

Promotion of Local and Regional Spatial Data Infrastructure Development in Germany

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Key words: Spatial Data Infrastructures (SDI), Spatial Data Usability, e-government, GIS-Implementation

SUMMARY

Since several decades many efforts have been made to establish a powerful spatial data infrastructure all over Germany to support as many users as possible. The paper will describe one recent project initiative in one part of Germany. The main intention of the initiative is to foster the further development of SDI at the local and regional level taking into account the technical and organisational interfaces which are necessary to link both levels. One important subset of SDI is provided by the German surveying authorities. This subset can be looked as the backbone of a comprehensive SDI which covers all segments of spatial data. Nowadays, local authorities usually start from different starting points of their IT development. Some of them already use geoprocessing software tools, others don't do. The requirements concerning spatial data contents, spatial data formats, etc. often are different. Sometimes this is due to organisational reasons, sometimes due to other reasons. All these circumstances have to be kept in mind when developing a strategy to improve SDI at the local and regional level.

ZUSAMMENFASSUNG

Seit mehreren Jahrzehnten werden in Deutschland Anstrengungen zur Entwicklung einer leistungsfähigen Geodateninfrastruktur unternommen, die möglichst vielen Nutzern dienen soll. Der Beitrag beschreibt eine derzeitige Projektinitiative für einen Teil Deutschlands. Das Hauptziel der Initiative besteht darin, die weitere Entwicklung der Geodateninfrastruktur auf der lokalen und regionalen Ebene zu unterstützen, wobei die technischen und organisatorischen Schnittstellen zwischen beiden Ebenen zu berücksichtigen sind. Ein wesentlicher Teil der Geodateninfrastruktur wird in Deutschland von den Vermessungsverwaltungen bereit gestellt. Dieser Teil kann als Rückgrat einer umfassenden Geodateninfrastruktur angesehen werden, die alle Bereiche raumbezogener Daten umfasst. Lokale Verwaltungen stehen zur Zeit an unterschiedlichen Stellen hinsichtlich ihrer IT-Entwicklung. Einige nutzen bereits Programme zur Geodatenverarbeitung, andere nicht. Die Anforderungen im Hinblick auf räumliche Dateninhalte, Datenformate, etc. sind oft unterschiedlich, zum Teil aus organisatorischen, zum Teil aus anderen Gründen. Alle diese Bedingungen und Umstände müssen bei der Entwicklung einer Strategie, die auf die Verbesserung der Geodateninfrastruktur auf der lokalen und der regionalen Ebene zielt, berücksichtigt werden.

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1. SDI LEVELS

The term Spatial Data Infrastructure (SDI) encompasses the policies, standards and institutional arrangements involved in delivering spatially related information from all available sources to all potential users. A spatial data infrastructure provides for a basis for spatial data discovery, evaluation, download and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and the general public.

Currently, many regional and national Spatial Data Infrastructure initiatives are taking place. According to Smits et al. (2002), most of those initiatives are very much in line with the ISO/TC211 and the OpenGIS Consortium developments. In order to get regional and national SDIs interoperable, the INSPIRE - Infrastructure for Spatial Information in Europe initiative was founded. One of its outcomes is an architecture reference model and foundation standards proposed in a Position Paper of the AST - Architecture And Standards Working Group.

