INTEGRATED GEOSPATIAL INFORMATION FRAMEWORK

Germany

Action Plan

World Bank Implementation Methodology

WORLD BANK GROUP
Urban, Disaster Risk Management, Resilience & Land

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BKG

Credits

This template has been prepared by the World Bank Urban, Disaster Risk Management, Resilience and Land Global Practice' (GPURL), Land and Geospatial Team, and supported by the Korea Green Growth Trust Fund.

The World Bank team was led by Kathrine Kelm, Senior Land Administration Specialist, Land and Geospatial Team, and included Andrew Coote, Dr Lesley Arnold and Dr Robin McLaren.

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More Information

For further information regarding this template or to acquire additional copies please contact:

The World Bank
1818 H Street, Washington DC, 20433, USA
Kathrine Kelm, Senior Land Administration Specialist
Urban, Disaster Risk Management, Resilience and Land Global Practice
Email: kkelm@worldbank.org | Web: www.worldbank.org

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Status

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ABBREVIATIONS

AdV	Working Committee of the Surveying Authorities of the Laender of the Federal Republic of Germany (Arbeitsgemeinschaft der Vermessungsverwaltungen der Länder der Bundesrepublik Deutschland)
API	Application Programming Interface
BKG	Federal Agency for Cartography and Geodesy (Bundesamt für Kartographie und Geodäsie)
CORS	Continuously Operating Reference Station
DGK	German Geodetic Commission (Deutsche Geodätische Kommission)
EU	European Union
GDI-DE	Spatial Data Infrastructure Germany (Geodateninfrastruktur Deutschland)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ICT	Information and Communication Technology
IGIF	Integrated Geospatial Information Framework
IMAGI	Interministerial Committee on Geoinformation (Interministerieller Ausschuss für Geoinformationswesen)
ISO	International Organization for Standardardization
KPI	Key Performance Indicator
LaVerDi	LandscapeChangeService (Landveränderungsdienst)
MDI-DE	Marine Data Infrastructure (Marine Dateninfrastruktur Deutschland)
mFund	Research initivative from the German Federal Ministry for Digital and Transport funding digital data-based appications for Mobility 4.0
MKF	minimum mapping area (Mindestkartierfläche)
NEGS	National E-Government Strategy
NGIS	National Geospatial Information Strategy (Nationale Geoinformations-Strategie)
NSDI	National Spatial Data Infrastructure
NFDI4Earth	National Research Data Infrastructure for Earth System Sciences

SDG	Sustainable Development Goal(s)
SDI	Spatial Data Infrastructure
ToR	Terms of Reference
UN-GGIM	United Nations Global Geospatial Information Management
WB	World Bank
ZKI	Center for Satellite Based Crisis Information (Zentrum für satellitengestützte Kriseninformation)

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The work was coordinated by BKG's Executive Unit – International Affairs, and led by *Gwendolin Seidner, Katja Hilgert* and *Pier-Giorgio Zaccheddu*.

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DOCUMENT STRUCTURE

The report is structured as follows:

- **Chapter 1: Context** - provides a brief introduction and the current status of Germany's geospatial information management reflecting the existing National Geospatial Information Strategy (NGIS) and the underlying National Spatial Data Infrastructure (NSDI).

- **Chapter 2: Geospatial Information Management in Germany** – provides a baseline ("as is") assessment of the current state and summarizes current initiatives of the NSDI.

- **Chapter 3: Strategic Alignment to Policy Drivers** – describes national policy initiatives and international commitments that already exist in the NSDI.

- **Chapter 4: Strategy**– lays out the strategic objectives, guiding principles and goals endorsed by the NGIS.

- **Chapter 5: Action Plan** – is the main part of the document, outlining the current situation and a set of actions based on the nine strategic pathways of the IGIF, to complement the IGIF and NGIS objectives with a view to continuously improve the added value of the NGIS and NSDI for Germany.

- **Chapter 6: Conclusions and Next Steps** – covers what has been learnt from this work and indicates what needs to happen next to implement the action plan in Germany.

- **Appendix**– is used for additional reference material and detailed information about new IGIF actions.

CONTENTS

EXECUTIVE SUMMARY

Geospatial information has a very high value for each country, especially through the ubiquity and cross-cutting function of geospatial data. The value can be shown in the fact, that geospatial information is indispensable when it comes to finding answers to social challenges such as climate and environmental protection, sustainable raw material supply or the energy transition. Optimal value creation requires a common vision among all stakeholders.

With the National Geospatial Information Strategy (NGIS), which was drawn up in 2015 by the NSDI Steering Committee of the National Spatial Data Infrastructure (Lenkungsgremium GDI-DE) in dialog with industry, science and interest groups, it was possible to describe a vision for the geospatial information sector for the year 2025.[1]

The analysis of the IGIF has been conducted to gain an additional international perspective to the activities of the existing NGIS. Since Germany already has a strategy for geospatial information management in place, the IGIF has been considered as inspiration and tool to evaluate and assess the NGIS and the underlying NSDI.

Herewith, Germany shares its experiences, knowledge and existing challenges in geospatial information management with other countries and offers guidance and support by implementing a geospatial data management and infrastructure.

Through the NGIS and NSDI activities over the past two decades, in Germany many issues and contents of the IGIF analysis are already met and redundant for this report. For example, business cases are already in place in Germany as well as a strategic alignment to policy drivers. Hence, a dedicated investment plan for the IGIF action plan is not needed, as all substantial elements of an IGIF Country-Level Action Plan for Germany do exist in one or another way in the current NGIS and NSDI organization structure and ongoing activities.

Germany is very well-positioned, as most relevant geospatial information management issues have already been tackled or are solved, but there are some activities that are still worth to be started. That is why the IGIF Country-Level Action Plan for Germany is an important evaluation and assessment of the current situation and provides a summary of activities (ongoing and new) for a more efficient and effective geospatial information management in Germany.

More information about the NGIS and NSDI can be accessed via the website.[2]

[1] https://www.gdi-de.org/en/NGIS
[2] https://www.gdi-de.org/en

1. CONTEXT

1.1 Purpose

This report comprises the IGIF Country-Level Action Plan for Germany (hereinafter: action plan) as well as the evaluation and assessment of the current situation. It provides a summary of activities (ongoing and new) for a more efficient and effective geospatial information management in Germany. It was prepared by the Federal Agency for Cartography and Geodesy (BKG), an entity affiliated with the Ministry of the Interior and Community, in collaboration with the Working Group Implementation NGIS and a representative of the AdV.

1.2 Brief Country Description

Germany is located in central Europe and has a land area of 357.588 km². The population in 2020 was estimated at 83.000.000 by the National Statistical Office. Germany is a densely populated country with an average of 233 people per km².[3] Considering Gross Domestic Product, Germany is the largest economy in Europe and also one of the largest worldwide.[4] Furthermore, Germany is in the top of the largest exporting and importing nations.[5] The principle of the state organization in Germany is based on federalism, which means a close cooperation between the federal government and the 16 federal states.[6]

1.3 Background on NSDI Activity

Since 1998, the Interministerial Committee on Geoinformation (IMAGI) coordinates cross-departmental concerns of geospatial information on federal level. The IMAGI supports the provision and use of geospatial data in the federal government, transparency in the field of geospatial information shall be increased. The IMAGI is the committee which coordinates the federal government's position on geospatial information for other interdepartmental and inter-administrative bodies. The goal of IMAGI is to improve the framework conditions for access to federal geospatial information and for the development of new services and technologies.[7]

[3] https://web.archive.org/web/20211030054049/https://www.destatis.de/DE/Themen/Laender-Regionen/Regionales/Gemeindeverzeichnis/Administrativ/02-bundeslaender.html (in German only)
[4] https://www.imf.org/en/Publications/WEO/weo-database/2020/October (in German only)
[5] https://de.statista.com/statistik/daten/studie/37013/umfrage/ranking-der-top-20-exportlaender-weltweit/ (in German only)
[6] https://www.bpb.de/izpb/159329/foederalismus-in-deutschland (in German only)
[7] https://www.imagi.de/Webs/IMAGI/DE/organisation/organisation-node.html;jsessionid=0B102528EFD6085A627C98D72B4CC9BC.1_cid287 (in German only)

In 2003, the German NSDI has been adopted by the initiative of the head of the Federal Chancellery and the heads of the state and senate chancelleries.[8] The federal government (through IMAGI) as well as the federal state and local governments have been working together to achieve the goal to make public geospatial data available in a web-based, networked and standards-based spatial data infrastructure. The approach was to establish a federally supported NSDI, which has been implemented by developing the architecture and the national technical components.[9]

An administrative agreement between the federal government and the federal states[10] provides the basis for actions of the NSDI, which is an agreement between the parties involved to expand the NSDI and to integrate it into the Infrastructure for Spatial Information in Europe (INSPIRE).[11] The NSDI is financially secured, the costs are borne jointly by the federal and state governments. Its architecture is continuously improving, as well as the national technical components.

1.4 Key Organizations / Stakeholders

NSDI "Champion" in Government: IT Planning Council (IT-PLR)

The IT Planning Council is a central political body that coordinates and supports collaboration between the federal and state governments with the goal to establish an IT infrastructure that is consistent across Germany's administrative system and benefits citizens and companies in equal measure.[12] The NSDI operates under the auspices of the IT-PLR.

