Inventorying Intangible Cultural Heritage on the Web: a Life-cycle Approach

Maria Teresa Artese

Isabella Gagliardi

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● **Maria Teresa Artese**
IMATI – CNR Unit of Milan, Italy

● **Isabella Gagliardi**
IMATI – CNR Unit of Milan, Italy

ABSTRACT

According to the 2003 *Convention for the Safeguarding of the Intangible Cultural Heritage* of UNESCO, creating inventories and making them accessible is a specific obligation for the States Parties. These activities are complex and require methodological tools to integrate the different backgrounds, competencies and skills needed to succeed. In this paper we will present a framework for the complete management of multimedia information systems related to Intangible Cultural Heritage, that we applied to the design and implementation of the Ethnography and Social History Archive of the Lombardy Region in Italy. We describe the characteristics that distinguish our unified approach, within a broader context of the methodological design of web applications, emphasising the innovative features of the online systems developed. We present the environments for managing, searching and browsing ICH data, with a final comparison.

Keywords

multimedia ICH database, innovative tools, ICH data structure, visualisation, searching and browsing of data, AESS, Cremona Luthiery, Lombardy region

1. Introduction

In recent years, there has been increasing interest in the preservation and enhancement of traditional cultural heritage with particular regard to themes like rural culture, daily life, minority arts and crafts. There are numerous ethnographic museums all over the world and virtually on the web, the twin effects of globalisation and official support have created an interest in local identities. In this scenario, the emphasis recently has been on the so-called immaterial or intangible heritage, as defined by UNESCO in the *Convention for the Safeguarding of the Intangible Cultural Heritage* of 2003[1], with particular regard to the protection of dialects, local cultures, music, dance, theatre, customs and traditional knowledge. There

are examples of on-line intangible cultural heritage archives in Scotland, France and Spain, created following the *Convention*, while South Korea, Japan and China had defined strategies for safeguarding their traditions well before the UNESCO *Convention* was ratified. According to the *Convention*, various actions, aims and people with different backgrounds, competencies and skills need to be involved in creating archives and inventories for the management and protection of intangible heritage in an integrated and organic manner.

Open source software with various applications is available to manage collections of tangible heritage. For intangible heritage inventories, whose characteristics are roughly defined in the UNESCO *Convention*, stakeholders (such as cataloguers, institutions, tradition holders, tourists, ethnographers, communities, etc.) can choose between various solutions for searching and browsing online inventories and catalogues, but tools and systems for complete data management are not yet available, to the best of our knowledge.

Our research aims, presented in this paper, are:

1. To study and implement an effective and efficient data structure able to manage all the information related to ICH, considering both the requirements of expert cataloguers and ethnographers and the tradition bearers.

2. To create an environment in which to experiment with new tools for research, navigation and the visualisation of multimedia and real data.

3. To implement a framework to enable the complete management of the ICH on the web.

The significance of the research is as follows:

- **Framework analysis**: define a starting point and a common arena for use by researchers, ethnographers and others interested in preserving, safeguarding and understanding intangible cultural heritage.

- **Integrated tools**: different tools for managing, querying and visualising multimedia information are provided in a unified and organic way.

- **Different points of view**: ICH inventory requirements are considered by different experts (such as UNESCO experts, ethnographers, tourists, web users, designers, etc.) and to fulfil different aims (e.g. safeguarding, transmission, conservation, study, etc.).

- **Coordinate and integrate**: the activities of a large working team, involving researchers, ethnographers, ICT (Information and Communication Technology) and UX (User Experience) experts, technicians, social media specialists, etc. as well as communities and tradition bearers, can be performed in a common control room synergistically.

- **Participation**: communities and tradition bearers play a vital, central role, as required by the 2003 UNESCO *Convention*, throughout the life cycle of the entire system, integrated with experts' skills.

- **Evolution over time**: the system is able to manage any multimedia information containing data that evolves over time, as for example is the case with historical buildings and tangible artworks;

- **Extended use**: the system has been implemented and is not only in use in parts of Italy, but also forms the basis of the first supra-national inventory of ICH, developed within the Interreg project ECHI2 (Ethnography Swiss-Italian for the promotion of intangible heritage. P.O. Cross Border Cooperation, Italy, Switzerland 2007-2013).

- **Novelty**:
  - an integrated environment in which there are appropriate methods and tools to manage and retrieve each type of data.
  - the possibility of adapting solutions already implemented as necessary, even in the light of technological updates, for example by adding or restricting information, inserting new search and visualisation tools and integrating new functions and data.

Here we present a framework born from the collaboration between the National Research Council (CNR) and the Ethnography and Social History Archive of

Lombardy Region (AESS) for the management of multimedia information systems related to ICH. The framework is composed of three environments for data input and navigation. We describe them within a methodological approach for designing applications, focusing on technological aspects. We omit aspects related to the semantics of cataloguing, as these are the responsibility of experienced ethnographers.

The paper is structured as follows: after a description of the UNESCO *Convention* of 2003 and of the issues that arise for the management of ICH, we will describe the framework, with a detailed view of the features we investigated, and the implemented environments for data entry (a brief overview), searching and browsing of data, with a final comparison. Then, after a brief analysis of related works, we conclude with a discussion of the system presented and describe possible future developments.

2. The UNESCO *Convention*

According to the 2003 UNESCO *Convention for the Safeguarding of the Intangible Cultural Heritage,* the Intangible Cultural Heritage (ICH) — or living heritage — is defined as:

...the practices, representations, expressions, as well as the knowledge and skills, that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. ICH is manifested in the domains of oral traditions (including languages), performing arts, social practices, knowledge, traditional craftsmanship and is transmitted from generation to generation, constantly recreated by communities and groups in response to their environment, their interaction with nature and their history, and provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity.

Drawing up inventories is one of the specific obligations outlined in the *Convention* and can be seen as a process composed of 3 steps:

1. Recognition: made by the communities, groups or individuals who decide which specific heritage is worthy of being identified, maintained and transmitted.

2. Identification: consists of describing one or more specific elements of intangible cultural heritage in context and distinguishing them from others. This process leads to inventorying.

3. Inventorying: is recording information in a suitable way to preserve and safeguard the identified heritage. Inventorying should be done 'with a view to safeguarding', applying measures to ensure that intangible cultural heritage can be transmitted from one generation to another.

The *Convention* focuses on the role of communities and groups (tradition bearers and practitioners) in recognising and safeguarding intangible cultural heritage. It leaves each State Party a great deal of freedom to draw up inventories but, in spite of this freedom, requires community involvement. Since communities are the ones who recognise and (re-)create intangible cultural heritage and keep it alive, they have a privileged place in safeguarding it.

3. Framework for ICH on the web

A framework for intangible cultural heritage is a multimedia complex information system, able to manage the entire ICH life cycle, from content definition to database design, from data population to searching and visualisation tools, from valorisation to the involvement of communities and tradition bearers. The first stage is to analyse what is required, in order to create and correctly identify the necessary data structure, functionalities and tools for this composite system:

· **Content**: the system should be able to accomplish, in a simple and straightforward manner, different ways of populating it, readily accessible for different people, from cataloguers, historians and ethnographers whose information is largely theoretical, to communities and tradition bearers who have practical hands-on knowledge, and tourists who see an event, enjoy it and take pictures.

· **Identifying users**:
  - experts: people who use the web only for specialist consultation, or study purposes
  - community: people with hands-on knowledge
  - tourists: people who want to be informed about events, fairs, carnivals and so on around them, to enrich their knowledge and have new experiences
  - web users: people who consult the on-line system, looking for materials of interest, and browsing through available information, jumping from one topic to another
  - young people wanting to learn how to practise the tradition or activity

- **Objectives**:
  - target search: to find specialised information
  - category search: to be used when users have no specific idea of what they are searching for (e.g. carnivals or food fairs)
  - local: what is happening in my area? Are there events for children? Something to do outdoors?
  - study: when users are looking for in-depth information
  - safeguarding and transmission

- **Devices**: there are always new devices of different sizes and resolutions, and this must be taken into account, but it is also important to understand the different purposes and needs for which people visit a site. For example, if you are consulting an ICH archive from an office desktop PC, the aim may be to study and deepen your knowledge, but if you are using a smartphone, typically during a trip, the purpose may be to discover something new.

Therefore, users may have different backgrounds, they may browse and search data at different levels of detail, in different places and with different devices and aims. So a framework should be able to offer them all exactly the tools they need.

As mentioned above, UNESCO permits the freedom to define an inventory according to local needs. To identify the minimum information set, they suggest the following outline:[3]

1. Identification of the element
2. Characteristics of the element
3. Persons and institutions involved with the element
4. State of the element: viability
5. Data gathering and inventorying
6. References to literature, discography, audio-visual materials, archives

With respect to traditional web sites, ICH calls for innovative and inclusive tools for searching, visualisation and browsing: as for museums (Lopotovska et al., 2013, pp. 1-4; Lopotovska, 2015, pp. 191-207), the ICH web sites / app could integrate several tools to:

- provide easy access to data through standard search tools, adapted for PC, tablet and smartphone
- facilitate access with tags and keywords

- integrate different sources of information on the web
- develop innovative tools for visualisation and information access on the web: e.g. story-telling, timeline browsing, games, 3D, augmented reality, etc.
- design and implement content-based retrieval and clustering algorithms; recommendation and similar to/suggestion tools, search by colour, mood, texture, shapes, etc., automatically extracted from text and multimedia

Finally the system should ensure collaboration, from the design phase to when the system is up and running, to allow specialists, researchers and tradition bearers, to enter, expand, modify and delete any entries, even on the same information at the same time: the system must be designed to allow concurrent access to data while keeping information safe and secure.

