

How to maintain high quality in times of diminishing resources

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Abstract

Ex-post filling-in of quality reports does not lead to higher quality. To improve quality it is essential to make quality assurance an integral part of the processes – make it “the way we work”. In the Danish international trade in goods statistics we have had big challenges optimizing our system for validating the 40 million records we receive every year in a way which maintains sufficient quality while human resources are continuously diminishing. Based on standard unit values the system calculates a score for erroneous records based, firstly, on their suspicion compared with the enterprises’ previous reports, and, secondly, their impact on the published figures. This score is the basis for prioritizing re-contacts to enterprises in order to validate data. However, after some years the method lost some of its precision. We therefore developed supplementary measures. The quality measures are now anchored in a new quality management function at division level. Using the GSBPM its first initiative was to describe and analyse all processes with a view to identify and implement the necessary quality assurance measures in each process step – as integral parts of the statistics production itself. The paper describes how far we have come until now and how it works.

1. Introduction

In the division for External Economy in Statistics Denmark, three statistics are produced – International Trade in Goods, International Trade in Services and Balance of Payments. This implies monthly dissemination of statistics subject to intense attention and great importance for many users. There has always been great focus on quality in the division, but the challenge on quality is changing.

To be ahead of problems and uncertainty regarding the quality of the statistics produced in the division of External Economy in Statistics Denmark, it was decided to establish a quality management function (QMF) within the division. The intention is for the QMF to

have a coaching role rather than a controlling role. The idea is that quality assurance measures shall be brought into the production processes in a way that the staff members do not feel extra burdened by quality measures – but to make it “the way we work”.

In implementing a new quality management function we try to ensure that the necessary quality measures are implemented in each step of the statistical production process. We have described and analysed all processes within the GSBPM framework [1].

As an example on our challenges we introduce the big challenges we have had in the Danish International Trade in Goods Statistics optimizing our system for validating the 36 million records we receive every year in a way which maintains sufficient quality while human resources are continuously diminishing. In 2007 we implemented a new error detection model. Based on standard unit values the model calculates a score for erroneous records based on their suspicion and their impact on the published figures. Since the score is the basis for re-contacting enterprises, to validate data, it is important that it be good at predicting erroneous trade. At the time of implementation the score was able to correctly identify erroneous trade 60 per cent of the time, in 2012 the hit rate had decreased and now only correctly identifies errors in 46 per cent of the time.

Since the method has lost some precision, we have developed supplementary measures. We have developed error detection processes that find errors that were too small for the error detection model to find. Also we have created specific routines to improve the standard unit values. However, developing supplementary measures does not ensure that the quality stays high.

2. Quality management function

The first task for the QMF was to draft a Quality Policy (QP) for the division to discuss and implement. This was in place by the end of 2013 and was discussed in the beginning of 2014. It was agreed that the QP is to be a “dynamic” document, i.e. open for changes when needed. The QP is made for the External Economy division, but has the European Code of Practice (CoP) [2] as a point of departure, and is related to Total Quality management, TQM) as the broad picture and Quality Assurance Framework (QAF) [3] as a realization of the CoP. Our starting point is that all we do in our daily work is based on the fact that we

are going to fulfil our user's needs. And this is the task for all staff members in the division.

The QP is kept short - it has "10 simple and unbureaucratic principles" relating to quality that takes our current TQM "maturity level" as a point of departure and to which everybody can relate and have as a "constant reminder". They may seem obvious, but are not always easy to follow in practice – at least we have some "room for improvement".

Regarding data reception our aim is to give our data providers good guidance and online validation so that we can get correct data the first time – or in one contact. If we can manage this, the burden on the data providers can be kept low and the data quality can be better, using less resources.

Our second principle regards data processing where we aim to have well documented validation and estimation processes that are standardized as much as possible. If we can manage this, the tasks in connection with data processing can e.g. more easily be given to new people, or we can have a better overview and more easily make changes if needed. More standardized processes can also make it easier for more people to solve the same tasks.

Our third and fourth principle regards data dissemination and aims at quality assurance of releases and user oriented documentation and ensuring that all products reflect EU-demands, International recommendations and other user needs. If we can manage this we can maintain users' trust in the statistics that we publish.

These four principles covering QAF takes care of the needs of our data providers and users. To enable these we have some quality principles regarding the management and cooperation processes and some regarding the supporting processes.

