Typology of Products in Official Statistics

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The portfolio of products compiled by national statistical institutes has increased within the past years. Some handbooks (for instance ESS Standard for Quality Reports – Eurostat 2009) propose a typology for statistical products to distinguish between various production processes and to evaluate specific quality components. The increased variety of production processes and statistical products requires an extension of existing typologies to cover arising challenges for quality issues.

We start by discussing the concepts “primary” and “secondary” data use in the context of the evolving importance of the use of administrative data and register-based statistics. The paper develops a higher-dimensional proposal for a new typology for official statistics taking into account the necessities caused by the increased occurrence of multiple data sources. The various dimensions necessary to characterize a certain product-type are described as well as their relation to the basic parts of statistical production (data collection, processing and data presentation).

The contribution concludes by linking the proposed types of statistics to quality reporting by enumerating the most relevant components and indicators relevant for assessing their quality.

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1. Introduction

Nowadays exists a huge variety of outputs delivered by a National Statistical Institute (NSI), which represent different types of statistical products. This variety is not only related to the increasing broadness of subjects covered by Official Statistics but also refers to inherent characteristics reflecting different methodological aspects of the production process. Such aspects are typically the underlying data source respectively the way of obtaining/collecting data, different methodological processing steps employed for the generation of results, or multiple ways of presenting resulting figures.

In this situation of diversity of manifestations of statistical products there exists a need to classify the statistical products related to official statistics not only by content-driven criteria, which is the primary aspect in the dissemination process, but rather by such ones directly connected to the statistical production process.

The aim of this paper is to develop a typology, i.e. a systematic classification schema of statistical products, according to their common characteristics of methodological aspects in the underlying production process. The availability of such a typology is not just of importance to establish a systematic organization of statistical products but it has a direct impact on quality reporting and documentation issues as different types of statistical products require different focussing on quality criteria.

2. Various Proposals for Classification

The idea of a typology of statistical products is by far not new in Official Statistics. There have been considerations and thoughtful implementations in NSI's and as well on European level. In this section we just briefly mention two of the most commonly used classification schemes.

2.1. Primary and Secondary Statistics

The simplest form of classifying statistical products is to distinguish between products based on primary and secondary statistics respectively. The teaching materials used by Statistics Austria [Hartmann 2002] defines as a main constituent of "primary statistics" that they are based on a data collection process specifically designed for the purpose of the particular statistic. On the other hand if the underlying data for a statistical product are already available from a source outside the NSI the term "secondary statistics" is used. Since in most cases secondary data sources are used which have been collected for administrative purposes the term "secondary statistics" is often used as a synonym for "statics based on administrative data".

As the collection of such a primary data source within a survey may be tailored to optimally fit to the specific needs of the statistics being produced it seems clear that primary statistic offers in comparison to secondary statistics, which have been collected to fulfil another purpose than answering the topical question, better chances to obtain a high data quality. Thus it becomes obvious that the simple dichotomous classification "primary statistics" and "secondary statistics" which is based on the data collection method as the only criterion carries a strong impact on quality reporting.

While the dichotomous differentiation seems on a first look clear-cut a closer inspection of products produced today by NSIs reveals that many products make simultaneous use of primary surveys and administrative data such that the classification as a primary or secondary statistic is far from being straightforward.

Finally it should be mentioned that the above differentiation between primary and secondary statistics has evolved outside the field of official statistics a more general meaning by addressing any data material which is not originated by the investigator within the context of a study as secondary data source. Such a broader view on secondary statistics can be found e.g. in Crawford 1997: "Secondary data is data which has been collected by individuals or agencies for purposes other than those of our particular research study."

This more general view implies that data which are primary in the context of one study, will become secondary for all others. Generally the data are primary to the source who collects and processes them for the very first time. They become secondary for all other sources, who use them later. Thus the terms primary and secondary are defined solely by the circumstance, if the data were collected for the intended purpose of the study or not.

This broader meaning of secondary data not restricting the term secondary almost exclusively to administrative data collected outside a NSI is quite different from the understanding of the terms in official statistics.