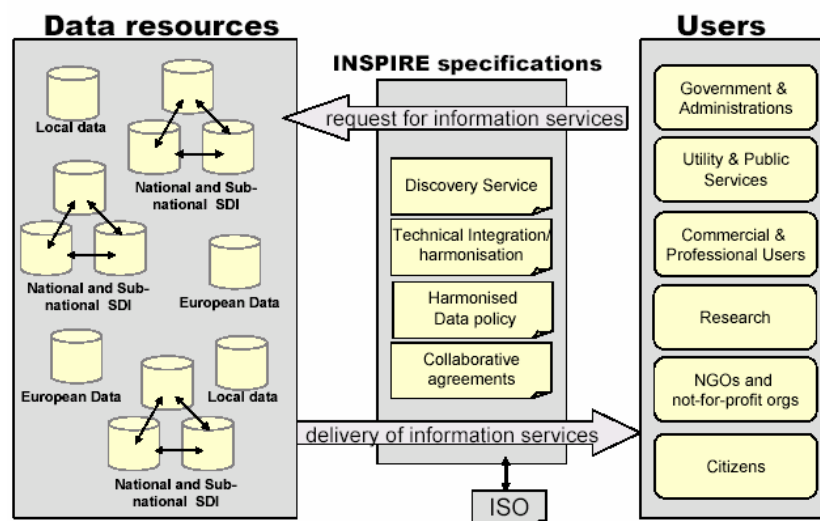


Figure 1: INSPIRE Information Flow (Source: Smits et al. 2002)

INSPIRE is the large current initiative of the European Commission to promote the multipurpose availability of feasible geographic information. The purpose of this initiative is to support European Community policies with a territorial dimension or impact. INSPIRE is supposed to address technical standards and protocols, organisational and co-ordination issues, data policy issues including data access and the creation and maintenance of spatial

information in the context of a European Spatial Data Infrastructure ESDI. The INSPIRE vision outlines a Spatial Data Infrastructure which addresses data resources at the European level, at the national and sub-national level and at the local level, as well. The INSPIRE initiative even links with relevant initiatives at the global level such as the work concerned with a Global Spatial Data Infrastructure (GSDI). Therefore, the INSPIRE principles should be considered at all levels of an SDI implementation.

At the sub-national or regional level, one of the main goals is to process all relevant geographic information by jointly linking it to the information available at the two adjacent administrative levels, namely to the national level at the one hand and to the local level at the other hand, respectively. The needs of potential users have to be elaborated in detail with regard to access to transformed data, pictures, maps, reports, multi-media content, to metadata search and retrieval for data and services, to data access at distributed content repositories located at different geo-spatial data servers and so forth.

The following sections describe a project which supports the implementation of a regional level SDI. Special credit is given to the situation in one of the German Laender, Rheinland-Pfalz.

2. THE REGIONAL LEVEL IN GERMANY

2.1 Background

Germany is a federal republic consisting of 16 states (so called "Länder"). One of these federal states is Rheinland-Pfalz with 4 million inhabitants. Rheinland-Pfalz itself consists of 24 rural district areas (see Figure 2).

