KEY ELEMENTS OF QUALITY FRAMEWORKS, TO BE APPLIED TO STATISTICAL PROCESSES AT NSI'S

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1 Introduction

In official statistics, a process from input to final output is divided into several processing steps. The output of one step is input into the next step. This leads to a sequence of inputs, half-products and final products. Additionally, in economic statistics the final or the half-product of one statistic is often input to a processing step of one or several other statistics. This can be viewed as a chain or network of processes. As part of the EU-programme called BLUE ETS (BLUE -Enterprise and Trade Statistics) we aim to develop a framework for managing and monitoring the quality of inputs and half-products in such a way that the final products or statistical processes meet predefined quality standards. We aim for a framework that is useful for different NSIs. Some NSIs have first experiences with quality management of products and processes (e.g. Pink, 2010), but we think this could be developed further and in a more systematic way. As a first step, we reviewed existing methods for managing quality. We were especially interested to look into already existing methods "elsewhere" such as methods for industrial processes or public services, as to profit from their experiences. We looked into a few frameworks that were well-known to us; however we do not claim to be complete.

The present paper aims to find key elements in existing quality frameworks that could be used to develop a quality management method of the primary production process in official statistics with emphasis on a chain of processes. The remainder of the paper is organised as follows. Section 2, summarises some general quality frameworks, mainly from industry, and extract key element from them. In Section 3, we discuss the frameworks when applied to objects of official statistics: a statistical process, a data storage point and a statistical chain with emphasis on how to improve its quality. In section 4, we synthesize a tentative quality framework for a statistical chain.

2 Quality frameworks: TQM, OQM, Lean and Six Sigma

TQM/EFQM *Figure 2.1* shows the EFQM model. The EFQM model consists of nine focus areas. The first five areas from left to right are called the enablers with which "results", the other four remaining areas, can be produced.

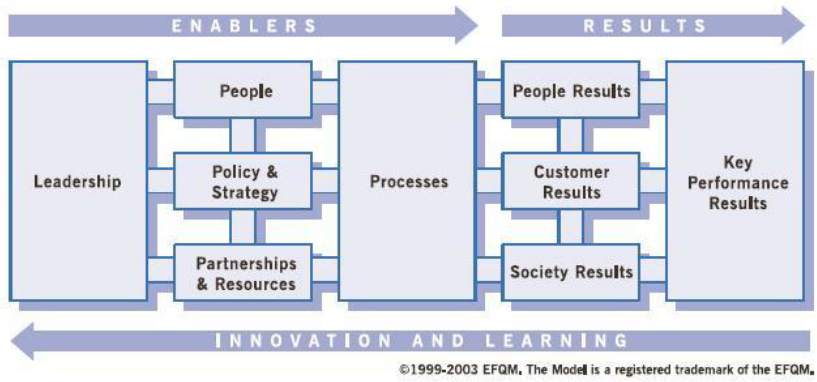

Figure 2.1 EFQM model.

The underlying model for quality improvement in a TQM model or one of its variants is the Deming or Shewshart cycle. This cycle consists of a Plan, Do, Check and Act phase. In the *Plan* phase the change and quality measurement system to measure change is designed. This includes a set of indicators, each one having a dimension (e.g. coherence, completeness, etc), measuring points and is part of measuring system. It, furthermore, includes norms to evaluate the scores of indicators.

OQM. TQM frameworks focuses on specific areas. What we needed at Statistics Netherlands (SN) was a framework in which we could chose our own focus areas. At SN we therefore developed the Object Oriented Quality Framework (OQM) (Nederpelt, 2010). In the OQM framework a focus area is composed of an object and a property having a relationship with that object. An object can be any noun. A property can be any adjective. In related quality frameworks about quality such a property is often referred to as a dimension.

Six Sigma. Six Sigma aims for a production process in which the probability area of an error is smaller than six standard deviations away from the mean: of 1 million products there are at most three products with an error. Improvement with the Six Sigma program is project based. The projects go through the Define Measure Analyse Improve Control (DMAIC) cycle. The characteristic of the DMAIC cycle is that every phase is supported by techniques/methods from statistics (see Montgomery (2009)).

