Integration of Authoritative and Volunteered Cultural Landscape Information

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Key words: e-Governance; VGI; SDI; citizen participation

SUMMARY

Cultural heritage information provides incentives for touristic valorisation and concepts for strengthening regional identification. It can also influence political decisions in defining significant cultural regions worth of protecting from industrial influence. In that way cultural landscape information allows citizens to influence the statewide development of cultural landscapes in a democratic way. Based on official data sets from public administrations, information about cultural assets can be extended and enhanced by interested participants. Such a collaborative approach allows governing authorities to manage and supervise official data, while public participation enables affordable information acquisition. The paper demonstrates, in which way permanent public access to cultural landscape information according to the ideas of open government data and citizen participation can be realized. At the same time, the presented solution takes the need of state authorities into account, which require clear notification of the significance of the presented information.

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1. INTRODUCTION

A crucial international policy instrument enabling stricter protection of cultural heritage was founded with the Convention Concerning the Protection of the World Cultural and Natural Heritage of UNESCO in 1972. It lists natural and cultural heritage sites of exceptional importance which are therefore necessary to persevere (UNESCO 1972). Another important policy for Europe was created in 2000, with the European Landscape Convention. It is used in several European countries as a legal framework for the protection of cultural landscapes (Council of Europe 2000). Some German States already started to build information systems to document their cultural assets. The State of Rhineland-Palatinate also foresaw the necessity of protecting and inventorying its cultural heritage, and developed a legal guideline within a country development program for an implementation of a statewide cultural landscape information system. A cultural landscape information system called KuLIS was developed to provide tools and access for cultural heritage documentation usable by both the state administration and the public. Results of this process, experiences and current developments are outlined in this article.

2. SYSTEM DEVELOPMENT

2.1 System Requirements

The main objective of KuLIS was to provide a citizen-orientated and internet-accessible open platform. It would also be built following administrative and scientific regulations. Further requirements and work packages which strongly influenced the system design are defined in Table 1.

System Requirements
Development of a feature catalogue for cultural assets in Rhineland-Palatinate
Design of a spatial database to implement the catalogue structure
Evaluation and transfer of existing data about cultural assets with spatial relation into the database
Providing OGC conformal web map services being includable in the Spatial Data Infrastructure (SDI) of Rhineland-Palatinate
Visualization and digitalization of cultural assets in a web application interface

Ability to create and update information of new or existing information about cultural assets with citizen participation
Management and validation of the provided information by scientific and administrative supervisors
Analysis tools for further investigations and definition of important cultural landscapes

Table 1 System requirements definition

The requirements led to a web platform which united semantic and spatial information about cultural assets into one system, and therefore needed a combination of different web technologies. Because independence and adaptability to further development were fundamental necessities, open source technologies were used to meet these requirements.

2.2 Feature Catalogue of Cultural Assets and Existing Data Sources

External data sources and collected cultural knowledge were integrated into a catalogue of typical landscape features of Rhineland-Palatinate. Referring to systematics of comparable catalogues it was developed in close coordination with the advisory body using proven engineering technologies. Similar to other existing catalogues, a hierarchical function-oriented structure was developed which enabled the classification of functional cultural landscapes. Twelve such categories were then defined (Table 2). Each category is divided into functional complexes which cluster the unique cultural features. In the lowest level one feature can be part of a feature group or a functional ensemble.

No.	Functional feature categories
1	Urban Settlements, Health and Social Services
2	Rural Settlements, Agriculture, Horticulture and Fisheries
3	Forestry
4	Production and Processing of Raw Materials
5	Trade, Industry and Energy Production
6	Traffic, Transportation and Communication
7	Government, Administration, Law, Defence and Military
8	Religion and Worship
9	Education, Culture and Science
10	Sport, Tourism and Recreation
11	Natural Landscapes and Nature Conservation
12	Intangible Goods and Associative Features

Table 2 Functional feature categories

This way, the features can be stored as point, line or surface objects in a geographical and thematically precise manner. For example, a stadium can be defined as part of sports facilities in category 'Sport, Tourism and Recreation' (Table 3).

The created feature catalogue and its hierarchical structure provided the foundation for the later implementations of a database structure to store and manage information about cultural assets and their relations inside of the system.