General requirements to be followed by frameworks for ICH are:

- **Usability**: users must be able to use the system without any technical knowledge or prior training. The search engine must be interrogated in a simple and intuitive way (Nielson and Landauer, 1993, pp. 206-221; Nielson, 1999).

- **Accessibility**: information should be accessible to everyone, even and especially to people with disabilities. In particular, the website and the services provided should be browser-independent. The Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C)4 has defined rules and made tools available for assessing the accessibility of websites.

- **Scalability**: the data structure must be planned to allow for the continuous updating of both the web and technology, so that the system can adapt to new needs and to new technological solutions as they become available.

- **Interchange and compatibility**: the system must allow the export of data, choosing the appropriate level of semantic description. It should also take into account the existing standard, such as metadata standards (Gill. 2008; Doerr, 2003, p. 75; EAD, 2015), SKOS (Miles and Bechhofer, 2009), etc.

· **Multilingual**: the system must incorporate information architecture that is language independent. The list of available languages should be updated at any time, depending on the needs of the project, where the same entry can be inserted and made available in multiple languages, through links from one language to another, as well as for the data entry and search interface.

In the following sections we illustrate our proposal, a unique framework for the management of intangible cultural heritage on the web, developed and applied to the huge archive managed by Lombardy Region: the Ethnography and Social History Archive (AESS).

4. The AESS framework

From a technical point of view, the AESS multimedia information system (Artese and Gagliardi, 2014a, pp. 132-137), designed for the Lombardy Region ICH archive, combines well-established web searching tools with innovative tools which aim to put the user, whether expert or not, at the centre of an integrated environment for inventorying, browsing, searching and viewing sections, allowing also for the conservation and safeguarding of intangible cultural heritage.

The AESS archive has dealt with information pertaining to the oral history of the Lombard Region since 1972: the data concerns mainly popular songs and other audio and video records describing popular traditions handed down generation by generation, such as traditional fairs, and customs, performed songs, interviews, and so on. Linked with multimedia data (audio, video, image, pdf) are books, journals, discs, DVDs, files, etc., on which this information is stored (printed, recorded, etc.). The latest changes in structure happened in 2011 (within the INTERREG project ECHI) with the establishment of an inventory card for Intangible Cultural Heritage (ICH card in Figure 2): from now on we call AESS this complete data set, managed through a DataBase Management System, in our case Oracle and MySql.

In defining the data structure we started from the requirements of the UNESCO *Convention*, combining both information to be stored and involving tradition bearers and communities. AESS documentation also involves the use of different recording formats and tools: e.g. a carnival can be recorded through videos, photos and

audio, as well as through interviews with the people who participate, or make food or costumes or sing traditional songs, together with their lyrics and sheet music. This documentation may be added to year after year, to show how the carnival has evolved over the years, or how it has remained the same. In recent years, the availability of social networks and apps has changed the way in which community members can interact and communicate intangible heritage with other people.

4.1. Users, data and aims

To manage the AESS archive in a unified and multimodal way - that is data input, web browsing and search, users, organisations, and database - a framework has been designed and implemented that makes the database available online through a customisable website. The framework software includes different environments developed in multilingual mode, in relation to the different organisations / users who access it. Identified users are:

1. Lombardy Region staff and other institutional users: directors and technicians who have specific competences and requirements for their own work - data-entry and updating, data quality control, etc.

2. cataloguers belonging to other Italian regions, public or private bodies or even individuals who have photographs or other ICH materials of interest for AESS staff: they need a simplified interface to upload files to store in the archive. They would also benefit
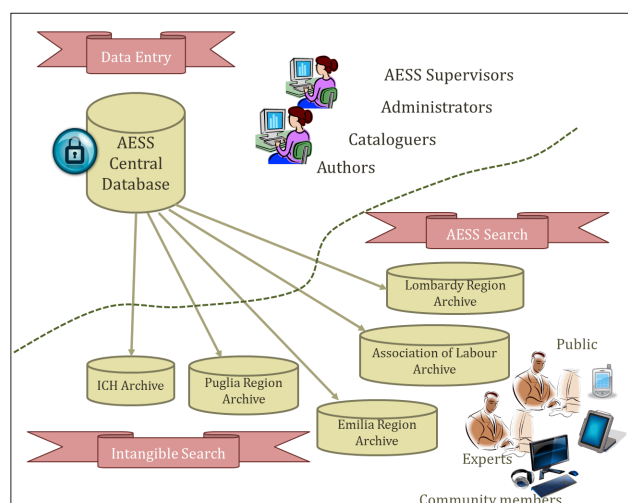
Figure 1
The AESS system.

from being able to add comments or materials to objects already present in the database, in a blog style.

3. professional users: experts, ethnographers, and art historians who need a simplified interface to interrogate the system for their study and research activities, but are accustomed to a specific card terminology.

4. educators and teachers who need a user-friendly and attractive interface to make local history and tradition available to schools and young people.

5. generic users without any competence in ethnography or in browsing the web, who therefore require a further simplified interface to use the system to satisfy their amateur interest and curiosity.

6. tourists who want to know what to see and enjoy nearby, and can decide when to make a trip by looking at the event calendar.

7. community / tradition bearers who have knowledge of particular elements of heritage, help in creating and recreating it, and are willing to participate in the inventorying.

Figure 1 shows the AESS framework: we can see the back-end and front-end environments, with a further segmentation for web navigation and search facilities. The cataloguers and supervisors are at the top, with different possible activities depicted, and the users are at the bottom.

The information system has been structured (Artese and Gagliardi, 2014b, pp. 657-668) to store and maintain all the information selected by ethnographic cataloguers, not only for users browsing the web, but, above all, to preserve the traditions of Lombardy and other territories through the production and storage of digital documents.

The main characteristics of AESS data are:

· **Size**: the amount of data handled can be huge and is constantly increasing. This requires proven tools for data management, such as Oracle or MySQL databases, and may require finer and more selective modalities for interrogating and visualising.

· **Multimedia**: a lot of images, audio and videos together with textual data give information in a more direct way, and also show how the traditions change
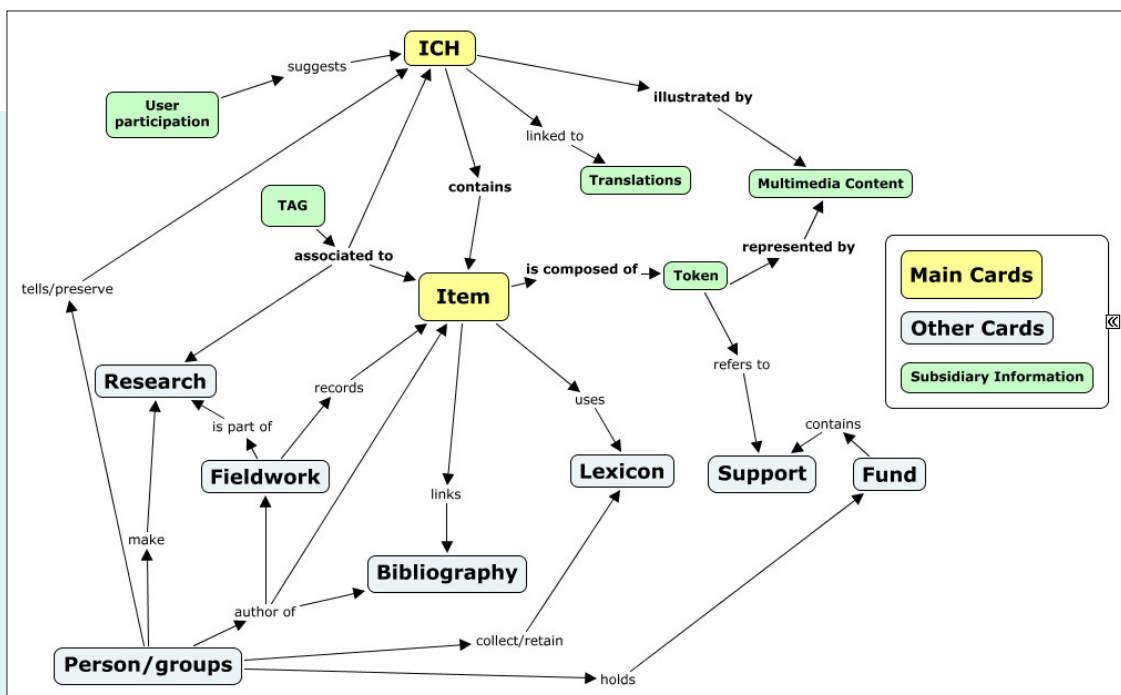
Figure 2
The AESS data structure.

over time. The same event can be represented by images, video and photos taken years apart: the changes in the traditions should thus be clearly visible in a timeline.

· **Complexity**: data is interrelated and interdependent. Strategies for the integration of elements, both in searching and visualising, should be provided. The data structure highlights the circularity of data, the most important entities are related each other and it should be possible to reach any of them through a few clicks of the mouse.

· **Detail**: both ethnographers, social history experts, etc., and tradition bearers will search the catalogue, so there have to be different depths of information.

· **Alive**: according to UNESCO, ICH is constantly recreated by its bearers, and no two manifestations are ever totally identical. ICH elements are continuously evolving, from manifestation to manifestation, while being transmitted from person to person and from generation to generation.

· **Multilingual**: the framework should be language-independent, with two levels: one level is related to the interface, while the second is concerned with data content.

· **Multiagency/different datasets**: different organisations, public and private companies may enter data into the database, thus providing different datasets: they can be displayed along with Lombardy Region ones, or on the web by themselves, using different host names and a customised interface.

Two different archiving strategies need to be carried out in the AESS database:

1. Detailed inventorying: intangible cultural heritage elements are described as a whole - images, videos and / or interviews are attached to describe the events.

