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THE DIGITAL SERVICE FILE (DSA) – THE RAG INTEGRATION AND INFORMATION PLATFORM FOR SPATIAL DATA

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ABSTRACT

Purpose	The Digital Service File (DSA) is the RAG intranet portal for the long-term application of geodata and other data sources. It combines the functionality of modern mapping services designed for spatial analysis and display with a searching service that includes full-text searches of various data containers held by technical departments. The DSA is available as a web application to all employees of the RAG Group on the basis of existing authorisation criteria.
Methods	The system uses GIS and search technologies that are now routinely employed by RAG (Esri ArcGIS and MOSS – Microsoft Office Sharepoint Server). The web interface is based around the Microsoft Silverlight application framework.
Results	Since the system's successful launch in 2011 the DSA has been continuously augmented with additional key components. Users can now employ DSA 2.0 to access the RAG drawings archive containing more than 100,000 mine drawings and plans as well as the RAG aerial photograph archive, which also has more than 100,000 aerial records.
Practical implications	The incorporation of various general components, such as personalisation (myDSA), high-quality map output, the linking of additional data containers in SAP and ELO and the integration of special, process-supporting "tasks" (e.g. mining subsidence processing), is now leading to the more widespread use of the DSA system.
Originality/ value	The DSA is an indispensable tool which will continue to support and reproduce core processes in the future.

Keywords
spatial data, GIS, Sharepoint, personalisation, mine plans, aerial photos

1. INTRODUCTION

1.1. Background

RAG has been using geo-information technology for resolving geospatial questions for more than 20 years as an integral part of many of its business activities. This practice was initially put in place for active mining operations involving statutory planning and approval procedures. While this remains a key part of the company remit, an important offshoot has now developed as part of the "long-term consequences and liabilities" programme. Over the coming decades – and this means well beyond the date when the German coal industry ceases production in 2018 – geospatial data are still likely to be in great demand for solving all kinds of issues related to mining subsidence, mine surveying, real estate and mine water.

This data covers a range of subject areas and is held at various organisational levels (Fig. 1), in different EDP systems and in a number of different analogue archives (Fig. 2). Legal and operational requirements mean that many of the data files have to be kept available for many years to come.

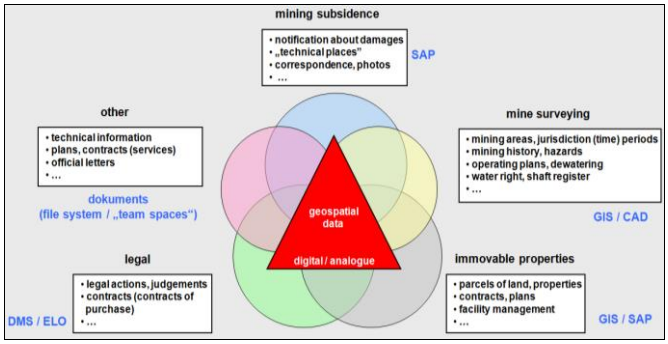

Fig. 1. Specialist areas requiring geospatial data (extract)

Because of the Government's decision to downsize the German coal mining sector there will be increasingly fewer qualified personnel available to the industry in the years ahead. In order to compensate for the resulting loss of expertise, ensure greater knowledge transfer and support the company's ability to provide information as and when required an information and integration platform – the Digital Service File (DSA) – is now being developed for all RAG geospatial

information (Fig. 2). As the mining industry's long-term consequences and liabilities will impact on a number of subsidiary companies (RAG Deutsche Steinkohle, RAG Montan Immobilien, RAG Anthrazit Ibbenbüren), the DSA is being developed for use as a Group-wide operating tool.