We illustrate this further by an example: if an NSI is using data for a certain product having been collected by a survey originally dedicated to another statistical product it would still be classified as primary according to the understanding of most NSIs. Nevertheless the more general meaning of secondary statistics would classify it as a secondary data source. For example, if a NSI department has conducted a survey on consumer behavior by means of sample survey, then another department might use this data in a study on exposure to poverty as a valuable secondary data source.

2.2. Other Criteria for Classification of Statistical Products

Of course there are other elements which seem eligible for classifying statistical products and have been used for the classification of statistical products so far. For instance the circumstance if a sample survey or a census is used in the production process has a major impact on the methodological aspects and relevance on different quality issues. Therefore this aspect is quite often used a sub-classification of a primary statistic.

An important motivation for aiming to classify Statistical products lies in the relevance of the product type for the resulting determinants for the quality of a product. When quality reporting became one of the important carrier of metadata, describing a statistical product along the dimensions of quality in the European Statistical System (ESS) it became evident that the contents of the quality reports are different depending of the nature of the product under consideration. Not least for this reason Eurostat developed in the revision of the Handbook on Quality Reports [Eurostat 2009] a typology which serves as a guideline for the content of a quality report for each of the particular types differentiated.

The following types were defined within the handbook:

- Sample Survey
- Census
- Statistical Process using Administrative Sources
- Statistical Process involving Multiple Data Sources
- Price or other Economic Index Process
- Statistical Compilation

Without going into details of this proposal a weakness of this typology becomes easily apparent. The above classification does not necessarily assign statistical products uniquely to a certain type. For instance the production of an index might typically be based on a sample survey as well as on the use of administrative data. The reason for this deficiency which gives rise to discussion is that the definition of types is based on different aspects of the production process instead on a single attribute.

Quite generally spoken, the actual direction of development of the work of NSIs goes in a direction, where in the near future a great deal of products will have to be assigned as a “Statistical Process involving Multiple Data Sources” which diminishes the value of the classification schema proposed.

