Towards an integrated cultural resource management system

The Silk Road HGIS online platform

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Keywords: *Silk Road — Cultural resource management — Historical Geographical Information Systems (HGIS).*

CHNT Reference: CHEN, W. (2022). 'Towards an integrated cultural resource management system: The Silk Road HGIS online platform', in CHNT Editorial board. *Proceedings of the 27th International Conference on Cultural Heritage and New Technologies, November 2022.* Heidelberg: Propylaeum.

Introduction

Back in the 1980s, researchers started their attempts to apply GIS technologies to archaeology studies and heritage conservation. As an important and versatile analytical tool that can effectively visualize and manage both spatial and attribute information about cultural heritage. GIS technologies were mostly used in the conservation field for exploring spatial and temporal determinants, identification and documentation, management, and predictive modelling. Research about establishing and operating GIS-based platforms and systems has drawn increasing attention among historians, archaeologists and conservators, and several official documents have been produced to guide the application of GIS technologies in heritage conservation, such as the *GIS and cultural resource management: a manual for heritage managers* published by UNESCO in 1999 (Box, 1999).

Due to its multiple advantages in presenting and integrating historical cartography and data with geovisual interface design, the HGIS (Historical Geographic Information System) is gradually changing the methods of interpretation and demonstration that traditional research once followed. The effectiveness and importance have been proved in international and national HGIS projects, and many of them have involved a series of datasets related to spatial transformation, historical administrative division or biographical information of China, such as the *China Historical Geographic Information System* (CHGIS) launched by Harvard University, *China in Time and Space (CITAS)* developed by the University of Washington and the *Chinese Civilization in Time and Space (CCTS*) designed by Academia Sinica*,* which together built a solid foundation for the Silk Road HGIS online platform and further advancements.

This paper demonstrates the contents, features, and applications of the Silk Road HGIS online platform. Specifically, the characteristics and innovations of the Silk Road HGIS platform can be summarized as follows: (1) Traditional databases for historical and archaeological research typically focus on a single topic, with preliminary datasets covering topics such as placename change, spatial evolution, social-related data (population migration, food, or transportation), or geographic environment transformation. While the Silk Road HGIS online platform provides a complicated and comprehensive archive that collects seven datasets in the fields of ecology, archaeology, humanities, and geography, etc., the majority of the data came from published sources, and the

geographical entities were aligned from historical maps and reviewed by historians in order to obtain more accurate data visualization models. (2) Second, most HGIS platforms are national or regional in scope, whereas the Silk Road HGIS covers the majority of the Eurasian continent, with over 40 countries traversed by the Silk Road, and is presented over a time span of more than 2000 years. (3) The shape, scale, and base map style of the final model were all capable of being selected with multiple choices in the analysis modelling section, in which 11 types of analysis models can be exported, including heat map analysis, cross-section analysis, and extraction of connected river networks, etc. And the platform is configured to allow file uploads, so users can customize their models on the provided historical maps.

The UNESCO world heritage: the Silk Road

The Silk Road is one of the most famous ancient trade routes to promote cultural dissemination between eastern and western civilizations throughout human history. It originated in the Western Han Dynasty (BC202-8) for the renowned ambassador Zhang Qian's political mission from Chang'an (present-day Xi'an), crossed Central Asia, and eventually reached the Mediterranean countries. This concept of “Seidenstrassen” (meaning Silk Road in German) was first proposed by the German geographer Ferdinand von Richthofen in 1877 to describe the route connecting China, central Asia and India using silk trade as the preliminary medium between 114 B.C. and 127 A.D. The Silk Road’s world heritage transnational nomination work began in the 1990s, but not until 2014 was the Silk Road, i.e., the route network of the Chang 'an-Tianshan Corridor, a 5,000-kilometer stretch of the entire route that covers China, Kazakhstan and Kyrgyzstan, officially included on the World Heritage List.

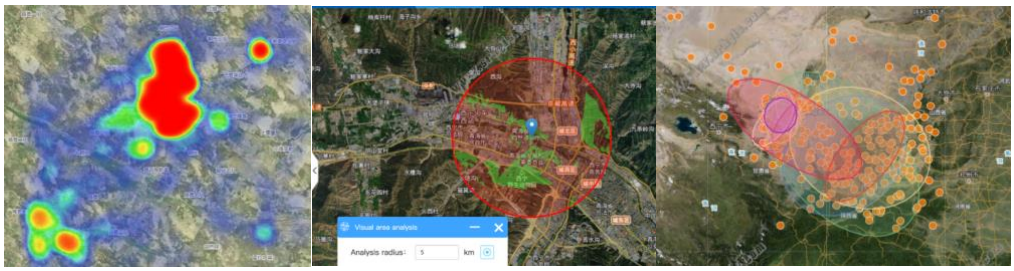
The GIS-based cultural management information system: the Silk Road HGIS Platform

Stimulated by the global strategy of *The Belt and Road Initiative*, the academic project “*Construction of Silk Road History Geographical Information System*” was initiated in 2013. Supported by the National Office for Philosophy and Social Science, the project has created a comprehensive historical resource management database as a potential programming tool pertaining to Silk Road geo-historical materials. Named the *Silk Road History GIS (SRHGIS) Platform* (http://www.srhgis.com/dtcx, accessed on September 3, 2022), it was established by the Capital Normal University in 2015 with the principal aim of identifying mass historical information and converting it into usable data, and rediscovering the original itinerary of the ancient Silk Road over its 2000 years of transformation.

