Bundesamt für Kartographie und Geodäsie

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Infrastructure for the integration of statistical and geospatial information

National recommendations based on an analysis of the Global Statistical Geospatial Framework

Reference documents

Name	Title	Version	Date
DOC1	The Global Statistical Geospatial Framework http://ggim.un.org/meetings/GGIM-committee/9th-Session/documents/The_GSGF.pdf		2019
DOC2	GSGF Europe - Implementation guide for the Global Statistical Geospatial Framework in Europe https://www.efgs.info/wp-content/uploads/geostat/3/GEOSTAT3_GSGF_EuropeanImplementationGuide_v1.0.pdf"	1.0	28 February 2019

Management version

The aim of official statistics is to provide information for the development of an informed opinion and as a basis for decision-making processes in a democratic society. Integrating statistical and geospatial information adds an important facet to this goal. Georeferenced information reflects people's real life at a small-area level in particular. This will facilitate enhanced and evidence-based decision-making processes. For this reason, a current requirement is to optimise, as far as possible, the framework for producing harmonised and standardised geospatially enabled statistical data.

Together with the Federal Agency for Cartography and Geodesy (BKG), the Federal Statistical Office (Destatis) has analysed and assessed the requirements and recommendations of the European Implementation guide for the Global Statistical Geospatial Framework (GSGF) in order to evaluate the situation in Germany and derive recommendations for action.

Evaluation of the five GSGF principles has shown that many requirements and recommendations of the European Implementation guide have been already implemented or are currently being implemented in Germany. A major part of the requirements of Principle 1 "Use of fundamental geospatial infrastructure and geocoding" and Principle 3 "Common geographies for dissemination of statistics" has already been implemented together by BKG and Destatis. However, there is still a great deal of "catching up" to do regarding Principle 2 "Geocoded unit record data in a data management environment", Principle 4 "Statistical and geospatial interoperability" and Principle 5 "Accessible and usable geospatially enabled statistics".

The following priority actions are required based on the analysis:

Licence policy and open data

- Uniformly regulating the provision of addresses under an open data licence for the country as a whole

Availability of fundamental geospatial data

- Regulating the federal administration's use of the central address register
- Harmonising the framework for V GeoBund und V GeoLänder

Methodological questions concerning publication

- Prioritising methodological investigations within the network of statistical offices in order to identify appropriate confidentiality procedures

Geocoding

- Destatis, where appropriate supported by BKG, implements the measures concerning the national address register
- BKG refines the geocoding tools

Service-oriented data provision

- Evaluating new standards and technologies for service-oriented data provision

Small-area reference infrastructure

- Gradually developing a grid cell database at BKG and Destatis

In a next step, concrete measures will be developed to facilitate well-targeted and successful fulfilment of the requirements of action. Implementation is planned in the context of an exchange

of views and ideas between BKG and Destatis regarding the action plan based on the 2016 Memorandum of Understanding, which usually takes place every year. The next exchange of views is scheduled for 2021. Where necessary, separate working groups will be set up for certain activities.

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1 Introduction

Cooperation between the Federal Agency for Cartography and Geodesy (BKG) and the Federal Statistical Office (Destatis) is always based on the current needs of policy makers, businesses, public authorities and the general public.

The aim of official statistics is to provide information for the development of an informed opinion and as a basis for decision-making processes in a democratic society. Integrating statistical and geospatial information adds an important facet to this goal. Georeferenced information describes in particular situations and circumstances of people's real life at the local level. This will facilitate enhanced and evidence-based decision-making processes. For this reason, a current requirement is to create the conditions for producing harmonised and standardised geospatially enabled statistical data.

The relevant framework provided at the global level is the Global Statistical Geospatial Framework (GSGF) (see Chapter 2).

Together with the Federal Agency for Cartography and Geodesy, the Federal Statistical Office has studied the requirements and recommendations of the European Implementation guide for the GSGF in order to evaluate the situation in Germany and derive recommendations for action (Chapter 3).