NSDI Coordination Body: NSDI Steering Committee (Lenkungsgremium GDI-DE)

The strategic orientation of the NSDI and the work programme is discussed and decided in the NSDI Steering Committee. It includes representatives of the federal government (representing IMAGI), the federal states and the municipal umbrella organizations. The NSDI Steering Committee is responsible for the management as well as tasks and actions of the NSDI. It establishes Working Groups, Task Forces or other groups per decision. One example is the already mentioned Working Group Implementation NGIS of the NSDI.[8]

NSDI secretariat: NSDI Coordination Office (Koordinierungsstelle GDI-DE)

The NSDI Coordination Office advises the Steering Committee, prepares its decisions and organises the implementation of the decisions taken. It is based at the Federal Agency for Cartography and Geodesy (BKG) in Frankfurt am Main.[8]

NSDI Technical Operation (Betrieb GDI-DE)

The national technical components (registry, geodatenkatalog, testsuite, geoportal) are conducted by the organizational unit NSDI Technical Operation. It ensures availability and

[8] https://www.gdi-de.org/en/SDI

[9] https://www.gdi-de.org/en/GDI-DE/technical%20components

[10] https://www.gdi-de.org/sites/default/files/2020-04/Verwaltungsvereinbarung_2017.pdf (in German only)

[11] https://www.inspire.jrc.it/

[12] https://www.it-planungsrat.de/en/the-it-planning-council

further development of the national technical components. The NSDI Technical Operation is commissioned to the BKG and therefore located in Frankfurt am Main as well. [8]

NSDI Federal and Federal States Contact Points (Kontaktstellen GDI-DE)

The federal level and each federal state has established an SDI contact point to support the NSDI Coordination Office in the implementation of the measures decided by the NSDI Steering Committee. The NSDI Federal and Federal States Contact Points advise the geospatial data holding authorities in their area of responsibility on the provision of the relevant data for the NSDI and INSPIRE. [8]

NSDI Advisory Committee (Beratungsausschuss GDI-DE)

Representatives of the NSDI Steering Committee and representatives of business and scientific interest groups are currently working together in the NSDI Advisory Committee. The participation of scientific interest groups is taking place through the cooperation with NFDI4Earth. Thus, developments in research data management and geospatial data can be promoted and applied in the future. The participation of business is taking place through the NSDI Economic Concil. The NSDI Advisory Committee meets at least once a year. [13]

NSDI Economic Council (Wirtschaftsrat GDI-DE)

The NSDI Economic Council is an association of business groups, to institutionalize the cooperation between associations, business representatives and the NSDI. This council provides advisements from a practical point of view on the market and user-oriented development of geospatial data and geospatial data infrastructures. [14]

Working Group Implementation NGIS (Arbeitsgruppe Umsetzung NGIS)

Established in 2016, the Working Group Implementation NGIS supports the NSDI Steering Committee in the coordination and implementation of the NGIS. The working group is to present the progress made in the implementation of the NGIS objectives, to accompany monitoring measures and to prepare necessary strategic adjustments. [15]

NSDI communicative centre (GDI-DE Wiki)

The NSDI is a network where the NSDI Coordinating Office cooperates with all NSDI stakeholders. The daily organization of work is supported by a technical collaboration platform that e.g. allows working groups to prepare expert knowledge and create the basis for decisions and standard definitions and implementation. The collaboration platform also facilitates the communication with other initiatives from politics, science and industry. [8]

[13] https://www.gdi-de.org/index.php/en/Kooperationen/Beratungsausschuss%20GDI-DE
[14] https://www.gdi-de.org/index.php/en/Cooperations/economic%20council%20SDI
[15] https://www.gdi-de.org/en/NGIS/implementation

2. GEOSPATIAL INFORMATION MANAGMENT

2.1 Overview

Considerable volumes of geospatial data covering the fundamental data themes[16] that form the basis for a NSDI that already exists in Germany. However, lacks of data and knowledge sharing can lead to duplication of effort, and decision making based on incomplete and inconsistent information. These days, geospatial information is ubiquitous. This is evident in the use of navigation systems, location services on smartphones, and the increasingly common dashboards that visualize facts online with the help of maps. But geospatial information for itself is just a part of the data ecosystem, geospatial data gains importance primarily in connection with specialized data, such as statistical data or administrative data. Currently, geospatial information is an indispensable tool for dealing with the crises surrounding the Corona virus, by for instance georeferencing hospitals or traffic routes in connection with demographic data such as population density and age structure. This new collaborative dataecosystem can be provided for strategic and political decision-making for efficient actions.[17]

In Germany, geospatial information should be used effectively for all geospatial decision-making processes, be collected to its fullest extent economically and used in a way that adds value and help to support national and local interests and fulfill obligations. Therefore, the NGIS has been established in 2015. The NGIS is a strategy for developing a future-oriented and sustainable geospatial information policy adopted by the NSDI Steering Committee and supported by the IT-PLR. The NGIS defines the common goals of the federal, state, and local governments, which are designed and implemented in dialogue with industry, academia, and other stakeholders. The NGIS addresses all entities in public administration, business, and academia that collect, maintain, provide, or use geospatial data. All stakeholders are invited to contribute to the implementation of the goals of the NGIS with their own measures.[17] The NGIS is an important addition to the National E-Government Strategy (NEGS)[18] and thus a building block for Germany's digital policy.

Germany has already invested a lot in geospatial information management. The following baseline assessment served to look at existing measures of the NGIS with the international perspective of the IGIF and, if necessary, identified new findings or further developments. At the same time the assessment revealed that all substantial elements of the IGIF do exist in one or another way in the current NGIS and NSDI organization structure and ongoing activities.

[16] The United Nations defines 14 themes as necessary to building a national infrastructure: https://ggim.un.org/meetings/GGIM-committee/9th-Session/documents/Fundamental_Data_Publication.pdf

[17] https://www.gdi-de.org/en/NGIS

[18] https://www.it-planungsrat.de/der-it-planungsrat/nationale-e-government-strategie (in German only)

2.2 Baseline Assessment

In Spring 2021, a baseline assessment of the current geospatial information management situation in Germany was completed after about a year of work. The baseline assessment reflects the degree to which Germany has developed in terms of each IGIF strategic pathway. This baseline assessment was based on the IGIF Diagnostic Tool of the World Bank (vs 2.0).

The IGIF is anchored by nine strategic pathways within three main areas of influence: "governance", "technology" and "people". The nine strategic pathways seek to maximize the innovative and integral nature of geospatial information by making it available and accessible to governments, communities, businesses, academia and civil societies. This provision serves to innovate, co-create and develop new products, services and applications that deliver new knowledge for evidence-based policy and decision-making. [19]

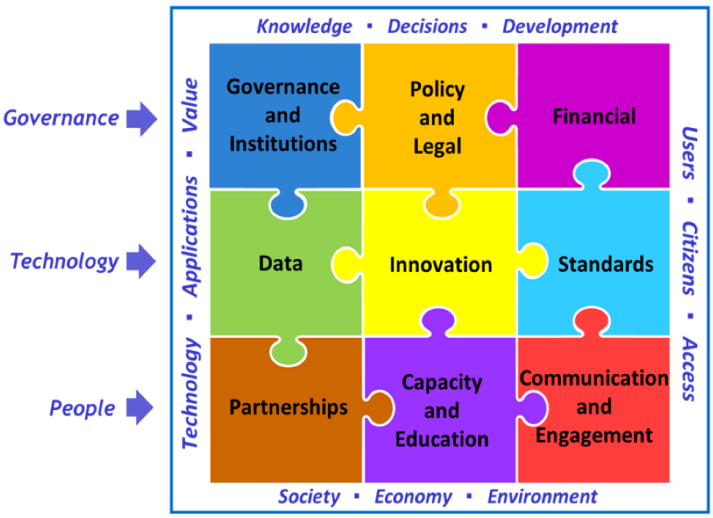


Figure 1: The nine strategic pathway of the IGIF (Source: UN-GGIM)

The IGIF Diagnostic Tool assigns scores from 0 to 100 to each IGIF indicator in each strategic pathway to provide a comparable assessment of the current state of the NSDI. The scores are averaged for each strategic pathway to provide an overall score for the NSDI. It is important to appreciate that the resulting precision of the scores is a mathematical artefact as indicator scores could be argued up or down in many cases resulting in more or less changing average figures. Nevertheless, an overall clear picture emerges and provides a benchmark against which further progress can be measured.

By using the IGIF Diagnostic Tool an overview of the current situation of the NSDI has been gained. This up-to-date consideration of existing structures can lead to new opportunities. The IGIF Diagnostic Tool was first applied by some SDI-related units of BKG. The NSDI Coordination Office was involved directly afterwards. The issues and content were analyzed and, based on a first draft, further players were consulted, such as the Working Group Implementation NGIS of the NSDI. Furthermore, one state representative (Lower Saxony) of the AdV provided an additional perspective.

[19] https://ggim.un.org/IGIF/overview/

Results of the Baseline Assessment
Scores for the individual strategic pathways are reported in tabular and graphical form thus:

Governance and Institutions	78
Policy and Legal	81
Financial	71
Data	81
Innovation	70
Standards	95
Partnerships	75
Capacity and Education	66
Communication and Engagement	59
Overall	**76**

