APPLYING STATISTICAL PROCESS CONTROL (SPC) TO OFFICIAL STATISTICS

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SUMMARY
The concept of quality control is becoming more and more important in the field of official statistics. In the last decade many national institutes of statistics adopted a systematic approach to quality. The paper deals with the issue of applying the concept of statistical process control (SPC) to official statistics. Process approach allows developing and improving the effectiveness and efficiency of a quality management system to meet the needs of all stakeholders. In the paper we focus on:
- Identification of statistical processes and establishment of links between them and
- Tools and methods for managing the statistical processes.

Keywords: official statistics, statistical quality control, statistical process control, quality control

1. THE NEED FOR QUALITY IN OFFICIAL STATISTICS

Official statistical data is of paramount importance in assessing economic, social, cultural or environmental issues and plays a crucial role in building polices both at macro and micro level. That's why the quality of official statistics, and thus the quality of the data and information available to the government, the economy and the public is of utmost importance.

Until fairly recently the quality of statistical output has traditionally been viewed in terms of accuracy. However, quality as employed in other activities has generally included broader interpretations ('fitness for use', 'meeting user need' and 'customer satisfaction'). Eurostat proposed a definition on quality which encompasses several issues (relevance of statistical concept, accuracy, timeliness and punctuality in disseminating statistical results, accessibility and clarity of the information, comparability and coherence and completeness) and as such is appropriate for official statistics.

2. RECENT DEVELOPMENTS IN QUALITY OF OFFICIAL STATISTICS

Unlike the private business which became aware of the importance of quality management more than 50 years ago, it has been since several years an increased awareness of the importance of quality work in the national statistical institutes. A lot of work has been done in recent years to apply to concept of quality to official statistics. The International Monetary Fund, Eurostat, OECD, Statistics Canada, Statistics Sweden and other national statistical offices have identified various sets of data quality components and have adopted a system of quality management to improve their organizations and the quality of the data produced. There has been a tendency to use the quality management systems implemented in the private business sector with modifications and adaptations in order to be in compliance with the special characteristics of the official statistics.

At European level, this new trend was even accentuated with the establishments of the Leadership Expert Group (LEG) on Quality in Eurostat in 1999. A new chapter started in 2005 when Eurostat developed and accepted the Code of Practice (CoP) for the production and dissemination of statistics and decided the monitoring of its implementation.

While it has been relatively easy for the most national statistical institutes (NSI) to agree on the basic quality principles and frameworks, and to follow general principles such as independence and integrity in the production of statistics, the implementation of a systematic quality work and quality management to improve all products and processes, is a greater challenge. This paper deals with the issue of implementation of statistical process control in the national statistical institutes.

3. THE DIFFERENCE BETWEEN STATISTICAL QUALITY CONTROL AND STATISTICAL PROCESS CONTROL

Although the main principles of the different quality management systems are common, there is a difference in conceptual purpose applied to the use of such systems. The traditional quality control focuses on the product. It monitors the product quality and reworks or scrap off-spec product. "Statistical process control (SPC) is a powerful collection of problem-solving tools useful in achieving process stability and improving capability through the reduction of variability."[1] So, SPC focuses on the process, and not on the product.

SPC is a strategy that focuses on quantifying, classifying, and reducing variability in the process. It is based on the philosophy that making the right product in the first place is better than trying to rework the wrong product.

What are the benefits of adopting and implementing SPC? SPC provides surveillance and feedback for keeping processes in control. Statistical techniques provide an understanding of the business baselines, insights for process improvements, communication of value and results of processes, and active and visible involvement.

SPC provides a mechanism to make process changes and track effects of those changes to establish controllable process baselines. Once a process is stable (assignable causes of variation have been eliminated), SPC provides process capability analysis with comparison to the product tolerance. So, SPC optimizes the amount of information needed for use in making management decisions and focuses management on areas that really need improvement.
These benefits of SPC cannot be obtained immediately by the national statistical institutes. SPC requires defined processes and a discipline of following them. Above all it requires a strong management commitment.

[1] Montgomery, D., *Introduction to Statistical Quality Control, 5th Edition*, Wiley, 2005.

4. IDENTIFICATION OF PROCESSES

The key steps for implementing Statistical Process Control are:

1. Identify the processes;
2. Identify measurable attributes of the process;
3. Characterize natural variation of attributes;
4. Track process variation;
5. If the process is in control, continue to track;
6. If the process is not in control;
7. Identify assignable cause;
8. Remove assignable cause;
9. Return to "Track process variation".

