

Understanding digitization of cultural heritage objects

Abstract

Digitization of cultural heritage objects has a lot of challenges that comes with it, in some aspects such as the dimension to digitize, the meta-data and other parameters. We are investigating different methods here in order to get an overview of some proposed architectures, among them the COSCH system.

Keywords

Digitalization, acquisition techniques, documentation, ontologies

Introduction

What is important when digitizing or documenting an object? An optimal digitization or documentation would take all required parameters into account, such as:

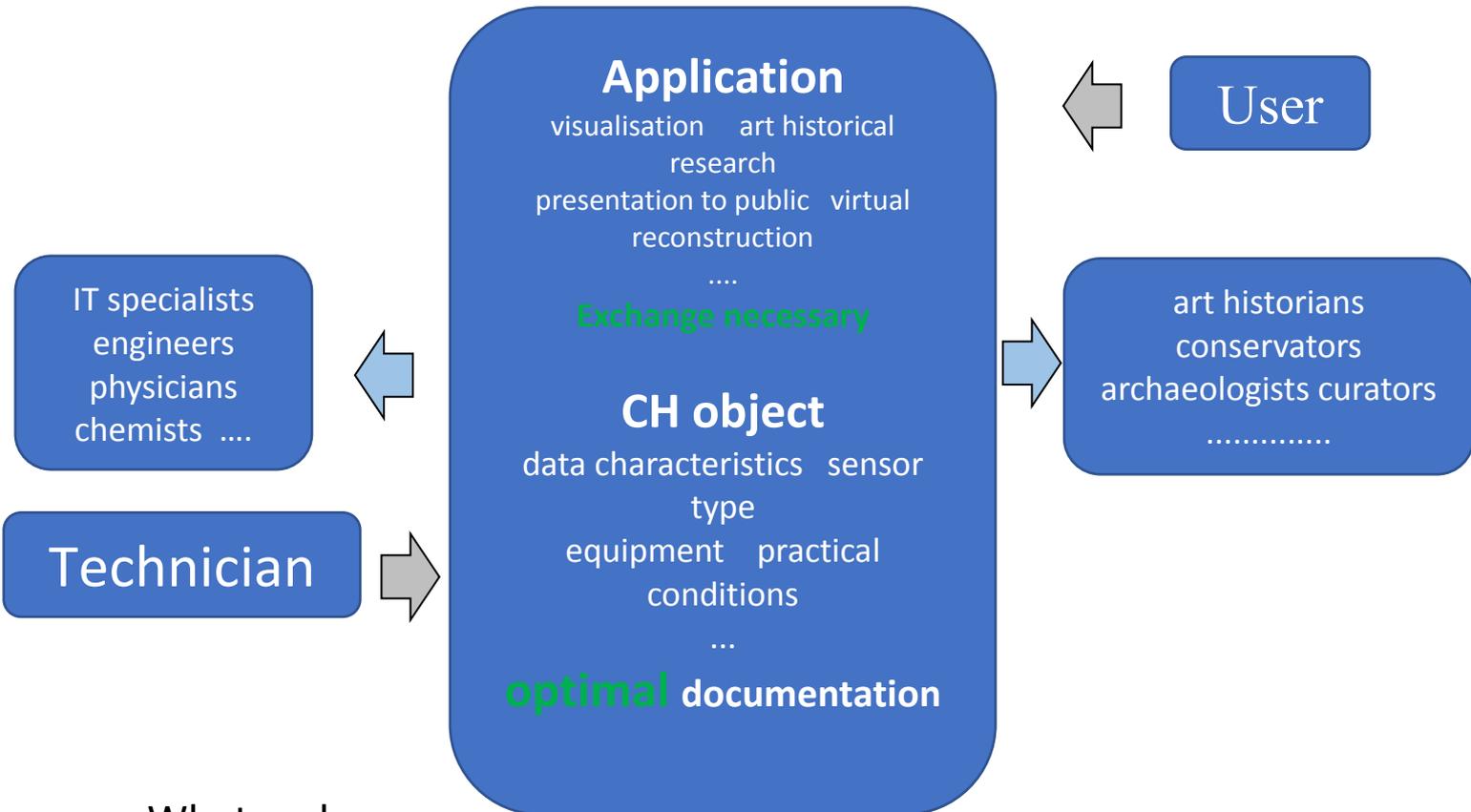
- Spatial shape
- Visual appearance (real color, texture)
- Surface structure
- Physico-chemical composition

There is a lot of parameters, so what does imply optimal digitization or documentation? It is therefore needed to select data characteristics being able and adapted to serve the needs of the application, spectral characteristics, resolution (horizontal – vertical), precision, measurement density, 2D- 3D, viewpoints, external conditions. And to select equipment best suited to produce the content required, qualification of instruments: indoor – outdoor, spatial –spectral, measurement conditions...), as well as selecting an appropriate processing chain to produce valuable output.



Figure 1: Example of sensors used for CH object digitalisation

Moreover, the exchange of information is subsequent to the CH object study.



What makes exchange

Figure 2: place and pipeline of CH digitalisation

Reality can be so complex that equally valid observations from differing perspectives can appear to be contradictory.