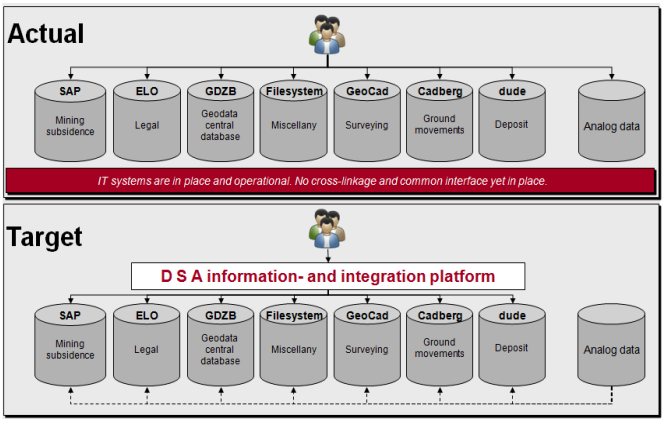

Fig. 2. The RAG geospatial database (actual and target status)

1.2. Functions and objectives of the DSA

The DSA ensures that geospatial data is available across theme and organisational boundaries, which not only reduces the cost and effort involved in resolving geospatial questions but also improves the quality of the service provided.

The system interprets the concept of "spatial information" or "geospatial data" in an extended way. This means that as well as GIS and CAD data it can search other documents with direct or indirect spatial dimensions, including references in Office documents and in ELO or SAP files in the form of addresses or other spatial terms (GeoNames). This form of integration means that, for the first time, a comprehensive full-text search can be made of all data containers based on a wide range of attributive and spatial search criteria within the same request. The DSA therefore combines the functions of a conventional cartographic service, providing for the analysis and depiction of geodata, with the possibility of carrying out full-text searches in various data containers relating to different specialist areas.

The DSA is not just a substitute for the working procedures currently undertaken by technical departments but it is also intended to provide additional support to these processes which are currently effective and practical. Moreover, the DSA will be used to assist current operations and it will also provide support for processes that will be required as part of the mining liabilities phase that will last for many decades to come. As these processes and the parties involved cannot yet be fully and accurately described, the basic requirements for the DSA system, as defined from day one, were to include a high degree of flexibility along with the possibility of expanding the user interface (GUI), the functions and the scope and type of the interconnecting data containers.

In order to create a user-friendly system that can easily be applied by as many Group employees as possible, the DSA was designed as a web application operating within the RAG's own Intranet on the basis of existing GIS and search engine technologies and in compliance with current authorisation concepts.

The DSA also includes personalisation features that will enable the system to meet the specific needs of individual users (myDSA). One of the problems the design team faced was that these features could not be precisely specified to accommodate all future requirements.

Initial ideas for creating a new geospatial data structure for the long term and building a new, cross-discipline data model were soon dropped for reasons of cost, acceptability and resource availability. The DSA system is instead based around the concept of "structured access to unstructured data". With few exceptions the existing data pool will therefore be retained in its current form and the responsibility for this data will also remain in the hands of the data controllers at various technical departments. This concept also improves the level of acceptance, as the departments in question do not have to change their databases or their operating processes just to accommodate the new DSA system, while at the same time the DSA can be built into their procedures at any point where it is considered to be of benefit.

Another advantage of the DSA system is that it brings greater transparency on a company-wide basis. Where are certain types of data connected to a particular theme being held? Even if an interested party does not have direct access to the contents of a data file because of a lack of proper authorisation, they will at least have a pointer to indicate the existence of the information and the department where it is being stored.

Greater data transparency will in addition lead to an improvement in data quality at the attached data containers.

As an integration platform the DSA will also enable parametrised switching into third-party systems, for example opening the identified documents using appropriate standard applications or switching to SAP workflows for selected data records.

2. METHODS

2.1. Data analysis

At the start of the DSA development process in 2009, group-wide analysis was carried out to trace those data stocks that were being held with an extended spatial dimension and which could be made available via the DSA. An investigation was also carried out to identify who was currently responsible for this data, who used it and the processes in which geospatial data was being put to use. This analysis yielded 395 individual databases that were subsequently allocated to one of ten thematic blocks and to one of 78 newly defined geo-object types (for example height, address and infrastructure). Some 80 attributes were specified for each database on the following subject areas:

- data format
- data volume
- data quality
- storage period
- up-to-dateness/completeness
- use/processes
- interfaces/responsibility
- authorisations

The 395 databases were quantified and prioritised. In total there was an estimated volume of some 40 terabytes of digital

data and 8 kilometres of recorded analogue data. The analogue data files were not initially processed as part of the DSA project but were digitalised as required by the relevant specialist department and only then integrated into the DSA system.