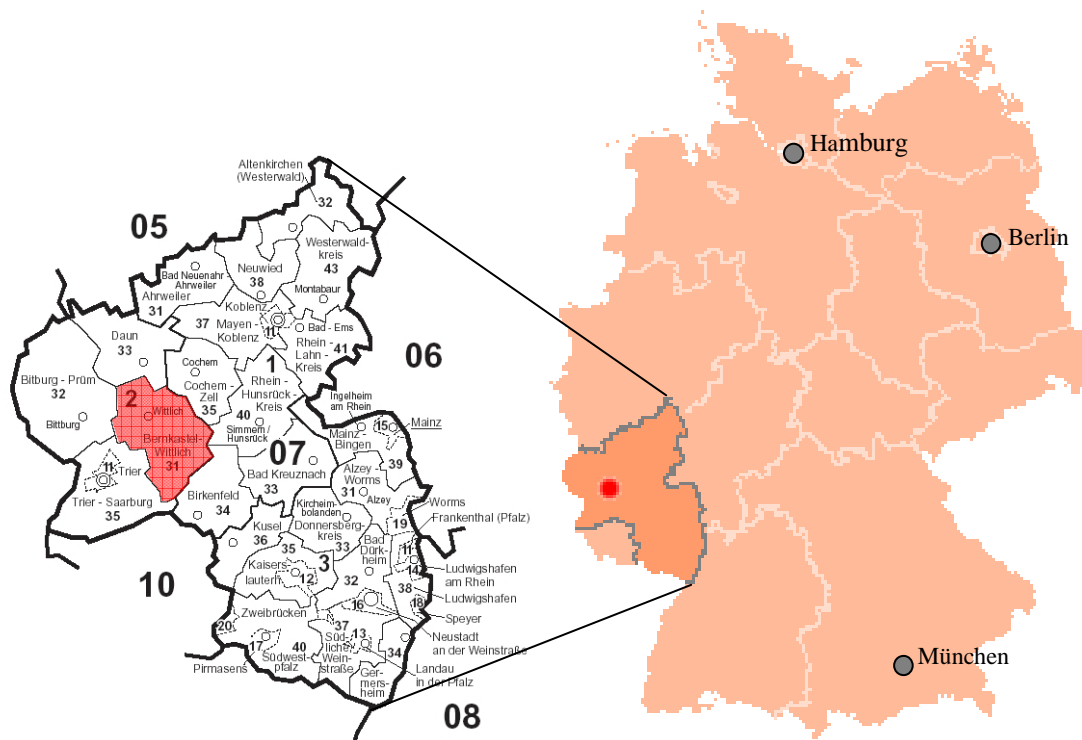


Figure 2: Administration Levels of Federal Republic of Germany

The Nomenclature of Territorial Units for Statistics (NUTS) was established by Eurostat in order to provide a single uniform breakdown of territorial units for the production of regional statistics for the whole European Union. Every NUTS-territory has an individual alphanumeric code attached. The German Länder form the German part of the European NUTS 1 level territories, the same holds for the German rural district areas forming the NUTS 3 level territories. For all 24 rural district areas (NUTS 3) being part of Rheinland-Pfalz (NUTS 1) a GIS implementation is planned.

The tasks of a local authority, one for each rural district area, are very complex. Several hundred employees care about the needs of the citizens, which concern nearly all areas of life: Education, sports, civil protection, nature conservation, preservation of ancient monuments, building inspection, motorcar permit, social welfare, youth matters, decrees, to name a few of them.

The federal state of Rheinland-Pfalz, like entire Germany, faces two big challenges. It has to work with less money and at the same time it should change the service for the citizens and for the economy for the better. The intention is to achieve a modern public administration which is efficient and transparent, which accomplishes more and costs less. One of the steps towards that direction is the implementation of a GIS-System which a spatial data infrastructure demands for.

In the past, the local authorities had invested – if they had done so – into systems which are able to work with structured data only inside a closed local authority unit.

Important information, which is of prime importance for these organisations, is available in a wide range of different formats and is maintained either on incompatible systems like special data-servers, general purpose web-servers, data bases or is still available only in an analogue form like on paper sheets and on paper maps. As a result, co-workers of public administration bodies spend 30 % of their time to search for information, according to a study of the DELPHI-group.

The government of the federal state Rheinland-Pfalz intends to promote the GIS-implementation in context of an overall e-government solution.

2.2 Motivation

There is one regional authority which is responsible for the provision of the geo-spatial basic data of the state, called LVerGeo Rheinland-Pfalz. In 2002 the LVerGeo contracted with the Landkreistag Rheinland-Pfalz, the umbrella organisation of all 24 local authorities.

According to this contract the local authorities are licensed to use all geospatial public administration basic data available in

- the Automated Real Estate Register – ALB
- which includes information about land parcels (e.g. key numbers, location, ...), type of property, ownership, etc.
- the Automated Real Estate Map – ALK
- which comprises cadastral boundaries, landscape parcels, type of landuse, buildings, special topographic features, house numbers, etc.,
- Digital Landscape Models – DLM
- Digital Topographic Maps – DTK
- Digital Terrain Models – DGM
- Digital Orthophotos – DOP

In the past - every local authority had to pay a specific licence fee to the LVerGeo for every data set they needed. As a result of the contract they get all the data they want for a lump sum which is to be transferred once a year from their umbrella organisation to the authorities providing for the geospatial data.