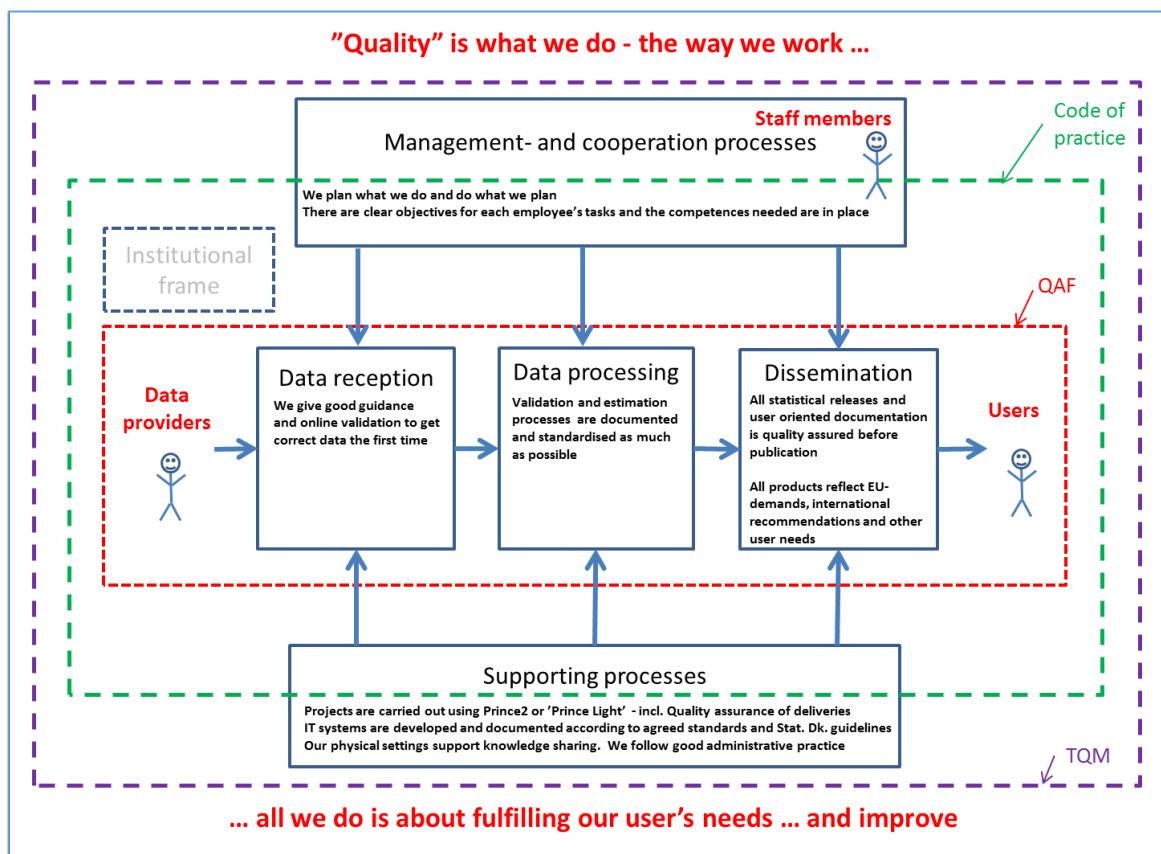
Regarding the management and cooperation processes we made two principles. To the extent possible "we plan what we do and do what we plan". We all know this is not always possible and not always wise or sensible. We still want this as one of our quality principles in the hope that this will make us better at planning our tasks and make us better at realizing our plans - especially when it comes to finishing our projects on time and within budget. The second principle is that each employee has clear objectives for their tasks and

the competences needed to solve them. This is especially something that should be addressed in appraisal interviews, but also when tasks are distributed among employees.

Regarding the supporting processes we have four principles. The first regards the project management. Statistics Denmark has chosen Prince2 as the project management system for the institution. This is an established and proven practice in project management developed in the UK. In our division we have adapted a “light” version for smaller projects using the same vocabulary as the common version. The second regards the IT-systems and their development and documentation that follow agreed standards and guidelines. The third regards our physical settings supporting knowledge sharing. And finally, there is the principle that we follow good administrative practice.

If or rather when these principles are something that we live up to, we can confidently say that Quality is what we do – the way we work. In any case, the basis for our work is that all we do is about fulfilling our user’s needs and to constantly do what we can to be better at what we do – to improve.

This QP is summarized in the following figure:



3. GSBPM as a frame

The second task for the QMF was to draft a proposal for supplementary measures to ensure quality in the production processes of the division. As a starting point for this task the production of External Trade in Goods, in Services and Balance of Payments has been documented in the GSBPM framework. As a first step we looked at each process step asking the question: What is done within this process to ensure that we do what we are supposed to do and get the best possible output from this process. For some of the processes we found that the quality assurance measures taken were not adequate and supplementary measures were suggested. Some supplementary measures have already been implemented, while others will come over the next couple of years.

In the GSBPM set up the processes 4 (collect), 5 (process), 6 (analyse) and 7 (disseminate) has been described.