The main results of analysis have been combined in a small number of central recommendations for action. These results are listed in Chapter 4. On this basis, measures are to be derived to further promote the national integration of statistical and geospatial information in terms of a modern technical infrastructure. This includes standardised, service-based and metadata-based workflows – from geocoding individual statistical data through to publishing the resulting products.

2 Basis

2.1 Global Statistical Geospatial Framework

In the light of monitoring progress towards the sustainable development goals and preparing the 2020 round of censuses, the United Nations Expert Group on the Integration of Statistical and Geospatial Information (UN EG-ISGI) was set up with the aim to prepare a global framework for better data integration.

This Global Statistical Geospatial Framework [DOC1] has been available since 2019. The GSGF is designed to facilitate the production of harmonised, standardised and georeferenced statistical data. This goal is defined more precisely by five principles which are supplemented with so-called key elements (see Figure 1).

The resulting data can then be integrated with further statistical, geospatial and other information to enable information and data based decision-making processes.

The document describes the prerequisites for and methods of successful integration of statistical and geospatial data. It comprises a detailed description of the framework, including a complete and consistent description of the inputs, five principles and four key elements.

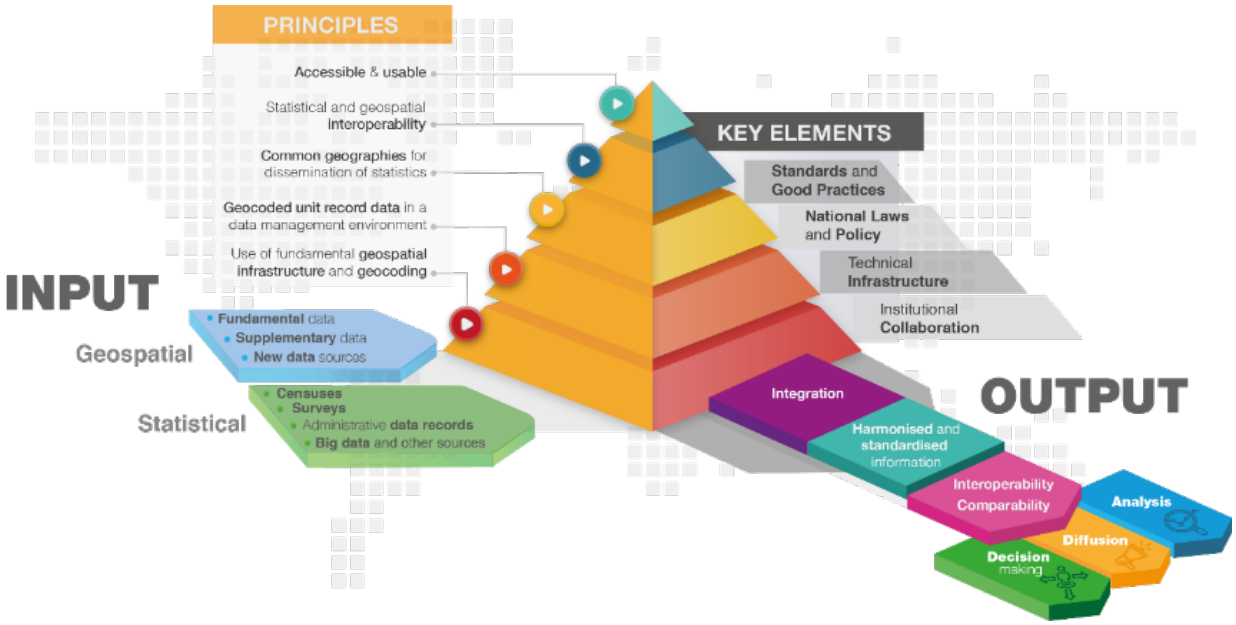

Figure 1 – The GSGF (figure taken from [DOC1], page 5)

2.2 Implementing the GSGF in Europe

To provide a European GSGF perspective, the European Statistical System (ESS), together with European surveying and mapping agencies, developed an implementation guide (GSGF Europe) in the framework of the GEOSTAT 3 project.