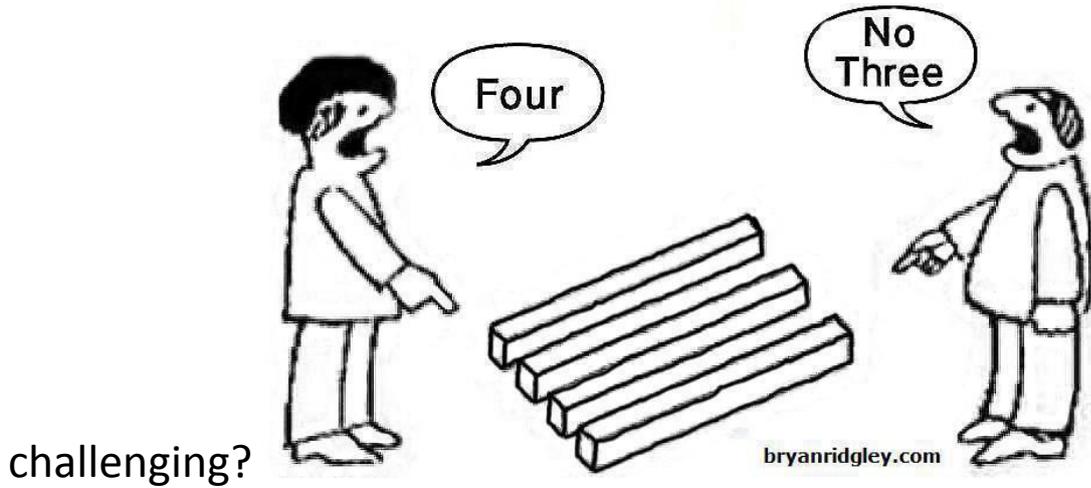


Figure 3: Humorous drawing about the problem of different perception and languages

Thinking about dependencies, required content varies considerably in dependency of applications leading to understand applications. Produced content varies considerably in dependency of technology, requiring understanding technology. Possibility to produce content varies considerably in dependency of object and environment.

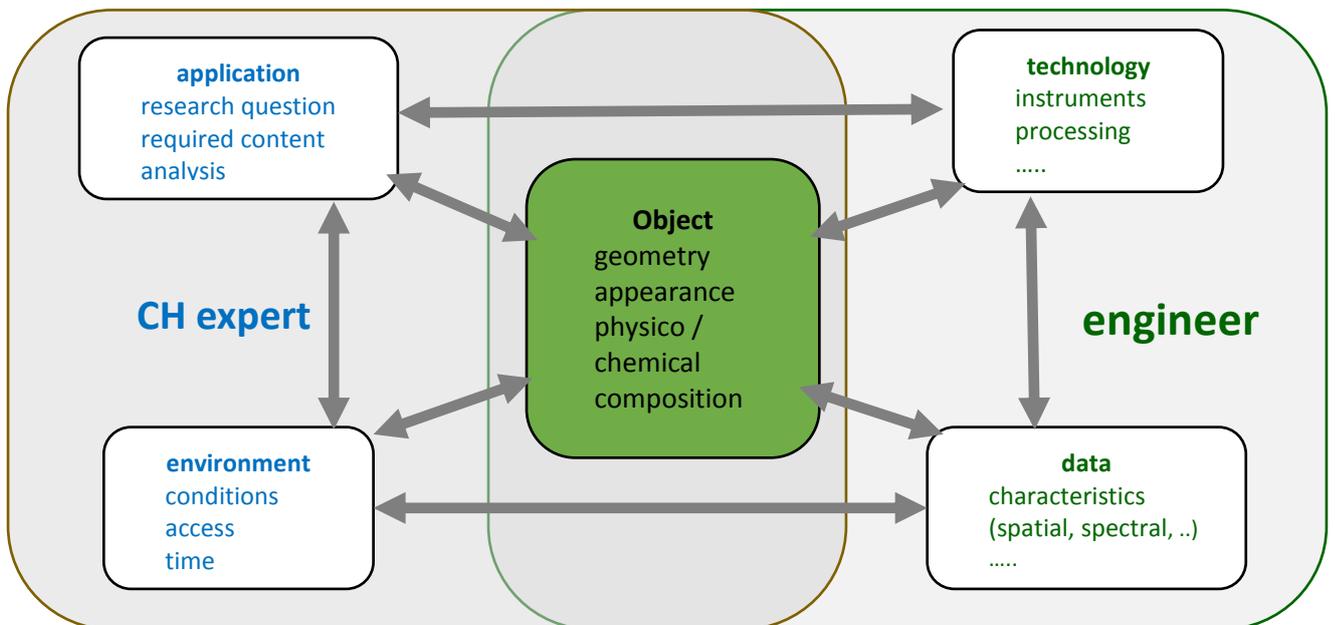


Figure 4: Relationship between the CH object, engineers and expert during the digitalisation process

Modelling approaches

The first step is to analyze the different processes of digitization:

- Object
- Application
- Environment
- Technology
- Data

Then, structure collected content, identify the relevant characteristics and build a semantical link between all impacting elements (COSCH KR).