2. In-depth cataloguing: each song, interview, ballad or recipe is described in detail, and in this case, images, videos or audio are attached to describe the object.

to be managed in a unified manner through the data entry system.

Data quality is ensured by the control and card validation performed by experts and Lombardy Region staff. The input of tradition bearers and community members guarantees that the data stored is chosen and 'authorised' at grass roots level.

4.2. Data structure

The main AESS database entities (Atzeni et al., 2006) are shown in Figure 2 which depicts the complete structure we defined. The ICH, related to the first activity above identified — inventory cataloguing — describes the intangible cultural elements as a whole, related to the five UNESCO domains: oral traditions and expressions; performing arts; social practices, rituals and festive events; knowledge and practices concerning nature and the universe; traditional craftsmanship.

An ICH card can be seen as a virtual container, which may be linked to detailed descriptions stored in the database by ITEM cards, and is added to year by year, for instance with new images or videos of the latest event. All information linked to the ICH card allows the user to reconstruct and show the evolution of the event over the years, showing both its textual descriptions and its MULTIMEDIA timeline. The ITEM card is used to store a document significant to an intangible tradition: it is the minimum unit of information that can be catalogued (for
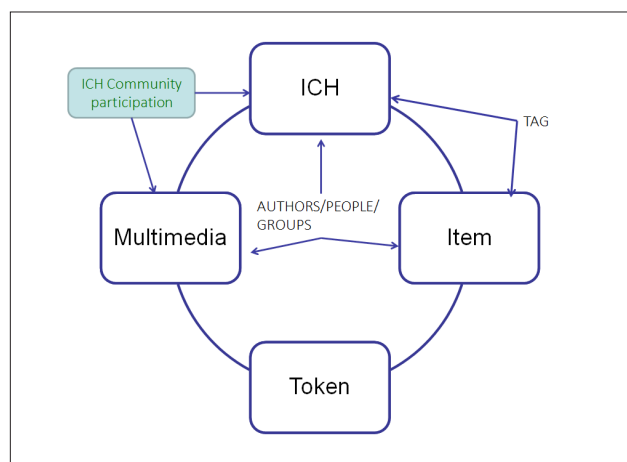
Figure 3
Circularity of data in the AESS data structure.
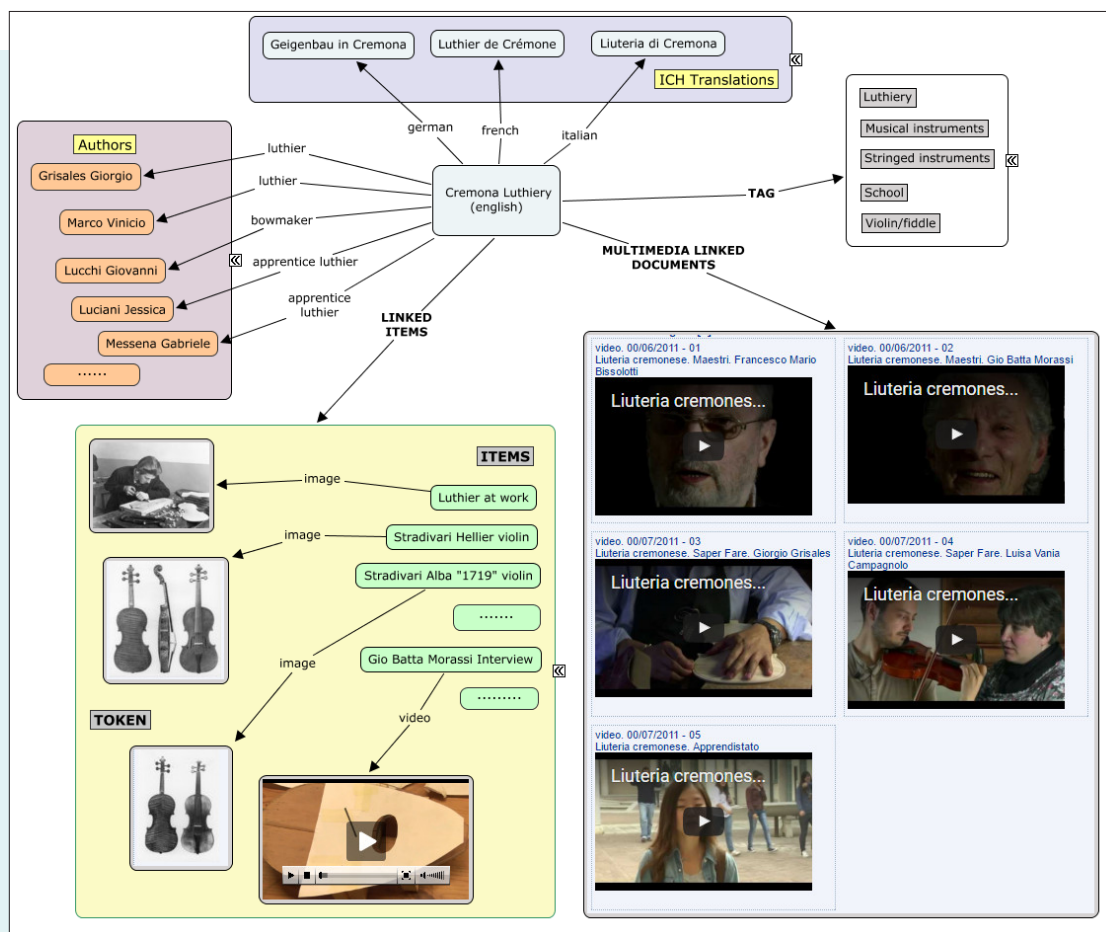
Figure 4
'Cremona Luthiery' detailed card.

example, a song, an interview) — for in-depth cataloguing — and is described by title, the first few words of the text, abstract and keywords. In most cases it is accompanied by audio, video, texts, etc. The TOKEN is the particular structure used to describe the various articulations of the ITEM in relation to the SUPPORT, representing the physical objects (or the digital files) containing the information. An ICH card can be linked to different ITEMs (to integrate multimedia) or MULTIMEDIA CONTENT can be connected directly to it, supplying information such as title, author, data and locality for each item of content.

The AESS database today has 73,900 ITEM cards related to 51,700 SUPPORT cards, 1,098 ICH cards, in 4 different languages, and 39,210 MULTIMEDIA CONTENTS of which 29,723 are images, 6,565 are audio files, 1,734 are video files, 1,072 are text files and 115 are pdf files with music pentagram. Among other things we also have 8,805 Person / Group cards, 615 Bibliography cards, 217 Fund cards.

Figure 3 shows in a simple way how data is connected. ITEMs, ICH (and RESEARCHes) can be supplied with TAGs, which are keywords related to the semantic contents of the objects. Tag structure allows one to insert keywords in any language the database is arranged for and, in the search phase, all the objects containing the tag searched for will be retrieved, no matter what language is used for the tag.

A practical example of how the Cremona Luthiery, inscribed in the *Intangible Cultural Heritage List* of UNESCO, is structured and stored in the AESS database is shown in Figure 4. There are 4 ICH cards for Cremona Luthiery, one for each language available — Italian, English, German and French — linked to each other. Each of them is linked to 59 ITEMs, which are represented by TOKENs of different types, in this case both images and videos. ICH cards are also linked to 54 Authors, each of them with his/her role specified, 5 Tags are given in the language of the ICH card and other specific Multimedia documents, in this case there are 5 video files.

According to the UNESCO *Convention*, communities play an important role in safeguarding intangible cultural heritage, so several tools have been developed for them:

- cross-border local communities may suggest the inventorying of a practice or a popular tradition, adding a recommendation in ICH COMMUNITY SUGGESTION. When these suggestions are judged to be useful, a new ICH record is created in the database by the Lombardy Region staff, also storing information about who made the suggestion.

- outside the database, a YouTube channel and a Facebook page have been created to collect suggestions in the form of audio, videos and photos of intangible cultural heritage not yet integrated in the database, or by supplying more information.

One of the peculiarities of AESS data arises from the relationship between documents (ITEMs) and their physical supports (SUPPORTs), so the following may occur:

1. the existence of several versions of the same document, for example, the same song performed by different singers with little local variants, that leads to the production of different documents and supports.

2. the presence of the same document on different supports, for example the same image in negative and on file, that leads to the creation of different TOKENs and supports.