The guide sets out requirements and individual recommendations for implementation for each of the five GSGF principles (see [DOC2], pp. 70-85).

The GEOSTAT 4 project was launched in February 2020. Its purpose is to propose more concrete guidelines and measures for implementing the recommendations of the GSGF Europe.

National analyses and considerations regarding the European recommendations are explicitly welcome and will be incorporated into the project.

3 BKG and Destatis analysis

The GSGF Europe requirements and recommendations form the basis for evaluating national progress in integrating statistics and geospatial information and, where necessary, for developing appropriate national measures. A joint BKG and Destatis working group has analysed the requirements and recommendations in relation to the situation in Germany.

The following figure shows the relevant schematic relationship:

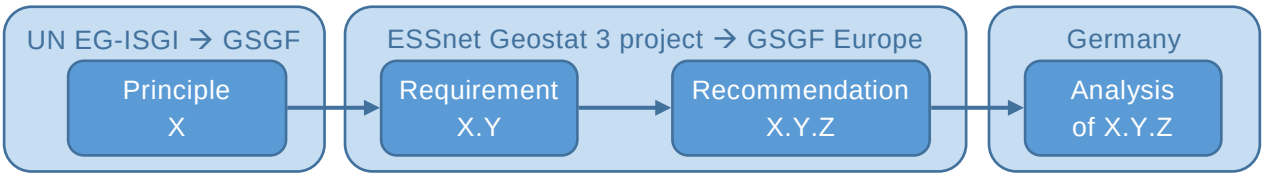

Figure 2 – Relationship between principles, requirements and recommendations

Each recommendation was analysed and assessed in three areas, namely "Organisation/framework/law", "Methods" and "Technology/standards" and, where required, a need for action was defined.

The degree of detail of the recommendations, covering the whole range from geospatial data management through to publication, varies. And there are redundancies between some recommendations. For this reason, the present recommendations for action are not structured along the lines of the corresponding GSGF Europe numbering. In the following Chapter, the findings are rather summarised to provide central requirements. Reference is made in brackets to the respective GSGF Europe recommendations.

Actions are currently not required regarding some of the recommendations. These are not outlined in this report.

Some recommendations are currently already being implemented in the framework of joint activities. Here reference is made to the bilateral BKG and Destatis action plan.

4 Requirements faced by BKG and Destatis

4.1 Licence policy and open data

Successful implementation above all depends on the data and data availability. Compilation and dissemination of fundamental geospatial data[1] are coordinated both by working groups of the Federation and the Länder set up for the different domains and within the hierarchy of spatial data infrastructures. Their views differ especially in terms of costs and licences. Open data have been defined as a political goal by the German Federal Government. Not least due to the Open data directive of the European Union (Directive 2003/98/EC on the re-use of public sector information), which was amended in mid-2019, the "open data"-question has recently gained momentum in public administration. The Federal Government is determined to develop a data strategy for Germany that will not only be a major element in promoting data-driven innovations, but also a

[1] Here the term "fundamental geospatial data" refers to geometries in a narrow sense (areas, lines, points). In this case the data of official land surveying authorities are meant. Geospatial data instead are all data with a spatial reference. This may also include statistical tables containing a regional code.

module of a European vision for the data era. The Federal Cabinet has already adopted the key elements of such a data strategy of the Federal Government[2]. This also includes geospatial data.

Some Länder support the open data goal also with respect to fundamental geospatial data. Other Länder are clearly opposed to this; they insist that users should share part of the costs of collecting and maintaining the official fundamental geospatial data. In this context, differences in licence models and fees have increasingly turned out to be an obstacle to the integration and use of geospatial data.

At the European level, an amended version of the Open data directive was adopted in 2019. The directive stipulates that public sector bodies should make certain high-value data sets available free of charge. These high-value data sets can be expected to be defined in early 2021. This will probably concern a large number of fundamental geospatial data which the majority of the Länder have so far provided against payment only.