One important feature we are going to implement is an annual cycle. This cycle will comprise (among others) all processes with a person responsible, and persons having tasks on each process. Some tasks will occur once a year while other tasks may occur more often – up to several times a month. The idea is for each process to ask these questions:

- Who is responsible for this process – this will be put into the annual cycle
- When is this process running – this will be put into the annual cycle
- How do we ensure that the input data are the data needed – how are the data updated?
- How do we update changes in rules e.g. EU regulations
- What starts/initiates the process
- What is the process – which value does the process give?
- What comes out of the process – intermediate product – end product - what is done to ensure that this process has been “successful”?

4. Example from process 5.3

The following is an example of how the quality assurance measure of a specific part of process 5.3 (Review, validate and edit) was found not to be adequate. But first an

introduction to the data going into the International Trade in Goods Statistics at Statistics Denmark.

4.1 Our error detection model

The gathering of data for the International Trade in Goods Statistics is split in two. Trade within the European Union is gathered within the Intrastat system, where all companies over the threshold must report trade. The threshold is set each year such that 95 per cent of imports and 97 per cent of exports is covered. For Extrastat all transactions over 1.000 EUR is collected through customs. This means that approximately 35.000 (where Intrastat accounts for 8.000) Danish companies report to the Danish International Trade in Goods Statistics each year. They can report trade on approximately 9.400 different commodity

Quality Management / Metadata management								
1 Specify Needs	2 Design	3 Build	4 Collect	5 Process	6 Analyse	7 Disseminate	8 Archive	9 Evaluate
1.1 Determine needs for information	2.1 Design outputs	3.1 Build data-collection instrument	4.1 Select sample	5.1 Integrate data	6.1 Prepare draft output	7.1 Update output system	8.1 Define archive rules	9.1 Gather evaluation inputs
1.2 Consult and confirm needs	2.2 Design variable description	3.2 Build or enhance process components	4.2 Set up collection	5.2 Classify and code	6.2 Validate output	7.2 Produce dissemination product	8.2 Manage archive repository	9.2 Conduct evaluation
1.3 Establish output objectives	2.3 Design data collection methodology	3.3 Configure workflows	4.3 Run collection	5.3 Review, validate and edit	6.3 Scrutinize and explain	7.3 Manage release of dissemination product	8.3 Preserve data and associated metadata	9.3 Agree action plan
1.4 Identify concepts	2.4 Design frame & sample meth.	3.4 Test production system	4.4 Finalize collection	5.4 Impute	6.4 Apply disclosure control	7.4 Promote dissemination product	8.4 Dispose of data and associated metadata	
1.5 Check data availability	2.5 Design statistical processing methodology	3.5 Test statistical business process		5.5 Derive new variables and stat. Units	6.5 Finalize output	7.5 Manage user support		
1.6 Prepare business case	2.6 Design prod. system and workflow	3.6 Finalise production system		5.6 Calculate weights				
				5.7 Calculate aggregates				
				5.8 Finalise data files				

codes and 250 different countries. To publish the International Trade in Goods Statistics we need to know whether it is import or export, which country the good is going to/from, which commodity it is, the value, weight and potentially the supplementary unit. This

result in nearly 36 million reported lines each year. This amount of data requires an error detection model that can automatically identify the most important errors.

Our error detection model is based on the model used at Statistics Sweden on data on international trade. This model is heavily influenced by the model of Hidioglou and Berthelot [4]. The model has two distinct features. First a credibility check is made, where the company's reported trade is compared to previously reported similar trade – this comparison is done based on standard unit values, and the reported trade is given a suspicion level. Then the model weights the trade likely to be erroneous by its impact on the published figures. This results in a score function that ranks the reported lines for further investigation, $\text{score} = \text{suspicion} * \text{impact}$.

The standard unit values of the reported lines are calculated at different levels. The first level is import/export (flow), commodity code, company and country for the previous 24 months, if there are more than 6 observations at this level, this standard unit value is used, if not the level is on flow, commodity code and country. To determine whether a new line deviates from the previous trade, the standard unit values are divided into lower and upper quartiles. If a line is above the upper quartile or below the lower it is given a suspicion. The distance to the quartiles determines how suspicious the line is.

The impact of the suspected lines is found by looking at how much it deviates from the expected value. The deviation is in relation to the different publication levels, e.g. 8 digit commodity codes, SITC chapters etc.

Although 50 per cent of all reported lines are given a suspicion, less than 1 per cent is found to have an impact on the published figures that is high enough to require further validation. Note that this level is subjective and that 1 per cent out of 36 million lines are 360.000 lines. This means that a lot of reported lines that are probably incorrect are never corrected, and hence these lines will in time distort the standard unit values.

Since we only manually validate about 1 per cent of the reported lines it is important that the lines chosen for manual validation are the ones which are most probably incorrect and have the highest impact on the statistical figures to be disseminated. However the more distorted the standard unit values are the more likely it is that the lines flagged for validation are in fact correct, and never should have been sent out for further validation.