1) **Contents of the platform:** The menu bar runs along the top and was designed into 5 sections, with the two main contents of map search and side-by-side windows comparison in the middle. On the map search page, the control panel on the left side of the webpage consists of 3 parts: resource catalogs, display content and model analysis. What the resource catalog section presents are results from seven sub-databases, focusing on transportation and trade, land use, ecology and environment, ethnicity and religion, cities and settlements, cultural exchange and archaeological sites, accompanying several historical atlases at the bottom**.** The chosen data will be notified in the display content section, and different date sets can be layered and visualized within one project in the main view area. Thirdly, the model analysis section currently offers 11 individual models, enabling users who want to build geographical models using personal data via imported KML/CSV files. Specifically, the 11 types of models are: cross-section analysis, feature centroids calculation,

visual area analysis, swath profile analysis, buffer zone analysis, heat map analysis, tracking analyst, directional distribution analysis, extraction of connected river networks, contour analysis and network analysis.

a



b c d

Fig. 1. Screenshot of the Silk Road HGIS platform a)homepage of the platform; b) result of heat map analysis; c) result of visual area analysis in Pingliang city; d) result of directional distribution analysis (© Shaanxi Normal University General Publishing House).

Features and functions: According to the way of processing data, the main functions of the platform can be summarized into three types: management, analysis and display. The names of major cities that were traversed by the Silk Road from B.C. 200 to A.D. 2000 were reviewed, matched with their current location, and displayed. It is a time-consuming and labour-intensive work since the diversified ethnical pronunciation and unprofessional translation created huge barriers in places' recognition and coordination at the beginning stage. Thanks to the *Chinese historical atlas* (中国历史地图集) developed by the *Taiwan Academia Sinica Computing Center*, most of the commonly used names of towns and cities along the Silk Road over a long-time span were demonstrated and displayed directly on the webpage, and archaeological sites and remains were also accurately identified and marked. Historical resources of social science data in aspects of the environment, transportation, agriculture, urban planning and archaeology were converted into usable information with advanced visualization tools.

The side-by-side comparison function offers the possibility of comparative analysis with up to 3 different windows. With configuring a swipe wedge, different layers of maps can be easily layered,

compared and personalized images can also be exported freely. Its datasets range from environment, population, and culture to settlements and other aspects, and users can even create personalized geospatial models, draw circular, linear, and other shapes while mapping, and select specific base map styles from various servers such as mapbox, Google, and Baidu. In addition, it is also possible to layer spatial data of different dynasties and dimensions as the bottom timeline indicates. In this way, cross-regional and long-term data can be presented in models or images more intuitively.

2) **Application in heritage conservation and further advancements:** Although the Silk Road HGIS platform was originally established due to the needs of historical research, it inevitably drew attention to conservators and influenced the cultural heritage conservation sector in a positive way. With the support of the web-GIS platform, scholars are capable of integrating architectural, historical geography and cartographic knowledge into a comprehensive framework, testifying the hypotheses and exploring the relationships, patterns and evolutionary mechanisms through geospatial modelling. Applications can be found in predicting the physical location of archaeological sites, deducing the age, original structure or material of heritage and monuments. Advanced technologies such as time series remote sensing images can be introduced and combined in practical projects to uncover the reciprocal relationship between the natural environment and human activities in arid zones (a major part of the Silk Road was covered by desert), and provide a deeper understanding of the transformation process of the historical environment or extend applications in preventive conservation studies. Successful examples can be referred to, such as the *Risk Map of Italian Cultural Heritage* produced by the *Istituto Centrale del Restauro* (ISCR), a classification and management model of cultural heritage to evaluate the fragility and risk of territories with a preventive purpose.

Limitation of the HGIS platform

It can't be denied that the Silk Road HGIS online platform has advanced Chinese historical geography studies in terms of integrating mass historical data of spatial-temporal characteristics and enriching visualization methods of qualitative data, but there are still a few limitations that need to be discussed. Although the navigation menu and the header have been translated into English, all the remaining sections were exclusively available in Chinese. At the same time, missing data is randomly distributed on the historical maps, especially in the settlements and archaeological sites section. When uploading files to produce geospatial models, the website responds at a slow loading speed and sometimes crashes. Lastly, according to the project coordinator (Zhang, 2017), the display section includes 3D animation, visual restoration and storytelling map, but by the time of writing this paper, the mentioned functions are still not yet online.

Funding

This research was funded by the China Scholarship Council (202006130023).

References

Box, P. (1999). *GIS and Cultural Resource Management: Amanual for Heritage Managers*. UNESCO, Bangkok

Zhang, P. (2017). 'Historical geographic information platform for the Silk Road: Design, concept and application', *Chinese Cultural Heritage Journal of Yunnan University (Social Sciences Edition),* 16(5), pp. 49-54.