Open data make the re-use of administrative data much easier. However, the practical use of open geospatial data reveals some difficulties, too, as there are different licence models which are not fully compatible.

The following actions are required in this area:

- BKG will support refinement of the national Data Licence Germany 2.0, which is currently often used for open administrative data, to ensure compatibility of the different open data licences. The data licences concerning combined source data for publishing statistical information and geospatial data should generally be as little restrictive as possible (recommendation 5.1.2).
- BKG is promoting a uniform regulation for Germany as a whole regarding the provision of address data under an open data licence (recommendation 2.5.4).

The following priority measure should be taken by Destatis and BKG:

- Uniformly regulating the provision of addresses under an open data licence for the country as a whole

4.2 Availability of fundamental geospatial data

There is a high additional demand for fundamental geospatial data at both national and international level. Eurostat has repeatedly expressed an interest in large-scale fundamental geospatial data from Germany and the other EU Member States. A focus of using these data in statistics is on geocoding, for which addresses are required in particular. Additionally, access to cadastral parcel geometries is needed for individual specialised statistics such as environmental statistics, construction, and construction prices. This additional demand has not yet been regulated satisfactorily in Germany as this information is provided against payment only. Furthermore it is necessary to maintain and provide ‘historical’ information on addresses and cadastral parcels. As a rule, the list of AdV licenced fundamental geospatial data products and services can be modified

[2] Key elements of the data strategy: https://blog.cosinex.de/wp-content/uploads/2019/11/2019-11-18-pdf-datenstrategie-data-1.pdf

or extended by a decision of an AdV[3] plenary session, based on V GeoBund[4] (Annex 1). For projects in the official statistics network, the statistical offices require a uniform framework for V GeoBund and V GeoLänder[5] (Annex 2).

A general regulation regarding BKG's provision of fundamental geospatial data could also be included in the Federal Statistics Act (BStatG). Here a regular submission of fundamental geospatial data to the Federal Statistical Office for purposes of keeping an address register could be added in Section 13 (2) of the BStatG. The regulation is to be achieved in the course of the legislative process to prepare a register-based census. To ensure high data quality, the federal administration's use of the central address register must be regulated by law in addition to the general data provision.

The following actions are required in this area:

- BKG will use its best efforts in the AdV committee to ensure that, in addition to addresses, cadastral parcel geometries will in the long run be provided not only for geocoding purposes at the national level (Destatis and the statistical offices of the Länder), but also for use within the European Statistical System (ESS), that is, by Eurostat (see recommendation 1.1.2).
- BKG will use its best efforts in the AdV committee to encourage the AdV to work out a concept of responsibilities for cadastral parcel geometries along the lines of the existing address concept. The aim of the concept will be to define, in a transparent manner, the roles and responsibilities in collecting and maintaining information on cadastral parcel geometries. This also includes availability of 'historical' information on addresses and cadastral parcels (recommendations 1.1.4, 1.2.1).
- BKG will use its best efforts to ensure a uniform framework regarding V GeoBund and V GeoLänder (recommendation 1.3.2).
- The Federal Statistical Office will investigate whether a general regulation of BKG's provision of fundamental geospatial data is included in the process of amending the Federal Statistics Act (BStatG) next time (recommendation 1.3.2).
- The Federal Statistical Office will use its best efforts to achieve a basic legal regulation regarding the federal administration's use of the central address register (recommendation 2.5.5).

The following priority measures should be taken by Destatis and BKG:

- Regulating the federal administration's use of the central address register
- Harmonising the framework for V GeoBund and V GeoLänder

[3] AdV – Arbeitsgemeinschaft der Vermessungsverwaltungen der Länder der Bundesrepublik Deutschland (Working Committee of the Surveying Authorities of the Länder of the Federal Republic of Germany)
[4] V GeoBund – Vertrag über die kontinuierliche Übermittlung amtlicher digitaler Geobasisdaten der Länder zur Nutzung im Bundesbereich (Agreement on the Continuous Transmission of Official Digital Fundamental Geospatial Data of the Länder for Use by the Federal Authorities)
[5] V GeoLänder – Vertrag zur gegenseitigen Nutzung amtlicher digitaler Geobasisdaten der Länder (Agreement on the Reciprocal Use of Official Digital Fundamental Geospatial Data of the Länder), which is important for official statistics when individual offices carry out tasks on behalf of the whole statistics network.