3. fragments of the same document on different supports, e.g. a part of an interview on one CD and another part on another one.
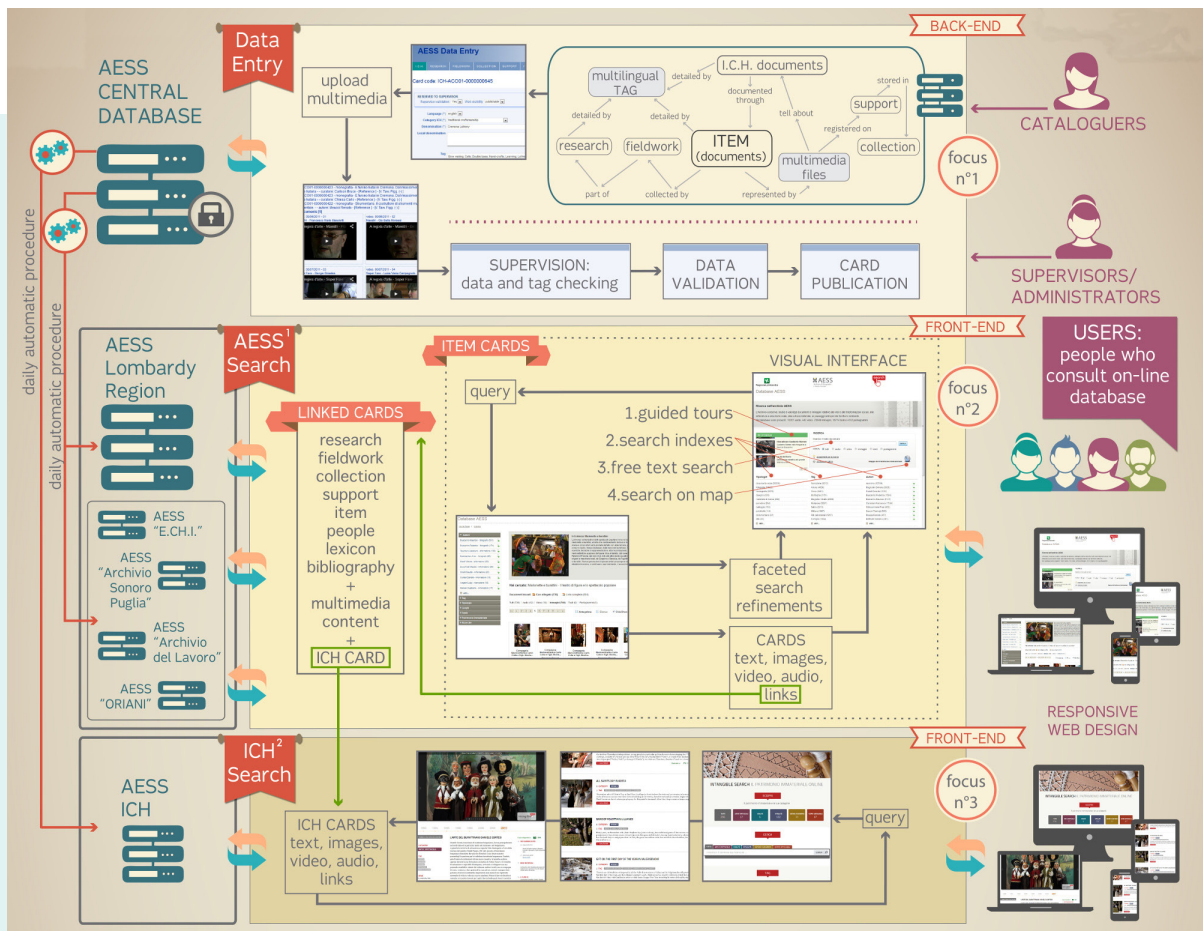
Figure 5
Logical schema of the AESS framework.
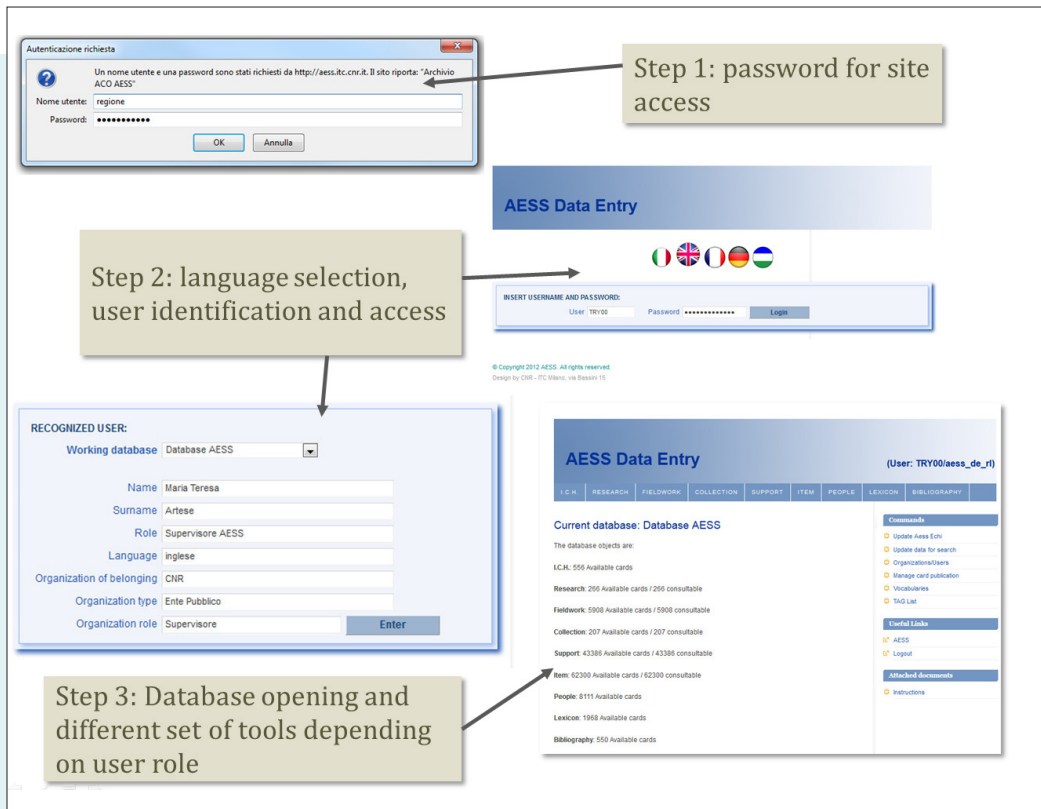
Figure 6
Data entry validation and home page.
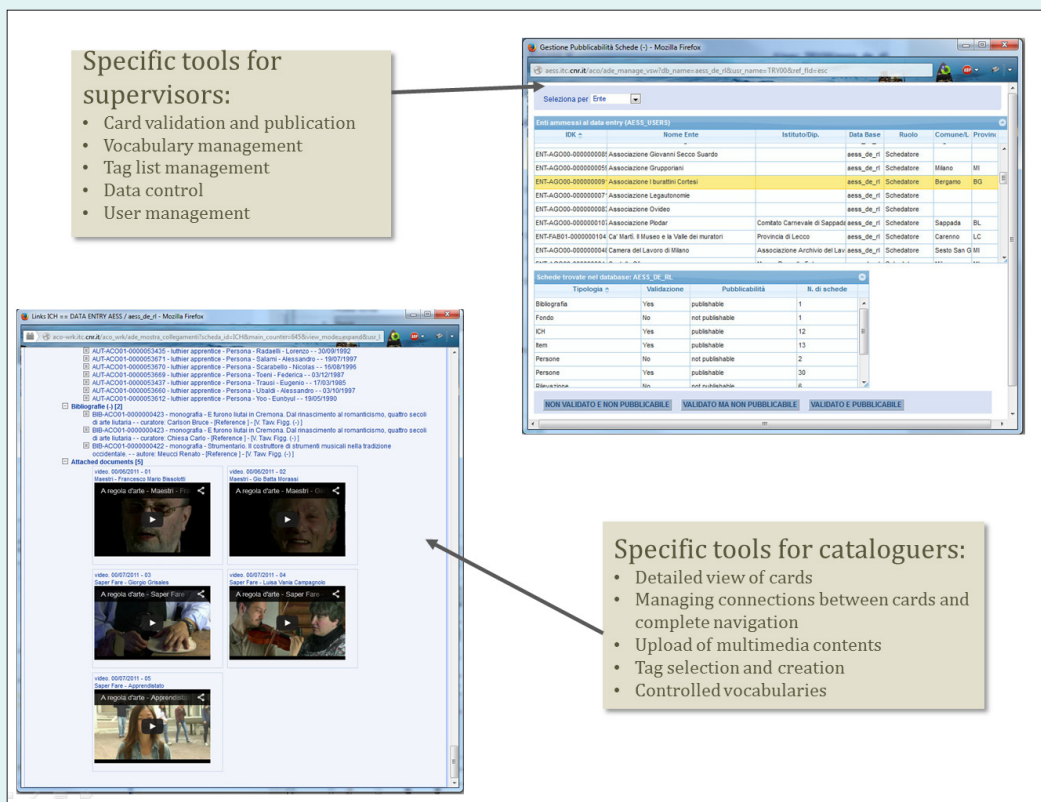
Figure 7
Data entry specific tools for users.

5. AESS on the web

The database structure and the aims of the system have called for different web sites, either performing different scopes (such as data entry and searching / browsing) on different datasets (such as the complete database or data subsets belonging to different organisations, or ICH cards with multimedia objects). In designing navigation and interaction for users we keep in mind that:

1. AESS web sites have to adhere to internet standards both the codified ones and *de facto* ones (Follow Web Convention) (McGovern et al., 2002).

2. Our target users have very different backgrounds and aims that may vary from ethnography to musicology, from cultural history to simple interest, and so on (Design for the reader).

3. Because of the complex nature of data and of their interaction, we provide users with information about where they are, where they come from, where they are going, and what kind of data is related to each object they open.

Developed interfaces provide context tips to help navigation and make it easy to identify links and other helpful elements.

The AESS logical schema is composed by the following environments (as shown in Figure 5):

1. Data entry, the back-end for data input and management, according to the AESS data structure. All datasets are stored in a single database (the AESS Central database) in order to keep them consistent, up-to-date and to avoid unnecessary duplication.

2. Web navigation:
   - AESS Search (now Lombardy Digital Archive), the front-end, is the search engine created to display data related to the whole AESS Lombardy Region database or to other virtual data subsets automatically created.
   - ICH Search (or Intangible Search), another front-end module, is a specific engine thought to

Figure 8
Data entry form for the 'Cremona Luthiery', section one.

navigate ICH data from a macro point of view, through indexes and free text searches, displayed on a map.

5.1. Back-end: Data Entry

The data entry system has been implemented to allow Lombardy Region experts and cataloguers belonging to other organisations to input their own data. It is an on-line system which provides tools for cataloguers and supervisors, and is useful for facilitating data integration and managing multimedia content, and creates connections between data, control, analysis, validation and data publication to ensure quality. The data entry system handles all types of AESS Data structure cards: users enabled to manage data are provided with logins and passwords and all data is added into the AESS Central Database. It is foreseen that the interface will be customised for the various user levels, e.g. administrator versus cataloguer and full data versus ICH card.