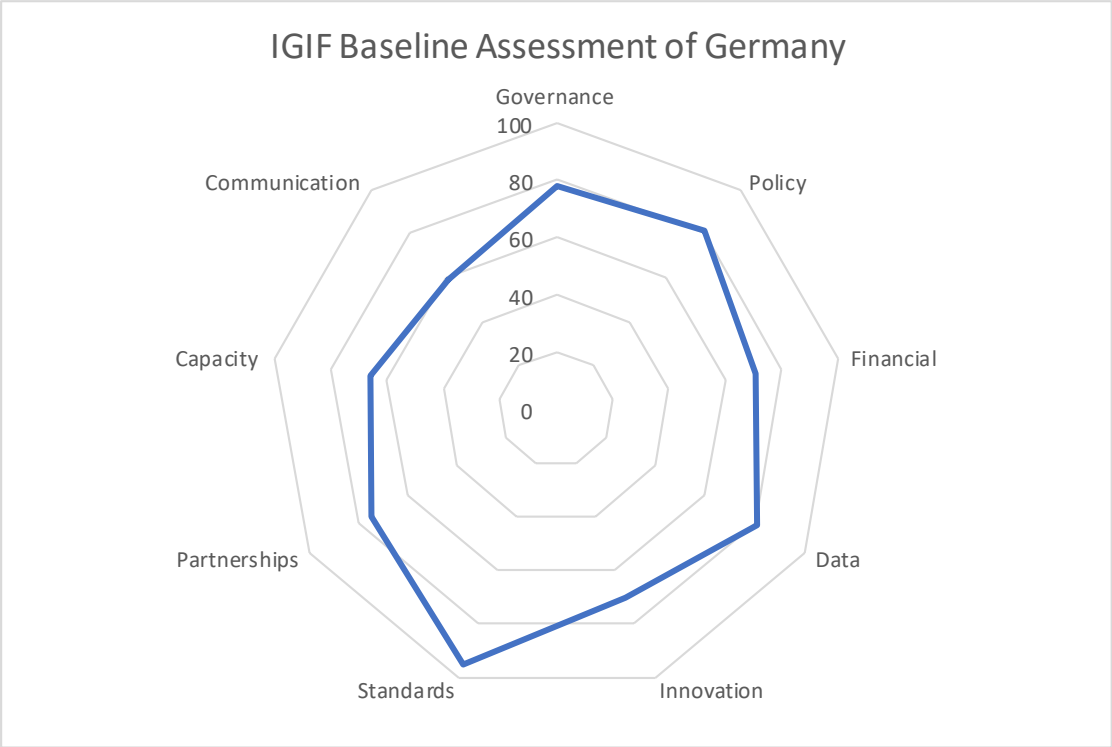


Figure 2: IGIF Baseline Assessement of Germany, (Source: Own figure, status 2021)

The outline of the IGIF Baseline Assessment of Germany from 2021, identified needs and the derived IGIF actions are described in chapter five in more detail.

3 STRATEGIC ALIGNMENT TO POLICY DRIVERS

3.1 Introduction

It is critical that the Action Plan is aligned with the key Government strategies (NGIS, NEGS) as well as the international commitments (UN Agenda 2030, INSPIRE) with a view to maximize implementation policy success.

In Germany, the geospatial information policy alignment is documented by the Geospatial Information Progress Reports (1-5) of the German Federal Government.[20]

Since 2005 the German Federal Government has created a Geospatial Information Progress Report every four years. The reports provide information about the essential developments in geospatial information. In addition, current needs for action are named. The report coordination is carried out by the IMAGI.

In the meantime, five Geospatial Information Progress Reports have been published. In a nutshell, these reports include the following geospatial policy alignment:

i) Identifying national policy and international commitments that can be positively impacted by optimum use of geospatial information.

ii) Prioritizing drivers for investment by identifying and prioritizing key thematic areas for NSDI investment based on:

   a) relevance of NSDI to high-level implementation of the policy or International commitment;

   b) achievability within the timeframe for implementation; and

   c) alignment with sponsor's business entry point(s), such as land administration or disaster risk management.

iii) Describing spatial use cases that, from interactions with stakeholders and knowledge of the geospatial market, offer an "a priori" assessment of the highest socio-economic impact.

iv) Analyzing key stakeholders – outlining relevant functions, their structure (centralized or distributed) and influence in terms of geospatial information policy.

[20] https://www.imagi.de/Webs/IMAGI/DE/themen-und-projekte/geo-fortschrittsberichte/geo-fortschrittsberichte-node.html (in German only)

3.2 National Policy and International Policy Commitments

3.2.1 National Policy and Use-Cases

The table that follows outlines policies, projects and other examples inter alia from the Geospatial Information Progress Reports (1-5) of the German Federal Government that take advantage of geospatial information and technology.

Further information about all contents can be found in the Geospatial Information Progress Reports 1-5 of the German Federal Government. [20] Authorities, institutions and groups from the federal, state and local governments, the business community, academia and civil society participated in the preparation of these reports.

Table 1: National Policy and Use Cases (Source: Geospatial Information Progress Reports 1-5 of the German Federal Government.[20])

Theme	Title of Primary Policies	Summary Description and Importance of Geospatial Technologies
Disaster Risk Management and Emergency Services	**Federal modular warning system to include map application[21]**	The Modular Warning System of the Federal Government (MoWaS) is extended by a new map application, among other things to select cross-border official geobase data as well as relevant locations, points of interest (POI), for the respective hazard situation. This supports the responsible authorities in the creation of a warning message. In addition, a flexible input environment is planned that can be connected to the GDI-DE.
	Provide area-specific warnings via warning app NINA[22]	Modern technologies make it possible for the public to access tailored, relevant information via the Internet, e.g., using mobile devices, in near real time and regardless of location. By using different information channels, the (warning) information necessary for the population (e.g., in the case of a flood events) can be provided to the public.
Defense and Security	**Uniform map material for the EKUS project**	An EKUS is intended to combine the functionalities of a police messenger with the offline availability of operational data and digital map services on the end

[21] https://www.bbk.bund.de/DE/Warnung-Vorsorge/Warnung-in-Deutschland/Warnmittel/MoWaS/mowas_node.html (in German only)

[22] https://www.bbk.bund.de/DE/Warnung-Vorsorge/Warn-App-NINA/warn-app-nina_node.html;jsessionid=A6B0027D89FFEEF203A142B29D81C775.live131 (in German only)

		devices of the task forces. The digital map and GPS function is used to display task forces, objects and targets. As a result, this supplement, specifies, and relieves the burden on mission-guided voice communication.
Digital Transformation	**Copernicus Data and Exploitation Platform - Germany (CODE-DE)[23]**	Within the framework of the European Earth Observation Program Copernicus, extensive geospatial information (satellite data, data from Copernicus services) is collected by the European Commission and made freely and openly available to everyone at the European level. The CODE-DE project will provide users in Germany - public authorities, research institutions, companies - with easy and fast access to Copernicus data. CODE-DE includes four important functions: - Optimized access to all Copernicus satellite data and products for national users - Processing of these data into further derived products - Provision of an extended portfolio of products - Monitoring the use of the platform itself
Marine	**Specialized access to marine and coastal data: MDI-DE[24]**	The Marine Data Infrastructure (MDI-DE) integrates the essential data sources across all subject, authority and institute boundaries. With the help of the MDI-DE Internet portal, the marine data previously distributed across the federal and state governments will be made comprehensively available for use. In this way, data inventories of the most important data holders on the coast become uniformly searchable and usable.
Earth observation	**Center for Satellite Based Crisis Information (ZKI)[25]**	ZKI has made remarkable achievements in the development of remote sensing-based emergency mapping since 2004. The quality of ZKI products is recognized worldwide. For example, emergency responders used ZKI maps based on current satellite imagery after the 2009 earthquake in Haiti and the 2011 tsunami in Japan. ZKI is also involved in relevant European structures (including GMES) and international mechanisms, such as the International Charter Space and Major Disasters

[23] https://code-de.org/en/

[24] https://www.mdi-de.org/mapapps/resources/apps/mdide_mainapp/index.html?lang=en&stateId=9aa0f53d-f019-4e3b-a0f5-3df0194e3bee

[25] https://www.dlr.de/eoc/en/desktopdefault.aspx/tabid-12797/#gallery/30435

Land use	**DLM-DE - Digital Land Cover Model for Germany** **LaVerDi**[26]	The concept of the DLM-DE aims at interoperability between geospatial base data and geospatial domain data. As a result, the DLM-DE, with a minimum mapping area (MKF) of 1 ha, represents a high-resolution geodata set in vector format that allows the land cover for Germany to be mapped according to European nomenclature with unprecedented accuracy. The "LandscapeChangeService" (LaVerDi) was developed at the BKG with the aim of using free Copernicus satellite data for an automatic derivation of land cover changes and to provide this information regularly for individual landscape elements via an application. The focus is on operational classification algorithms and change detection methods that can be used to derive up-to-date and consistent information on land cover changes in order to continuously maintain geodata of a consistent quality.
Urban Planning	**Promotion of model projects 'Smart Cities'**	The federal government is shaping smart cities in Germany together in a dialog between politics, administration, business, science and civil society. By funding the development of a computer model for building-resolution urban climate modeling, the government aims to enable smart cities to investigate urban climatological relationships and apply the results to sustainable urban planning.
Mapping	**Smart Mapping Project - Future of Web Cartography - Agile and Cutting-Edge**[27]	With Smart Mapping the geospatial administrations of the federal and state governments (under the auspices of the AdV) are pursing the aim to develop a process that enables cartographic products to be created automatically (without interaction) on the basis of official geodata. A key innovation of Smart Mapping is the redesign of a modular development platform for the fast, flexible and economical generation of cartographic products for surveying authorities.

[26] https://gdz.bkg.bund.de/index.php/default/landschaftsveraenderungsdienst.html (in German only)

[27] https://adv-smart.de/index_en.html

3.2.2 International Commitments

There are a small number of global initiatives, where Germany contributes to, that are of particular relevance and listed below.