Category	**Complex**	***Group:* Feature**
10. Sport, Tourism and Recreation	10.1. Sport	*Sport Facilities:* Golf Course, **Stadium**, Tennis Centre ...
	10.2. Recreation	…
	…	…

Table 3 Hierarchy for feature 'stadium' in the catalogue

Existing data about cultural features in Rhineland-Palatinate were examined during a first evaluation. Different official databases and sources, available from state institutions were processed and transferred to the spatial database of the system. Based on these sources, around 59,000 individual cultural features with point, line or surface geometries could be found and transferred into the new data structure (Boos et al 2012).
Other public institutions planned to provide their related data as Open Geospatial Consortium OGC conformal Web Map Services (WMS). Services provided in the Spatial Data Infrastructure (SDI) of Rhineland-Palatinate could be included directly into KuLIS. The considered infrastructure and its components allowing the integration of external data are described in the next paragraph.

2.3 System Design

Considering the need for citizen participation, a system had to be designed which permitted user enhancement of information about cultural assets by volunteers both in a thematic and geographic way. The need for an intuitive and widely accepted frontend for information display and management through different editors led to a wiki approach. As a content management system, the open source software MediaWiki allowed information creation and updating along with user management for editorial purposes (MediaWiki 2013). Furthermore, it was configurable for implementation of additional functionalities required in the project. To map the catalogue structure to the wiki and combine the content with geographical information derived from existing administrative data, a spatial data infrastructure structure was needed to provide an interface for the web mapping application, the spatial database and the server-side services. Linking information between MediaWiki and a spatial database of the mapping application was realised using a unique feature identifier ID for each cultural object. Figure 1 illustrates the infrastructure of the implemented cultural landscape information system.

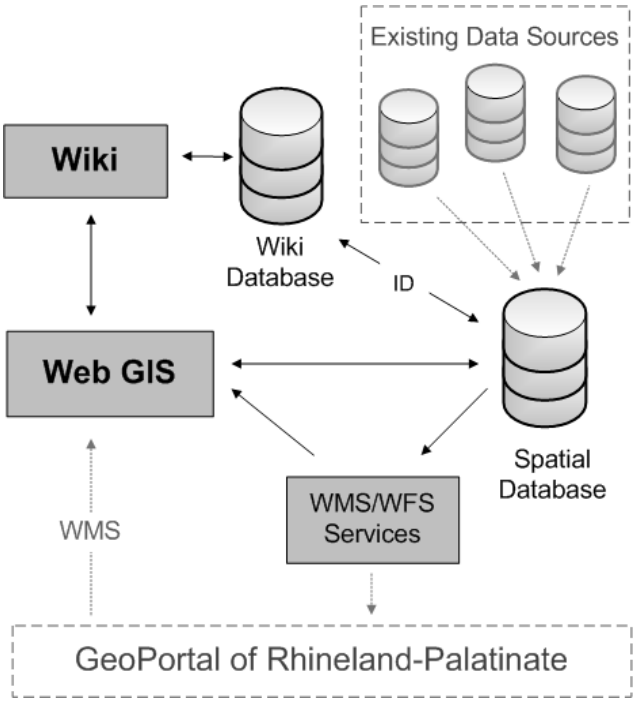

Figure 1 KuLIS System Design

A more detailed description of the used components is presented in the next sections.

Semantic MediaWiki: For each cultural asset in the built wiki application, a wiki article with its unique feature identifier ID exists. On top of the wiki installation, the Semantic MediaWiki extension (Semantic MediaWiki 2013) is set up to enable semantic attribution for articles. By creating a new article for each cultural asset, a form enables the setting of semantic attributes.

As a result, all features in KuLIS have a profile as shown in Figure 2. Besides general descriptions such as name and an illustration, it shows the classification in the catalogue structure in a first block. A second block follows, with a textual and graphical description of the location as place coordinates along with its pin on a map. The properties of the feature, including the geometry type (point, line or surface) and a chronological classification are presented in a third block of the profile. Finally, the last section presents value attributes related to cultural importance. The semantic extension makes it possible to organise and search the features in the hierarchical structure of the feature catalogue. Intelligent querying of defined attributes of the profiles allows for the analysis and relation of content regarding cultural relevance. The extension offers further functionality, and brings the application in line with Semantic Web approaches (Berners-Lee et al 2001). With this implementation, a tool is established for later analyses and investigation of the cultural assets and their semantic relationships. In combination with the spatial information, it enhances the definition of cultural landscapes.