3. GOALS

The ambition of the study is to develop a conceptual model, where the business processes of a local authority are mapped as far as they are directly linked to GIS matters. The benefit and the application potential of a GIS will be clarified by documentation and analysis of these business processes.

The conceptual model has to be compatible with the ISO-standards and the recommendations of the OpenGIS-Consortium. ISO as the "International Organisation for Standardisation" is a network of national standards institutes from 147 countries working in partnership with international organisations, governments, industry, business and consumer representatives. The Open GIS Consortium, Inc. (OGC) is a member-driven, non-profit international trade association fostering the development of geoprocessing interoperability computing standards.

It was assumed that in all the 24 local authorities the same business processes (combined intersection) are running – which in the meantime could be shown to be true in reality.

The project develops a GIS implementation strategy for one exemplary local authority. The strategy has to support the modular build-up of a GIS. The requirements for the GIS solution are described in detail in a set of specifications. This set will become the basis for the tendering procedure later.

By reason of its modular build-up the study will support all local authorities at the same time:

- Authorities which have still no GIS in use
- Authorities which already use a GIS-System, and want to optimise it
- Authorities which use a GIS-System and want to adapt it to additional requirements

This ensures that all local authorities addressed by the study can take their benefits from the project no matter in which stage of the GIS implementation they are. Another goal of the study is to develop a strategy how to build up a spatial data infrastructure for the co-operation and the data exchange within the local authorities themselves on the one side, and in between the local authorities and other public administration bodies on the other side. All existing spatial data which are generated in the different administration bodies have to be integrated.