Table 2: International Commitments (Source: Geospatial Information Progress Reports 1-5 of the German Federal Government.[20])

Policy Area	Summary Description of Primary Initiatives	Importance of Geospatial Information and Technologies
Sustainable Development	**Transforming our World: The 2030 Agenda for Sustainable Development. UN Resolution 70/1[28]** This Agenda is a plan of action for people, planet and prosperity. It also seeks to strengthen universal peace. We recognize that eradicating poverty in all its forms and dimensions, including extreme poverty, is the greatest global challenge and an indispensable requirement for sustainable development.	Geospatial data is essential to monitoring and reporting on many of the Sustainable Development Goals (SDG) and targets.
Disaster Risk Reduction	**Sendai Framework on Disaster Risk Reduction 2015 – 2030[29]** The framework aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.	Geospatial data and systems are key components of the National Emergency Management Agency approach to implementing the framework.
Climate Change	**United Nations Framework Convention on Climate Change (Paris Agreement)[30]** The Paris Agreement builds upon the Convention and for the first time brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.	Global environmental monitoring relies on satellite imagery and other NSDI foundation data themes, such as water, transport and land use.
Technology	**GAIA-X[31]**	Geospatial data is a key element of a

[28] https://sustainabledevelopment.un.org/post2015/transformingourworld/publication
[29] https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030
[30] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
[31] https://www.data-infrastructure.eu/GAIAX/Navigation/EN/Home/home.html

	This project complements the further development of a European data infrastructure with important technology components, such as networked cloud platforms and AI applications.	digital infrastructure.
Reference Systems	**Resolution for a Global Geodetic Reference Frame for Sustainable Development UN-Resolution 69/266**[32] The Argentine-German Geodetic Observatory AGGO makes an important contribution to the implementation of this UN-Resolution as it addresses all substantial decision points like global cooperation and improvement of the nat'l geodetic infrastructure. Given the far distance from Germany AGGO is in an ideal location for the accuracy measurements e.g. of the VLBI determinants.	Exact basis for measurements ensures proper decision-making
Digital Infrastructure	**INSPIRE Work Program 2020-2024: Towards a Common European Green Deal data space for environment and sustainability**[33] In line with the European data strategy, this work program is intended to make a significant contribution to the development of a European spatial data infrastructure and thus support the objectives of the European Green Deal.	Accessible data beyond borders and harmonized datasets are the result of solid international networks
Survey and Cadaster Administration	**EuroGeographics**[34] EuroGeographics has developed into an essential network for international cooperation ("best practice") of the land surveying, cadastral and land registration authorities in Europe, which also helps to develop and represent common positions for cooperation with the European Commission. The "Knowledge Exchange Networks" (KENs) serve this purpose, among others.	Pan-European accessible data and harmonised data are the result of solid international networks

[32] https://ggim.un.org/documents/A_RES_69_266_E.pdf
[33] https://op.europa.eu/en/publication-detail/-/publication/510cd3aa-32e4-11ec-bd8e-01aa75ed71a1/language-de
[34] https://eurogeographics.org/

4. STRATEGY

4.1 Vision and Mission

The NGIS[35] and the goals defined therein represent the desired status and vision in the geospatial information sector by the year 2025. Therefore, no supplements implied by the IGIF are needed in the already existing strategy. The following is a brief summary of the NGIS:

The vision of the NGIS represents a starting point for a future-oriented sustainable geospatial information policy in Germany. As one of several stakeholders, NGIS is also called upon to proactively promote a valuable contribution to the National E-Government Strategy (NEGS) in their respective responsibilities.

Our Vision:

All players proactively support within their field of responsibility a value-added data exchange and the application of available geospatial information as a valuable common good.

The NGIS is intended to achieve a common basic understanding of jointly defined goals and to transparently present the distribution of tasks required for this purpose. The NGIS thus plays a key role in in sustainable geospatial information provision and use.

Our Mission:

Geospatial information is a substantial raw material for a digital society. Hence,

- make it broadly available for informed decision taking,
- support data reuse to a high extent, and
- encourage creation, test and implementation of new applications.

4.2 Strategic Goals and Objectives

The goals of the NGIS are divided into six target areas, which are in line with the NEGS[18]. The six target areas themselves contain 15 objectives with a total of 47 sub-objectives. Each of these goals is of great importance for a sustainable national geospatial information policy. Accomplishing these goals and objectives will enable Germany to achieve its aforementioned vision. The goals, objectives and sub-objectives are described in the NGIS[35]. The six target areas listed in a shorter version below:

[35] https://www.gdi-de.org/sites/default/files/2020-07/NGIS_Startegie_V1.pdf (in German only)

Target area A: Benefits for Citizens, Business, Science and Administration

> Geospatial information has different potential uses for the individual user groups of our society. For this reason, internally and externally oriented services must be directed towards being fit for their purpose as well as the requirements of other users.

The objective is to improve the interdisciplinary access, search and presentation of geospatial information and to provide geospatial information from public administration, but as far as possible of business, science and social interest groups as well. User needs define the quality and diversity of geospatial information. Standards guarantee compliance with quality and interoperability requirements.

Target area B: Profitability and Efficiency

> Multiple use of geospatial information according to the principle "collected once - used several times" can reduce costs and effectively activate the potential for added value.

The objective is to interconnect geospatial information from multiple public and private agencies in partnerships, especially for the collection and provision of geospatial information. Licensing models ensure legal certainty for data providers and data users.

Target area C: Transparency and Social Participation

> Geospatial information offers the opportunity to make political and social processes with spatial relevance more transparent. They create the basis for participation and commitment for all social groups to get involved in participation processes of public planning authorities (participation). Geospatial information contributed by stakeholders can support decision-making and continuation processes of the administration (cooperation).

The objective is to increase transparency in political and social processes, to highlight the value of geospatial information by best-practice showcases, public work and training. Stakeholders contribute with their knowledge and commitment to the cooperative collection and updating of geospatial information .

Target area D: Data Protection and Security

> Data protection and data security are inseparably linked to the provision of geospatial information and are important prerequisites for ensuring the interests of the state, business, science and citizens.

The objective is to ensure confidentiality, availability and integrity of geospatial information. Personal data protection and sensitive or critical data security are inseparably connected to the provision of geospatial information and are important prerequisites for their use.

Target area E: Viability and Sustainability

> Geospatial information is indispensable for the social and political discourse on the orientation of state and society.

The objective is to ensure the implementation of international standardization and to meet the continuously increasing demand of geospatial information at the local, regional, national and international levels.

Target area F: Efficient IT – Support

> The collection, management and provision of geospatial information as well as its networking and analysis require the use of powerful information and communication technology and nationwide broadband coverage in Germany. Meeting these requirements guarantee the use of the NSDI national technical components and the tapping of the development potential.

The objective is to guarantee the technical infrastructure necessary to the operation of the NSDI by federal and state governments. One profound prerequisite for this is the use of high-performance information and communications technology.

4.3 Enabling Technology

Germany is well-positioned to take advantage of modern technologies to advance decision-making and government policy-setting using the power of geospatial information. Many government departments are familiar with geospatial information and are using this information on a daily basis.

Impediments to NSDI implementation have in the past often focused on lack of technology e.g. capture devices, hardware and software and data. In most cases, technology limitations have eased with increased competition in the market driving down unit costs. Similarly, access to high quality satellite imagery, the success of crowd-sourcing initiatives and smartphone-derived location-based services has reduced the timescales and costs of NSDI data acquisition and initiated the development of new products and services.

However, reaping the full benefits of the opportunities of geospatial data and technologies, continuous reform and innovation to modernize and support ways of working are required, particularly across the public sector.

The challenges for Germany are to:

- Improve cross-sectoral sharing of geospatial information to make use of the value and potential of geospatial information
- Improve data accessibility and promote recommendations for open data better within all administrative levels and across sectors

The following enabling technologies have already been applied in Germany:

- **Geoportal and SmartMapping:** Technological advances for individualized production, horizontal integration in collaborative networks and digital integration of supply chains have emerged to create new ways of producing and distributing information products beyond a single enterprise.
- **Increased Volume and Variability of Data:** There have been significant advances in digital acquisition and communications technologies from sensors in vehicles, rapid imagery acquisition from satellites, targeted imagery capture using cost effective drones, and automated processing and storage devices that enable large volumes of data to be managed effectively in cloud environments.
- **Community Participation:** The concept and technology of including users of social media is now being used in 'community science' projects to enhance government services and improve the accuracy and quality of maps.
- **Common APIs:** Application Programming Interfaces (APIs) have recently been developed to better manage the COVID-19 pandemic. Many of the Apps have been created by individuals, such as university students, by businesses, and through Public-Private Partnerships (PPPs). Geospatial data, e.g. statistical data, is essential for the development of Apps concerning the COVID-19 pandemic.

- **Innovation Hubs:** Digital and mobile innovations based on geospatial information have created new opportunities for businesses to get closer to their customers, and create more convenient, secure and engaging touchpoints between businesses and their customers.

4.4 Benefits

In Germany, location-based data is becoming more and more important. It is essential for evidence-based decision-making, especially since the continuously developing digital transformation. A digital blueprint (digital twin) of our world we live in is based on geospatial data. It is inseparably connected to almost all issues related to economic growth, the health sector, infrastructure, transportation and navigation, sustainable social and environmental development. Some examples of the benefits of geospatial information are listed below:

- Geospatial information is a basic ingredient for strategic planning, future orientated decision-making and political action. Knowledge transfer is key to expanding competencies through training opportunities.[36]
- Available geospatial information for the protection of the environment and health can already be used without substantial restrictions. Strengthening the cooperation of federal, state and municipal authorities leads to a better risk management in terms of potential weather and weather-related events.[37]
- Citizens benefit from the existance of valid and up-to-data geospatial data through increased efficiency in road navigation, emergency services dispatch and improved interactions with the public sector.
- Geospatial data provided across levels for sustainable use helps in the areas of climate protection and adaptation to climate change, sustainable resource management and innovative environmental and energy technologies.

[36] Recommendations for action to support the implementation of the NGIS:.https://www.gdi-de.org/download/2021-04/Beschluss_140_Handlungsempfehlungen_Unterst%C3%BCtzung_NGIS_Anlage1.pdf (in German only)

[37] https://www.bmi.bund.de/SharedDocs/downloads/DE/veroeffentlichungen/themen/moderne-verwaltung/geoinformationen/4-geo-fortschrittsbericht.html (in German only)

5. ACTION PLAN

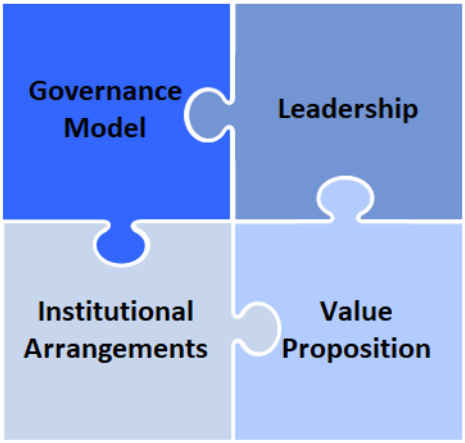
This section sets out the proposed plan and is the “heart” of the document. It is arranged according to the nine strategic pathways of the IGIF - Governance and Institutions, Policy and Legal, Financial, Data, Innovation, Standards, Partnerships, Capacity Building and Communication and Engagement.

