

## INFORMATION STANDARDS FOR CULTURAL HERITAGE WITH THE ISO 191XX SERIES

Yu Fujimoto

JSPS Research Fellow/Graduate School of CIS, Doshisha University – [yfujimoto@doshisha-bkj.net](mailto:yfujimoto@doshisha-bkj.net)

**KEY WORDS:** Geographic Information System, ISO 191XX series, Application Schema, Survey Data Archivist

### ABSTRACT:

Information, and therefore information standards, for cultural heritage are essential to research, education, preservation of cultural heritage and societal advancement. To promote and ensure that such goals of information-sharing and preservation are met, it is important to conform to international standards such as those set forth by the International Organization of Standardization (ISO). In this study, I developed an application schema in accordance with ISO 19109 for use in archaeological research. Furthermore, I implemented test systems corresponding to personal work performed by members of an archaeological research group. I constructed both embedded and standalone systems using the aforementioned application schema. The standalone system is currently in an experimental phase. It supports a portion of the application schema, providing the ability to manage research records of a general survey in archaeology or any other preliminary research into cultural heritage. Such collected information is stored and exportable, enabling standardised international information exchange.

### 1. INTRODUCTION

Information regarding cultural heritage is crucial to research, education and societal advancement. Promoting the shared and mutual use of such information is essential and will help preserve cultural heritage for future generations. To achieve these goals of information-sharing and preservation, it is important to conform to conventional international standards such as those set forth by the International Organization of Standardization (ISO). The ISO 191XX series defines standards in the field of digital geographic information, establishing a structured set of standards for information concerning objects or phenomena directly or indirectly associated with a location relative to the Earth (ISO/TC 211). These standards are applicable to the standardisation of cultural heritage information. In this study, I developed an application schema in accordance with ISO 19109 ('Rules for application schema') for use in research and implemented a test system corresponding to parts of this schema.

### 2. MERITS OF CONFORMING TO ISO 191XX

#### 2.1 Managing Information by GIS

Cultural heritages are represented by the following three types of information: (1) geospatial information indicating the relevant location or region; (2) temporal information specifying the historical time period and (3) thematic information indicating characters of the cultural heritage. To properly manage cultural heritage information, systems must suitably handle the above information. Geographic Information Systems (GIS) meet these basic requirements; this system enables to manage wealth of information with relating to geospace and time systematically. Furthermore, using GIS as a platform, guiding cultural heritage standard will be defined. The ISO 191XX series standards will serve as a framework for

representing cultural heritages. In particular, defining an application schema using ISO 19109 will be essential to establishing standards for cultural heritages.

#### 2.2 Conforming to ISO 191XX series

ISO 19109 defines rules for creating application schemas in a clear and consistent manner (Japanese Standards Association, 2009). By applying ISO 19109, suitable standards for different application domains can be defined. Using this standard, a common and correct understanding of the content and structure of cultural heritage may be attained.

The process of developing an application schema governing cultural heritage using ISO 19109 is as follows:

1. Design a conceptual model for cultural heritages that identifies feature types, properties and constraints.
2. Describe the application schema via the Unified Modeling Language (UML).
3. Integrate the application schema with other standardised schemata, including ISO 19107 (spatial schema) and ISO 19108 (temporal schema), thus forming a comprehensive application schema.

In Japan, two academic groups aim to establish information standards for cultural heritages. The standards will conform to the application schema standard noted above. The first group, centred around Usui, aims to develop an application schema specifically for archaeological sites with survey reports (MURAO, USUI, MORIMOTO, SHIMIZU, FUJIMOTO, & YAMAMOTO, 2008). The second group aims to develop an application schema with survey processes. At present, these two groups have started to collaborate.

