual planning systems provide one example, the already mentioned active use of metadata another.

The role of editing has changed from the previous resource demanding procedure largely devoted to finding and correcting errors. Now the focus is more on continuous improvement through collecting and using process data, which show problematic areas and error causes in the measurement process. It is still necessary to correct influential errors. Generic tools are developed, and expectations on these generic tools for editing are that fewer IT-tools means decreased system maintenance cost and more flexible distribution of the work among the editing staff due to well-known interfaces. Efficient methods means fewer records to follow-up by re-contacts and this, again, means better work environment for editing staff. Also, a coordination of process data will be used for improvement of the measurement process. The generic tools are developed in successive versions. The implementation requires resources, and it has a long-term perspective. Previous data that are needed were not always kept, bridges between systems may be needed, and methodological work with parameters is necessary.

7. Data warehouse strategy and register coordination

SCB participates in development of statistical systems, both nationally and internationally. When building statistical systems, registers form a basis. For instance, the Business Register (BR) is a ground, on which primary economic statistics are built, followed by secondary statistics, like the National Accounts (NA). Conversely, the NA put requirements on the BR and the many surveys that provide input to the accounts. In Sweden (a Nordic country) there are three base registers; about Population, Business, and Real Property, respectively. Each of these base registers is an important basis in a system with further registers. There are also important links between the base registers: between person and business for employment etc.

A statistical system requires coordination of concepts and in practical implementation work: for statistical units, variables, reference times, frames, measurements etc. Among the output quality gains are higher comparability and coherence. The base registers have at SCB a fundamental role in coordination and in the system approach. They are responsible for definitions of specified sets of units, populations, and variables. Without such a responsibility there is – especially with many stove-pipes and tailor-made local production systems – an obvious risk of differences when, for instance, defining a variable and giving the variable a name. Using the same name for different variables obviously implies risks for misunderstanding and mistakes.

Statistics Sweden has recently established a strategy for coordination of registers and for data warehousing. It is by necessity a long-term plan. It will be refined over time and with increasing knowledge. There are several reasons for moving towards a comprehensive and well structured data store.

The goal may at a first glance seem overwhelming, but it is in this context essential to distinguish between a logical and a physical construction. Here only aspects of the former are discussed. The warehouse goal is not a single overall data store, but more. One aspect is the need for different data stores during the production process. There are raw data coming from administrative sources and different modes of data collection. Data from different sources are integrated; already this procedure implies requests on data and storage. Then data are handled with respect to targets and edits, for instance. Further on there are macro data and data/statistics for presentation. It is useful to have a set of well defined successive stores to be kept for

different purposes. Another aspect is information about the data, for example about the origin and different events during production. Both data and metadata are needed. The term metadata is here used in a wide sense, including process data.

With a well constructed and structured data warehouse it will be possible to move towards metadata driven production. This term has long been mentioned. Now it is getting a more visible place on the agenda. Triton is an example where metadata is used in statistics production that is event-driven.

8. Design and test – two ingredients

The Swedish process model has three processes before data collection: Specify needs, Design and plan, and Build and test. They prepare the statistics production, and they are important elements in QA. These sub-processes are still at an early stage, and there is much room for improvement. For instance, the design of a survey has in the de-centralised culture been highly person-dependent.

The communication with customers/users is essential to understand needs and wishes, and also to discuss different possible approaches and solutions. This is the first step in quality assurance; to specify quality together and to give confidence in the future production and output.

A first version of an internal guide for design of statistical surveys has been developed. The main readership is survey managers and corresponding persons, for instance those working much with customers. This guide gives an introduction to basic concepts and reasoning. Another aspect is illustrations of the lack of simple answers to important design questions. Many trade-offs are described, for example between different error types that are difficult to balance. The guide points at the need for a team with different competences when designing a survey.

The guide complements the process support system. The latter naturally has a layout by sub-process. The design sub-processes have steps considering overall aspects (like quality components) and steps designing specific sub-processes (like sampling, data collection method(s), and coding). The descriptions, which are fairly brief so far, are successively improved and expanded.

There should be some additional "handrail" as support for the methodological work when designing a survey. A first step has been taken in a project, but continued work is needed. Long experience is valuable in design work, for instance to judge which problems are the great ones, needing most of the effort. The importance of the survey should be taken into account when allocating staff; surveys where the statistical results get a lot of attention should be designed by the more experienced persons. A less experienced person should not work on his/her own; instead some consulting of experience should be prescribed. The risk that the designer's "own favourites" get more attention and resources in the allocation than motivated must also be avoided.