The plan considers and reflects ongoing activities and measures of the NSDI, especially those related to the NGIS. For each Strategic Pathway, the current situation in Germany is described in summary form. Based on the results of the assessment using the World Bank’s IGIF Diagnostic Tool, a need for optimization was identified for most of the strategic pathways. The derived IGIF actions are listed in a table for each strategic pathway with information on whether these IGIF actions are already covered by existing or ongoing NSDI measures.

Most of the IGIF actions derived in this plan are largely covered by existing or ongoing NSDI measures.[38] Thus, the IGIF actions also serve to review and check of already existing and ongoing measures as identified within the NSDI. Since the NGIS is a vision with a time target of 2025, all dates for the action plan are set by default to this year. If it is a regularly conducted activitiy, these information is added to the action in brackets. Only few ‘new’ actions have been included and are indicated as such. For these, detailed action profiles have been compiled and are listed in the appendix.

[38] https://www.gdi-de.org/index.php/en/SDI/Steering%20Committee/tasks

5.1 Governance and Institutions



IGIF Strategic Pathway 1: The 4 Elements of Governance and Institutions (Source: UN-GGIM)

*This **strategic pathway** establishes the leadership, governance model, institutional arrangements, and a clear value proposition to strengthen multi-disciplinary and multi-sectoral participation in, and a commitment to, achieving an Integrated Geospatial Information Framework.*

*The **objective** is to attain political endorsement, strengthen institutional mandates and build a cooperative data sharing environment through a shared vision and understanding of the value of an Integrated Geospatial Information Framework, and the roles and responsibilities to achieve the vision.*

5.1.1 Outline of Current Situation

Clear organisational structures for the development of the NSDI were already created in 2003 with the decision of the head of the Federal Chancellery and the heads of the state and senate chancelleries of the federal states. The NSDI Steering Committee is responsible for the coordination and control of the expansion and operation of the NSDI. Once a year, the NSDI Steering Committee reports on the implementation status of the expansion and operation of the NSDI to the IT-Planning Council (IT-PLR), which is the central body for federal cooperation in information technology in Germany. On a political level the IT-PLR is the 'champion' with regard to geospatial data and digital developments in Germany.

The NSDI is an undertaking of the federal government, the federal states and local authorities. Representatives from the business and scientific communities assist the council in an advisory capacity, which ensures the user-oriented further development of the NSDI. The NSDI is jointly financed by the federal government and the federal states on the basis of an administrative agreement. The agreement[10] specifies, among other things, the objectives, the financing and the organisational structure of the NSDI. The tasks of the individual actors are also briefly specified.

The NSDI Steering Committee is supported by the NSDI Coordination Office. Among other things, it is responsible for the operational implementation of the decisions taken by the NSDI Steering Committee. With its four national technical components[9], the NSDI Steering Committee operates IT applications that support the NSDI stakeholders in their daily work. These components are operated by the Federal Agency for Cartography and Geodesy (BKG).

Working groups on national level address issues like “Architecture”, “Metadata”, “Geospatial Services”, “INSPIRE” and “Geospatial Data”. Furthermore, there are supporting working groups on European Union level where NSDI players are members of most of them.

The German geospatial system is characterised by evolved structures and numerous actors with different backgrounds, goals and possibilities. In this area of tension, it is important to develop a common basic understanding and mutually supported goals.

For this reason, the NSDI Steering Committee developed the NGIS in 2015 with the involvement of industry and science in a broad-based public online participation process and with strong political resonance. The NGIS is thematically broadly based. It is based on three central principles from which a comprehensive system of objectives is derived. The goals defined in it describe the desired state of the geospatial data system in Germany by the year 2025. The measures for implementing the NGIS are linked to the requirements of the European level as well as the national and regional levels.

User involvement is an important topic for NSDI. Users are informed about current topics via various means of communication, such as a newsletter, social media contributions and its own website. Tools for feedback are also available. The user feedback is discussed in the working groups, thematic circles and workshops. Furthermore, a collaboration platform is provided for the information exchange, on-topic-communication and user feedback.

Based on the assessment, needs could be identified to optimize the current situation. For instance, the interdisciplinary cooperation with the joint federal and state level committees could be improved to get feedback on NSDI data and services, for the promotion of best-practices of geospatial information and for the interaction with the global community. Derived actions are listed in the table shown in chapter 5.1.2.

5.1.2 Actions for Strengthening Governance and Institutional Arrangements

Governance and institutional arrangements and cross-sector information sharing culture are to be strengthened in Germany through the following actions:

IGIF action Nr.	IGIF action description	New IGIF action required
1.1	Promote geospatial information in particular with best practices for decision-making within the NSDI in the context of the government data strategy.	No, covered by ongoing NSDI action
1.2	Implement the communication concept of the NSDI addressing NSDI benefits and increasing awareness and acceptance for e-Government to the “champion” (representing the federal and	No, ongoing NSDI action

	state level) and to stakeholders outside the administration. (regularly)	
1.3	Develop and integrate change-request tools within the German Geoportal.de to get and implement user feedback for all NSDI data and services, comprising regularly queries with contact points ofthe federal states and the federal government.	No, ongoing NSDI action
1.4	Connect NSDI better with the joint federal and state level committees to get feedback on NSDI data and services. (regularly)	No, ongoing NSDI action
1.5	Increase interaction with the global geospatial community (e.g. support and actively make use of the activities of the United Nations Global Geodetic Center of Excellence and Global Geospatial Knowledge and Innovation Centre). (regularly)	Yes, new BKG action See Appendix
1.6	Implement UN recommendations as appropriate (e.g. UN-GGIM recommendations on "Core Data"), considering the INSPIRE Maintenance and Implementation Work Programme (MIWP) and other European requirements provided through the EU data strategy, EU Green Deal, etc.	No, ongoing NSDI action

5.2 Policy and Legal

IGIF Strategic Pathway 2: The 4 Elements of Policy and Legal (Source: UN-GGIM)

*This **strategic pathway** establishes a robust policy and legal framework that is essential for instituting effective, efficient and secure management and exchange of geospatial information - nationally and sub-nationally.*

*The **objective** is to address current policy and legal issues by improving the policies and laws associated with, and having an impact on, geospatial information management. This is achieved by proactively monitoring the policy and legal environment, including mandating responsibility for the production of data, and keeping abreast of issues and challenges arising from the evolving, innovative and creative use of geospatial information and emerging technologies.*

5.2.1 Outline of Current Situation

In Germany, access to data and data protection as well as intellectual property rights is legally covered by national and EU law. EU law (e.g. concerning INSPIRE) has to be applied uniformly. Germany is organized in a federal system, which includes 16 federal states with their own competences and the federal level (Bund) having overarching competences in the respective areas (16+1 system). Due to the federal system there can be differences in geospatial policies and laws, e.g. access to some data of the federal states and municipalities is limited. For most of the principles of information managment, such as data ownership, usage, pricing, data exchange, data access and security, and licensing and copyright, there are legal requirements which are observed by the organisations. Common licensing models with transparent terms of use for data users are in place. The NSDI Steering Committee has issued a recommendation on licenses for open geospatial data in order to achieve greater uniformity. Open data is implemented at the federal level and by an increasing number of federal states. The European Open Data directive will further promote open data in Germany.

Geospatial information management is discussed on European level as well as on national and regional level. The further development of the NSDI takes place with the involvement of various institutions and stakeholders via e.g. the NSDI Economic and Advisory Committee. To implement NSDI actions, the different structure of federal state situations has to be considered.

Based on the assessment, the following needs could be identified to optimize the current situation: There is a need to make more geospatial datasets available through open data.

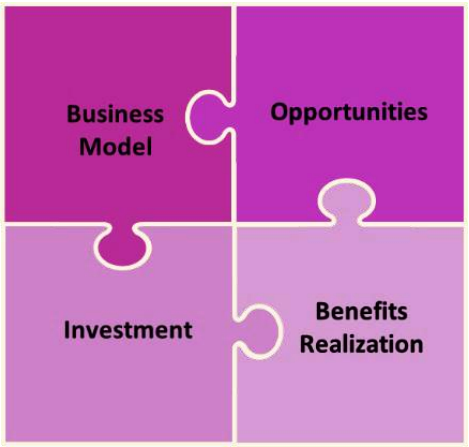
Sharing and distribution of geospatial data should be enhanced and more federal states convinced to provide open data. Derived actions are listed in the table shown in chapter 5.2.2.