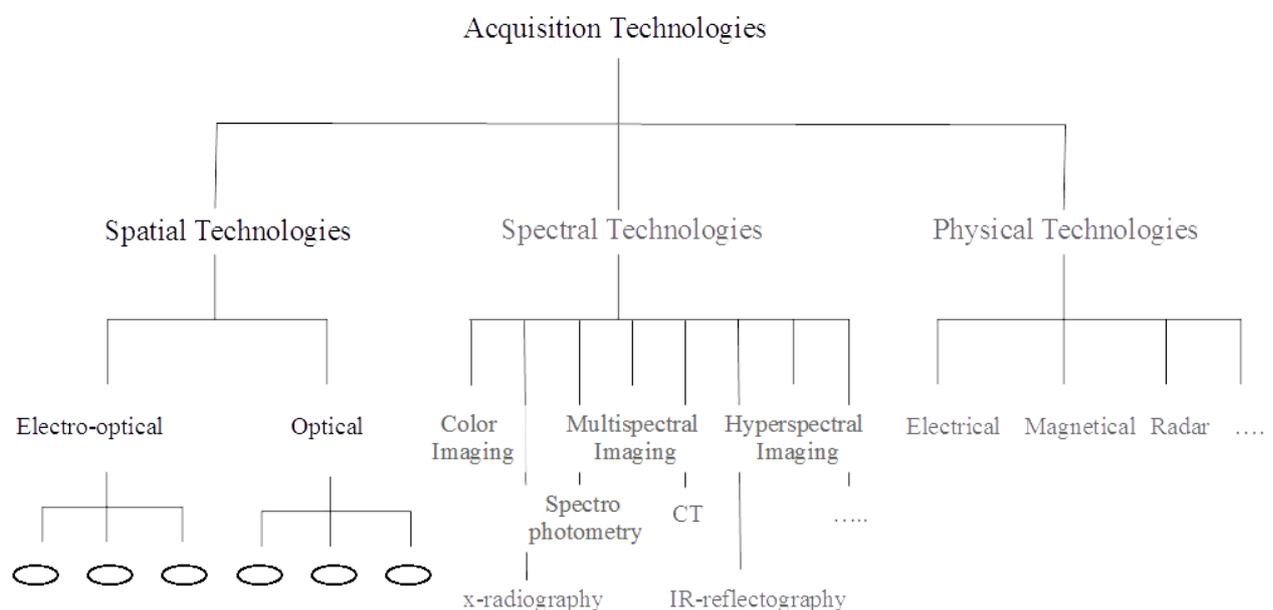
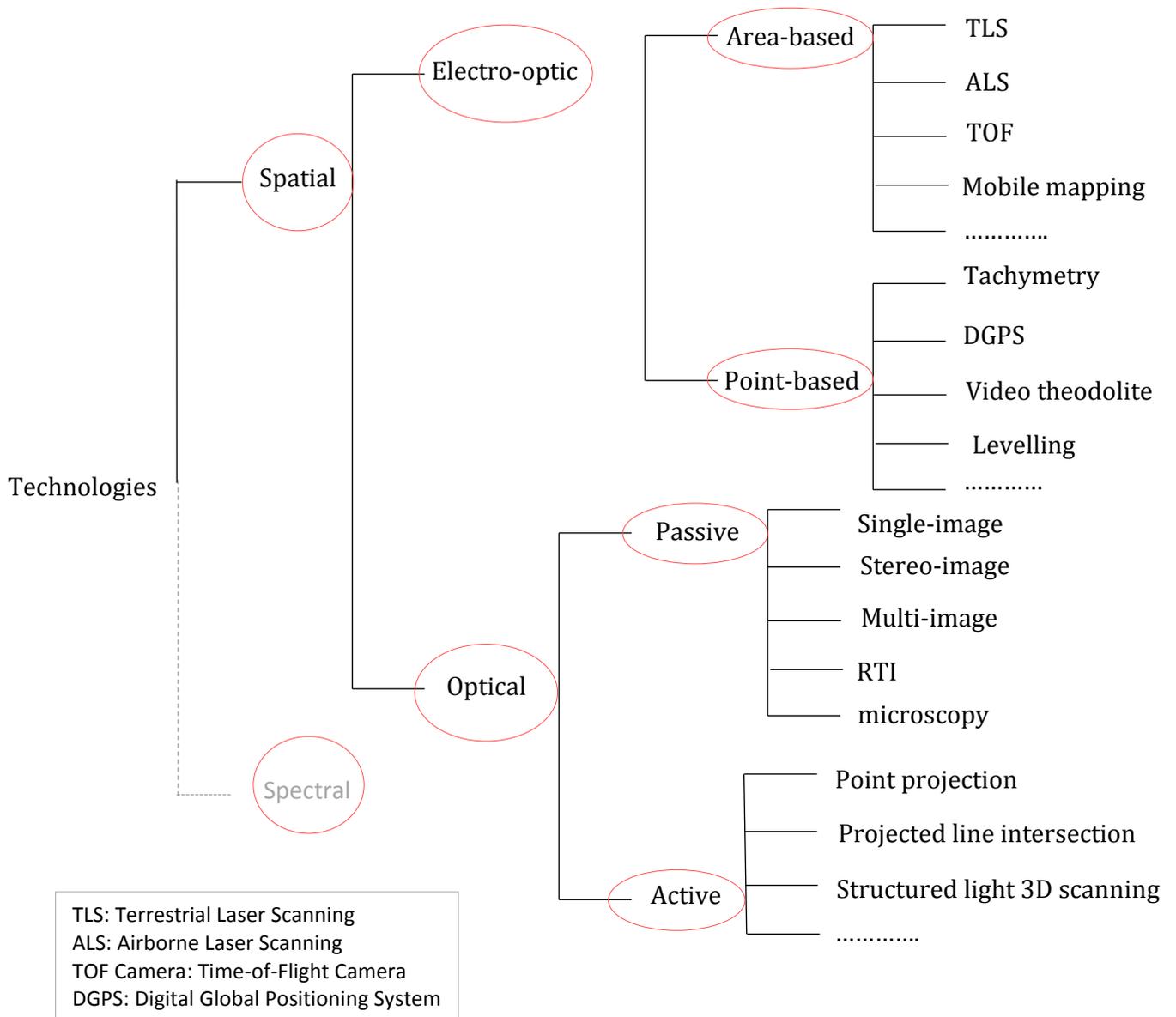