2.2. Technical conception

When designing the Digital Service File as a centralised information and integration platform for the RAG Group, the maintenance and use of the decentralised, distributed data storage system and the integration of data with a spatial reference were deemed to be the determining criteria for the architectural blueprint and the choice of technology.

The corporate data, which was distributed over various source systems, was to remain in their respective storage locations and be subject to integration into the information platform via existing or newly created interfaces.

At the same time, the implied spatial reference for all connected data serves as the integrating factor between the data records from the different source systems. The allowance made during the search process for this geographical affiliation of data from different sources is one of the core functionalities of the DSA and it is this that provides the real added value compared with conventional, keyword-based search-engine technologies.

The company's existing server technologies, namely Microsoft Office SharePoint Server 2007 (MOSS) and ESRI ArcGIS Server 10 (Table 1), were used as the basis for the build-up of the integrated information platform.

Table 1. Server technologies for the build-up of the Digital Service File

Technology	Manufacturer	Core functionality
Mircrosoft Office SharePoint Server (MOSS)	Microsoft	Enterprise Search (search and indexing)
ArcGIS Server	ESRI	Enterprise GIS (map presentation and geodata management)

These technologies provide the services that are required by the integrated application and backend processes. The interfaces between the subsystems and between the different architecture layers are designed as web services. The architecture of the overall system (Fig. 3) therefore mirrors the template used in service-oriented architectures (SOA).

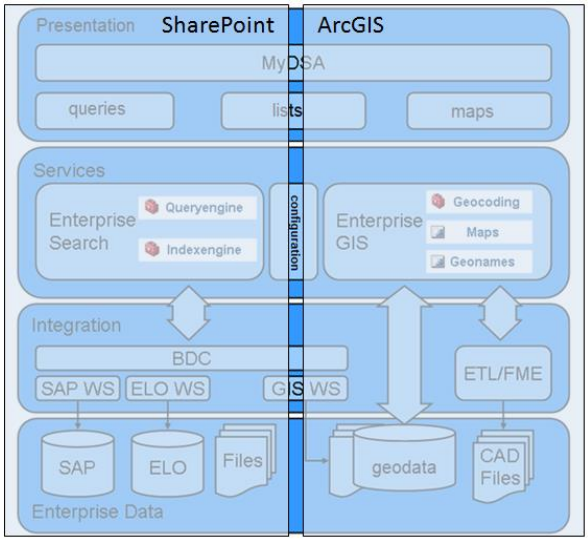

Fig. 3. Overall system architecture used for the Digital Service File

The decoupling of the subsystems based on a layer architecture and the service-oriented integration of the backend systems, together with the configurability of the system components, makes it easier to expand the platform by including additional content and data sources.

2.2.1. Indexing of the data sources

The integration of the data sources into a centralised, searchable index provides the basis for a cross-element search through the different data containers. Here the data is not duplicated but is merely indexed for a full-text search. Table 2 shows the data sources that were linked-in for the first version of the DSA.

The Microsoft Office SharePoint Server (MOSS) is used as the standard technology for carrying out a DSA indexing and search routine. The linked data sets are interrogated at regular intervals and all relevant information is placed in a central index along with a unique file identifying key.

Table 2. Connected data sources and systems

Source system	Data source	Description
ArcGIS	Geodata	Spatial data on various specialist themes
SAP	Subsidence file	The mining subsidence file is an SAP based application that was specially developed by RAG for handling subsidence claims
ELO	Electronic Leitz folders	Electronic archive for Legal Department files
SQL Server	Shaft register	The Shaft Register is a web-based application for managing shaft information using an MS SQL server database
Filesystem	Datafiles and documents	Relevant files from the file system

The different source systems can be linked to the MOSS via a standardised interface for indexing and search purposes. Any particular data source from databanks or other business systems can be indexed via an XML-configurable Business Data Catalogue (BDC). The data for indexing from such third-party systems is interrogated via standardised web-service interfaces. In this way it is also possible to index SAP data from mining subsidence files and geodata from the RAG geodata infrastructure (GDI) and then to integrate this information into the search index so that a full-text search can be carried out.