4.3 Methodological questions of publication

A whole range of methodological questions arises in the process of integrating statistical and geospatial data - from geocoding through to publication. The following actions are required in this area:

- A core set of statistical variables (e.g. total population) for a medium grid width (1 km^2) or other small-area statistics can only be published under an open data licence if statistical confidentiality is ensured as stipulated by the Federal Statistics Act. In this context, the question of an appropriate and common confidentiality procedure arises. As small-area data provide a higher information content, the need for keeping the statistical information confidential increases, too, when using these data. This contrasts with the widespread need and wish to use open data which have a fine spatial granularity and are rich in content. As a result, the complexity of confidentiality increases many times owing to the small-area perspective and the associated higher information content. With the aim to safeguard confidentiality, Eurostat prepared a Handbook on Statistical Disclosure Control. In the light of georeferencing, this handbook needs to be extended now. To answer the question of which confidentiality procedures are most appropriate for which information, methodological investigations are being carried out at the global (UN EG ISGI) and the national level (Destatis) (recommendation 5.1.1).
- Today, in the European open economic area, a wide range of questions can no longer be answered at the national level alone. To permit useful cross-border analyses of international statistics, both a consistent basis for compilation and consistent confidentiality standards are needed. Here coordination between the national statistical institutes is necessary (recommendation 3.2.3).
- Recommendation 5.3.3 calls for priority of European over national statistics publications. Destatis is clarifying this recommendation and exploring ways of implementing it.

The following priority measure should be taken:

- Prioritising methodological investigations in order to identify appropriate confidentiality procedures

4.4 Geocoding

The coding of geospatially enabled information using geographic coordinates is a decisive step of integration aimed at providing georeferenced information at a small-area level for evidence-based decision-making processes.

The following actions are required:

- A national address register represents an important set of reference data for geocoding purposes (recommendation 1.2.3). Currently, the relevant efforts are being intensified. Concepts have been developed for both a permanent address register within the system of statistics (DAR) and a register of buildings and dwellings (GWR) in the form of a general administrative register. A decision is yet to be taken as to how these two registers can be used in combination in the future. For this reason, “a national register” will sometimes be referred to here in rather general terms. The activities aimed at setting up a national address register have been included in the action plan relating to the Memorandum of Understanding (MoU).
- The geocoding process requires a service-based and OGC-compliant infrastructure (recommendation 1.2.4). The geocoding tools provided by BKG and used by Destatis must

be further refined to meet the requirements of statistics. To this end, the requirements need to be communicated by Destatis and then be taken into account by BKG. Views and ideas are shared in the Georeferencing sub-working group of the AG SteP[6]. BKG attaches high priority to this measure.

- Successful geocoding requires quality-assured input data (addresses). This validation should take place directly when the data are captured (recommendation 2.5.1). To ensure appropriate data capture validation, addresses should not only be compared but also be checked at the time of geocoding based on the stock of reference data used and irrespective of who captures or supplies the addresses.
- Common definitions and harmonised semantics are needed for successfully geocoding information from most varied domains. In some domains, this is already the case (e.g. streets, Official Municipality Code - AGS), while actions are still required in other areas (e.g. harmonisation of the spelling of addresses). Here common object models (ontologies)[7] should be created as a well-founded basis (recommendation 4.2.1).

The following priority measures should be taken by Destatis and BKG:

- Destatis, where appropriate supported by BKG, implements the measures concerning the national address register.
- BKG refines the geocoding tools.