Figure 5: Example of hierarchical classification tree of acquisition technologies in CH

A classification is possible for the technologies of acquisition. Few important parameters are taken into account:

- **accuracy:** possible 3D point displacement between true value and measured value distance/camera view / measurement area / measurement volume)
- **working space:** required space (position & height) of the instrument itself and its mounting during a measurement
- **resolution:** interval between single points
- **dependency:** distance / camera view / measurement area / measurement volume)

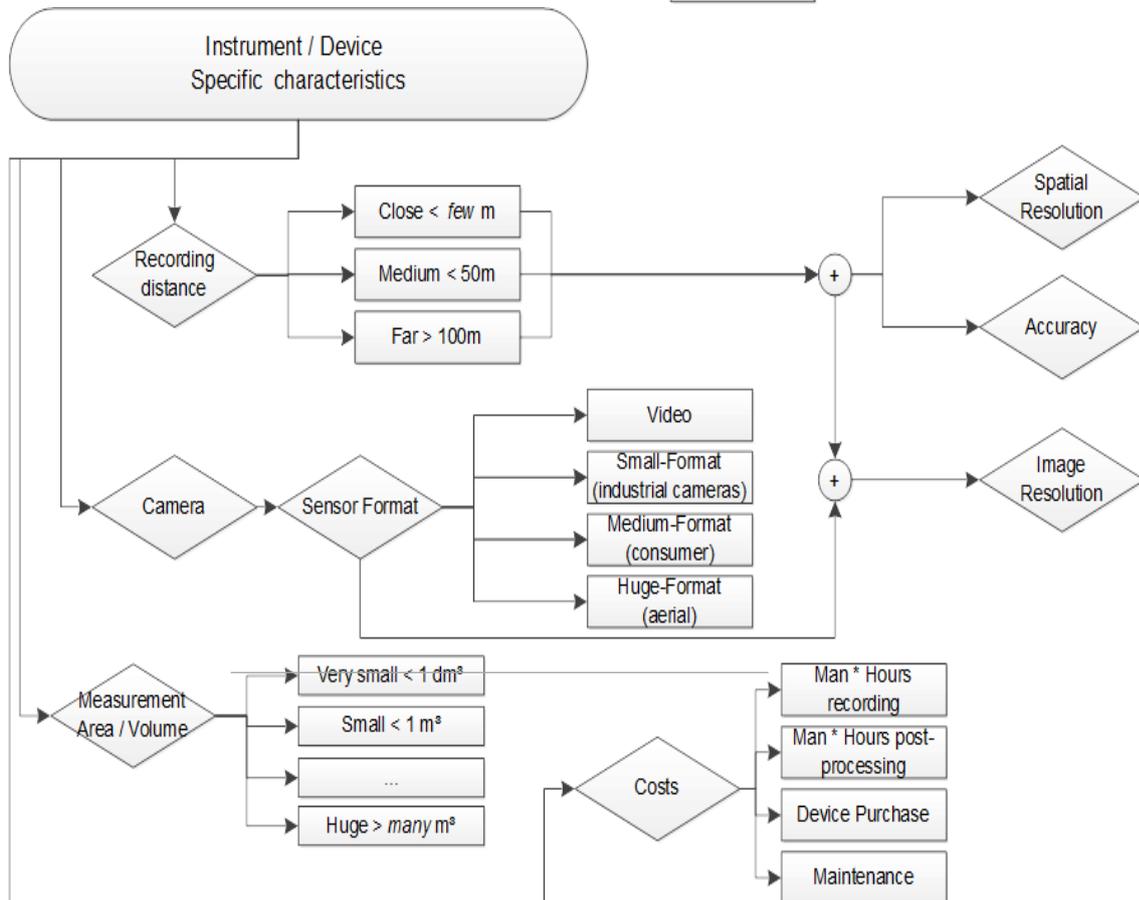
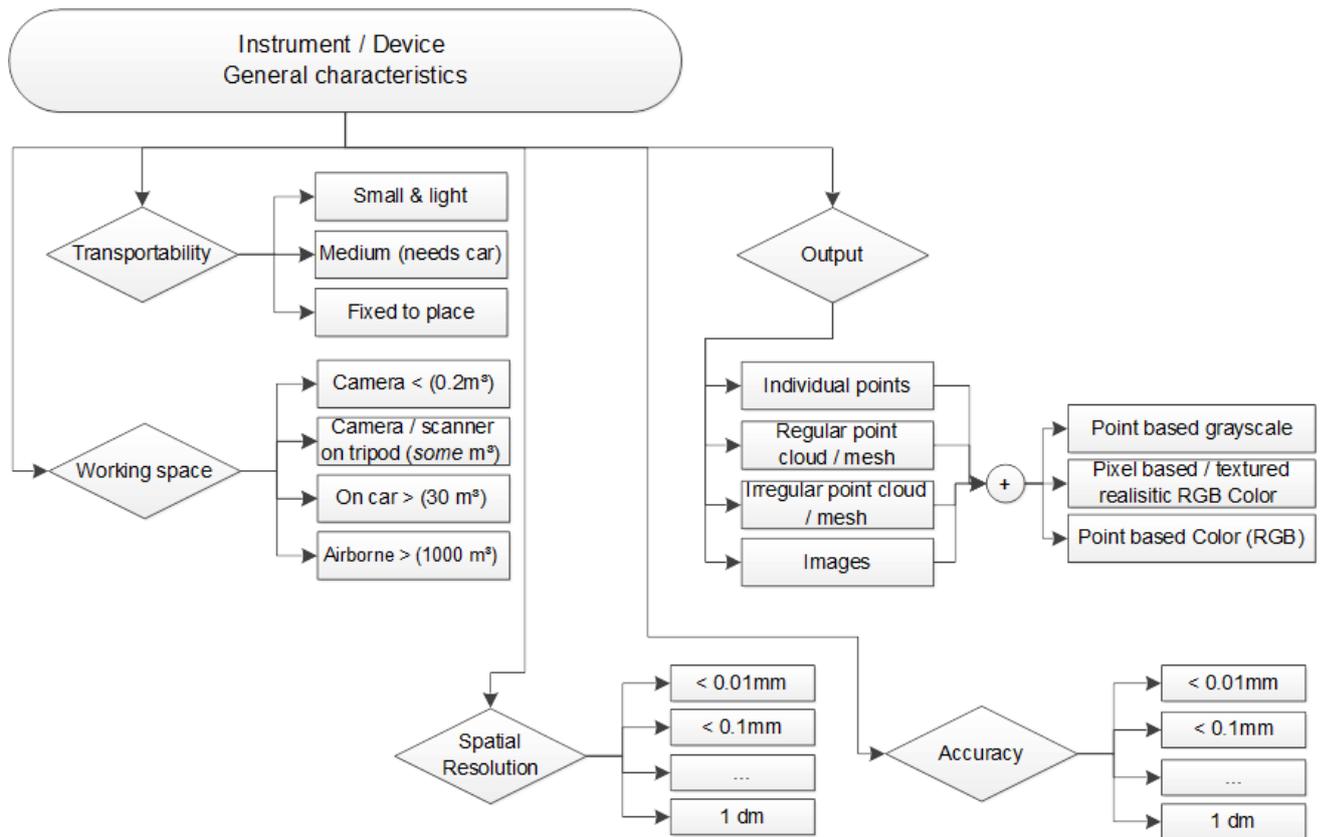
- **transportability:** degree of effort for moving the instrument from A to B according to space, weight...