### 3. DEVELOPING APPLICATION SCHEMA

#### 3.1 Diary of Personal Work

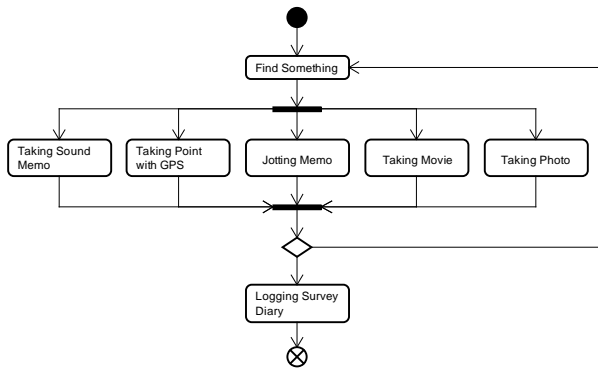


Figure 1. Diary of Personal Work

A necessary step towards defining an information standard is ordering and classifying the work process and constructing information models.

Research projects involving cultural heritage consist of both common and personal work. For example, in an archaeological survey, personal work includes writing in a diary or journal, photographing, recording videos, jotting down memos and recording points of interest with GPS. Common work includes measuring archaeological features and drawing or sketching one's findings. All results are integrated to form a survey report, which is subsequently published.

A survey project typically includes several members. Although they work collaboratively, they collect wealth of information by themselves. When they return to the home base, they log their findings (Figure 1). Such information is typically managed by each member's own methods and rules. With regard to digital information, file formats and organisation of files and directories are not usually consistent. Rules for managing personal information are typically uncontrolled.

Uncontrolled information management can cause serious issues in database construction. Nonetheless, important information included within the aforementioned personal work is valuable and should be standardised and recorded. An additional difficulty is tracking the location of such information after the completion of a research project may be difficult.

#### 3.2 Developing Application Schema

Because there is little difference among survey processes in different research projects, a versatile information standard is attainable. In this section, portions of the latest application schema are shown. The current version of this schema is 1.3 (test phase). Portions of personal work and project information are available. Because common work corresponds only to archaeological sites and has not yet been implemented, the common work portion is not included in this paper.

**3.2.1 Project:** As shown in Figure 2, the 'Project' class and its related classes, 'Project Member' and 'Organization', are instantiated when a research project is first organised. These classes are instantiated only once per project.

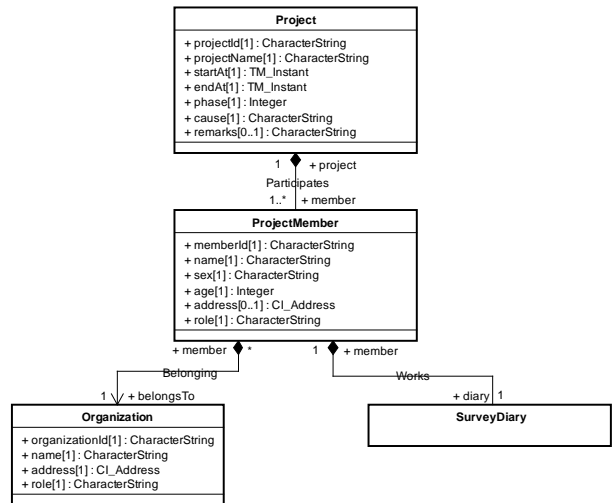


Figure 2. 'Project' Class and its Related Classes

**3.2.2 Device:** As shown in Figure 3, the 'Device' class and its related classes, 'Camera', 'GPS', 'IcRecorder' and 'DeviceSpecifiedInformation', are instantiated at any time during a project as the need arises. The 'serialNumber' attribute within the 'Device' class is required to trace the ownership of each device by the manufacturer's serial number. The 'Device Specified Information' class defines additional attributes for each device using extensible name-value pairs.

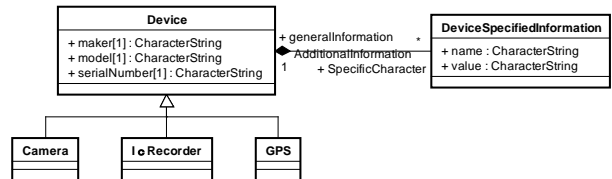


Figure 3. 'Device' Class and its Related Classes

**3.2.3 Survey Diary:** As shown in Figure 4, the 'SurveyDiary' class is instantiated after a research project has been organised and is underway. Descriptions of daily work by each project member are recorded as instantiations of 'Record'. The 'Record' class is therefore instantiated every day when work is performed.