3. Characterization of Statistical Products

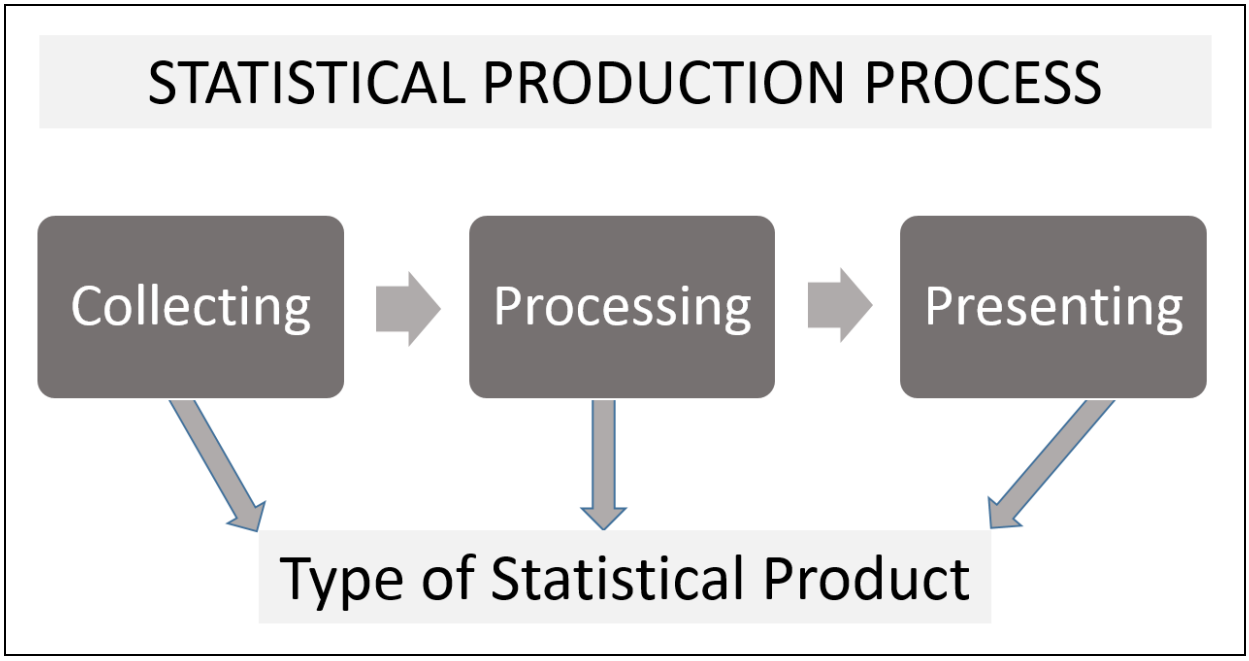
3.1. Canonical dimensions

One of the problems of the typology proposed by Eurostat is that the criteria determining the type of a statistical product are attributes describing different peculiarities of different stages of production process.

Using administrative sources or performing a sample survey deals with aspects of data collection while the differentiation between statistical compilations and indices are very much related to methodological processing.

Another important issue is the development which still is going on in official statistics. Due to the increasing technical possibilities and the changes in the production process of official statistics utilization of a multitude of data sources for generation of one statistical product becomes more and more frequent. In many practical situations sample survey data are nowadays enhanced by additional administrative data sources either to improve the data collection process itself or by supporting the data quality by using administrative data for imputation purposes. In the case of register based statistics usually a huge number of different administrative sources are incorporated. Due to the necessity of decreasing response burden classical census surveys appear like a dinosaur threatened with extinction.

In this context we like to propose a multi-dimensional model for classifications of statistical products which is based on the three pillars of the statistical production process. We strongly believe that the type assigned to a statistical product has to depend on characteristics of each of the phases of the production process as the classification of official statistics seems to be influenced by more than one aspect.



Broken down to the statistical production process as suggested by the above figure there are three basic questions connected with the classification of a statistical product.

- Where do the underlying data of the statistical product originate?
- What processing steps have been involved to derive the statistical product?
- Which presentational techniques are applied to the statistical product?

This suggests a three-dimensional approach to characterize a statistical product and to compose a type of a statistical product.

Not at least we stipulate that the model should be open and flexible to accomplish with future developments taking place in official statistics.

In the following sections we briefly discuss these 3 dimensions.

3.2. Underlying Data Source

Surveys still play a key role in official statistics and planning and realization of especially sample surveys is and will be in the near future an inevitable ingredient for a lot of statistical products.

The second increasingly important source of data for a lot of products are data adopted from administrative sources. As to avoid an overburden of respondents utilization of administrative data already available in databases run by public authorities are exploited as much as possible. Reducing respondents' burden as well as data collection costs utilization of administrative data is nowadays highly preferred and outbalance the possible drawback that administrative data may exhibit a lower level of quality than data specifically collected for the purpose of the study by a survey.

Lead by the general aim of an integrated statistical system the increasing interconnections between various statistical products lead more and more to situations where the production of a statistical product makes use of data already collected in another project (see our discussion of primary and secondary statistics in section 2.1). A classic example is the production of National Accounts which is mainly based on the use of data collected for some other business statistics.

Another data source which becomes more and more important in producing official statistics are statistical registers. We would like to define a statistical register as a database, which comprises some population in total and is updated continuously for statistical purposes as to facilitate and improve the process of data collection and production of statistics. From the above definition it becomes clear that we address with the term "statistical registers" such registers which are primarily managed by NSIs for statistical purposes, while many registers used in public administration are maintained by official authorities for their own needs. We would summarize the later type of registers under the term administrative data source.

To ensure completeness and accuracy of statistical registers as high as possible different external administrative sources are used and have to be linked (e.g. personal identification codes, business identification codes) which poses new challenges for itself.