The geodata from the RAG GDI system are already accessible via the ESRI ArcGIS Server platform in the form of geo-services with a standard web-service interface. In order to achieve optimised access from the indexing runs an in-house MOSS web-service adapter, which also provides an incremental update of the database, was set up for the source systems GIS, SAP and ELO.

2.2.2. Subject search

The subject search enables a structured search of the unstructured data integrated in the index. By entering a simple keyword a search can be undertaken for existing data in various subject groups and in the corresponding geo-object types. Additional search settings and combined search queries can be defined by way of various search options and advanced search function.

In the advanced search mode a time filter can be activated for documents from the datafile system, SAP or ELO. When searching through the indexed geodata it is also possible to use the objects selected on the map as a search criterion for the index interrogation.

Depending on the setting and combination of the advanced search criteria there are different index interrogations in the source systems with different query outputs.

The differences in the search requests arise from the different characteristics of the data sources. As the geodata does not have a timestamp there is basically no time filter involved. Moreover, when activating the map section as a geodata search criterion a direct search can be made in the key attributes of the index for the object ID (OID) of the geo--object. By contrast, when dealing with document-based data sources the map section can only be searched via the geospatial keywords (GeoNames) in the map extract. The GeoNames and/or geo-objects in the map section are initially established through a geospatial search of the GIS layers before an index interrogation, combined with additional search criteria, is undertaken with the hits from the GIS interrogation.

3. RESULTS AND DISCUSSION

3.1. Current developments

While the first phase of the DSA development project was mainly concerned with the extensive search features and their interaction with the map functions, including the linking-in of data containers from diverse specialist departments, the next stage in the development process focused, firstly, on extending the functional scope of the DSA and adapting it more closely to the individual needs of the user, and, secondly, on integrating into the DSA, or newly implementing for the system, process-supporting applications already used in other web services.

3.1.1. Extended range of functions

myDSA

The DSA now makes the following available to the user: a comprehensive range of functions, tools and content sources that in the rarest of cases may all be required in full, and at the same time, in order to process the enquiry. Personalised software plays a significant role in this context. The personalised software has been designed with the user very much to the fore – and not just at the development stage but also for the entire service life of the software, which means that the functions and features are optimised in accordance with the needs and demands of the individual end users.

In the DSA this personalisation feature is represented by the "myDSA" function that allows the user to store in profiles, and within the application, all the settings he/she has activated in the DSA, such as the choice of search options, the selected map contents or the layout of the dialogue windows. These settings can then be re-used at a later date and even shared with colleagues.

A great deal of care was taken to provide all the DSA modules with this personalisation interface, the aim being to ensure a high degree of personalisation and to increase user acceptance accordingly.

As well as personal profiles, which each user can create and edit on an individual basis, every user is also provided with global profiles that are generated centrally by the DSA system administration. These profiles will serve, initially, as an instrument for switching from the older web services, which are soon to become obsolete in-house, to the new DSA system, in that they will mimic the "look and feel" of the existing web system while at the same time displaying current applications now being used throughout the Group.

The user will therefore be provided with an interface and functions that he/she is already familiar with from other applications and will in addition have access to other useful content resources and tools that will help him/her to pursue the enquiry.

Figure 4 shows examples of the two profile variants described above that the user can employ to construct an individually tailored DSA in line with his/her specific requirements.