Figure 6 shows the Data Entry, with the user logging in (steps 1 and 2) and in step 3 there is the home page with all available cards in the top navigation bar, database information in the middle and user tools on the right.

Figure 9
Data entry form for the 'Cremona Luthiery' card, end section.

Specific tools for cataloguers are: a detailed view of the cards, connections management, multimedia upload, tag creation and selection, and controlled vocabularies. Moreover, supervisor users can access tools to validate cards, manage vocabularies and tags, validate data, and manage users and the web (see Figure 7). Figures 8 and 9 show 'Cremona Luthiery' managed by the Data Entry, with the textual information and multimedia documents.

5.2. Front-end: web navigation

For the front-end we developed two different websites to search and navigate the AESS data structure, according to different user needs, knowledge (of the topics) and ability. Both of them extract data from the same database albeit at different levels, but they differ in the type of information they offer for the interactivity and participation level, and for the integrated tools for browsing and searching. They are oriented to different types of users:

Figure 10
Pages from the AESS 'Search' site, customised for different associations.

- AESS search is a website mainly dedicated to ethnographers, experts, and Lombardy Region staff
- ICH search is a website oriented to the general public

In the following sections the front-end web sites will be described in detail, and their different characteristics are compared in a table.

5.2.1. AESS Search

The entire complexity of the data structure is offered to users, to allow ethnographers, Lombardy Region staff, and other regional specialists to perform complex searches to retrieve exactly the objects they are searching for. Multimodal means of navigation and retrieval have been designed and implemented. The website[5] provides a standard search interface, simple and powerful, which allows users to perform searches on different card types, on fields chosen by the ethnographic experts of Lombardy Region. Specific interfaces for different user categories have been made, providing tools that allow online consultation both to specialists and a wider audience. According to the multi-agency criteria, it is possible to customise the web site for each organisation, extracting data automatically from the AESS Central Database and applying proper options, e.g. logo, colours, graphic style, data level visualisation, etc. Figure 10 shows the home page for AESS and other organisations: pages share the same structure, but the data, colours, logos, images, style, etc. are different.
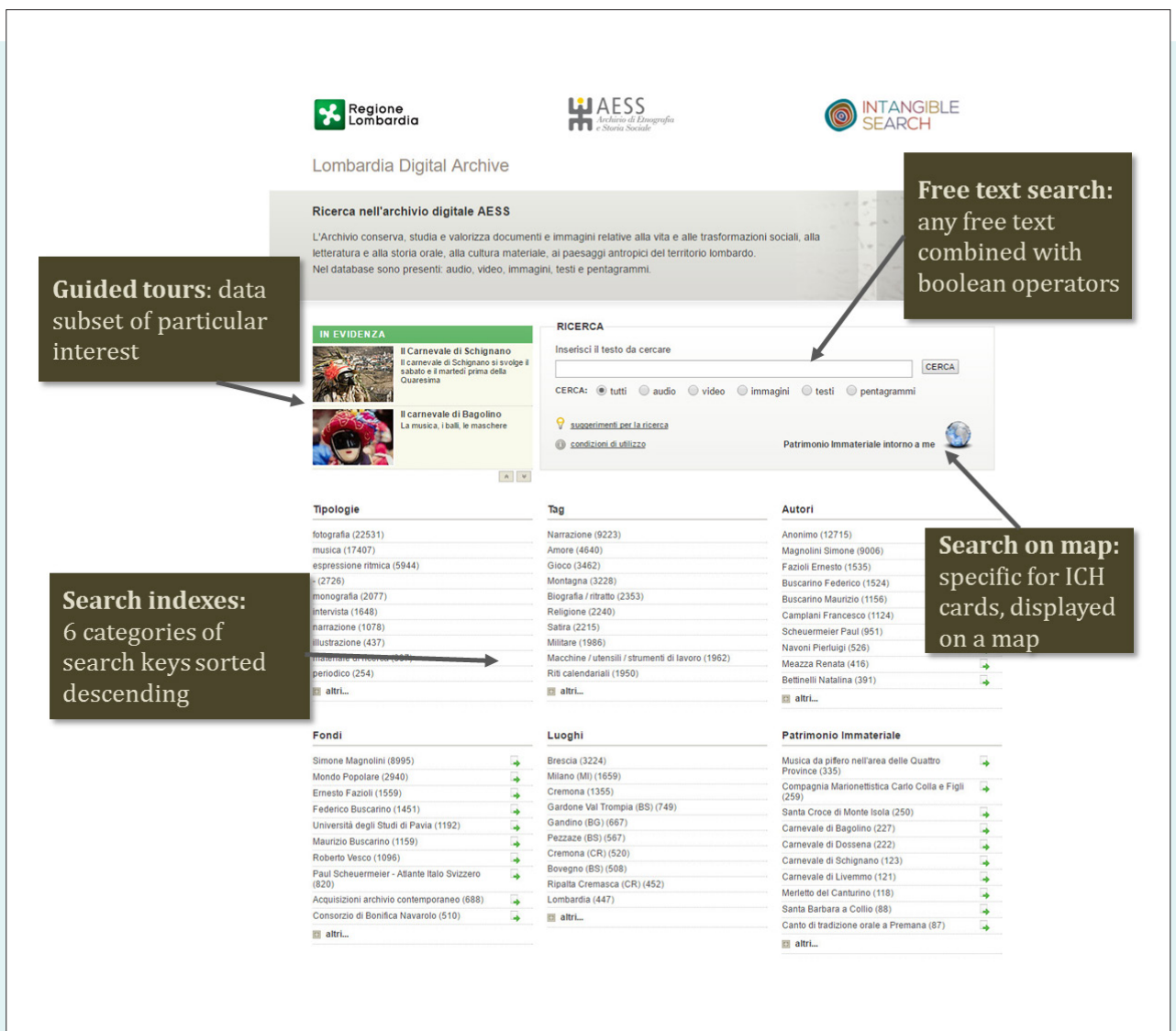
Figure 11
Different search strategies.

The home page of AESS search (now updated to Lombardia Digital Archive) offers several search strategies intended for different types of user (see Figure 11):

· **Search indexes**: the database can be explored using keywords (indexes) belonging to 6 categories, which have been identified by experts as the most significant. Each click leads to the page containing the ITEMs retrieved under the selected term. Clicking on the green arrow, available for Author, Funds and ICH keys, leads to the corresponding card, from which, thanks to data circularity, the user can explore all the types of documents related to the object selected.

· **Free text search**: the system performs the search created by the search text input by users. Boolean operators AND, OR and NOT are available as in a standard Google search. It is possible to limit the search to a particular type of item, e.g. by choosing the 'video' button the system will return only documents with videos.

· **Guided tours**: in the 'Highlights' section the system offers search ideas prepared by experts, a click on each suggestion runs a pre-packaged search with results and other news relating to these pre-defined searches.

Figure 12
Image results for 'Cremona Luthiery'.

· **Search on Map**: specifically designed for ICH documents, it shows them as points on a map.

Search results are shown in the middle of the page: we find here documents that match the query, divided into the five domains covered by the system: audio, video, text, images, and pentagram. In Figure 12, it is possible to see results from our pilot example, this is the page obtained when clicking the link 'Cremona Luthiery' from the index section on the home page 'Intangible heritage': all documents linked to the ICH card are shown, together with a small abstract, and there are different ways to access the results.

Figure 13 shows the typical result of a guided search: the icon closest to each document states its type, while the icon colour shows the presence or absence of a multimedia attachment available online. The left side of the results page is dedicated to the index section, where users can find the index subsets got from documents retrieved, like a faceted query (Basu et al., 2008, pp. 13-22): by selecting values it is possible to refine the current search, and make it more specific by narrowing the retrieved documents set. Faceted searches aim to combine navigational and direct searches to achieve the best of both approaches. Figure 14 shows images with the tag 'luthiery', taken by refining the previous query 'images from the photographer Ernesto Fazioli'.

Figure 15 shows an example of results from the AESS website customised for another organisation, the 'Archivio Sonoro Puglia'.

Figure 13
Guided tour for 'Canto Narrativo'.