When the model was implemented in 2007 the hit rate was 60 per cent, that is the score was able to correctly identify erroneous trade 60 per cent of the time. In 2012 the hit rate was at 46 per cent. This decrease in the hit rate is probably due to the fact that the standard unit values have not been validated systematically enough.

4.2 Supplementary measures

From the implementation of our new error detection model we have been aware that the standard unit values must be validated for the model to be effective. Over the years we have developed supplementary measures to our error detection model. These measures affect the standard unit values directly as well as indirectly.

First we developed some supplementary measures that indirectly affect the standard unit values. These measures were mainly developed because we found that certain types of errors continually escaped our error detection model. E.g. if the supplementary units are large relative to the value, our error detection model will not find them. This is mainly because lines with a value less than 500 EUR is not part of the error detection, and because the focus of the standard unit values are mainly on the price per kg., and the impact on the published figures is in terms of impact on the value. We created a supplementary process that detects instances where the supplementary units are large relative to the value. If the value is less than 1.000 EUR the weight or supplementary unit is corrected automatically, if the value is above the probable error will be sent to the companies for validation.

Another supplementary measure that indirectly affects the standard unit values is a check for inconsistencies between the commodity code, supplementary unit and weight.

For several of the commodity codes there is an inherent relationship between the weight and the supplementary unit. As an example can be named commodity code 20057000 (olives prepared or preserved otherwise than by vinegar or acetic acid) where the weight, in kilograms, inherently is larger than the supplementary unit, as this is drained weight in kilograms. The supplementary process is set up such that all lines with a value less than 1.000 EUR is corrected automatically whereas lines with a value over 1.000 EUR is sent to the companies for validation.

Validation of standard unit values is very time consuming, hence it is a task that is often prioritized last. This has resulted in a lot of the standard unit values over time becoming distorted. We have a validation system where one can take a given standard unit value for a company and correct it, however given the number of companies (approximately 35.000) and the number of commodity codes (approximately 9.400) there are several thousand standard unit values to validate. Hence we decided to manually set lower and upper quartiles for commodity codes where we know e.g. the maximum and minimum weight. We gain several things from this. Firstly, we increase the likelihood that the lines found through our error detection are in fact incorrect. Secondly, the more incorrect lines we correct the closer we are at getting healthy standard unit values, and lastly, for all the lines that fall outside of the lower and upper quartiles we can investigate whether the commodity code used is correct.

These supplementary measures all improve the standard unit values, however as explained it is important that the standard unit values are continually validated. By becoming aware of who is responsible for this specific process and keeping a close eye on the hit rate has gotten us closer to the best possible outcome from this process, but additional measures will be implemented over the next year.

4.3 Improving the quality assurance measures

Generally we found that the quality assurance measures could be improved in process 5.3. We have mapped out our production processes, however, we are not able to separate the effect of each of the error detection processes from each other. Currently we have a status code system where changes from some of the error detection processes can be logged. By improving our current status code system we plan to be able to monitor the effect of each of the production processes. This way we can detect if one of the processes is not working as expected, or we can easily see if resources should be reallocated to more effective processes.

5. Summary and conclusion

Due to diminishing resources the challenge on quality is changing. To be ahead of things it was decided to establish a quality management function within the division of External Economy at Statistics Denmark. The main focus of the quality management function is to

ensure that quality assurance measures are brought into the production processes, such that it becomes “the way we work”.

In this paper we explain how the quality management function first drafted a Quality Policy for the division. Here the focus of our daily work is identified, namely that we ensure that in all we do we fulfil our user’s needs. Ten principles were formed to clarify how we ensure the quality in our work. The ten principles are split in three focuses, data, management and supporting processes.

The second task for the quality management function was to draft a proposal for supplementary measures to ensure quality in the production processes of the division. For each process in the division we must ensure that we do what we are supposed to do, and that we get the best possible output from this process.

The example from process 5.3 (Review, validate and edit) shows how there is a need for quality assurance, and how this can be improved by applying some of the suggested supplementary measures. Namely assigning responsible persons for the process, and monitoring the hit rate.

Overall there is a growing need for quality assurance, and with the help from the quality management function we are getting closer at making quality assurance in our production processes “the way we work”.

6. Literature

[1] GSBPM version 4.0, see:

<http://www1.unece.org/stat/platform/display/metis/The+Generic+Statistical+Business+Process+Model>

[2] CoP; European Statistics Code of Practice, Adopted by the European Statistical System Committee 28th September 2011

[3] QAF; Quality Assurance Framework of the European Statistical System, Version 1.1

[4] Hidioglou, M. A., and J.-M. Berthelot (1986), Statistical Editing and Imputatuin for Periodic Business Surveys, Survey Methodology, Vol. 12, No. 1, Juni 1986.