4.5 Service-oriented data provision

A modern spatial data infrastructure (GDI) is essential to ensure sustainable integration of statistical and geospatial information. The data needed are made available via web services and can thus be accessed through standardised interfaces. The standards that are important for the spatial data infrastructure are mainly developed by the Open Geospatial Consortium (OGC). While special technologies were developed for the geospatial information sector in the past, the OGC has increasingly supported the general web trends more recently (cf. Spatial Data on the Web, an initiative of W3C and OGC[8]).

GSGF Europe generally recommends to explore the use of service-oriented distribution platforms, offer greater flexibility in terms of usability and support data access through a variety of interfaces via APIs. OGC-compliant services and non-proprietary formats (e.g. OGC Geopackage for file downloads) should be used for dissemination in order to ensure flexibility from an end-user perspective (see recommendation 5.2.1). As far as possible, these recommendations will be considered by Destatis and BKG in future developments.

To further enhance the existing spatial data infrastructure, the following actions are required in particular:

- Geospatial services in a service-oriented architecture (SOA) are recommended for the standardisation of components used to create geospatial products. The national statistical offices should aim to share common tools (recommendation 4.1.6). Therefore, the creation of a GIS IT infrastructure at the Federal Statistical Office should be aimed at sharing specified, central and common components and tools in a well-considered, redundancy-

[6] Georeferencing sub-working group of the Standardisation of Processes Working Group (AG SteP). The sub-working group discusses questions of process standardisation in the context of georeferencing. It comprises both Federation and Länder representatives.
[7] Ontologies are used to define the meaning of geospatial information in a structured manner (geosemantics).
[8] A basic document on the topic is available at: https://www.w3.org/TR/sdw-bp

free and well-defined overall system. Coordination with similar existing or planned applications (e.g. data hub, grid cell database, geospatial platform, address register) should be ensured when developing new applications.

- Under the banner of “Statistics as a Service” (SaaS), the efforts for service-oriented dissemination via APIs should be intensified in order to provide machine-readable open data formats for national statistics (recommendations 4.3.1, 5.2.4). This requires to monitor and, where applicable, to implement the related OGC developments regarding the introduction of new interfaces (OGC API). Here the BKG activities are still at an initial stage. In addition Destatis, and where appropriate BKG, should encourage Eurostat to include SaaS in the ESS strategy.
- The potential of disseminating administrative and statistical geographies as Linked Open Data (LOD) should be explored (recommendations 3.1.5, 4.5.1, 4.5.3). Here a GDI-DE project is in place that is operated by BKG. However, further analyses will be needed to assess the extent to which the project results can be operationalised and used by BKG as a standard form of data dissemination.
- Definitions of common conceptual models for objects for both statistical and geospatial communities should be developed like, for example, ontologies for addresses and buildings (recommendation 4.2.1). Action is required to harmonise the spelling of addresses in particular. Generally, further developments regarding ontologies for LOD should be followed closely.
- Although the OGC Table Joining Services (TJS) standard has not yet been widely implemented, the geospatial and statistical communities should jointly take part in developing the standard and in consolidating and implementing it (recommendation 4.4.2). So far BKG has not yet tested the opportunities of TJS. The development of TJS 2.0 should be followed with the aim of potential implementation.
- To improve usability in GIS systems, simple geometries as specified by OGC and in ISO 19125 should be published (recommendation 5.2.5). The geospatial data as defined by the INSPIRE data models are partly too complex; the INSPIRE data models require complex geometries. Modern non-proprietary formats, such as OGC Geopackage, must therefore be introduced by BKG as standard formats. This is in line with the intentions of the “Spatial Data on the Web” initiative of W3C and OGC.

Technological development regarding service-oriented data provision is highly dynamic. It is sometimes difficult to guess which of the new standards will establish themselves in the long term. The options for action listed above need to be assessed against this background. Furthermore, the staff resources required by the individual options for action as well as the impact on well-established technologies must be analysed. For these reasons, prioritisation is difficult and will only be feasible after further analysis.