It should be mentioned that the above mentioned data sources more or less reflect the situation on data collection in its current status of official statistics. But official statistics is faced nowadays with discussions about the value of using new alternative sources of data which are either available in the World Wide Web and might be summarized under the buzz-word "Open Data" or massive data sources collected by companies and other organizations which are called "Big Data". Without giving a clear definition what is really meant by this currently much hyped term "Big Data", we will use it as a synonym for new types of data sources, which have not been used extensively in official statistics so far. Examples could be the use of massive sets of movements of cell phone data, which may provide a valuable data source for statistics of commuters or scanner data from warehouses which represent an immense source of data which could be used for improving the quality of price indexes and lead to a better understanding of consumer expenditures.

Finally we would like to differentiate between two main purposes of data utilization in official statistics. Data collection as a classical process step in official statistics in its original narrow sense is regarded as the process of gaining data which are directly related to the subject under investigation. For instance collection of data describing the labour status of individuals when conducting a labour force survey is in the primary focus of the project.

On the other hand more and more additional data sources not directly related to the focus of the project are employed as auxiliary information within the production process for the purpose of ensuring a high data quality. These additional data sources which might be of primary statistical concern in another context are typically used for editing and validating input data. An example might be a survey on income data where administrative tax data are used for the purpose of data editing.

We mention these two facets of data utilization because it seems of relevance for us to fully describe the character of a statistical product. It is not sufficient just to mention that multiple data sources are involved in a statistical product. Quality impacts are quite different if the proper target of the statistic is derived by melting various data sources or if it is based on one data source and the additional data sources involved are just used for increasing data quality or validation purposes. In practical work such additional data sources for increasing data quality or the validation purpose are very often provided by administrative sources.

3.3. Data Processing Steps

Data used in official statics are processed in a manifold of different ways. Many times a simple aggregation process by counting certain forms of statistical units does already the job. On the other hand sometimes (like e.g. in population forecasts) more complex models have to be applied. In the context of administrative data when for certain statistical products not only one but numerous sources are used data linkage is one of the most challenging process steps.

When introducing the aspect of model based calculations the question immediately arises how to distinguish between simple statistical processing steps and the application of more complex models. In other words: Where does complexity start? We are far away to answer this ambitious question in a sufficient way as the transition from simple counting towards model based processing is quite fluent. Nevertheless there are some modelling procedures typically used in the production of official statistics though their application is not solely restricted to the field of official statistics. The following enumeration gives a list of processing steps which can be seen as model based processing. The methods which can be summarized under this umbrella are listed in alphabetical order:

Model Based Calculations:

- Backcasting methods
- Data validation techniques
- Disaggregation
- Flash estimation
- Forecasting methods
- Imputation techniques
- Index calculations
- Seasonal adjustment
- Small area estimation
- Statistical disclosure control
- Weighting of a sampling scheme

This enumeration is not necessarily complete but more or less covers the most frequently used methods in production of official statistics having characteristics which lead to their classification as model based calculation steps.

Similar as the data collection dimension the process dimension as well has two facets. The methods listed above are either used directly for the estimation purpose of the figures you intend to produce related to the subject of interest or are indirectly employed for achievement of a high quality data set. An example for the first mentioned direct use is the estimation of totals by means of models based weightings schemes derived from the underlying sample design. A typical example for the indirect use is given by model based imputation. Here the use of sophisticated methods like e.g. complex regression models or nearest neighbour methods is utilized to increase data quality with regard to completeness. However, having once imputed the missing values and established a complete and clean database the process for obtaining the figures which are in focus might be a very simple by just counting frequencies or summing up of values.

3.4. Data Presentation

The outputs produced in Official Statistics can be classified into three main types depending on the nature of the product itself.

- Statistical Tables
- Indicators / Indices
- Accounting Systems

With the term statistical tables we mean the big category of usual classic statistics" which consist of a bunch of mostly bivariate tables where numbers are systematically arranged in columns and rows. The output very often presents frequencies or sums of certain quantitative variables.