The first step is the most important step in the implementation of SPC. A process is an activity that transforms inputs into outputs. It has one or more outputs, which, in turn, have measurable attributes. SPC is based on the idea that these attributes have two sources of variation: natural (common) and assignable (special) causes. If the observed variability of the attributes of a process is within the range of variability from natural causes, the process is said to be under statistical control. The practitioner of SPC tracks the variability of the process to be controlled. When that variability exceeds the range to be expected from natural causes, one then identifies and corrects assignable causes.

The processes controllable by SPC need to exhibit certain characteristics to be suitable for SPC. It should be well-defined, have attributes with observable measures, it should be repetitive and sufficiently critical to justify monitoring effort.

In the production of the statistical output a number of processes are performed sequentially. The phases of the statistical business process (statistical value chain or statistical cycle) are best described by the "Generic Statistical Business Process Model" (GSBPM)[2]. It is based on the Generic Business Process Model of Statistics New Zealand and Statistics Canada. However, a number of other related models and standards exist. The relationships between these models are depicted in Figure 1.

The identification of processes must be followed by a thorough processes analysis and identification of sub-processes. The GSBPM can be divided into four levels[3]:

- Level 0, the statistical business process;
- Level 1, the nine phases of the statistical business process;
- Level 2, the sub-processes within each phase;
- Level 3, a description of those sub-processes.

[2] See: http://www.unece.org/stats/documents/ece/ces/ge.40/2008/wp.17.e.pdf.
[3] UNECE Secretariat, *Generic Statistical Business Process Model, Version 3.1,* December 2008.

Generic Statistical Business Process Model	Information Systems Architecture Model	Cycle de Vie des Données Model	DDI 3.0 Combined Life Cycle Model
1 Specify Needs	Planning - Specify survey contents - Establish survey procedures		Study Concept Repurposing (part)
2 Design			
3 Build			
4 Collect	Operation (part) – Frame creation – Sampling – Measurement	Collect	Data Collection
5 Process	Operation (part) – Data preparation – Observation register creation	Validate	Data Processing (mostly) Repurposing (part)
6 Analyse	Operation (part) – Estimation and analysis Evaluation (part) – Check survey outputs	Analyse	Data Discovery Data Analysis Data Processing (part)
7 Disseminate	Operation (part) – Presentation and dissemination	Disseminate	Data Distribution
8 Archive			Data Archiving
9 Evaluate	Evaluation (part) – Evaluate feedback metadata		

Figure 1. Relationships between statistical business process models[4]

[4] UNECE Secretariat, Generic Statistical Business Process Model, Version 3.1, December 2008.