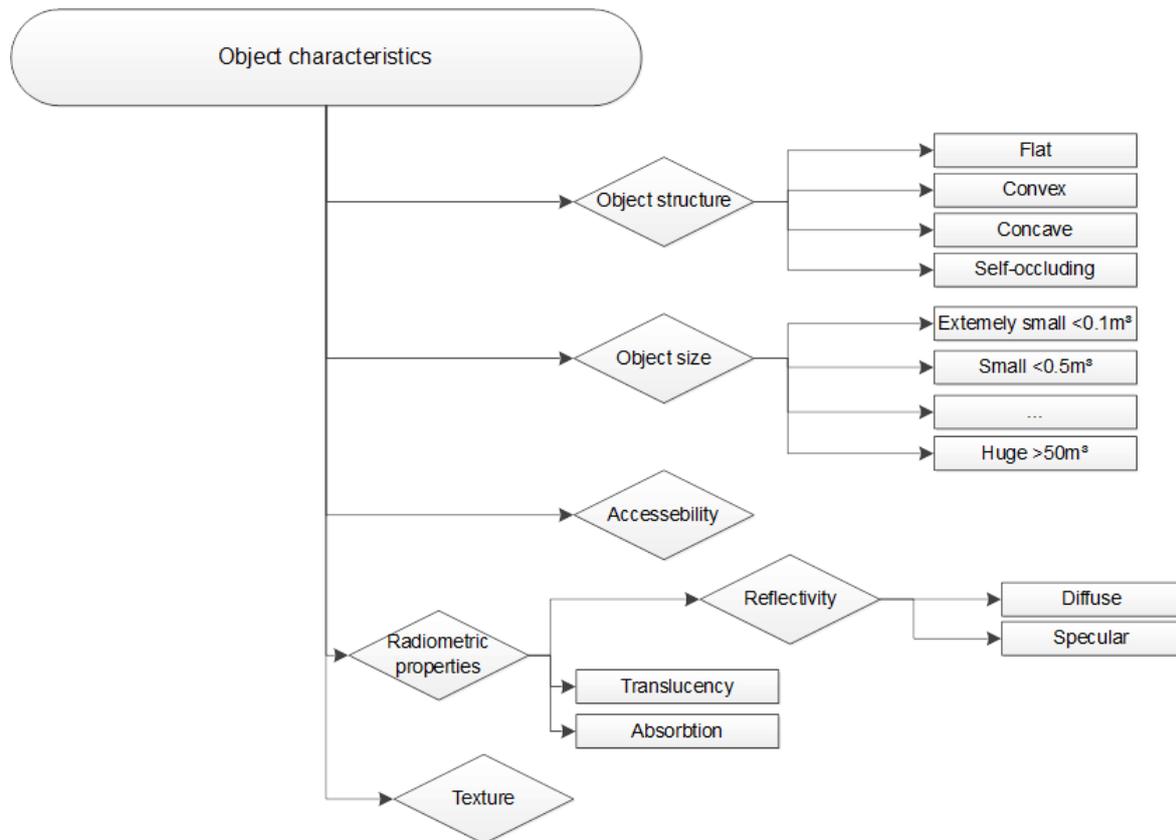
Here are few examples of proposed classification:

The COSCH KR is an ontological based classification system for cultural heritage object that allow to have a common language between the different actors of cultural heritage managements and acquisition. Here are few examples of the use of it:

Technology related characteristics:



Object related characteristics:



On top level ontologies, the most important are the rules and dependencies which link the five top-level classes and sub-classes.

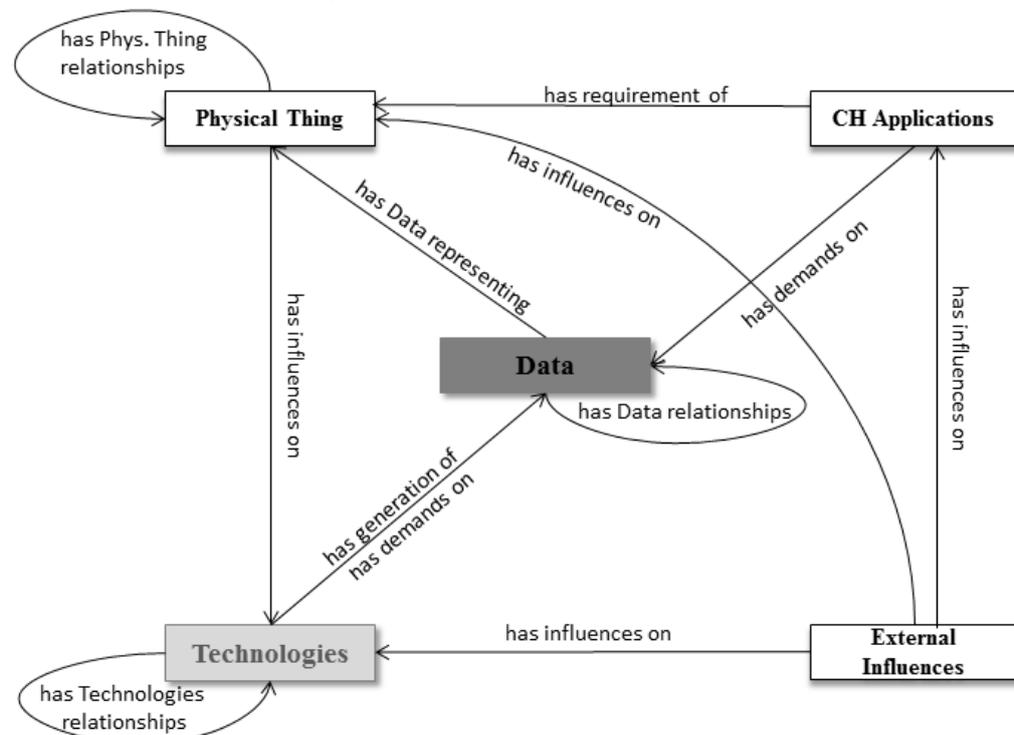