The second class is represented by indicators and as a special case indices where monitoring the development over time of a certain phenomenon is the main focus. Besides the display as time-series reflecting the temporal changes also disaggregation of aggregated indices for a more granular entity level or for various regions which lead to tabulations are of relevance.

The third category accounting systems is very typical for official statistics. The production process is guided by a systematic set of rules which governs the assignment of values to certain accounting positions. The most evident example of this output type is of course provided by the system of National Accounts.

It shall be noted that the characterisation of the output dimension is completely independent of the first two dimensions discussed before. For instance you can have an accounting system purely fed by administrative data but not using any model based approaches when processing the data.

Focusing on the presentation of the results itself we came to the conclusion that the dimension data presentation itself may not be variegating the different statistical products a lot.

Note that the dissemination of the results can be accomplished quite flexible by making use of either tables or graphs (bar plots, time-series, maps etc.).

Simple tabulation of results is done by nearly every statistical product in official statistics. It is one of the central elements of NSIs to deliver tables. When it comes to indicators some might observe a definition problem. What exactly is an indicator? If you take a certain figure out of a table and you observe it over time you may talk of an indicator. One of the criteria could be the time-series concept. Graphical presentations and inclusion in cartographic outputs are nowadays as well a topic of nearly every statistics. So it must be considered if the third dimension we presented is really necessary and useful for the purpose.

The increasing importance of the World Wide Web as medium of dissemination offers new presentation-possibilities of communicating statistical results. Especially the dynamic aspect of the electronic media allowing interactive specification of tables or graph as well as the possibility of utilizing movement (e.g. animated graphs) in the presentation of results has an enormous impact on the type statistical products are disseminated nowadays.

Being well aware of these facts we decided not to include the aspect of presentation involved for the development of a typology of statistical products.

4. A Template for Schematic Characterization

Based on the considerations described in the previous chapter we propose the following template to fully characterize a statistical product.

Template: Characterization of Statistical Product

Database

	Subject of Statistic	Auxiliary Information
Sample Survey		
Census		
Administrative Data		
Existing Data		
Data from Registers		
Big Data		

Production Process

	Short Characterization
Accounting	
Data Matching	
Simple Aggregation	
Model Based Calculations	
Backcasting Methods	
Data Validation Techniques	
Disaggregation	
Flash Estimation	
Forecasting Methods	
Imputation Techniques	
Index Calculations	
Seasonal Adjustment	
Small Area Estimation	
Statistical Disclosure Control	
Weighting of Sampling Schemes	
Other Methods	

As you can see from the above template the definition of underlying data sources differentiates between the roles the play in the production process as either being the subject of the statistic or just an auxiliary information for improving the quality.

With regard of the production process we preferred a verbal description and thus relinquished to differentiate between the direct and indirect use of model based calculations described in section 3.3.

4.1. Examples for Product Characterization by our Template

To elucidate the assigning of characteristics to a statistical product it is helpful to look for practical examples typical for official statistics. Of course we cannot cover the whole portfolio of a NSI but to get a first insight into the possible proceeding when assigning the characteristics it is helpful to look at some specific projects.

Looking at a very complex highly relevant survey based statistics like EU SILC we have a lot of describing characteristics.

In data collection we have survey data where respondents (households) are questioned about their income situation. Additionally the data are enhanced for certain income components by administrative sources. Administrative sources play as well a key role as auxiliary data. Besides administrative sources data from registers as well as existing data are used also as auxiliary information. Looking at processing some can assume that simple aggregation is the main focus of the statistics. But looking closer at the processing you will have a lot of complex working steps which are conducted by model based procedures. For instance the complex weighting scheme of EU-SILC is one of the key processes. Besides that sophisticated imputation techniques are use intensely. Data presentation is not limited to simple tabulations since there we have indicators on poverty whose source are EU-SILC data. Maps are as well a topic here.