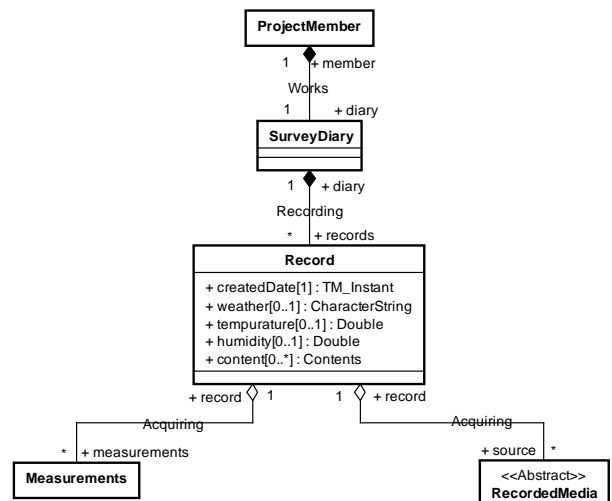


Figure 4. 'SurveyDiary' Class and its Related Classes

**Measurements:** As shown in Figure 5, the 'Measurements' class and its child classes are instantiated only when personal measurements are made and recorded. The 'Measurements' class has an aggregation relationship to the 'Record' class. In the current schema, only GPS measuring is available. Furthermore, because measurements for drawing plans and cross-sections are common work, these are not included in this schema.

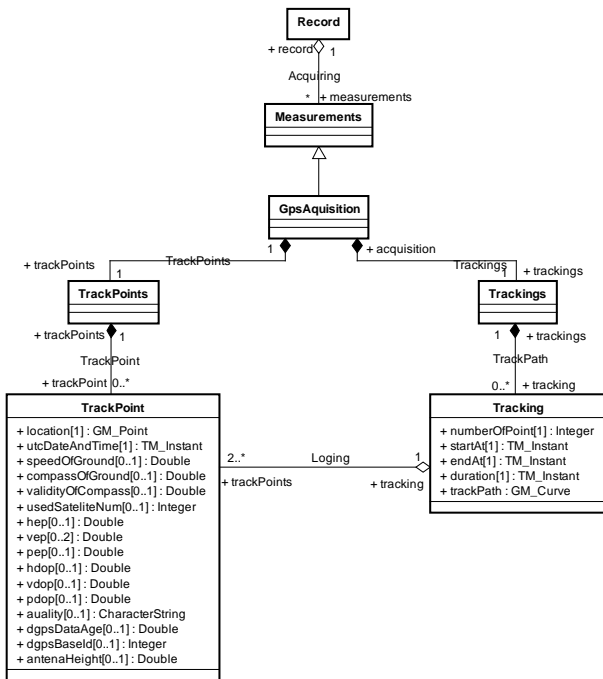


Figure 5. 'Measurements' Class and its Related Classes

**3.2.4 Recording Media:** As shown in Figure 6, the 'Recording Media' class and its child classes, 'Movies', 'Images' and 'Sounds', define multimedia records. They are instantiated only when work is performed. The 'Video' and 'Voice' classes are related to GPS tracking, and the 'Photo' class is related to GPS track point to associate geographic location. Additionally, the schema is extensible to support other recording devices.

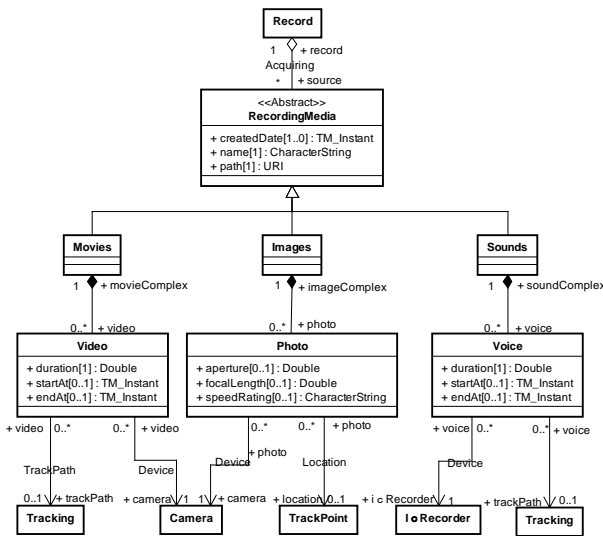


Figure 6. 'Recording Media' Class and its Related Classes

**3.2.5 Memos:** As shown in Figure 7, the 'Memo' class and its related classes are instantiated when required. The 'Memo Complex' class is a child class of the 'Recording Media' class. Waypoints acquired using GPS are treated as a type of memo in this schema.