4. PROJECT ORGANISATION

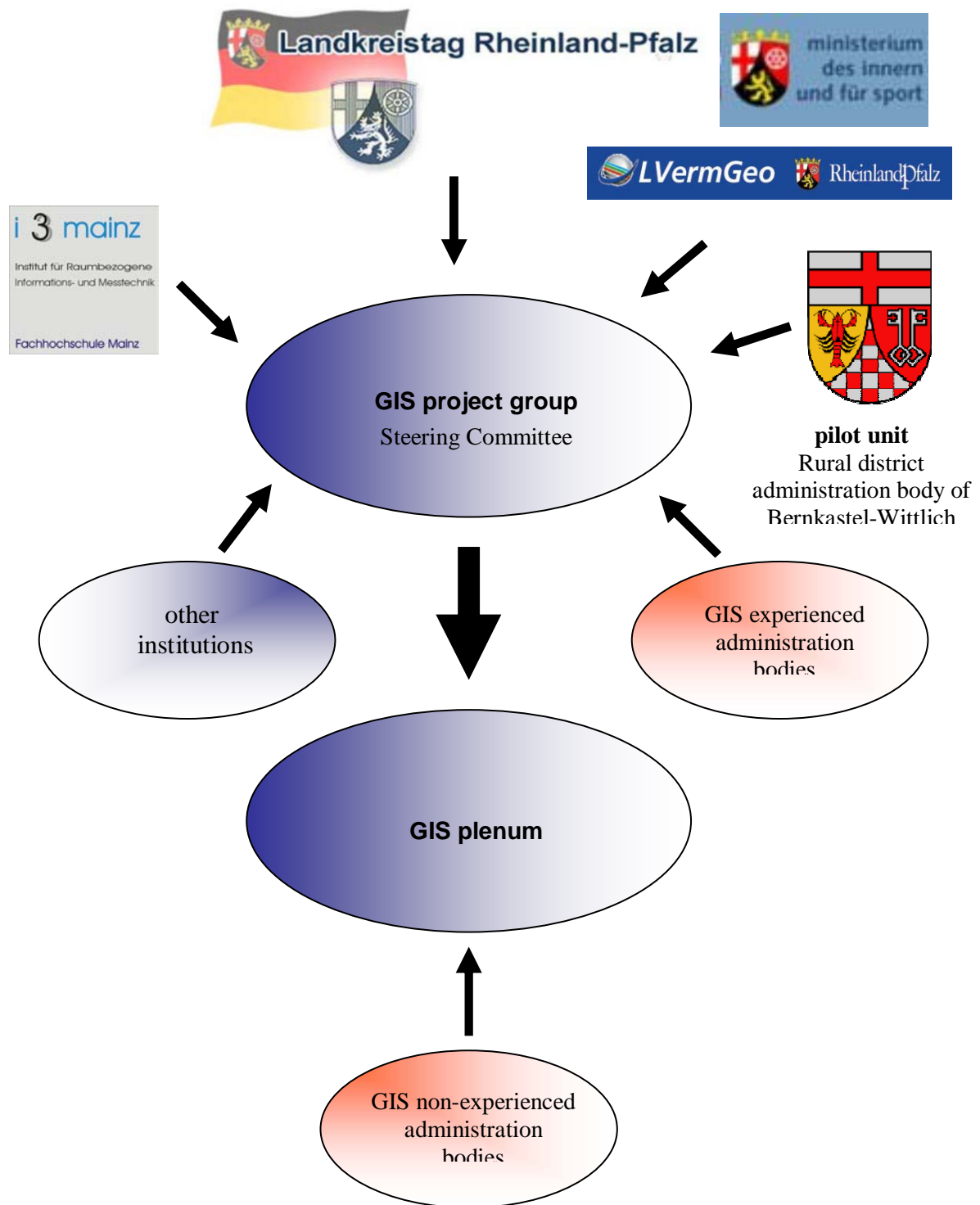


Figure 4: Project organisation chart

The first stage of the project had a runtime of 18 month and finished in December 2004. It was financed by the Landkreistag Rheinland-Pfalz, which is the local central association.

- One of the 24 local authorities was selected as a *pilot authority*.
- *i3mainz* performs the work for every item of the workplan in the pilot authority
- The work results are presented to a project group on a regular 2 months time basis
- The *project group* exists of approximately 20 experts.
- The group members are co-workers of those local authorities which already gained experience in the tasks of how to build up and to maintain a Spatial Data Infrastructure.
- This group is responsible for the continuous audit of the attained results, with the purpose to achieve transferable results from the pilot unit to the other 23 local authorities.
- After passing the project group audit, the results are presented to all authorities and to the GIS plenum which meets twice a year.
- The *GIS plenum* exists of more than 50 people.
- The plenum consists of 2 responsables from all affected 24 local authorities.
- The members of this group transfer the study results to their own local authority.

5. PRINCIPAL WORKPLAN

The following procedure model defines the stages of the principal project workplan.

- System analysis, including:
 - strategic planning
 - actual field research and analysis
 - conceptional modelling
 - professional concept
 - IT-concept
 - cost-benefit-analyses
- System choice, including:
 - public tender
 - offer rating
 - functional tests
 - system rating, system recommendation
- System implementation, including:
 - system installation, system acceptance
 - data acquisition, data migration
 - system use

6. CURRENT ACTIVITIES

At the moment of writing this paper, the following activities were completed.

- System analysis - strategic planning

The study is being performed in joint cooperation with the project-group. All elaborated documents are collected and archived to generate medium-term and long-term valid guidelines for the GIS implementation in Rheinland-Pfalz, Germany.

- System analysis - field research and analysis

Firstly, the local authority of Bernkastel-Wittlich was chosen as the pilot authority.

The pilot authority consists of 20 departments. Like in a production environment, the work results of an administrative unit can be labeled with the term 'products'. Every department is responsible for a specific list of such 'products'.

The field research bases upon the 'products' as it's principal unit. The reasons therefore are:

- the meaning of the term 'product' is well established and well understood in all units
- project results obtained for 'products' can be easily transferred to the other 23 local authorities, because they use them, too.
- 'products' are well suited to show the GIS application potential.