Figure 6: Top level of the description pyramid for classifying CH object

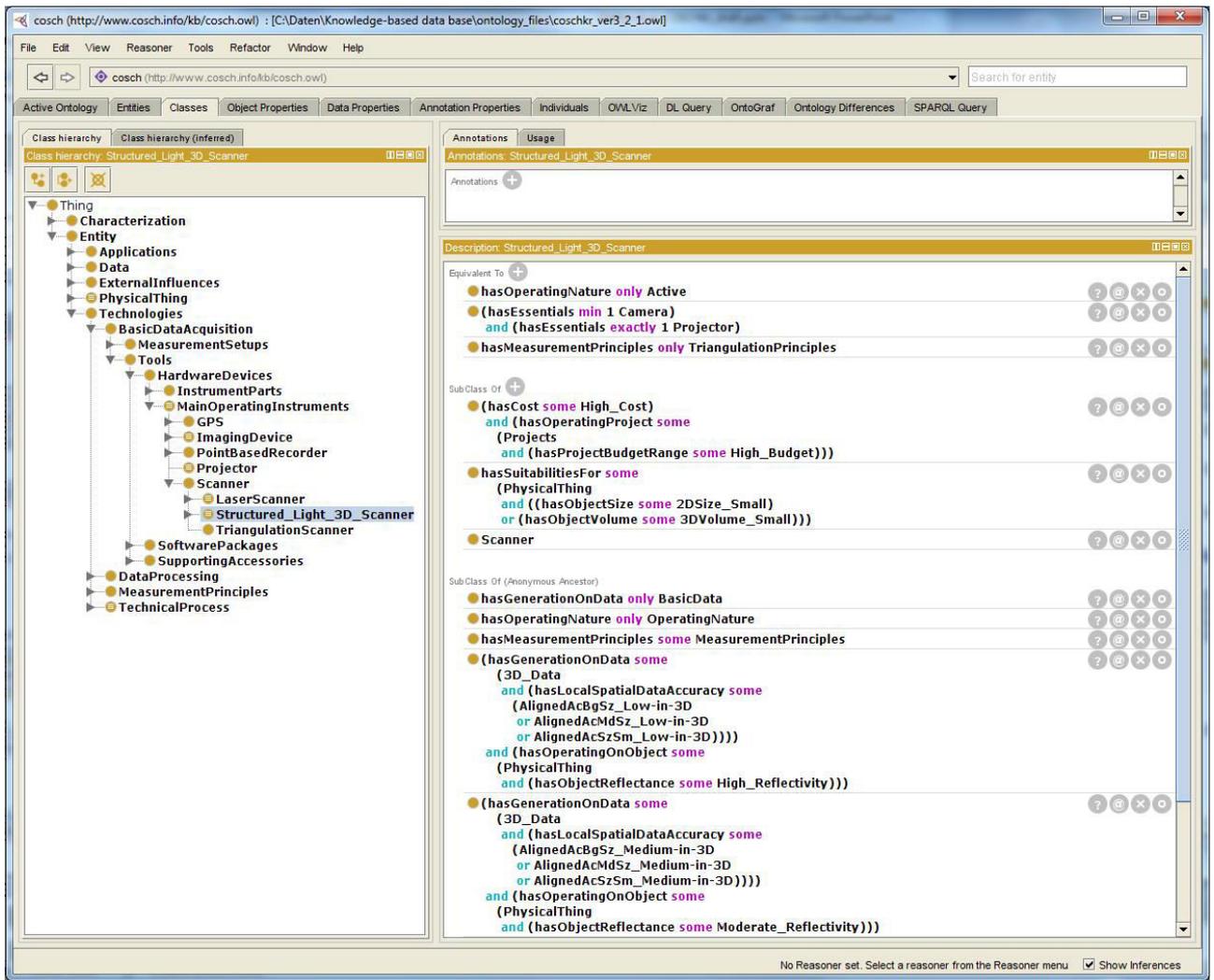


Figure 8: Example of ontology applied to classify a CH acquisition device

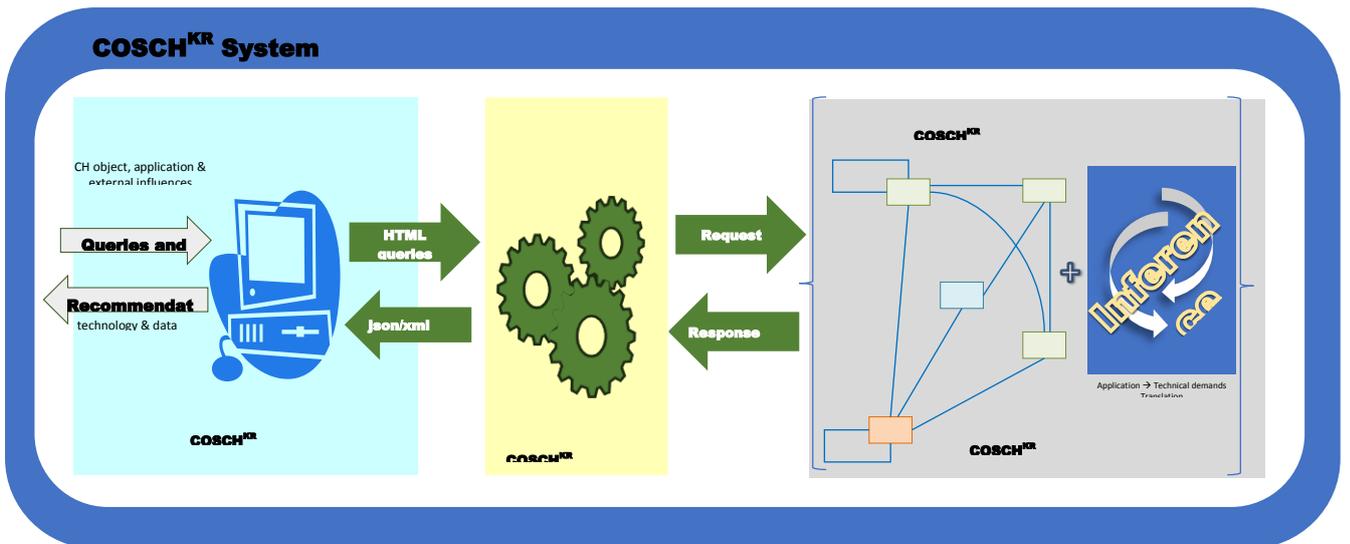


Figure 7: Example of the usage of ontology-based classification through a query system: the COSCH system

Examples

Spatial Case Study: Shape/structure analysis of a building: Creation of 3D-models of buildings/ruins to analyze their structure.