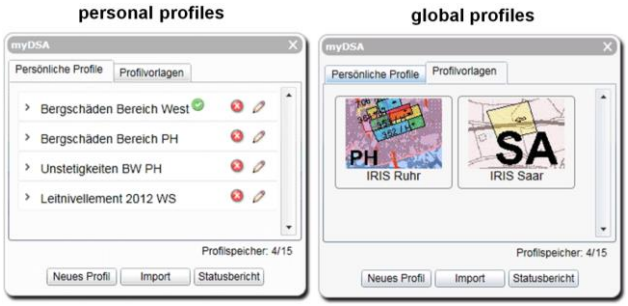

Fig. 4. myDSA profiles

Personalised search features

Special attention was also given to developing personalisation features within the search function and a large number of search filters have been put in place so that as part of the current DSA configuration level the user is able to formulate his/her search query to best advantage him/herself so as to obtain the most effective search results. Often the user invests a great deal of time in compiling his search options, only to find that these are so strongly tailored to one question that they cannot then be readily assigned to other problems. At this point the user can now resort to the aforementioned myDSA feature, generate a new profile and adapt their search options fully to match the new query.

Figure 5 shows the wide range of search filters that can currently be used in the DSA. One particularly useful feature is the file filter that consults the user's rights of access as part of the search query, thereby yielding only those results that the user can process and make direct use of. Another optimisation possibility is to use additional filtering by file type, an option that the user can deploy to refine their search results.

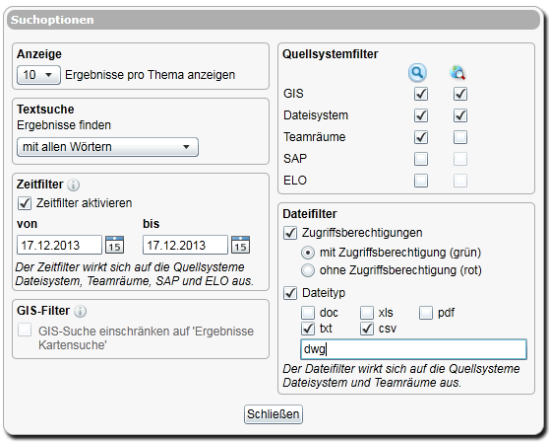

Fig. 5. Search options

Timeslider, legend and bookmarks

The current version of the DSA has also incorporated the time factor into the application. Themes that include time-relevant information can now be addressed directly by using a timeslider that allows their status to be depicted in various time slices.

If the user has access to historical data and wishes to use this to obtain information relating to different time spans the user can now generate the relevant details within the DSA system.

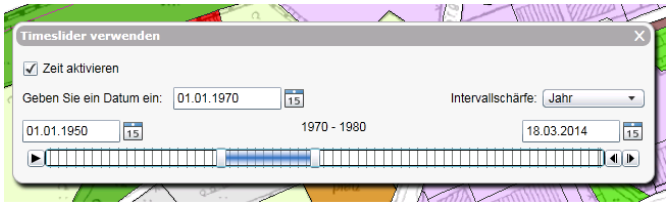

Fig. 6. Timeslider

The timeslider feature further extends the wide range of map contents available within the DSA and this makes it imperative to have access to a set of descriptive and dynamic captions as part of the application. The DSA is provided with a high-performance "legend" that adjusts itself dynamically to the map contents and ensures that the user has a full caption overview at all times, even when a wide range of content is selected simultaneously.

Application of the bookmark feature is closely linked with the "myDSA" function, for when the user is working through a case he/she often has to look up different spatial sections but does not want to set up an individual profile for each one. In such a situation it is practical to store these spatial sections via bookmarks and then to create a profile for them later in the procedure.

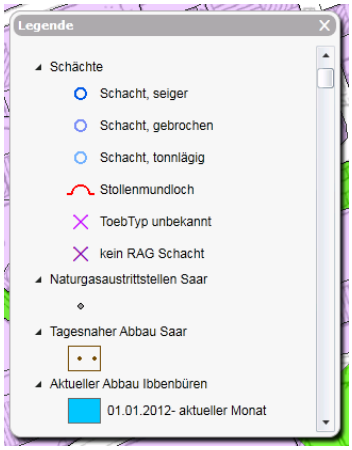

Fig. 7. Legend

Fig. 8. Bookmarks

3.1.2. Integration of new applications

While the first part of this paper covered the functional expansion of the DSA for personalisation purposes, the following sections will examine the integration of new applications, and the migration of existing services, into the DSA.