Figure 14
Refining a search with the tag 'luthiery'.
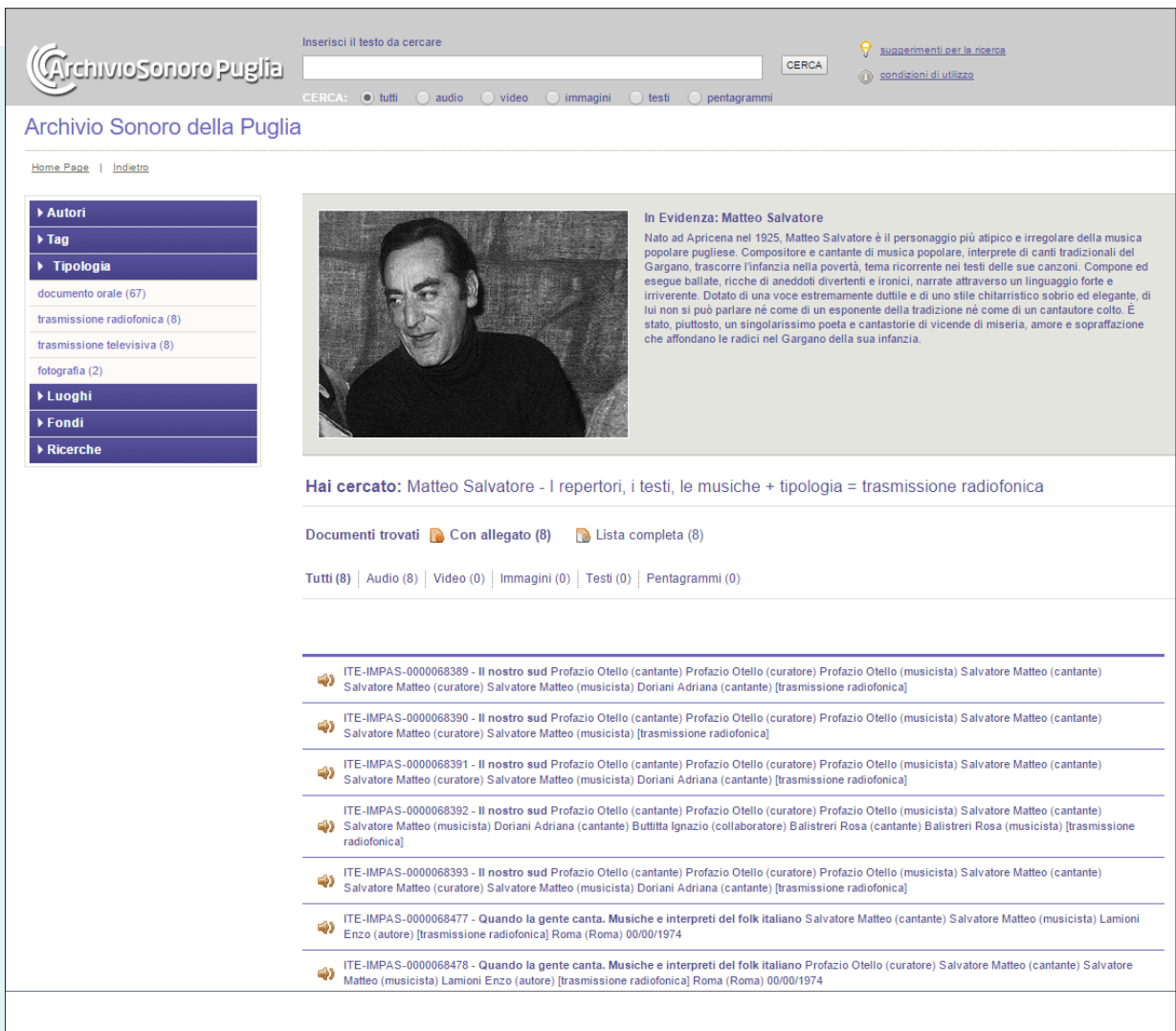
Figure 15
Guided tour for 'Matteo Salvatore' on the customised website
'Archivio Sonorodella Puglia'.

By selecting each document retrieved in the results page, its detail is shown, with semantic, structural (contents/container) and similarity links, together with the associated multimedia. Figure 16 shows a document of image type from the 'Cremona Luthiery' search.

Figure 17 shows other document types: above a video document is shown, together with images automatically extracted to form the video index while below an audio interview is shown, in which each topic is covered by an item extracted from the database, as indicated by the green arrow on the right of each subject heading.

Other card links: author, ICH card, support, fund
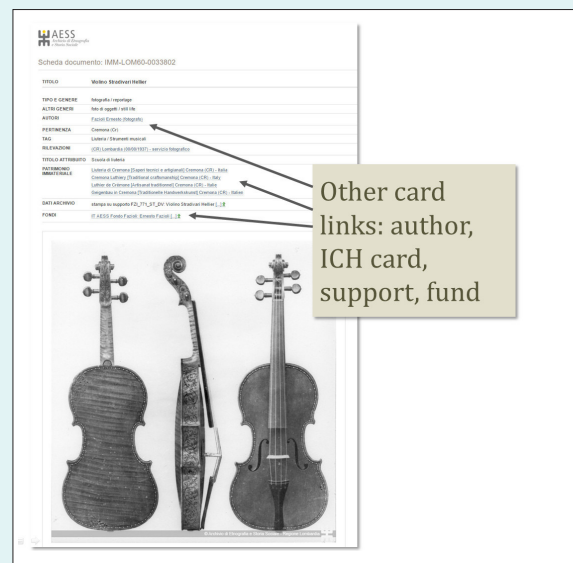
Figure 16
Details of a document card of image type.

Figure 17
Details of different document types: a video above and an audio interview below.

5.2.2. Tools

Different multimodal navigation and retrieval tools have been designed and implemented, according to different kinds of information and identified users (Figures 18, 19 and 20 show these tools integrated into early versions of the AESS search site):

1. retrieval in SQL standard, on different cards, designed to allow different users to interact with the system: three different search levels are offered (Guided, Free, Advanced).

2. similar audio retrieval: the user can navigate among the most similar audio documents based on their acoustic similarity. We used the Audio Information Retrieval TreeQ (Foote, 1999) to compute audio similarity. In this system, every audio file is represented by a histogram derived from a quantification tree built to maximise the information among all the files in the search set. The acoustic similarity index between two files is estimated by computing the d+istance cosine between the related vectors: the closer the index is to 1, the more similar are the acoustic features of the two files.

3. similarity-based textual descriptions: once the user has obtained a document list resulting from a query, s/he can apply the similarity link algorithm to retrieve the most similar objects according to their description (Gagliardi and Zonta, 2001, pp. 155-162).

4. similarity image retrieval: the user can perform a similarity search in order to retrieve similar images based on their pictorial content. The similarity image retrieval tool, which has been designed and created by the Image and Vision Laboratory of Milano Bicocca University, is based on the QuickLook image retrieval system (Ciocca and Schettini, 2006, pp. 81-103).

5. clusters of audio files: the user can choose among the available audio files, clustered by the algorithm defined in (Gagliardi and Pagliarulo, 2005, pp. 248-50). The functionality of audio clustering is performed by supplying information about the similarity of files in general, that is, not by reference to a particular file. The intensity of colour representing a cluster indicates its

Figure 18
Audio document indicating documents that are 'acoustically similar', the list is shown open in the right hand image.

Figure 19
Image document indicating 'similar images by description' results on the right.

size. A further experiment has been done in which the colour represents not only the number of items contained, but also gives some hints as to the content - so similar colour clusters represent music or songs that are acoustically similar (Zuffi and Gagliardi, p. 606109).

There is more detail of these tools in Schettini et al. (2008) and Ciocca et al. (2010, pp. 85-118).

To facilitate searching, mainly in a multilingual approach, a tool has been designed, implemented and integrated (Artese and Gagliardi, 2014b, pp. 657-668), in an experimental way, both in the data entry and in the

search and navigation environments, which is able to find automatic associations between tags and the on-line multi-lingual thesaurus and lexical databases, such as MultiWordNet, AgroVoc and DBPedia. This tool will help cataloguers to structure terms appropriately and to have the proper translations and relevant descriptions they need to input into the AESS archive. The MultiWordNet (MWN) database, AgroVoc thesaurus and DBPedia provide accurate and complete facilities and translations for terms, as well as the necessary definitions. Figure 21 shows this experimental integration: it displays the tag family (*famiglia* in Italian) with the various synonyms and meanings which can be used for navigating a search.
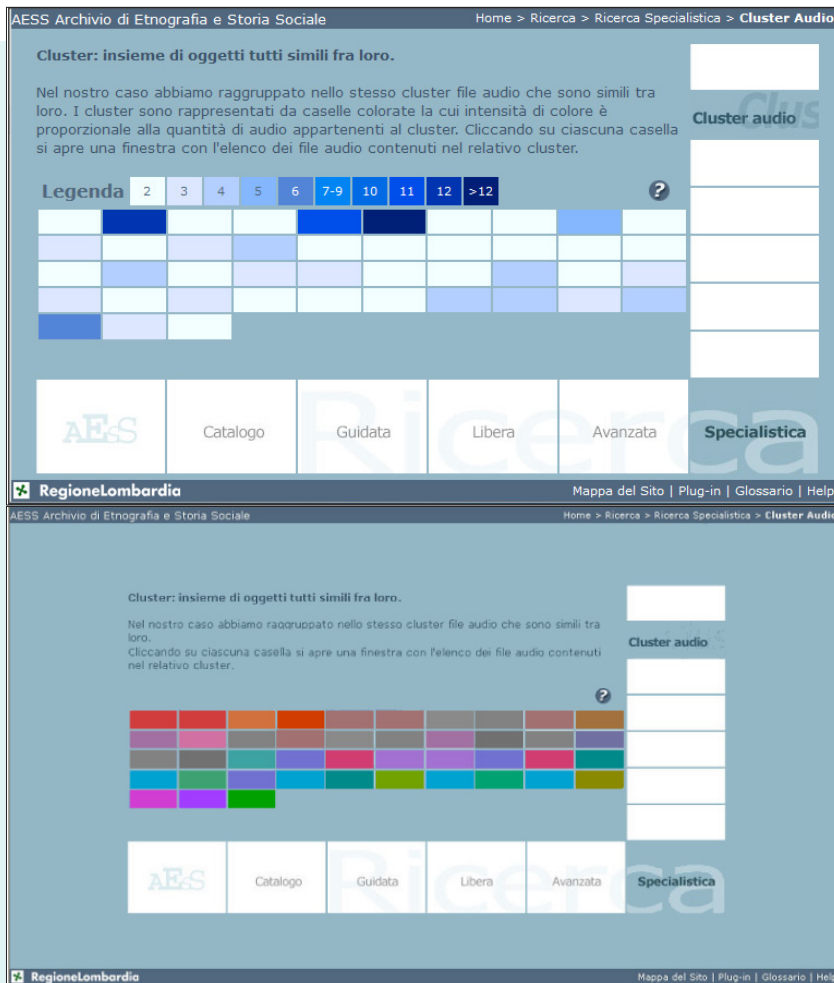
Figure 20
Above cluster audio, and below cluster audio with colour adjustment.
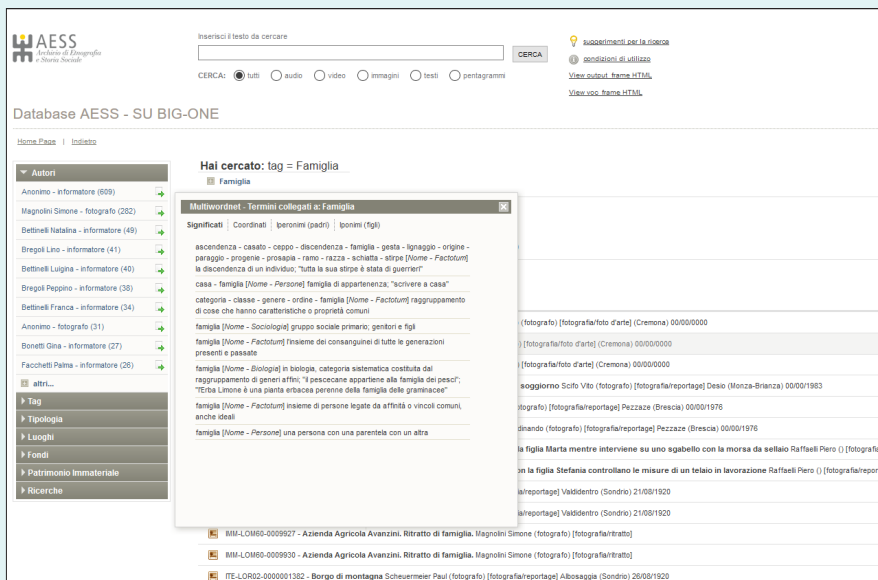
Figure 21
MultiWordNet integration on the AESS 'Search' page.