Altogether about 170 different 'products' were identified. 'Products' for example are:

- tourism support of tourism in the region
- building administration management of the buildings owned by the authority
- finances bank credits, safeguard credits, financial statistics
- roadworks to ensure save roads
- traffics organisation of school buses, public traffic
- heavy loads control of heavy loads crossing the region
- infection prevention avoidance of infectious illnesses
- land use regulation control of land use in the region
- landscape architecture to guarantee for a feasible development of cities and villages
- protection of species protection of wildlife habitats
- drinking water control to guarantee for the quality of drinking water
- agrarian subsidy to distribute special subsidies for farmers

To analyse the user requirements for all 'products' two questionnaires were developed.

- *Questionnaire 1* gives an overview about the 'products'. For all products it includes the following items:
 - What is the purpose of the product?
 - Which data are in use ?
 - How is the spatial data reference defined?
 - Which software will be established ?
 - Which formats will be used ?
 - Is a a GIS-System / Online-GIS-System still in use?
 - Is it possible to support this product by a GIS-application?
 - Is it possible to use the geo-spatial basicdata provided by LVerGeo ?
 - Which other authorities take part in the results?
 - How many people access the data ?
 - Are there any special problems ?

After survey completion all products were sorted in 5 categories to get a first idea of the existing GIS potential (see Table 1).

The meaning of the categories is:

- spatial data exists – GIS-applications are already in use
- spatial data exists – user-potential clearly identified – highest priority for implementation
- spatial data exists – implementation priority to be defined after the cost-benefit-analysis
- no spatial data exists – no own spatial data processing, GIS-analysis and –results to be used
- no spatial data exists – only administration procedures, no GIS is possible / benefiting

Evaluation category	Number of products	Percentage
1	8	5 %
2	8	5 %
3	134	77 %
4	3	2 %
5	19	11 %
Sum of 'products':	172	100 %

Table 1: Summary of product evaluation

Most of the 'products' are in category 3. This means that a GIS application would be possible in the most cases, but we have to check up the cost/benefit ratio before investing. Not every potential product with spatial data involved will become a GIS-application.

- The next step was to develop the questionnaire 2 for all products in the evaluation categories 1 till 3.

We used this questionnaire only for the products in categories 1 to 3, because only these 'products' have a GIS-potential, thus reducing the amount of exploration work for many project participants.

- *Questionnaire 2* is dedicated to gather more in-depth information concerning data-structures. It queries for the following items:
 - Notation of the data
 - How much analogue, how much digital data is existing ?
 - Is it graphic or alphanumeric data ?
 - Where does the data come from, who produces it ?
 - How accurate is the spatial data ?
 - Are there regular data updates ?
 - Exist data for the same subject with different time validity (historical data)?
 - Are metadata considered ?
 - How is the data availability ?
 - Exists synergy effects with other products?
 - Exists a data protection / privacy policy?

This questionnaire was filled out by performing personal interviews with the persons who produce the according products. Thanks to the fact that the interviewed persons had joined a presentation about GIS in the past, they knew what a geo information system (GIS) could perform and what it could handle, which helped to speed up the interview process. General information concerning the IT structure was gathered directly from the IT department. Some interesting information which is still missing like currently available skills of the potential users, for instance, will be collected in a later project phase.

Following the principal work plan the results were presented to the project working-group, passed the audit and will be presented to the GIS plenum.

7. SURVEY RESULTS

- A local authority produces about 170 different 'products'.
- About 85% of the 'products' of the local authorities have a spatial data component.