Mine-plan archive

The greatest challenge faced so far when developing an application module has involved the integration of the mine-plan archive into the DSA.

Here the solution that was ultimately developed had to be not only high-performance but also future-proof. More than 100,000 mine plans, representing over 500 GB of data, had to be processed from all kinds of maps and drawings for presentation in the DSA. To this effect the entire archive process, from data storage and the calculation of overviews to the depiction of raw scans, was completely revised and optimised in many areas.

This particular DSA function impresses because of its performance and intuitive easy handling. The user can either click or draw a line on the map to search for all relevant plans and can then have these displayed on the map. He/she can also refine the search for plans and drawings in all kinds of ways, for example, by adapting the search radius, the depth and even the limiting angle to suit his/her individual requirements.

Users can in addition easily record the editing of the search results within the mine-plan archive by marking the different drawings as "processed" or "relevant", by using different filters or by generating a report as a PDF file.

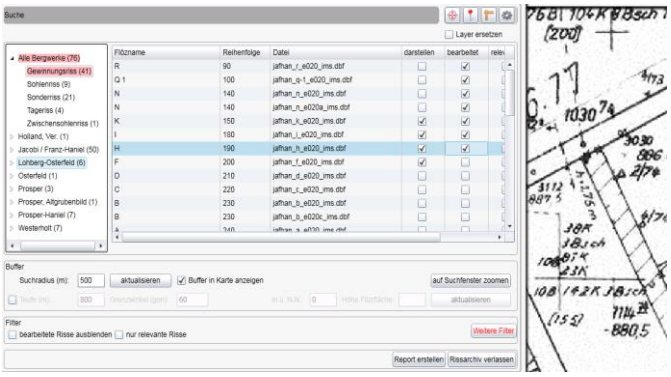

Fig. 9. Mine-plan archive

Aerial photo archive

RAG has in its possession more than 100,000 aerial photographs (black and white, colour and colour-infrared) taken between 1969 and 2014 with a ground resolution of down to 5 cm. These are used as a basis for producing orthophotos, layout maps and surface plans, elevation models and three-dimensional visualisations of, for example, spoil tips, surface installations and areas under mining-subsidence investigation.

To ensure that in future all these aerial photos can be kept available from the archive for internal and external enquiries it was decided that the digital aerial-photograph archive should be integrated into the DSA for use within the Group.

Every RAG employee is now able to find and display aerial photos by carrying out a direct search either via a map or a project. Any photos found can then be displayed on the map, while non-geographic aerial images can be opened in an extra window. The user can also retrieve additional information relating to the recording of the images, such as the flight date, the image scale, the camera and any products resulting from the shots.

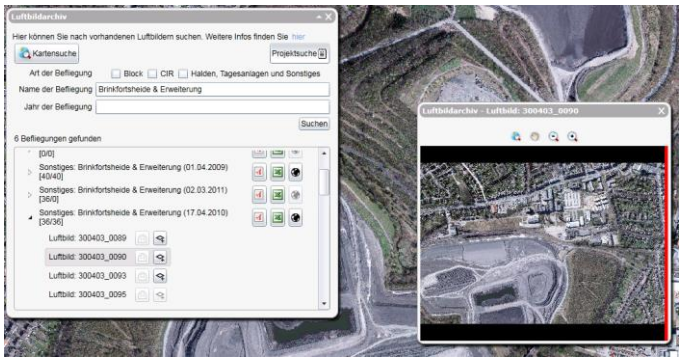

Fig. 10. Aerial photo archive

4. CONCLUSIONS

In its current development stage the Digital Service File (DSA), as an information and integration platform for the long-term utilisation of geodata within the RAG Intranet system, is able to replace all of RAG's existing map services and act as a hub for all kinds of specialist applications with a spatial relationship. It provides the user with a wide range of tools and content and its multiple personalisation options are designed to meet the most demanding individual requirements.

The ongoing aim of the project is to continue the future-proof development of the DSA, to involve the user in this development process, to create interfaces with other systems and, most important of all, to go on supporting and reproducing the core processes.

Acknowledgments

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