Dissemination through small scale web presentation: Creation of 3D-models of buildings/ruins for small scale dissemination through web presentation

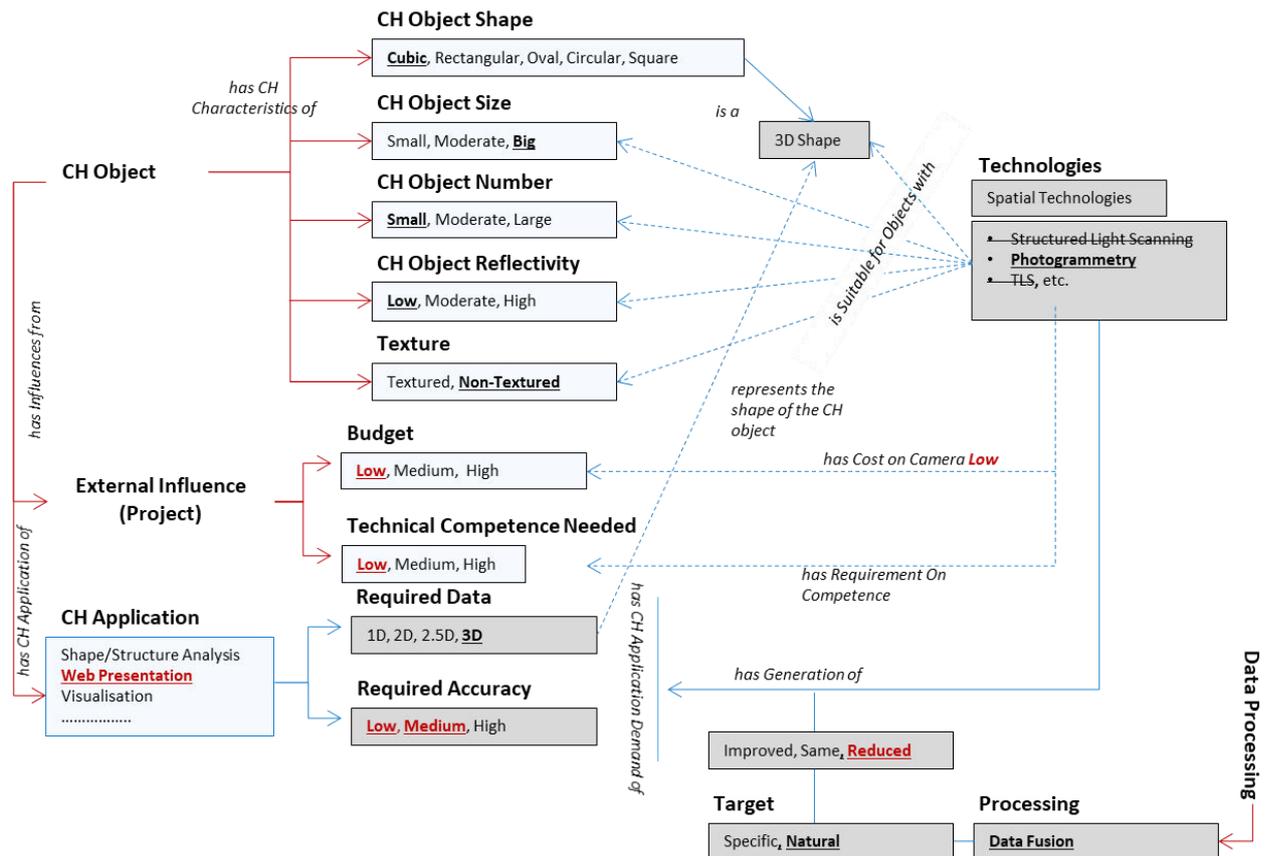


Figure 9: example of the COSCH structure applied to a query of CH objects.

Conclusion

- Digitization is a complex process which needs to be adapted to the needs of an application
- Semantic technologies open the door to transform such a common understanding and into computer interpretable knowledge
- Non-technical specialists are challenged in choosing the right way

- Developing and agreeing on a common understanding helps to avoid spontaneous processes
- Such interpretable knowledge flexibly supports the user and makes the knowledge exploitable

References:

1. Ponciano, Jean-Jacques & Karmacharya, Ashish & Wefers, Stefanie & Boochs, Frank. (2019). Connected semantic concepts as a base for optimal recording and computer-based modelling of cultural heritage objects. 10.1007/978-3-319-99441-3_31.
2. Homburg, Timo & Boochs, Frank. (2018). Situation-dependent data quality analysis for geospatial data using Semantic technologies.
3. Karmacharya, Ashish & Wefers, Stefanie & Boochs, Frank. (2018). Knowledge Based Optimal Recommendation of Spatial Technologies for Documentation of Buildings. 65-77. 10.1007/978-3-319-75789-6_5.
4. Wefers, Stefanie & Karmacharya, Ashish & Boochs, Frank & Pfarr-Harfst, Mieke. (2017). Digital 3D reconstructed models. A proposition for structuring visualisation workflows using semantic technologies for recommendations. Digital Applications in Archaeology and Cultural Heritage. 1. 537-546. 10.14434/sdh.v1i2.23327.
5. Wefers, Stefanie & Boochs, Frank & Karmacharya, Ashish & Heinz, Guido. (2017). How to optimally record cultural heritage objects? Decision support through connected knowledge. In: A. Bienert et al. (eds), EVA Berlin 2017. Elektronische Medien & Kunst, Kultur und Historie 24. Berliner Veranstaltung der internationalen EVA-Serie Electronic Media and Visual Arts, 2017.
6. Prudhomme, Claire & Roxin, Ana & Cruz, Christophe & Boochs, Frank. (2017). Towards the Design of Respond Action in Disaster Management Using Knowledge Modeling. 168-174. 10.1007/978-3-319-67633-3_14.
7. Homburg, Timo & Prudhomme, Claire & Boochs, Frank & Roxin, Ana & Cruz, Christophe. (2017). Integration, Quality Assurance and Usage of Geospatial Data with Semantic Tools. GIS-Zeitschrift für Geoinformatik. 3.