5.2.2 Actions for Strengthening the Policy and Legal Framework

Policy and legal arrangements can be strengthened through the following actions:

IGIF action Nr.	IGIF action description	New IGIF action required
2.1	Enhance sharing and distribution of national geospatial data, including none-governmental data providers by promoting NSDI data & services, within the implementation of the 'Online Access Act'.	No, ongoing NSDI action
2.2	Implement European Open Data and the Re-use of Public Sector Information Directive (20 June 2019) which introduces the concept of high value datasets and continue to work on convincing all federal states to make more datasets available through open data.	No, ongoing NSDI action
2.3	Analyze national legislation with the aim to make more geospatial datasets available through open data.	No, ongoing NSDI action

5.3 Financial



IGIF Strategic Pathway 3: The 4 Elements of Financial (Source: UN-GGIM)

*This **strategic pathway** establishes the business model, develops financial partnerships, and identifies the investment needs and means of financing for delivering integrated geospatial information management, as well as recognizing the benefits realization milestones that will achieve and maintain momentum.*

*The **objective** is to achieve an understanding of the financial plans required to establish and maintain an integrated geospatial information management system, as well as the longer-term investment program that enables government to respond to evolving societal, environmental and economic demands for geospatial data.*

5.3.1 Outline of Current Situation

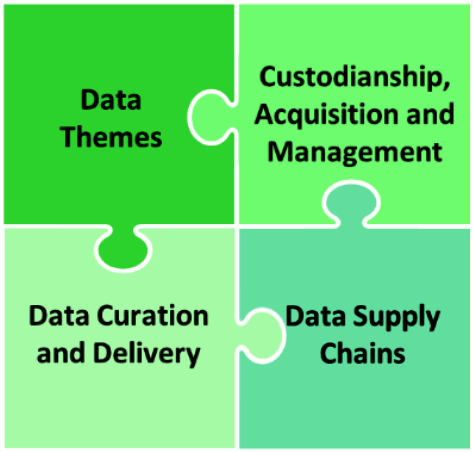
The NSDI establishment was a political, not a business decision. A 'classic' business model for the NSDI is not necessary due to an existing legal obligation to operate the NSDI including a further development of the system whenever boundary conditions change. However, the geospatial branch of economy in Germany has successful business models in operation. There is a licensing infrastructure for open data available but there is no coherent pricing and licensing structure for NSDI datasets/services because of the federal system. The licensing often consists of a "freemium"-model where basic data and services are free of charge and every data owner/federal state decides if advanced data and services are free or chargeable. Finance of the development and operation of the NSDI is in particular secured by an administrative agreement. Implementation has to follow the budget plans of the administrations. Based on the assessment, a need to optimize the current situation, e.g. to improve the participation of the private sector could be identified. A derived action is listed in the table shown in chapter 5.3.2.

5.3.2 Actions for Strengthening and Sustaining Geospatial Investments

To maintain delivering a sustainable integrated geospatial information management, the following action has been identified:

IGIF action Nr.	IGIF action description	New IGIF action required
3.1	Increase participation of the private sector and motivate the re-use of the NSDI services under the guidance of the NSDI Economic Council. (regularly).	No, ongoing NSDI action

5.4 Data



IGIF Strategic Pathway 4: The 4 Elements of Data (Source: UN-GGIM)

*This **strategic pathway** establishes a geospatial data framework and custodianship guidelines for best practice collection and management of integrated geospatial information that is appropriate to cross sector and multidisciplinary collaboration.*

*The **objective** is to enable data custodians to meet their data management, sharing and reuse obligations to government and the user community through the execution of well-defined data supply chains for organizing, planning, acquiring, integrating, curating, publishing and archiving geospatial information.*

5.4.1 Outline of Current Situation

To support the capture, management and maintenance of national geospatial data an NSDI concept (on architecture[39]) is in place and the operation of the national technical components.[9] One of these components is the Geoportal.de.[40] As a central access point, the Geoportal.de offers a wide range of freely accessible geospatial information from various areas of public administration, from federal authorities to local town halls. Data can be discovered, viewed and downloaded via the ‚geoportal.de' and the geoportals of the State governments. It is an important tool for the coordination of the participants of the NSDI network and helps to implement the service-based architecture of the NSDI.

Due to federal system in Germany geospatial data is very often decentrally collected and maintained, which means the owner of the geospatial data is likely responsible for its provision, too. For some geospatial data themes a national agency provides a nationwide and harmonized geospatial dataset, while the federal states are responsible for the data collection and maintenance. Data quality issues are tackled domain-specific, directed at data quality improvement. Further, the need of core geospatial datasets for INSPIRE has been recognized and defined within the NSDI. The core/fundamental geospatial data themes concept of the United Nations Global Geospatial Information Management (UN-GGIM) initiative has been evaluated and reflected in the actions within the European INSPIRE context. The EU INSPIRE legislation is currently under evaluation and readjustment. An integrated geodetic reference frame is in place and has regularly been updated. The resulting coordinate systems are well defined and agreed to be used by all stakeholders.

[39] https://www.gdi-de.org/en/SDI/working%20groups/architecture
[40] https://geoportal.de/

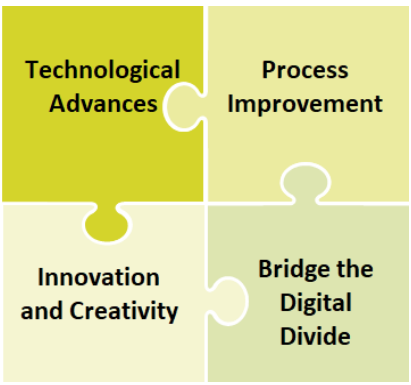
Based on the assessment, the following needs could be identified to optimize the current situation: Develop a national maintenance plan for core geospatial datasets and improve the allocation with data custodians. Furthermore, cloud technology could be expanded. Derived actions are listed in the table shown in chapter 5.4.2.

5.4.2 Actions for Strengthening the Data Management Framework

Actions that will deliver on the objective of the Data strategic pathway:

IGIF action Nr.	IGIF action description	New IGIF action required
4.1	Enhance core data sets with data custodians allocated and considering the UN and European concepts and requirements.	No, ongoing NSDI action
4.2	Develop and implement a national maintenance plan for core datasets, comprising data quality requirements	No, ongoing NSDI action
4.3	Improve cloud technology and a platform for data sharing.	No, ongoing NSDI action

5.5 Innovation



IGIF Strategic Pathway 5: The 4 Elements of Innovation (Source: UN-GGIM)

*This **strategic pathway** recognizes that innovation has the potential to stimulate, trigger and respond to rapid change, leapfrog outdated technologies and processes, and to bridge the geospatial digital divide. Technology is continually evolving, creating new opportunities for innovation and creativity.*

*The **objective** is to leverage the latest cost-effective technologies, innovations and process improvements so that governments, businesses and academia, no matter their current situation, may leapfrog to modern geospatial information management systems and practices.*

5.5.1 Outline of Current Situation

There are numerous efforts on national and federal state level to support geo spatial related innovation, usually as part of bigger initiatives, e.g. the data strategy of the Federal Government[41]. This includes private sector involvement and is supportive to the geospatial branch of economy in Germany. To evaluate technological advances, the NSDI Advisory Committee and the NSDI Economic Council have been established. The academic and private sectors take the opportunity to exchange information on research programs in the field of geospatial data within the framework of the NSDI Advisory Committee. Furthermore, the National Research Data Infrastructure (NFDI)[42] is closely liased with the NSDI Steering Committee. In addition, EU projects like Copernicus[43] (satellite remote sensing) are innovation drivers and are supportive for the achievement of the Sustainable Development Goals (SDG). The Federal Ministry of Transport and Digital Infrastructure[44] has been funding Research & Development projects related to digital data-based applications for Mobility 4.0 with a research initiative called mFUND[45]. The private sector is partly involved in those projects as well as open community products, such as Open Street Map, that may be used in conjunction with governmental geospatial data.

The BKG product TopPlusOpen[46] is one example of a application developed for citizens by government. A user feedback tool is established. Furthermore, there are several applications from the private sector using governmental geospatial data.

[41] https://www.bundesregierung.de/breg-de/suche/datenstrategie-der-bundesregierung-1845632 (in German only)
[42] https://www.dfg.de/en/research_funding/programmes/nfdi/index.html
[43] https://ec.europa.eu/defence-industry-space/eu-space-policy/copernicus_en
[44] https://www.bmvi.de/EN/Services/Visit-The-Ministry/visit-the-ministry.html
[45] https://www.bmvi.de/DE/Themen/Digitales/mFund/Ueberblick/ueberblick.html
[46] https://www.bkg.bund.de/SharedDocs/Produktinformationen/BKG/EN/P-2018/180608-TopPlusOpen.html

Based on the assessment, the following needs for optimizing the current situation could be identified: The link between the private and academic sectors should be further developed. Actions to combine crowd-sourced data with government geospatial data should be further developed. Derived actions are listed in the table shown in chapter 5.5.2.

5.5.2 Actions for Stimulating Innovation in Geospatial Information Management

NSDI Innovation will be achieved through the following actions:

IGIF action Nr.	IGIF action description	New IGIF action required
5.1	Involve the academic (e.g. through NFDI4Earth and the German Geodetic Commission) and private sectors (e.g. through the NSDI Economic Council) more in research programs and (policy) development related to geospatial information and strengthen the link to the SDI. (regularly)	No, ongoing NSDI action
5.2	Improve tools in the geoportal.de to combine crowd-sourced data with government geospatial data.	No, ongoing NSDI action

5.6 Standards

IGIF Strategic Pathway 6: The 4 Elements of Standards (Source: UN-GGIM)

*This **strategic pathway** establishes and ensures the adoption of best practice standards and compliance mechanisms for enabling data and technology interoperability to deliver integrated geospatial information and location-based knowledge creation.*

*The **objective** is to enable an efficient and consistent approach for different information systems to be able to discover, manage, communicate, exchange and apply geospatial information for a multitude of uses, improved understanding and decision-making.*

5.6.1 Outline of Current Situation

In Germany, standards for the provision of geospatial data, metadata and services are in place. The access to geospatial data is included in national law without citing specific standards in order to remain flexible. At international level, Germany is also represented in standardization organizations such as the International Organization for Standardization (ISO) or the Open Geospatial Consortium (OGC). In addition, Germany has implemented the European directive INSPIRE to create a European spatial data infrastructure with all its set standards.

The IT-PLR retains the political and juridical responsibility for the adoption, publication and monitoring of IT standards. The NSDI Steering Committee is responsible for the development, continuation and implementation of standards for spatial data infrastructure.