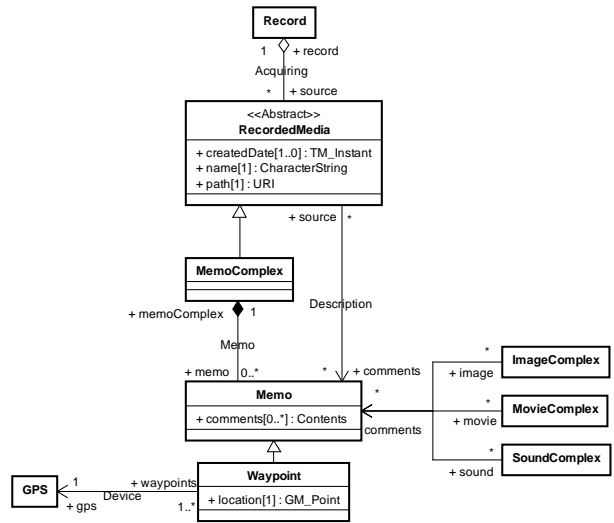


Figure 7. 'Memo' Class and its Related Classes

#### 4. IMPLEMENTATION

There are two methods to implementing the application schema: (1) embedding the schema in an existing application; and (2) building a standalone system. The following subsections describe each of them.

##### 4.1 Implementation via Embedding

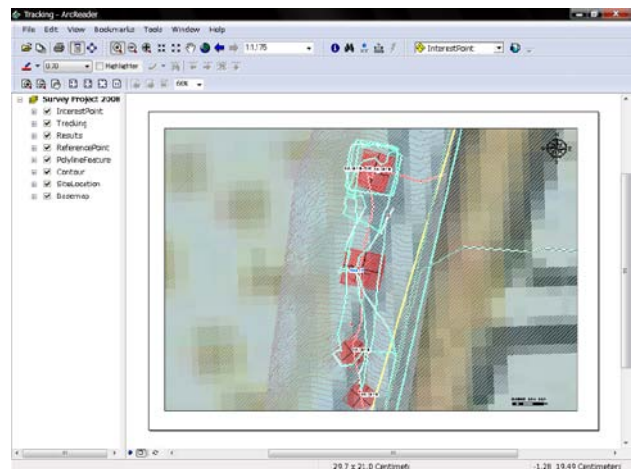


Figure 8. Example of Implementing the Application Schema as an Embedded system (using ArcGIS Personal Geodatabase)

ISO 19109 does not define file formats; instead, it defines methods for designing schemata to represent geographical features. It follows that any application system is able to handle all datasets defined in the application schema as long as the application system provides a definable relational database or schema engine. Furthermore, such application systems must provide a function of convert documents written in eXtensible Markup Language (XML) in accordance with ISO 19118(Encoding Rules) and ISO 19136 (Geography Markup

Language). An example is shown in Figure 8 in which I constructed an ArcGIS Personal Geodatabase in conformity with the former version of the application schema for cultural heritage using ESRI's ArcGIS. This database was created using archaeological survey records that were created as part of the 'Ili Project' (The Research Institute for Humanity and Nature, 2008) in Kazakhstan. This database (and a brief DVD report) has been submitted to the Institute of Archaeology, Kazakhstan. Application systems do not always provide basic operations such as panning, zooming or selecting features using conventional components. In other words, there are various limitations to particular application systems. Additionally, some commercial systems have user licence limitations, which might present a cost problem to research projects large and small.