5.2.3. Intangible Search

The web site Intangiblesearch[6] is the result, together with the ICH card, of the ECHI project, which was funded by INTERREG with the aim of designing a Register of the intangible legacy of trans-border Italo-Swiss heritage, in line with the new heritage paradigm proposed by UNESCO. Intangiblesearch is able to manage the complexity of the ICH database and make it simple, usable, easily accessible, interesting and even fun for the categories of users identified in the analysis phase. In the designing phase, particular attention was paid to the Ubiquitous Web Application paradigm, that is an anytime / anywhere / anymedia paradigm. The web site is responsive and usable through tablet and mobile devices, taking into account the 'weight' of images, audio and video for mobile users.
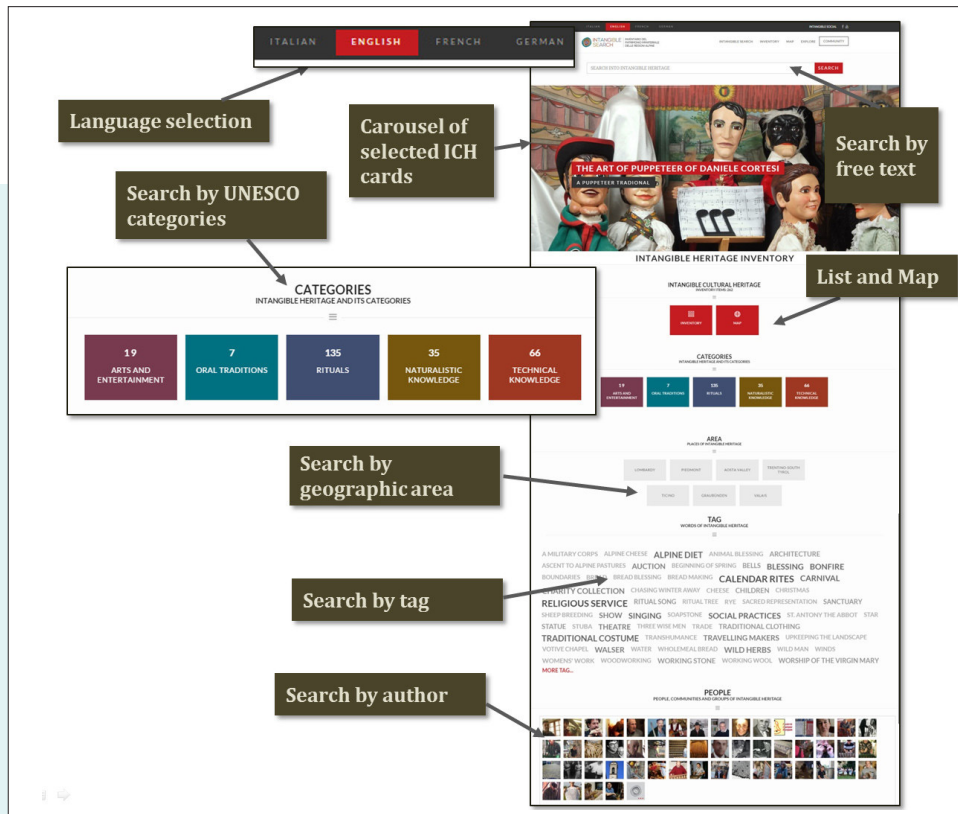
Figure 22
Home page of IntangibleSearch.it.
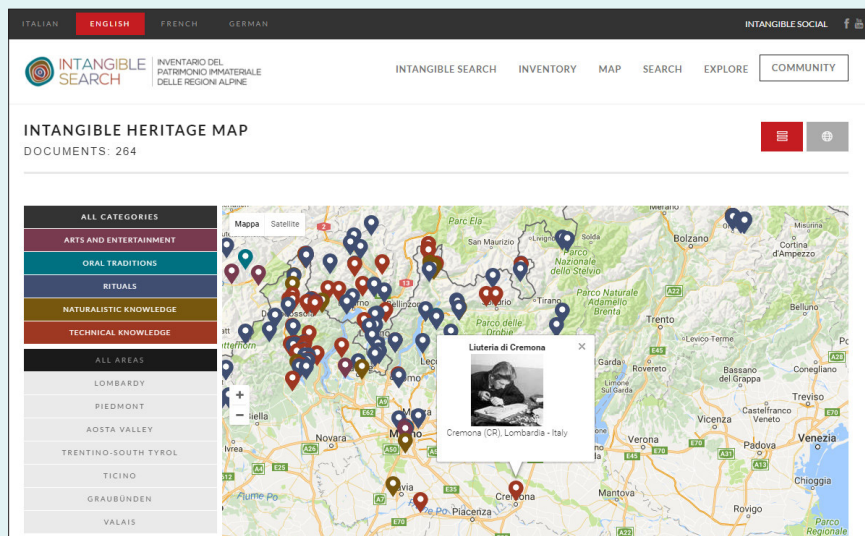
Figure 23
Results in map form: the colours represent the 5 UNESCO domains of ICH.

INTANGIBLE SOCIAL

(?) | 1929 | 1930 | 1937
1950 | 1992 | 2011

(?) | 1929 | 1930 | 1937 | 1950 | 1992 | 2011 | INDEX

BACK TO SEARCH

CREMONA LUTHIERY

AVAILABLE IN: ITA   ENG   FRA   DEU

The background knowledge and expertise of a traditional luthier from Cremona treasures the ability to make bowed string instruments such as violins, violas, cellos, double basses. Crafting these instruments takes up to many months and implies: careful selection and aging of the wood; carving of the shape along which the instrument will be modelled; carving of the several parts of the instrument (linings, soundboard, back); gluing of the instrument body, purfling of the board; neck placement; varnishing and stringing. Each working phase entails a specific position of the craftsman body in relation to the wooden piece which is being worked on and the working table too. These techniques shall be learnt and mastered.

Moreover all these parts are only millimeter- thick and have a delicate geometrical rapport which changes according to the characteristics of the wood. The most difficult endeavor is to obtain perfect symmetries of the lines that make up the instrument. To reach such climax you need trained eyes and expert hands; you need to adjust lines according to the different phases of the work and according to results of the previous stages. This expertise is exclusively manual but requires also deep knowledge of materials and working techniques.

These competences have been passed on since XVI century, from maestro to trainee, from father to son and have been acquired by practice. These skills, in fact, more than relying on words, are transmitted by body, visual and tactile experiences. They are perfected by practice and are learnt when the maestro shows his techniques with practical examples and the trainee is able to grasp by looking at his working skills. Traditional luthiery in Cremona is the only handcraft to have preserved characteristics and processes which can be traced back to the 1600 century artisans.

Still today in Cremona the luthier skills are connected to manual expertise, a long apprenticeship, a workshop run by a maestro helped by a couple of trainees, the use of material (wood, glue, varnish) and traditional tools. The preservation of original techniques, the excellent

CATEGORY

TECHNICAL KNOWLEDGE

TAG

LUTHIERY   MUSICAL INSTRUMENTS
SCHOOL   STRING INSTRUMENTS
VIOLIN/FIDDLE

WHERE

Cremona (CR), Lombardia - Italy

Mappa | Satellite
Cremona

TO LEARN MORE

Web Sites

- Associazione Liutai Cremonesi A. Stradivari
- Associazione Liutaria Italiana
- Come è fatto uno strumento
- Fondazione Antonio Stradivari Cremona La Triennale
- Fondazione Walter Stauffer
- La città di Cremona su internet - Liuteria
- Scuola Internazionale di Liuteria
- Unesco - Representative List of the Intangible Cultural Heritage of Humanity

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- Carlson Bruce, Chiesa Carlo
  E furono liutai in Cremona. Dal rinascimento al romanticismo, quattro secoli di arte liutaria
  Consorzio Liutai e Archettai Antonio Stradivari 2000