Note:
No IGIF actions have been identified for strategic pathway 6: Standards. Due to the very high fulfillment value by the 'IGIF Diagnostic Tool' of the World Bank (score of 96 of 100), Germany is already well-positioned in terms of standardization.

5.7 Partnerships

IGIF Strategic Pathway 7: The 4 Elements of Partnerships (Source: UN-GGIM)

*This **strategic pathway** establishes cross-sector and interdisciplinary cooperation, coordination and collaboration with all levels of government, the geospatial industry, private sector, academia and the international community, as an important premise to developing and sustaining an enduring nationally integrated geospatial information framework.*

*The **objective** is to create and sustain the value of geospatial information through a culture based on inclusion, trusted partnerships and strategic alliances that recognize common needs, aspirations and goals, towards achieving national priorities and outcomes.*

5.7.1 Outline of Current Situation

There is cooperation between all levels of government, e.g. between federal and federal state government within working groups on national level. Furthermore, there are Working Groups on EU level (INSPIRE) where NSDI representatives are members. On governmental level there is the cooperation of the IT-PLR with the NSDI Steering Committee. Several federal state committees are collaborating to create geospatial data, especially for some statistical or environmental themes.

The academic and private sector are addressed in the NGIS and in the administrative agreement. They are permanent guests in the NSDI Steering Committee to advise the body on the further development of the NSDI. Despite this satisfactory cooperation at management level there is still room for improvement on working group level (on architecture, geospatial services, ...). As the whole NSDI network has been involved in the development of the NGIS, the commitment of all stakeholders to the implementation must be maintained.

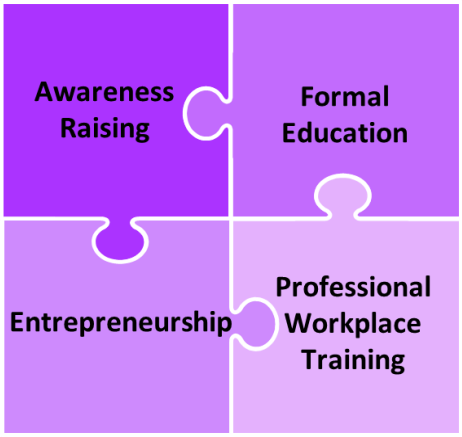
Based on the assessment, the following needs could be identified to optimize the current situation: Collection of “lighthouse projects” that demonstrate the successful collaboration for the integration of core geospatial data with other thematic data. It is important to provide a complete data coverage and avoid duplication of efforts. Derived actions are listed in the table shown in chapter 5.7.2.

5.7.2 Actions for Strengthening Partnerships

The objectives in terms of partnerships can be achieved through the following actions:

IGIF action Nr.	IGIF action description	New IGIF action required
7.1	Identify geospatial data gaps to analyze how the provision of complete coverage can be achieved.	No, ongoing NSDI action
7.2	Define "lighthouse projects" to demonstrate the successful collaboration for the integration of core geospatial data with other thematic data.	Yes, new BKG action See Appendix
7.3	Initiate topic and target group specific guidelines as necessary to overcome and reduce resource- and information deficits/obstacles to eliminate duplication of efforts.	No, ongoing NSDI action
7.4	Promote and organize more regular hackathons with the private sector using government geospatial data.	No, ongoing NSDI action

5.8 Capacity and Education



IGIF Strategic Pathway 8: The 4 Elements oof Capacity and Education (Source: UN-GGIM)

*This **strategic pathway** establishes enduring capacity development and education programs so that the value and benefits of integrated geospatial information management is sustained for the longer term.*

*The **objective** is to raise awareness, build and strengthen knowledge, competencies, skills, instincts, processes, resources and innovative entrepreneurship that organizations, communities and individuals require to utilize geospatial information for evidence based decision-making and effective service delivery.*

5.8.1. Outline of Current Situation

Capacity building for geospatial information management is already handled on all administrative levels in Germany. Between agencies and universities information is shared. Knowledge and best practice sharing across government and the private sector has been initiated in 2019 within the NSDI Advisory Committee. Capacity development and geospatial education is addressed in the NGIS and actively supported by the NSDI Steering Committee, the NSDI Federal and Federal States Contact Points and the NSDI Coordination Office. The NSDI organizes workshops and coordinates knowledge sharing e.g. via a NSDI collaboration platform, task forces etc. Several initiatives such as "Federal/Federal states Task Forces" are sharing knowledge. Furthermore, international, national and cross-domain conferences and workshops are regularly conducted and working groups are in place.

A number of German university's 'Geoinformatics Curricula' address NSDI topics. Research & Development is part of the NGIS. Moreover there are a number of geospatial-related research topics addressed in national and international research projects at universities, research institutions and companies. Research & Development organizations are involved as guests in the NSDI Steering Committee. Furthermore, the German NFDI4Earth gathers universities and research institutions towards a common national earth system science research data management and is partnering with the NSDI.

However, all those measures combined do not maintain a self-sustaining NSDI. Generally, permanent awareness of the geospatial profession is required as well as capacity development on geospatial information, data governance, standards, application development, project management and policy development. Given the distributed

responsibilities and different approaches it is only possible to accompany the numerous initiatives on central NSDI level.

Based on the assessment, needs could be identified to optimize the current situation. For instance, engagement to the public and involvement of all disciplines could lead to a better capacity development and geospatial education. The academic curricula could be adjusted to the current needs. Derived actions are listed in the table shown in chapter 5.8.2.

5.8.2 Actions for Establishing the Capacity Building and Education Program

To raise awareness and develop and strengthen the skills, instincts, abilities, processes and resources that departments require to manage and utilize geospatial information, the following actions were formulated:

IGIF action Nr.	IGIF action description	New IGIF action required
8.1	Strengthen the cooperation with the National Research Data Infrastructure.	No, ongoing NSDI action
8.2	Monitor the status and availability of skills in geospatial data management (by NFDI4Earth). (regulary)	No, ongoing NSDI action
8.3	Enhancing the implementation of the National Geospatial Information Strategy by including engagement to the public and involvement of all disciplines for a better capacity development and geospatial education.	No, ongoing NSDI action
8.4	Adjust academic curricula in close collaboration with GDI-DE and e.g. the German Geodetic Commission (DGK) – where appropriate.	No, ongoing NSDI action
8.5	Offer geospatial management trainings or implement Continuous Professional Development programs.	Yes, new BKG action See Appendix

5.9 Communications and Engagement

IGIF Strategic Pathway 9: The 4 Elements of Communication and Engagement (Source: UN-GGIM)

*This **strategic pathway** recognizes that stakeholder identification, user engagement and strategic communication are essential to successfully deliver integrated geospatial information management arrangements nationally and sub-nationally for sustainable social, economic and environmental development.*

*The **objective** is to ensure effective communication and engagement to enhance and deepen participation and contributions from all stakeholders and at all levels. Commitment, mutual understanding, collaboration, cooperation and communication are essential to successfully implement the Integrated Geospatial Information Framework within organizations and with stakeholders.*

5.9.1 Outline of current situation

The NSDI is in particular in touch with stakeholders from economy and science; partners and roles are defined. A strategic communication concept has been established and underpinned with concrete actions only after the NGIS was agreed. The Working Group Implementation NGIS will take these issues and the resulting experiences into account for the next NGIS validity period preparation. The work of the working groups of the NSDI leads to a constant (further) development of the SDI. In addition to the private and academic sectors, the open data community is also partly involved in the further development of the NSDI.
Most government geospatial data is well-received by the users. Some good examples for case studies to demonstrate the benefits to users already exist within the NSDI, e.g. as presented by the BKG at the Geoportal.de. The Geoportal.de offers easy access for geospatial data and services in Germany. Some further specialist portals offer easy ways to access dedicated geospatial data and services such as the BKG service center.

Based on the assessment, the following needs could be identified to optimize the current situation: The activities of the NSDI should be promoted better nationwide. In general, the importance of geospatial information for evidence-based decision making can be highlighted more, especially with regard to the United Nations Agenda 2030 for Sustainable Development. Derived actions are listed in the table shown in chapter 5.9.2

5.9.2 Actions for Establishing Communication and Engagement Framework

Following actions and evidence of for this Pathway were identified:

IGIF action Nr.	IGIF action description	New IGIF action required
9.1	Promote the nationwide NSDI outreach activities for geospatial information services. (regulary)	No, ongoing NSDI action
9.2	Identify and promote national case studies to spearhead economic and user-oriented development based upon the existence of reliable geospatial information.	No, ongoing NSDI action
9.3	Promote the importance of geospatial information for evidence-based decision making and for the achievement of the Sustainable Development Goals (SDGs) of the Agenda 2030. (regularly)	Yes, new BKG action See Appendix

6. CONCLUSIONS AND NEXT STEPS

This report (comprising the results of the baseline assessment and the action plan) is presented as the outcome of a collaborative effort of the main NSDI stakeholders for geospatial information management in Germany, coordinated by the BKG. The additional perspective through the IGIF has complemented the German activities and confirmed the undertaken measures for the NGIS and the NSDI for an efficient geospatial information management and infrastructure as well-defined and sustainable undertaking to be continued.

6.1 Feedback

This report has been circulated to the Working Group Implementation NGIS and one representative of the federal state Lower-Saxony, who contributed on behalf of the AdV. Those stakeholders were invited to comment on structure, intelligibility and correctness of the content, areas of eligible omission and any other possible concerns. Especially the main part of the action plan, the derived actions, have been discussed very closely within the Working Group Implementation NGIS in advance.

6.2 Implementation

It must be mentioned that the elaboration of the action plan is complementary to the existing NGIS. Most of the derived IGIF actions are already covered by NSDI measures and activities. The few remaining new IGIF actions fall under the responsibility of the BKG and will be implemented and monitored in parallel to the NGIS and NSDI activities.