Mäuseturm

Allgemeines

ID	117015
Name des Elementes	Mäuseturm
Funktionsbereich	Herrschaft, Verwaltung, Recht, Verteidigung und Militaer
Funktionaler Komplex	Befestigungs- und Verteidigungsanlagen, Schlachtfeldkomplex, Lager
Elementgruppe	Landwehr
Einzelelement	Wehrturm
Externer Link	http://www.welterbe-atlas.de /sehenswuerdigkeiten-kultur/burgen /maeuseturm/

Lage des Objektes

Landkreis/kreisfreie Stadt	Mainz-Bingen
Verbandsgemeinde/Verbandsfreie Stadt	
Ortsgemeinde	Bingen am Rhein
Direktion	SGD Süd
Planungsregion	Rheinhessen-Nahe
Gemeindeschluessel	073390005005
Lagebeschreibung	
Herkunft Lageinformation	Kulis-Digitalisierung
Lagegenauigkeit	
Rheinkilometer	530
Geografische Koordinaten	49° 58' 19" N, 7° 52' 50" O

Figure 2 Mäuseturm toll tower of Bingen

Spatial Data Infrastructure: All used software to set up the SDI for the system is part of the OSGeo project and therefore open source (OSGeo 2013). The location and related metadata of the cultural assets is stored backend in a PostGIS database, which includes the external data sources of the evaluation process (PostGIS 2013). A transactional WFS (WFS-T)

implemented with GeoServer allows for the creation, deletion and updating of the spatial information (GeoServer 2013). For performance reasons, a Mapserver set up provides the data structured in twelve Web Map Services (WMS) according to the number of functional categories (see Table 2).

With Mapbender, a Web GIS interface is implemented in the wiki frontend (see Figure 3, Mapbender 2013). It enables visualisation and digitisation of the location of cultural assets via the WMS and the WFS-T provided by the geospatial servers.

The use of a spatial database makes it possible to include information about boundaries of municipalities, cities and counties. During the location digitisation process, the recorded coordinates can be allocated this way and a precise textual attribution of the site (e.g. county or city) enhances the profile of the cultural asset information automatically.

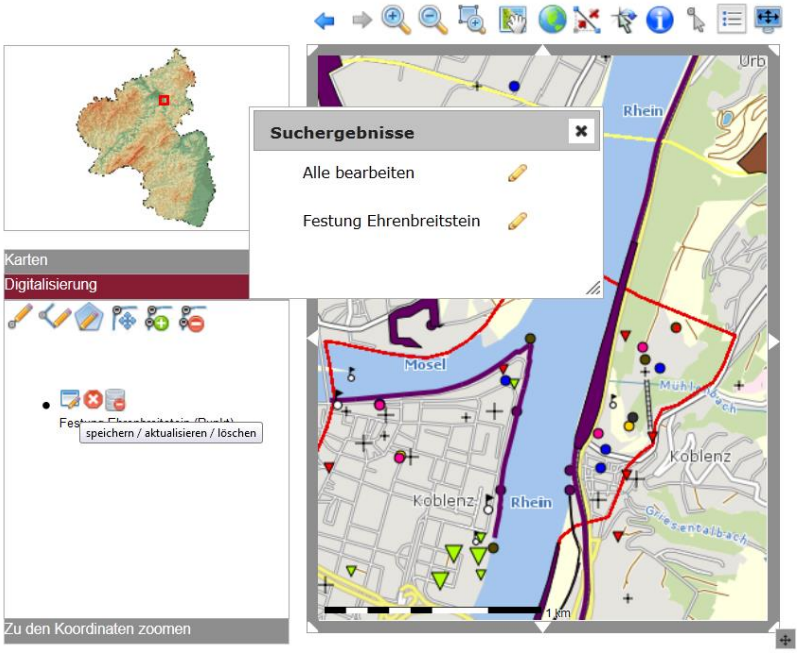

Figure 3 Web mapping application in KuLIS

3. QUALITY MANAGEMENT

Due to the fact that citizens are creating the data of an official information system, this raises the question of the administrative quality assurance role. It is for both political reasons and data-quality demands (high accuracy and consistency are needed) that an administrative authority must manage and continuously supervise the public's data acquisition. Enriching authoritative administrative data through crowdsourcing therefore is a sensitive issue; an E-Governance application requires an appropriate quality of gathered information while retaining sovereign rights of state administrations.