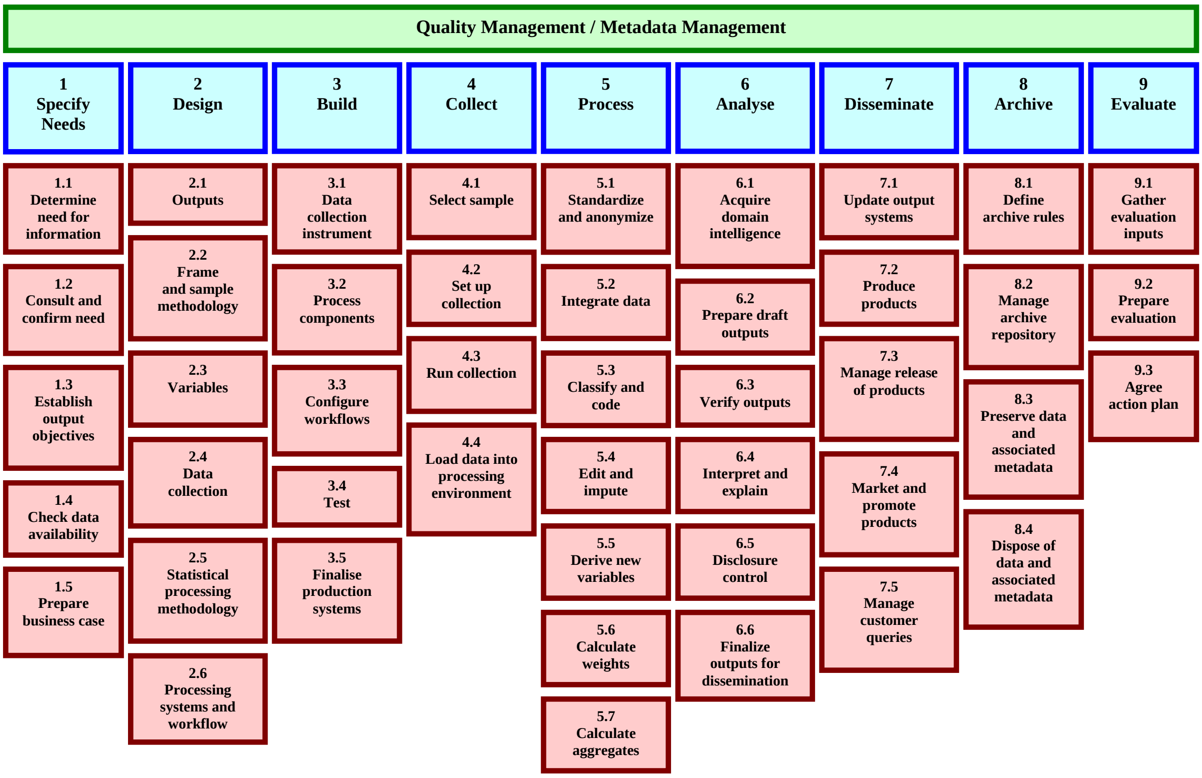

Figure 2. Levels 1 and 2 of the Generic Statistical Business Process Model[5]

5. DEFINING QUALITY STANDARDS FOR THE PROCESSES

The process must be designed in details and a quality standard should be specified for each process. The standard is a minimum base which can be refined and revised through time on the basis of the obtained feedback about its strengths and weaknesses.

It has two objectives:
1. To inform the managers of NSI about the efficiency of resources spent to attain optimal allocation and
2. To inform users about the risk involved in making decisions based on the different statistical products.

The quality standards for the producers (NSI) should include: description of the process and inputs in the process, list of the processes that result from that process, what are the necessary skills for operation of the process, metrics for measuring the performance of the process, what should be done if a standard is not being achieved, the name of the person who can change the process and a change control procedure for modifying the process.[6]

The standards for the statistical production processes should be specified in the framework of the statistical design phase which covers several processes (sample design, response rates, imputation and estimation). The main tool for monitoring of quality of statistical production

[5] UNECE Secretariat, Generic Statistical Business Process Model, Version 3.1, December 2008.
[6] McKenzie, R., Managing Quality During Statistical Processing, *Proceedings of Q2006 European Conference on Quality in Survey Statistics*, Cardiff, United Kingdom, 24-26 April 2006.

process is self-assessment by the operational managers who should also develop quality standards for administrative processes.[7]

The quality standards for data management processes should be built into the production system which should provide metrics that allow the operator to assess whether the standard for the process has been completed correctly.

In monitoring and decision making processes quality standards should be clearly specified. The standard should define the minimum response rate required for each category and the key respondents from which a response must be received.

The analytical stage of the process model is an area where the “inspection” that is the bane of the quality management gurus cannot be avoided. It requires more human judgement so it will be more difficult to set up standards.

6. CONCLUSION

In the last several years most of the national statistical institutes (NSI) worldwide have worked very hard on developing quality management strategies. One of these strategies is the statistical process control (SPC). In this paper we have presented the phases in the process of adoption of SPC by official statistics, focusing on the first and the most important phase -the identification of the statistical processes. We have also presented the proposed list of statistical quality standards for these processes.

The most important lesson to be learned from SPC is its basic idea of shifting the emphasis of quality thinking from a single statistical product to the whole statistical process and wider to the whole management process of NSI. Activities of NSI should be seen as processes where the needs of the customers on the one hand and the capabilities of the staff on the other hand play the crucial role. Successful adoption of SPC requires not only identification of the processes, but a discipline of following them and above all a strong commitment from the top management of NSI.

7. REFERENCES

[1] Mckenzie, R., Managing Quality During Statistical Processing, *Proceedings of Q2006 European Conference on Quality in Survey Statistics*, Cardiff, United Kingdom, 24-26 April 2006.

[2] Montgomery, D., ***Introduction to Statistical Quality Control, 5th Edition*****, Wiley, 2005.**

[3] UNECE Secretariat, *Generic Statistical Business Process Model, Version 3.1,* December 2008.

[7] Ibid