Design refers not only to design of a new survey or re-design of an existing survey, but also to continuous improvement of an ongoing survey. The last type is a frequent situation in a statistical institute. Even if many survey managers already make observations and draw conclusions for forthcoming production rounds, more systematic work and support would enable greater gains. The Triton platform, where more process data are automatically generated, will be such a useful source for improvements.

New routines for testing questionnaires have recently been developed. There are four major levels of testing. A higher level uses more demanding and more informative cognitive methods. A survey is described by some characteristics, which are related to importance in different ways, for instance official statistics. This description determines the appropriate lowest level of testing. A survey is free to use a higher level. The new routines are now introduced giving the surveys concerned some time to reach the higher minimum levels.

Responsive design is an area where some development is made. One reason is the prioritised area about non-response, which considers both non-response rates and non-response bias. Some indicators are chosen and used to monitor the data collection. Modifications of the priorities may then be made during the collection, based on these indicators, to improve efficiency of the collection and the response set used in estimation.

9. Some experiences

The main experience is perhaps in communication: it is difficult, plainly expressed. Expectations easily get too high, single words may be misunderstood etc. Communication efforts are indeed vital. There have been considerable efforts to show merits of standardisation and documentation. There is still some internal scepticism, although much less than some years ago. Expectations on the time needed for development of the new tools were then far too optimistic. This is still a problem, for example since a too optimistic view on cost reductions has continued. The time period with new developments and maintenance of many local systems is resource-consuming. The communication efforts will go on and be renewed, showing more clearly both the achievements and the plans for implementation and further improvements and developments.

Some fear that the output will be less tailor-made in a standardised environment. This is too simplistic a view. Again, the way of thinking and culture need to change. Standardisation saves some efforts and may enable better quality, for instance coherence and timeliness. The possibilities need to be learnt internally and communicated externally in dialogues with users and customers, when discussing needs and approaches.

The process department is actively providing methods, tools, and routines, and it suggests appropriate implementations. The process users require more and better tools. The data collection units, for instance, are active with suggestions. The survey managers are sometimes hesitant towards changes and often worried about new costs. High expectations on cost reductions may add some tension about the best way forward. Still, debates are rather on a general level than about single surveys. In individual cases discussions are mostly constructive and in agreement.

Some of the further examples of quality assurance follow in brief. There is ongoing work for a few important statistical products with positive effects. The Consumer Price Index (CPI) has during the last years built a lot of routines for its production, and there is now detailed and well organised documentation. There are many activities for the National Accounts (NA), for example regarding a new IT-system, to assure quality. Yet another example is provided in IT where a set of controls and activities have been implemented broadly after the directions from the Swedish National Audit Office. The implementation of the maintenance model was then quickened. This was mainly positive, but some more introductory assistance had been motivated.

10. Concluding discussion

The standardisation started very much to reduce costs and also in a spirit of more coordination and coherence for the statistics. The quality assurance aspects have gradually become more and more important. The construction with a process department and process owners has a long-term perspective.

Standardised methods, tools, and routines are put in place: in the process support system and in relevant surveys in an appropriate order of implementation. They contribute to cost-effectiveness and to quality assurance. Good descriptions and user support are important. Broad use leads to requirements, and increasingly also to better functionality, testing, and safety. Again, there are contributions to QA.

Standardisation takes time, and it requires changes in culture and allocation of resources. The period with development and implementation of new generic tools together with maintenance of old production systems is a challenge. Production with ensured and sufficient quality is necessary – production where systems sometimes use old tools, bridges, and new tools. Cost-savings need to be realised and used wisely.

The focus here has been on the statistical processes; how SCB works with the processes to ensure quality. The processes are a means to provide output of sufficient quality. It would be interesting to study effects of quality assurance activities, to measure costs with an appropriate level of detail, to find useful quality indicators, and to combine these different measures and relationships. A better understanding of effects on output quality of different choices and allocations would contribute to both cost-effectiveness and ensured quality.

Studies and trials are now more frequently on the agenda. Embedded experiments are made in a survey, for example to study effects of contacting respondents according to different strategies. This is one way to study how a process can be improved. In the next step the knowledge can be used for quality assurance.