4.6 Small-area reference infrastructure

An appropriate organisational and technical infrastructure is needed to make exhaustive use of spatial references in all domains and phases of official statistics production. Comprehensive support is required especially in the context of small-area references as an essential addition to the "traditional" regional statistics, which are based on data at administrative levels down to municipalities.

In technical terms, an appropriate data management environment is needed for the permanent storage of geocoded data, including associated linkage and analysis options - and, consequently, database technologies with supplementary functions for processing geospatial data. The following functions are of essential importance:

- Supporting INSPIRE-compliant geographical grids as statistical units.
  A grid with grid cells of 100 m x 100 m ("hectare" grid) provides the smallest possible permanent spatial reference for official statistics.
- Making sure that the grid cell IDs of common grid width can be related permanently to the regional codes of administrative and other territorial units used in official statistics
- Provision of "timestamps" and ability to handle time series
- Recalculating statistical data across different territorial units

Expanding this functionality by adding tools and procedures must be possible, if required.

The aim is to permanently ensure, to the extent permitted by law, the integrative use of data from different sources based on their spatial reference. This comprises the interlinking of data from various specialised statistical domains and the linking of statistical data with fundamental geospatial data from the official surveying and mapping agencies.

The following actions are required:

- Establishing a grid cell database with the INSPIRE-compliant "hectare" grid as the basic spatial reference frame for data management (recommendation 3.3.1) and an appropriate data management concept for efficient data use. This concept should comprise in particular functions for efficient aggregation and disaggregation of statistical data across geographical grids of different grid width, territorial units of different administrative levels, and other relevant spatial classifications of specialised statistics, such as river basin districts in the area of environmental statistics (recommendation 2.1.2). Such an infrastructure can serve as a basis for both standard publication programmes and flexible ad hoc evaluations ("Statistics as a Service", see also Chapter 4.5). Integrating functions to safeguard statistical confidentiality would be desirable (recommendation 2.1.2, see also Chapter 4.3).
- Implementing procedures for the calculation of accessibility areas (distance and time), relating to the cells of the hectare grid - for example accessibility information for selected points of interest (POI) like important infrastructure facilities.
- Unlike geographical grids, most fundamental geospatial data are subject to changes over time - regarding administrative territorial units, for instance, this concerns continuous territorial reforms. To ensure full interlinkage, the grid cells of typical grid width must be assigned in all cases to the respective fundamental geospatial data and the interlinked codes stored centrally. Synchronisation workflows should be set up at the statistical offices (recommendation 2.1.3). Interlinkage must be feasible at any time between grid cells of any grid width and other spatial units if need arises.
- Surveying and mapping agencies should provide current fundamental geospatial data in a timely manner (recommendation 3.1.3) and, at the same time, build time series of historical fundamental geospatial data (recommendations 2.2.2, 3.1.6). To build time series

or support historisation concepts, the underlying fundamental geospatial data must comprise standardised “timestamps” (validity period information). The surveying and mapping agencies of the Länder should be encouraged to ensure this - via the Working Committee of the Surveying Authorities of the Länder of the Federal Republic of Germany (AdV) (recommendations 2.2.2, 2.2.3).

- The permanent address register of official statistics (DAR), which is currently being set up, can be expected to play an important role for purposes of allocating small-area references, especially regarding historisation concepts, in the future, irrespective of whether the AdV launches activities concerning the requirements mentioned above (recommendations 1.2.3, 2.2.2). In the medium term, the address register should be integrated into the infrastructure supporting small-area references. The addresses stored by the surveying and mapping agencies and BKG (house coordinates for Germany (HK-DE data) and georeferenced address data (GA data)) will serve as a major data source in setting up and maintaining the address register.

Notes:

The action plan, which is an integral part of cooperation between BKG and Destatis, includes already measures to meet the needs of action described above: 2019-6 “Grid cell database“ and 2020-3 “Further development of the address register”. Plans are already in place to implement identical grid cell databases for different groups of recipients at BKG (federal administration, possibly further target groups) and Destatis (official statistics). The Thünen Institute will provide scientific advice during this process.