EU SILC

Database

	Subject of Statistic	Auxiliary Information
Sample Survey	X	
Census		
Administrative Data	X	X
Existing Data		X
Data from Registers	X	X
Big Data		

Production Process

	Short Characterization
Accounting	
Data Matching	Direct data linkage
Simple Aggregation	Frequency Counts, Total Values
Model Based Calculations	
Backcasting Methods	
Data Validation Techniques	Complex Editing taking into account auxiliary information
Disaggregation	
Flash Estimation	
Forecasting Methods	
Imputation Techniques	Regression Imputation, Hot Deck
Index Calculations	
Seasonal Adjustment	
Small Area Estimation	
Statistical Disclosure Control	
Weighting of Sampling Schemes	Design weighting, Non response weighting, Calibration
Other Methods	

As a second example we can look at the statistics on Driving License Categories which is based on a data delivery of the national driving license register. So compared to the characteristics of EU-SILC this statistics seems rather less complex. Since the statistics is based on administrative data stemming from a single register we have no survey but administrative data as characterization of the data collection process.

In the processing dimension we can identify simple aggregation and data validation techniques which of course can be regarded as model-based. Finally at the presentation level we can see simple tabulations as the main output.

Statistics on Driving License Categories

Database

	Subject of Statistic	Auxiliary Information
Sample Survey		
Census	X	
Administrative Data	X	
Existing Data		
Data from Registers		
Big Data		

Production Process

	Short Characterization
Accounting	
Data Matching	
Simple Aggregation	Frequency Counts
Model Based Calculations	
Backcasting Methods	
Data Validation Techniques	Rule Based Editing
Disaggregation	
Flash Estimation	
Forecasting Methods	
Imputation Techniques	Single Value Imputation
Index Calculations	
Seasonal Adjustment	
Small Area Estimation	
Statistical Disclosure Control	
Weighting of Sampling Schemes	
Other Methods	

When looking at this statistical product one can easily see that there exists room for future development. So using other sources as auxiliary information as e.g. the “Central Register of Residents” would possible enhance the data quality of the product. Making use of such an additional data source for as auxiliary information source would automatically require the implementation of data matching routines.

A nice side effect of the systematic documentation of statistical products in such a template is, that it enables a quick understanding of the production process and thus might lead to findings which possibilities exist for enhancing the quality of the product.

As a last example we take a look at the Register Based Labour Market Statistics. This is a statistical product where a multitude of registers is used supported by statistical data already available from other statistical products (like the quarterly Labour Force Survey).

With regard to processing you see that there are a lot of working steps which can be seen as model based calculations. Besides the dominating topic of data linkage (due to the utilization of multiple data sources), forecasting and/or backcasting techniques play an important role as some of the administrative data sources do not comply with the reference periods under consideration Disaggregation is a topic because some information is not available at the desired unit level but rather in an aggregated form only.

Register Based Labour Market Statistics

Database

	Subject of Statistic	Auxiliary Information
Sample Survey		
Census	X	
Administrative Data	X	X
Existing Data	X	X
Data from Registers	X	X
Big Data		

Production Process

	Short Characterization
Accounting	
Data Matching	Direct Data Linkage, Statistical Matching
Simple Aggregation	Frequency Counts
Model Based Calculations	
Backcasting Methods	Aligning to due date
Data Validation Techniques	
Disaggregation	Proportional disaggregation
Flash Estimation	
Forecasting Methods	Aligning to due date
Imputation Techniques	Hot Deck, Mass Imputation by transferring distribution
Index Calculations	
Seasonal Adjustment	Rule based Editing, Macro Editing, Using Auxiliary Information
Small Area Estimation	
Statistical Disclosure Control	
Weighting of Sampling Schemes	
Other Methods	

A conclusion which becomes evident from this example is that for the production of statistics using data from multiple sources the exhaustive use of model based methods is inevitable. Data presentation by simple tabulation is of course also a characteristic of this product. Indicators of labour market (employment rates etc.) are an outcome and maps and graphical presentations of the indicators are done as well.

5. Impact of Product Characterization on Quality Reporting

Problems associated with product diversification in the context of quality reporting has already been highlighted in a previous paper (Burg 2009, Burg 2010). Typically most concepts of quality reporting are designed with respect to classical survey based statistics and work well in this context.