AESS Archive

Figure 24
'The Violin Craftsmanship of Cremona' card and timeline from IntangibleSearch.it.
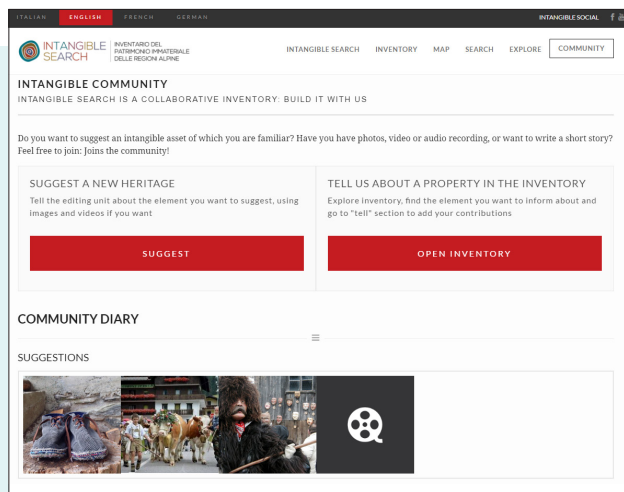
Figure 25
Community page with a suggestion opened on the right.
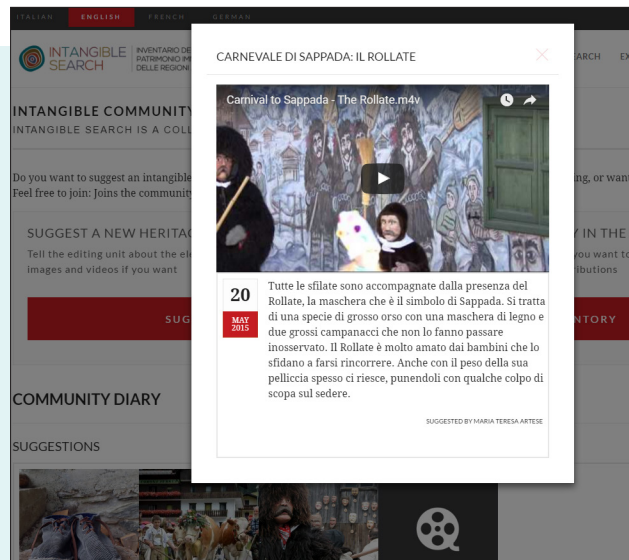
Intangible Search offers its interface in 4 languages: documents are shown in the language of the interface, if it exists, otherwise they are in Italian. Web 2.0 tools are integrated, with links for Facebook, Youtube and the community of Cultural Heritage.

The navigation flow of the web site is:

· **Search:** predefined queries related to the UNESCO domains, protagonists (people who play a role in the intangible heritage), tags (with a description) and free text search are available to users (see Figure 22)

· **Results:** users can get results in map form or in list form (Figure 23)

· **Details:** a detailed description of the ICH card is provided, great importance is given to multimedia links which are shown as a timeline/slideshow at the top of the page. For in-depth navigation, a link to the corresponding card in AESS Search web site is provided. Figure 24 shows the card and timeline for 'Violin Craftsmanship of Cremona', in which multimedia objects date from 1929 to 2011.

5.2.4. Participation

Social media and participation tools have been investigated to disseminate information to a larger audience: Intangible Search is directly linked to its Facebook page[7] and YouTube channel[8] by the icons available in the Intangible Social bar, at the top of the page. There is also an online publication, the *Intangible Magazine*[9], where it is possible to find news about events, interviews and reviews concerning the intangible heritage.

The Intangible Search web site also offers communities, people, etc. the possibility of actively participating in developing the archive, by suggesting new assets or adding materials and stories to existing ones. The Community section of the website, is, in fact, a specific page where one can find community suggestions and stories: the command 'Suggest' offers a simple form to be filled in in order to communicate with Lombardy Region experts and let them know about a new heritage element by using images, videos or simply telling a story. The same action can be applied to the assets in the archive: it is possible to add multimedia materials by using the command 'Tell us about it' that can be found in each detailed card when opened. People who have images or videos concerning any of the assets present in the Intangible Search archive can upload and share them with others contributing in this way to updating cultural heritage transformation and keeping it alive (Figure 25).

6. Discussion

Table 1 compares the two front-end web sites, with their main characteristics. AESS Search strengths are mainly related to the management of the complex data structure and large amount of data:

Table 1
Comparison between the two front-end web sites

FEATURES	AESS DATABASE	ICH DATABASE
ADDRESS	http://aess.regione.lombardia.it/ricerca	http://intangiblesearch. it or http://intangiblesearch.eu
DBMS	Oracle	MySql
TARGET USERS	Experts, community, teachers	Web surfers, tourists, young…
SCRIPT LANGUAGES	PHP + Javascript + Jquery	Bootstrap Framework + PHP + Javascript
DATA UPDATE	Automatically every night	Manually, when necessary, through a procedure
CARDS	All	ICH, Authors, Bibliography
LANGUAGE	Italian	Italian, English, German, French
WEB 2.0	None	New ICH suggestions, Facebook, YouTube
SEARCH MODES	Predefined query, text search and highlight, with choice of data type: audio, video, image, text, pentagram	Text search, highlighted ICH cards, UNESCO domains, persons, tags
QUERY REFINEMENT	2 step	1 step
ICH ON THE MAP	Yes	Yes
RESULTS ON THE MAP	Yes	Yes
SIMILARITY SEARCH	No	No
TIMELINE	Yes	Yes
RESPONSIVE	No	Yes

- Database used: Oracle
- The Intangible Heritage data structure: the complete AESS data structure
- Similarity search tools are integrated

while Intangible Search is related to the fruition of data:

- Multilingual user interface and data
- Multimedia fruition
- Web 2.0 characteristics: user suggestions, comments, Youtube and Facebook links
- Based on open source software

As both the systems get data from the same database, they offer a high quality of data, in currency, consistency, clarity and structural effectiveness (Bolchini and Garzotto, 2007, pp. 481-492). Completeness, richness and multi-levels are managed to provide adequate levels of information for target users. Multimedia is the same, although presented in a different way, and Intangible Search contains tools allowing for the participation of communities and tradition bearers, as requested by UNESCO in the *Convention*.

7. Related works

Since 2003, when UNESCO ratified the *Convention* for the protection and valorisation of cultural legacy, online archives have proliferated for the inventorying and cataloguing of cultural heritage (Artese and Gagliardi, 2015). This is the result of the UNESCO requirement that in order to inscribe an ICH into lists,[10] it has to be present in an inventory. States Parties' policies are different, the results also depend on whether or not they have ratified the *Convention* and/or have specific laws for intangibles. Scotland, France and Switzerland, among others, have created inventories with different levels of interactivity and the bottom-up participation of communities. Japan, South Korea and China, because of their traditions and history, enacted specific laws to identify and protect intangible cultural heritage long before the UNESCO *Convention* was drawn up. They have created inventories with the aim of both spreading knowledge of skills, dances, songs and so on, and of safeguarding these traditional heritage elements. The South Korean website, 'Ichpedia', offers different search strategies as data size and content depth are increasing, so users can

face serious difficulties in finding exactly the right information among a large mass of ICH data (Lee et al., 2015, pp. 679-685).

The Library of Congress[11] 'American Memory' site provides free and open access through the Internet to written and spoken texts, sound recordings, still and moving images, prints, maps, and sheet music that document the American experience. It is a digital record of American history and creativity.

Besides these specialised web sites, the EU portal 'Europeana'[12] rolls out not only intangible heritage, but also books, audio and film material, photos, paintings, maps, manuscripts, newspapers and archival material into one digital website combined with Web 2.0 features. It offers direct access to digitised European cultural heritage. Users can search and explore different collections in European cultural institutions in their own language in virtual form, without having to visit multiple sites or countries. The digital objects that users can find on Europeana are not stored on a central computer, but remain with the cultural institution that owns them and are hosted on their network. Europeana collects metadata about the items, including a thumbnail image. A further extension of Europeana is the 'AthenaPlus' project (Minelli et al., 2015, pp. 20-36), that gives innovative access to cultural heritage networks, and develops open source tools, such as MOVIO and CityQuest, to manage both front-end and back-end and to create digital exhibitions and storytelling within Europeana.

8. Conclusion

In this paper we have presented a framework for the management of the entire life cycle of Intangible Cultural Heritage information. The design and implementation of the framework, begun in 2007, has been completed, and now the environments for data insertion and fruition are in use. Several issues have been faced in developing this project:

- the need to coordinate the activity of a large working team
- the 'real' bottom-up participation of tradition bearers
- the definition of the complex data structure

- the implementation of three different environments
- the highlighting of the vitality of ICH
- the use of social media to disseminate information to a large audience

The preliminary results have been encouraging: in the near future, and in view of the reshaping of AESS Search to accommodate new devices and technological advances, the System Usability Scale test (SUS), (Brooke, 1996, pp. 4-7; Bangor et al., 2008, pp. 574-594) will be administered to different types of users, both those already planned, and new ones to broaden the audience of potential users. Furnas et al. (Furnas et al., 1987, pp. 964-971) note that *the keywords that are assigned by indexers are often at odds with those tried by searchers,* so in the future, an updated version of the content-based retrieval tools described in the Tools section will be integrated into the front-end websites.

We are developing an app for smart phones to help users to create healthy menus based on traditional ingredients and recipes that can be found in ICH data (Gagliardi and Artese, 2015, pp. 195-196): the application, after recognising the cards related to foods, can identify the main ingredients through the integration of database / open data on foods and nutrients. The users on the web can, in a simple way, interrogate the ICH inventory and obtain recipes and data about foods, together with information about traditional ingredients.

Innovation offers the most viable strategy to sustain traditional culture. Intangible cultural heritage will only survive in so far as it retains meaning and value to its source communities. This requires the freedom to reinvent tradition creatively to keep it relevant. On the other hand, the ability to preserve traditions in a virtual way allows them to be passed on to coming generations in an effective and lasting way.

Acknowledgement

ENDNOTES

* All the websites were consulted on 14 December 2016.

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