To bring the data in KuLIS to this standard, a special information qualification process was required. With the Flagged Revisions extension of MediaWiki (FlaggedRevs 2013), additional groups with new user rights were implemented in the system. A user class ‘editor,’ which had the right to mark articles as read and sifted, and a user class ‘reviewer,’ who could validate the correctness of articles in KuLIS, were created this way. Any registered user working with the cultural landscape information system can become an ‘editor,’ whereas a ‘reviewer’ must be an authorized person from a state institution. Figure 4 shows the concept of the quality management of the presented system, and illustrates the different tasks of the public and state institutions. In the illustration, the flow of cultural asset information and a validation process for gathered data is shown. State institutions offer their data in the system and can validate and qualify the correctness of the combined information of public crowdsourcing and government data. The public sector is able to access the validated information.

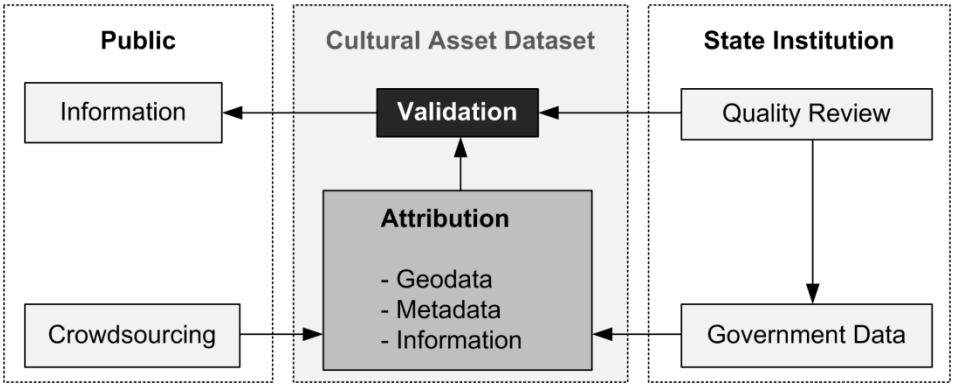

Figure 4 Administrative quality management in KuLIS

Configuring and adapting the used open source extension to the needs of the project, flags on top of each article were placed to inform wiki frontend users about the information quality of cultural assets using three simple levels, symbolised by the colours of a traffic light were used as flags (see Figure 5). Newly created articles were first marked as red, read and sifted articles by authorized users with orange, and quality proofed articles by state authorization with green. By implementing this intuitive and simple highlighting function, the status of the cultural asset information is shown at any time for all features.

Flag	Revision status of article
	New/Unsighted
	Read and Sifted
	Reviewed/Proofed

Figure 5 Traffic light flags in KuLIS

This way, permanent public access to all information according to the idea of open

government data and citizen participation is maintained. At the same time, the state authority requirements concerning clear notification of the significance of the presented information are met.

4. CONCLUSIONS

Cultural landscapes consist of an extreme variety of features, with such variability stemming from their geographic as well as semantic characteristics. This fact presents a challenge for new developments using an aggregate system combined from distributed software modules. The presented system as a combination of actual web tools combining semantic and spatial information in a public participation geoinformation system meets this challenge. Developing such an information system for cultural landscapes using just open source tools is not only possible, but also enables the chance to use state of the art technologies for further development.

Outlining the implementations in this work shows that KuLIS offers promising possibilities to fulfill the complex requirements of a state administrative controlled PPGIS. Using open source tools, used and maintained by a wide community, made it possible to adaptively change requests during the system development. Whereas common wiki implementations only work with point geometries, the power of spatial analysis and visualization is added to the system through a spatial data infrastructure. The combination of local and semantic attributes makes interlinking with other sources using the semantic web possible, and will be more important as the number of interlinkable sources grow in the future. The presented solution provides a modern platform based on open source technologies, enabling citizen participation. This approach can promote transparence and acceptance of administrative actions within a society.

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BIOGRAPHICAL NOTES

Hartmut Müller got his diploma and doctoral degree in Geodesy at Karlsruhe University, Germany. After 8 years of research he turned into the marketing and software development departments of international enterprises for 6 years. Since 1991 he is a professor at Mainz University of Applied sciences. Since 1998 he is director of i3mainz, Institute for Spatial Information and Surveying Technology. In the DVW – German Association of Geodesy, Geoinformation and Land Management he was the chair of working group 2 –Spatial Information and Spatial Data Management until 2010. **Falk Würriehausen** holds a diploma in Geodesy. Since 2008 he is a research associate at the i3mainz Institute for Spatial Information and Surveying Technology of Mainz University of Applied Sciences.

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