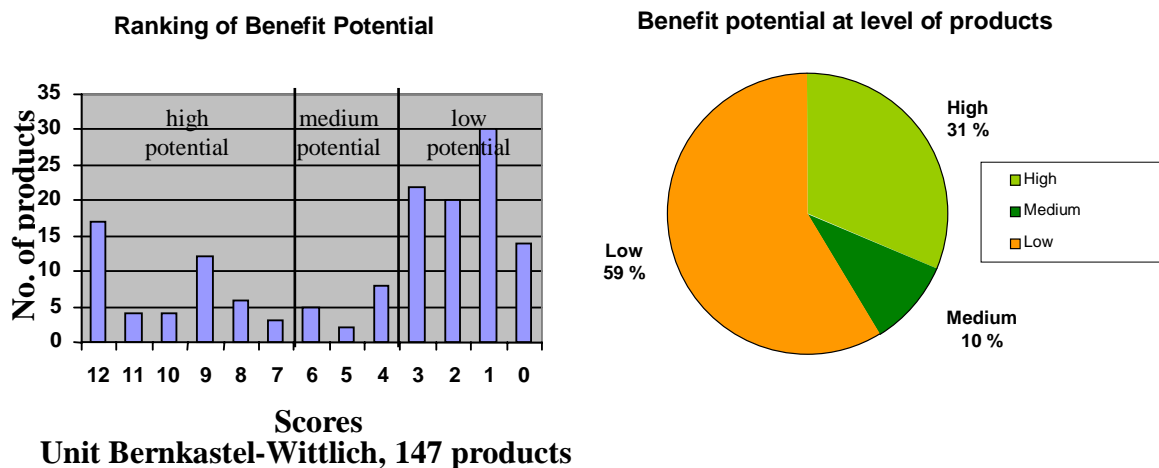


Figure 5: GIS benefit potential in a German public local authority

- For about 30% of the products with spatially related data involved the use of GIS yields a high profit in terms of the benefit potential ranking (see Figure 5).

8. REQUIREMENT SPECIFICATION

The requirements of all products for which a high or medium benefit potential of spatial data processing facilities was identified were collected in a comprehensive document consisting of the complete set of specifications. A formalised presentation method was used, namely the graphical needs presentation in the form of use case diagrams, one for each product (see Figure 6). The formal description language UML provides for the tools to generate such diagrams.