Priority measure:

- Successively setting up a grid cell database at BKG and Destatis including the features described above

4.7 International activities

Destatis and BKG are jointly represented in several international bodies performing geospatial activities: Committee of Experts on Global Geospatial Information Management (UN-GGIM), Regional Committee of UN-GGIM:Europe, United Nations Expert Group on the Integration of Statistical and Geospatial Information (UN EG-ISGI) and Working Group on Integration of Statistical and Geospatial Information (GISCO) (at Eurostat). To be able to present joint positions in these bodies, close coordination takes place in the preparatory and follow-up phases of the respective meetings. In international terms, the main focus of future actions is on the European geospatial agencies’ creation of a European spatial data infrastructure. The goal is to provide fundamental geospatial data for use at the European level.

Actions are required regarding coordination and permanent operational implementation. As far as the latter is concerned, the ideas of the European Location Services (ELS) project coordinated by EuroGeographics[9] should be taken into consideration (recommendation 3.2.2).

[9] https://eurogeographics.org/maps-for-europe/open-els-project/

5 Outlook

The evaluation has shown that many requirements and recommendations of the European Implementation guide have been already implemented or are currently being implemented in Germany. It can be stated that almost all recommendations concerning Principle 1 “Use of fundamental geospatial infrastructure and geocoding” are being implemented or have been implemented. However, there is still a great deal of “catching up” to do regarding Principle 2 “Geocoded unit record data in a data management environment” and Principle 4 “Statistical and geospatial interoperability”. A major part of the requirements of Principle 3 “Common geographies for dissemination of statistics” is already being implemented together by BKG and Destatis. More comprehensive action is required with respect to Principle 5 “Accessible and usable geospatially enabled statistics”.

Implementation has been and continues to be based on the action plan relating to the Memorandum of Understanding (MoU), which was agreed between Destatis and BKG in 2016 as a basis for organising and institutionalising close cooperation between the two authorities. The fruitful long-term cooperation between both agencies has been characterised by many products and projects that have been completed successfully or are still in progress:

- BKG provides current fundamental geospatial data at the national level, e.g. for the population census, or information on the size of areas and length of the road and rail networks.
- Potential options of using existing and future satellite and remote sensing data for statistical purposes are explored (Sentinel, Cop4Stat).
- Analysis projects are carried out on the basis of georeferenced statistical information.
- Destatis and BKG are partners in the area of data integration in the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM). A basic precondition for linking geospatial reference data with statistical information is the availability of the respective stocks of data at BKG and Destatis.
- The leading European conference on integrating statistical and geospatial information of the European Forum for Geography and Statistics (EFGS Conference in 2021) is organised jointly.
- Projects that focus on integrating statistical and geospatial information. An example is the creation of a generic database in which geospatially enabled information is stored based on a square 100 m INSPIRE grid.
- Including BKG as the first authority in Europe in the area of geospatial information and cartography in the list of Other National Authorities (https://ec.europa.eu/eurostat/de/web/european-statistical-system/overview). This list maintained by Eurostat comprises the National Statistical Institutes and, in addition, all national authorities which are responsible for developing, compiling and disseminating official statistics in the individual Member States.

On this basis, the results and recommendations for action compiled in the present analysis are summarised in few central requirements. Measures are to be worked out which, based on the recommendations for action, are aimed at optimising the national integration of statistical and geospatial data and establishing a modern technical infrastructure. The measures are to include standardised, service-based and metadata-based workflows - from geocoding individual statistical data through to publishing the resulting products.

The next step is to develop concrete activities that are aimed at implementing the recommendations for action. Usually, BKG and Destatis exchange their views and ideas on an annual basis to plan implementation of the action plan based on the 2016 Memorandum of Understanding. The next exchange of views is scheduled for 2021. Where necessary, separate working groups will be set up for certain activities.