## 4.2 Implementation via a Standalone System

To overcome potential limitations of existing application systems, the second implementation method is to build a standalone system. Certainly, developing all required functionality requires substantial time and effort, but the resulting system would be unconstrained by any existing application systems. As shown in Figure 9, I developed a standalone system called the 'Survey Data Archivist for Client (SDA for Client)'. Although this system is inadequate as a GIS system because it has no mapping or analyzing functionality, it enables information management of personal work. SDA for Client application conforms to the application schema for personal work, and it manages all of the information using XML documents in accordance with ISO 19118. SDA is designed to support the home base working process: users record a diary of their personal work, and then register GPS logs, photos, memos, videos and voices.

SDA has features to control naming files and defining the structure of directories; directories are located accordance with structure of application schema, files are randomly named. Original multimedia files or GPS logs are copied to designated directories with designated names. With regard to JPEG and AVI files, EXIF information is extracted during copying, providing such as date and time of acquisition, focal length, aperture and resolution of photo. Such properties will be written to underlying XML documents.

As for other geotagging software, such as 'Locr GPS Photo', this system supports the ability to export data in Google Earth's KML format; photos and memos are related to GPS track points, videos and voices are related to GPS track path by matching acquisition time (Figure 10).

SDA for Client is currently in an experimental phase; in active



Figure 9. Screen shot of SDA for Client

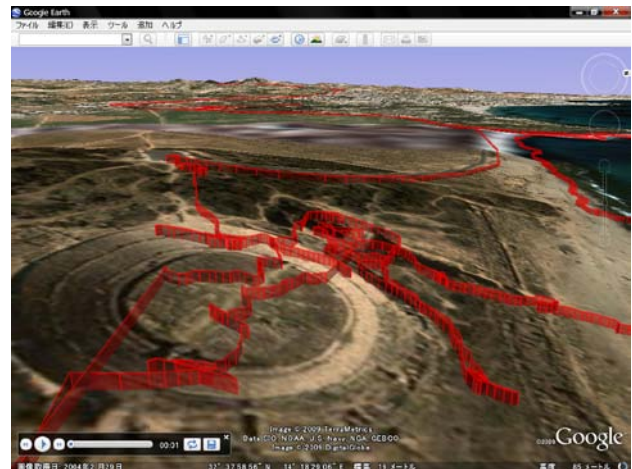


Figure 10. Exporting GPS Track Log with SDA for Client

use as a standalone application for recording personal work as part of a research project in Libya led by Takura Izumi of Kyoto University.

## 5. CONCLUSION

The application schema developed in this study supports the personal work performed by members of an archaeological research group. The schema has been constructed in conformity with international standards, enabling information interchange. Future work includes the design and implementation of the application schema for work performed in common.

### References from Journals:

MURAO, Y., USUI, T., MORIMOTO, S., SHIMIZU, K., FUJIMOTO, Y., & YAMAMOTO, Y. (2008). Apply of temporal schema to the archaeological feature model. *PAPERS and PROCEEDINGS of the GEOGRAPHIC INFORMATION SYSTEMS ASSOCIATION*, CD-ROM.

### References from Books:

Japanese Standards Association. (2009). Geographic information - Rules for application schema JIS X 7109:2009 (ISO 19109:2005). *JAPANESE INDUSTRIAL STANDARD*.

### References from Websites:

ISO/TC 211. (n.d.). Retrieved 08 05, 2009, from ISO/TC 211 Geographic information/Geomatics: <http://www.isotc211.org/>

Locr. (n.d.). Retrieved 08 14, 2009, from <http://www.locr.com/>

*Research Project: Historical Interactions between Multi-cultural Societies and the Natural Environment in a Semi-arid Region in Central Eurasia*. Retrieved 08 05, 2009, from The Research Institute for Humanity and Nature: [http://www.chikyuu.ac.jp/rihn\\_e/project/3FR-1.html](http://www.chikyuu.ac.jp/rihn_e/project/3FR-1.html)

### Acknowledgement:

This paper includes results of the Ili Project, a project of grants in aid for scientific research (ID: 20251007, Leader: Takura Izumi). Furthermore, the application schema of this study reflects partial results of the CITMAS project.