6.3 Next steps

This report has been endorsed by the NSDI Steering Committee in spring 2022. With the new international perspective of the IGIF the national action plan for Germany has confirmed and expanded the ongoing NGIS and NSDI measures. This report will not only be published internationally (within the United Nations), but also nationwide. Accordingly, the report will be published through all NSDI and BKG channels.

With the planned completion of the current validity period of the NGIS implementation in 2025, an evaluation of the NGIS will have to take place. In this context the established IGIF actions will be reviewed again by the BKG and, if necessary, adapted or new IGIF actions defined.

Thus, the efforts of this elaboration complete the national activities towards a sustainable, efficient and effective geospatial information management. Furthermore, Germany strives to provide guidance to other countries with regard to the development of a Country Level Action Plan, comprising the evaluation and assessment of the countries' circumstances. Knowledge and experience will be shared in workshops and already planned activities which had to be postponed due to the Covid 19 pandemic will be tackled at an appropriate time in the future.

APPENDIX

Reference material

- Germany - 2021: Country Fiche: https://inspire.ec.europa.eu/sites/default/files/fiche_inspire_-_germany_-_2021.pdf
- Administrative Agreement (in German only):

  https://www.gdi-de.org/sites/default/files/2020-04/Verwaltungsvereinbarung_2017.pdf
- Geospatial Information Progress Reports 1-5 (in German only):

  https://www.imagi.de/Webs/IMAGI/DE/themen-und-projekte/geo-fortschrittsberichte/geo-fortschrittsberichte-node.html
- National Geospatial Information Strategy (NGIS) (in German only):

  https://www.gdi-de.org/sites/default/files/2020-07/NGIS_Startegie_V1.pdf

IGIF-Action-Nr. and -Title	Priority
1.5 Increase interaction with the global geospatial community	A

Description/background/motive (What?)

More intensive networking with the global geospatial community can be actively used for national geospatial information management. Advantages of international cooperation for Germany are, for example, network building (target group-specific contacts), knowledge transfer, further development and innovations. By collaborating in the creation of global concepts such as the 'Integrated Geospatial Information Framework' (IGIF) of the United Nations and their national application, geospatial information management in Germany can be reviewed and evaluated. Cooperation is the essential basis for supporting and accompanying other countries in the implementation of the IGIF.

Global cooperation and coordination between Member States and relevant stakeholders will be better supported and improved, among others, in the geodetic domain in the future 'Global Geodetic Center of Excellence' (GGCE) and in the geospatial information domain in the future 'Global Geospatial Knowledge and Innovation Center' GGKIC. This will expand and strengthen the geodetic infrastructure and support Member States in improving their national contributions. Further cooperation in other international bodies such as the Group on Earth Observation (GEO) or the Global Geodetic Observing System (GGOS) is essential to consider requirements for geospatial information management as comprehensively as possible or to define and provide urgently needed geodetic variables (Essential Geodetic Variables - EGV).

Result/Outcome

Active participation and support of the international networks in geospatial information management and for the development of the global geodetic infrastructure

Stakeholders (Who?)

BKG

Approach (How?)

- Establishment and support of the GGCE
- Accompanying the establishment of the GGKIC and actively using it
- Implementation of the IGIF in Germany as well as support of other countries in the implementation of the IGIF
- Cooperation in the definition and derivation of essential geodetic variables (EGV)
- Expansion of the cooperation in the relevant international bodies

Instruments (With what?)

Workshops, working groups, participation in conferences

Duration	Status (Monitor)
Until 2025, regular and continuous	In progress

Risks

- Dependence on other international bodies
- Lack of personnel resources in the BKG

Cross-references to actions of the GDI-DE

None

Effectiveness for NGIS goals - Which NGIS goal is supported/served by the action?

No. 12: „Geoinformationen leisten einen wichtigen Beitrag zur Zukunftsfähigkeit und Nachhaltigkeit“ (12.1)

IGIF-Action-Nr. and -Title	Priority
7.2 Identify "lighthouse projects" to demonstrate successful collaboration in integrating core geospatial data with other thematic data	B

Description/background/motive (What?)

Geospatial information does not serve as an end in itself, but is the basis for political decisions by showing connections through linking with other information. By presenting examples and, in particular, "lighthouse projects," the benefits and value of geospatial data can be expressed in interaction with other specialized data. The demonstration of these "lighthouse projects" should serve to highlight innovations in order to convince policymakers to move these issues forward. Topic areas that revolve around addressing the consequences of climate change are of particular interest. "Lighthouse projects" could be, for example, digital twins, accessibility analyses, or digital atlases on heat, fire, or precipitation. The initiatives that could be "lighthouse projects" to demonstrate successful collaboration in integrating core geospatial data with other thematic data will be selected based on criteria to be defined. The 'D-GEO Lighthouse Projects' defined or already underway as part of the national implementation of the Global Earth Observation System of Systems (GEOSS) will be considered.

Result/Outcome

List of "lighthouse projects" based on defined criteria

Stakeholders (Who?)

BKG

Approach (How?)

1. Elicit and list potential projects
2. Create criteria catalog for the definition of lighthouse projects
3. Define "lighthouse projects" on the basis of the defined criteria
4. Disseminate the "lighthouse projects" in a publicity-effective manner

Instruments (With what?)

Workshops, working groups

Duration	Status (Monitor)
Until 2025	In progress

Risks

- Discrepancies in the definition of criteria for lighthouse projects
- Lack of personnel resources in the BKG

Cross-references to actions of the GDI-DE

None

Effectiveness for NGIS goals - Which NGIS goal is supported/served by the action?

No. 6: „Verständnis und Mehrwert von Geoinformationen sind bekannt“ (6.1, 6.3)

IGIF-Action-Nr. and -Title **8.5 Provide geospatial data management training and ongoing professional development programs**	**Priority** B
Description/background/motive (What?) Federal agencies from all business areas use geospatial data and related tools to drive innovation in their fields of work. The BKG has long supported employees from various domains of the federal administration with data and services. Information and training services for various target groups are currently offered on a regular basis and upon request. In order to establish these offerings as a permanent service, the BKG has developed a training concept with defined measures. With a modular structure and a broad range of training and continuing education courses, the BKG aims to offer more educational content. The aim of the training courses is to impart basic and specialized knowledge in the field of geospatial information. In this way, participants should be made aware of the potential of geospatial information for their own field of work and trained in such a way that they are able to deal with geospatial information, especially with products of the BKG. The offer also serves to inform authorities in the federal states and municipalities, the professional public and companies about the products and services of the BKG. In addition to generally increasing awareness of the BKG, this is also intended to strengthen existing services. In addition, the BKG is to be perceived as a competent contact in all areas of geospatial information through its appearance at the training courses, which is increasingly being consulted within the (federal) administration for more complex tasks.	
Result/Outcome Continuous training offered for basic and specialized knowledge in the field of geospatial information is provided	
Stakeholders (Who?) BKG	
Approach (How?) • Creation and further development of the training concept • Continuous evaluation of the training content • Information dissemination of the training offer	
Instruments (With what?) Seminars, workshops, information events (also online seminars)	
Duration Until 2025, regular and continuous	**Status (Monitor)** In progress
Risks • Training offers are not perceived • Lack of personnel resources in the BKG	
Cross-references to actions of the GDI-DE None	
Effectiveness for NGIS goals - Which NGIS goal is supported/served by the action? No. 6: „Verständnis und Mehrwert von Geoinformationen sind bekannt“ (6.2)	

IGIF-Action-Nr. and -Title	Priority
9.3 Promote the importance of geospatial information for evidence-based decision making and for the achievement of the Sustainable Development Goals (SDGs) of the Agenda 2030	B

Description/background/motive (What?)

Human-induced changes in the environment have drastic consequences for the Earth and must be continuously monitored. For this Earth observation data are needed to describe, for example, changes in sea level or the movements of the Earth's crust. The United Nations 2030 Agenda set 17 goals for more sustainable, environmental, economic and social development. The 2030 Agenda includes a set of indicators to measure the 17 sustainability goals. Recognizing the "geospatial dimension" of the Sustainable Development Goals (SDGs) and using geospatial data to analyze and calculate SDG indicators is currently being worked out in the United Nations Global Geospatial Information Management (UN-GGIM) initiative. Since the beginning, the BKG has been actively involved in UN-GGIM in Earth observation, especially in surveying (geodesy), linking (geospatial) data and mapping reality on digital, thematic maps (geospatial information). Activities of the Group on Earth Observation (GEO) are also considered. Only by linking core geospatial data with thematic data, e.g. from statistics, reliable forecasts and comprehensive analyses are possible. The BKG is a competent partner at all levels in these fields of activity and is therefore also involved in the national SDG monitoring for the SDG indicators relevant to geospatial data. Not only the geospatial data and services provided by the BKG are used in the national SDG monitoring; the federal authorities are competently supported by the BKG in the development of methods for the calculation of SDG indicators - also using remote sensing data.

Result/Outcome

Participation in and consultation of international and national working groups and projects for the calculation of SDG indicators as well as publication of the results to promote the importance of geospatial information on a national and international level

Stakeholders (Who?)

BKG

Approach (How?)

1. continuously participate in international and national working groups and projects
2. explain and make available results of sustainability indicators and their calculations to the professional community

Instruments (With what?)

Working groups, national SDG monitoring (https://sdg-indikatoren.de/), social networks

Duration	Status (Monitor)
Until 2025	In progress

Risks

- Complex coordination process due to federal responsibilities in Germany
- Changes in SDG indicators at global level cannot/can only be tracked with difficulty
- Lack of personnel resources in the BKG

Cross-references to actions of the GDI-DE

None

Effectiveness for NGIS goals - Which NGIS goal is supported/served by the action?

No. 6: „Verständnis und Mehrwert von Geoinformationen sind bekannt“ (6.1)