Lean. According to the Lean primer (Larman and Vodde, 2009) it is a philosophy that has two main principles. The first principle is that one has keep in mind the end result, not single processes that contribute to this. The second principle is that to optimise the processes that lead to the end result, human resources have to be trained continuously such that they can think of new, improved, ways to obtain the end result.

The general structure of the above described quality frameworks is similar: quality of processes is measured in a production or experimental setting, the results of the measurements are evaluated and analysed after which actions are taken. In all quality systems described in the present section we see three key elements: 1) dimensions, 2) quality measurement system and 3) an improvement cycle. Examples of the latter are the DMAIC cycle of six sigma and the PDCA cycle of Deming. For an improvement cycle, indicators and norms play an important role. In Section 3, in which we apply quality frameworks to the objects ‘data’, ‘business processes’ and ‘chains’, we will therefore discuss quality improvement of these objects in relation to indicators and norms.

In addition, especially lean stresses to keep the objective in mind: what do you want to achieve? Also, especially lean stresses the importance to use skilful people to recognize which parts can be improved. We think there are two additional key elements, namely ‘objective’ and ‘knowledge’.

3 Quality improvement of data, processes and chains

The quality frameworks of the previous section use an improvement cycle. In this cycle, indicators are defined that measure the quality of a focus area. Norms for these indicators are defined that express when the process or product meets its pre-set objectives: then the production process is “in control”. If the indicator value deviates from the norm, measures need to be taken. The challenge is to identify good focus areas, indicators, norms and measures. We will discuss some methods on how to do this.

3.1 Data, data quality and its improvement

With data we mean the "numbers" and meta-data of all products and half-products, also referred to as "data-stages". Examples of such data-stages can be found in the Generic Statistical Business Process Model (GSBPM) (Vale, 2009) and in the Dutch statistical architecture of SN. Data quality consists of different aspects that we classify according to dimensions. Recall that with a focus area we mean the combination of an object and a dimension, for example the accuracy of data. Within each focus area, we measure quality using indicators. To find the appropriate indicators for a specific situation, we can either take the approach to use a standard set of indicators (Daas and Nederpelt, 2010) or try to find just those indicators that fit our purpose. Norms are used to evaluate whether the value of an indicator is "suspicious" or not. One option to derive norms is to use a method that tries to weigh cost against benefit.

When an indicator value deviates from the norm, measures need to be taken. In many cases the measures will be taken manually. In the case of data, sometimes quality can be improved automatically A well-known example is automatic data correction when hard or soft edit rules (translated into indicators) are violated. Especially when a group of indicators or when "composite" indicators exceed preset norms, knowledge is needed to interpret the findings and to take the right measures.

3.2 Business processes, process quality and its improvement

We did not find a definite or clear definition of a business process. Every field including official statistics specifies its own definition. SN (Camstra and Renssen, 2011; Kent et al., 2010) recently started to work out how single business process are confined. Quality of processes usually involves a limited number of dimensions , such as efficacy, efficiency, flexibility and robustness. Hardjono and Bakker (2004) describe indicators for the dimensions of process quality. They are part of up to six approaches we found in the literature, to design quality indicators for a given (set of) business processes.

Measures to improve the quality of processes will mostly be manually rather than automatically. Where single data values can sometimes be corrected automatically, processes usually concern a rules or a set of rules.

Likewise to data quality, future research should include how to identify dimensions of process quality and how to derive indicators and corresponding norms that are useful for NSI's.

3.3 Chain, chain quality and its improvement

With a chain we mean a set of processes that are distributed over different organisations or over different units within the same organisation (business). Da Silva and de Sousa Filho (2007) described three main drivers that affect the functioning of a chain: the enabling environment, chain coordination and production inputs. The first driver serves as a general setting to the chain. The second driver is important in the case of implementing a quality framework into a chain. The third plays a role in operational decisions within the chain.