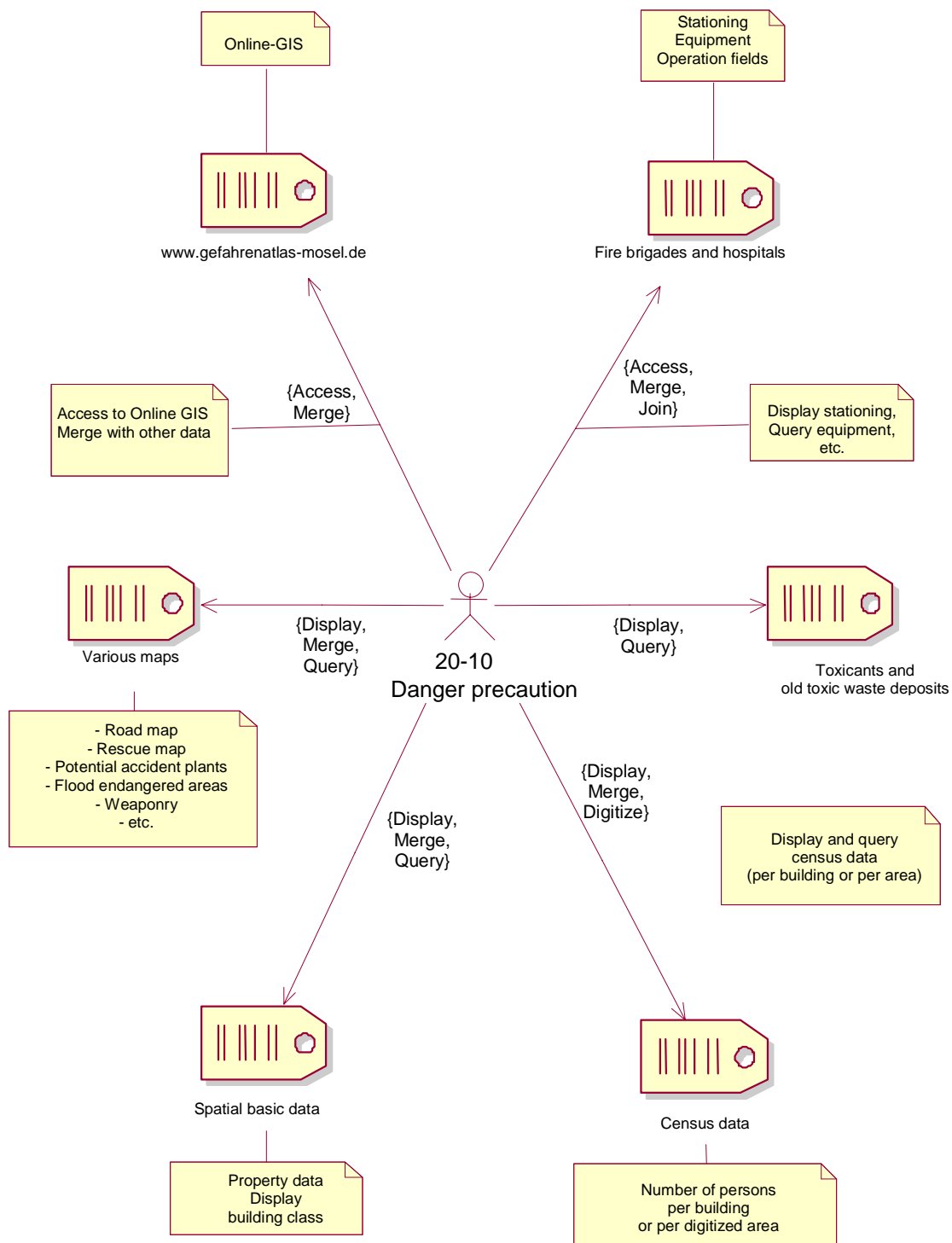


Figure 6: Use-case diagram for the public service product ‘Danger precaution’

The Unified Modelling Language (UML) has become an industry standard for specifying, visualising, constructing, and documenting the artefacts of models for software-systems, business-models and other non-software-systems. It simplifies complex processes, by making a “blueprint” for the construction.

The following reasons to use UML in this project were identified.

- Relations between actors and use cases can be shown
- Relations between different use cases can be shown
- When modelling the system we can follow an object-oriented approach
- UML is in use in a new conceptual model for the German geospatial basic-data.
- UML helps to structure the problem
- UML helps to generate the documentation.
- UML helps to prepare for the functional specification.

As the main diagram class, we used the use-case-diagram class, which shows the relation in an easily understandable way. Use case diagrams, therefore, are very well suited to link the users point of view on the one hand to the needs of the precise IT specification on the other hand. Figure 6 shows the requirement specification for the product 'Danger precaution' which is one of the services produced by the administration body under consideration.

9. CONCLUSIONS

A broad survey took place to explore the current situation in regional administration bodies in the south-western part of Germany. The result of this step was a documentation of the current status of the use of geoprocessing software tools and the users needs concerning spatial data structures and spatial data processing routines. Implementation of a spatial data infrastructure including all needed data, IT functionality, personnel skills, etc. is an ample task, sometimes long lasting and costly. That is why, usually, a step by step approach has to be used. Cost benefit considerations were made to identify the potential benefits obtainable through an SDI. From the concrete benefit numbers a priority list was generated, which can be used as a guide for the subsequent implementation steps which will take place in the near future. The users needs were collected in a comprehensive document which consists of a detailed description of all requirements and which is intended to be used as a technical base for future IT acquisition procedures.

The current situation concerning SDI at the local and regional level suffers from its heterogeneity and, partly, its non-availability. The backbone of a widely usable SDI is provided by the surveying authorities. Further efforts have to be made to bring together this backbone of an SDI with all other SDI components provided by a broad community of current or potential users. Improvements are necessary at both, technical and organisational, levels. Integration of SDIs from different levels is a core part of functionality. Guidelines on how to achieve this integration can help to promote the integration work in practice.

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