The development of the topical table of content which defines the structure of the "Standard-Documentation" used by Statistics Austria as main quality reporting medium was also guided by the statistical process chain of survey oriented products. This leads regularly to discussions about the pros and cons of a fixed structure when drafting documentations for other product types as some topics are of no relevance while other important issues are not explicitly named in the content-table.

Just to elucidate the above argument the following table summarizes the relevance of various quality aspects in dependence of the data source, where xxx represents a very high relevance:

	Sample Survey	Census	Administrative Data	Existing Data	Data from Registers	Big Data
Coverage	xxx	x	x	x	xxx	xxx
Response	xxx	xxx				
Representativity	xxx	x		x	x	xxx
Adequacy of Units	x	x	x	x	x	xxx
Measurement Errors	x	x	xxx		x	xxx
Timeliness	x	xxx	x			
Credibility of Data	x	x	x			xxx

Without discussing every detail of the above table that even the in statistics common term measurement error seems to be debatable as in the context of administrative data or big data probably the homogeneity of underlying concepts behind the data would be a better definition for this issue as no measurement in the sense of statistics takes place.

Besides the aspect of used data sources also the characterization of the processing steps has a direct consequence on the expectations with regard to the metadata which are of relevance in quality reports. Depending on different methodological aspects involved in the generation of a product, different elements of characterization of accuracy become more or less important.

The following list (which is far from being complete) should give a first indication of relevant quality topics for different processing steps.

- Accounting
  Misclassification error, definition of underlying concepts and classifications, availability and completeness of metadata
- Data Matching
  Matching rates, strength of association (level of certainty), homogeneity of underlying concepts
- Simple Aggregation
  Availability and completeness of metadata
- Model Based Calculations
  Sampling error, precision of results on various levels of reporting, goodness of fit measures, model diagnostics, analysis of sensitivity with respect to methodological assumptions, sensitivity with respect to effects of distorted data

We believe that the use of a systematic and concise product characterization could be a valuable guideline to define the relevant contents of quality reports for a specific statistical product.

6. Conclusion and Next Steps

The modernization in official statistics widened the methods on data collection and broadened the variety of production methods during the last two decades enormously. As a consequence the classical concepts of a one-dimensional typology in a closed form assigning terms to statistical products in official statistics does not reflect their complexity in a sufficient way.

The trigger to start our considerations about the classification of statistical products was that in the course of discussions within the quality subcommittee of the Austrian Statistics Council the question of integrating and defining the type of a statistical product into the meta-information (Standard-Documentations) was raised and controversially seen. Thus it became evident that the classical concepts of defining statistical product are not fully appropriate any longer as they do not reflect the complexity of modern statistical production processes in a systematic way.

As our considerations show, a set of characteristics is needed for the description of a statistical product. This led us to the conclusion that a schematic concept for mapping the multi-dimensional characterisation of statistical product in a systematic way is needed. To accomplish this task we developed and propose a template for the characterization of statistical products.

It is taken for granted that we understand our contribution as a proposal which is a starting point for further discussion. It will definitively be necessary to sharpen the ideas and proposals presented in this paper. In this context one of our next steps will be to discuss the proposal among the board of directors of Statistics Austria. As we plan to apply the template proposed for the characterization of statistical products within the Standard-Documentation of Statistics Austria we are looking forward to get feedback from different experts about the usability of the template as well as recommendations for further refinement.

Finally we have to admit that the schematic concept for characterisation of statistical products as it is proposed by our template which allows documentation of features in a systematic way does not fulfil the ultimate aim of having a well-defined typology of statistical products in a closed form along with clear-cut rules how to assign statistical products to certain categories. Nevertheless we believe that the development of a typology has to undertake the task of first organizing the information relevant in a systematic way and then in a second step develop specifications of manifestations which occur in the domain of official statistics.

We finally hope that our proposal of a schematic characterization by a standardized template supports the development of a more flexible approach towards quality reporting.

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