Apart from the dimensions already discussed in the section 3.1 and 3.2, quality within a chain can also deal with the performance of the chain "as a whole". We refer to the latter as the "chain dimension"

This chain dimension deals with chain information (benchmarking, standardisation) and quality aspects of the *set* of processes the chain is build of.

In order to weigh the outcomes of quality indicators against each other and to take appropriate measures for improvement, visualisation tools can be used like Dashboards, Balanced Score Cards and strategy maps.

Again, future work should include research on how to identify different indicators and how to set their corresponding norms.

4 Synthesis and future work

We present a general structure of a quality framework based on the results found in the literature study and on our own experiences. This general structure can be used to derive a quality framework applicable in the settings of official statistics as well.

In our opinion there are five key elements to a quality framework, that can be found in each of the quality frameworks presented in the previous sections. These five key elements are represented in Figure 4.1. The core of a quality framework (the bold rectangle) consists of the elements Dimensions, Measurement system and Improvement cycle. In addition, at the top (the roof) we have the quality objective(s) that the organization wants to achieve and at the base we have knowledge. The complete quality framework is obviously influenced by the environment (the organization, policy, human interactions, etc.).

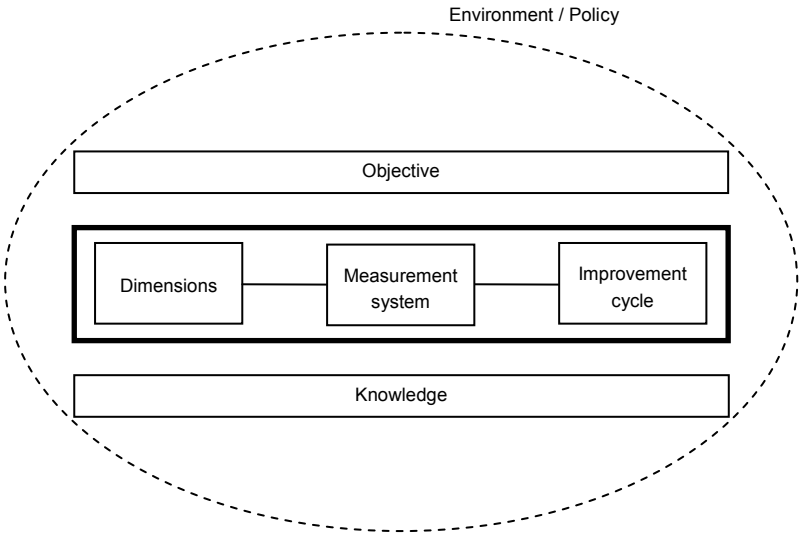

Figure 4.1 General structure of a quality framework

In the present paper we described several well known quality frameworks. These frameworks inspired us to produce the general structure of a quality framework. In Table 4.1 we show how these frameworks relate to our general framework. Each cell in that table is given a grey colour. The darker gray, the more a quality framework is targeted at that specific key element. From the table we can see that each framework indeed addresses each key element, but each has its own focus. Indeed, often Six Sigma and Lean are combined in order to make use of the complementary key elements they focus on.

Table 4.1: Quality frameworks related to the key elements of the general structure

Key elements	Quality Framework		
	TQM / INK/ EFQM	Six Sigma	Lean
Objective			
Dimensions			
Measurement system			
Improvement cycle			
Knowlegde			

4.1 Quality framework applied to NSI´s and chain of processes.

In future work we will apply, and possibly extend, the quality framework to producing statistics by National Statistical Institutes. We will derive which focus areas apply to which stages of production. We also try to work out how we translate objectives of the customer into a quality framework with indicators for the production process. Notice that we also wish to apply the framework not only to (short) processes for single statistics, but also to situations of chains of processes. This can for example be the case in economic statistics where output of one statistic may be input for another statistic. For example output of short term statistics may be input into structural business statistics, consumption and the production index, which in turn is used as input into National Accounts.

5 References

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