Accessing and Understanding Cultural Heritage Through Users Experience Within the INCEPTION Project

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Abstract. The interdisciplinary EU funded project INCEPTION – *Inclusive Cultural Heritage in Europe through 3D semantic modelling*, coordinated by the Department of Architecture of the University of Ferrara, is focused on bringing together innovative 3D modelling and ICT applications and professionals involved in different fields of Cultural Heritage. The aim is to increase knowledge, enhancement and dissemination through 3D digital models in order to promote the inclusiveness and accessibility of European assets. In this direction, a Stakeholder Panel with different skills in the field of Cultural Heritage has been involved leading the research toward effective strategies to increase use and reuse of digital models. These strategies are aimed at maximizing the impact of using digital data for cultural heritage applications involving a wide range of non-expert and expert users, starting from specific requirements for processing, managing, delivering cultural heritage information to a broad audience. A co-design workshop has been organized involving Stakeholders in order to investigate on their requirements and expectations, to obtain information that could be useful for the User Centered process of definition of INCEPTION's main outcomes and functionalities.

Keywords: Digital cultural heritage · User centered design · Accessibility

1 Introduction

The INCEPTION project, "Inclusive Cultural Heritage in Europe through 3D Semantic Modelling", started in June 2015 and lasting four years, aims at developing advanced 3D modelling for accessing and understanding European cultural assets. One of the main challenges of the project is to close the gap between effective user experiences of Cultural Heritage via digital tools and representations, and the enrichment of the scientific knowledge.

The project is developed through a strong synergy among the Consortium Partners and the Stakeholder Panel, an assembly of European institutions, already involved during the project preparation phase with the aim of directing research toward those

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strategies needed by "end users" and institutions to increase knowledge, enhancement and dissemination through digital models.

During the project development, several activities and meetings have been arranged in order to strengthen the Stakeholders' role within INCEPTION and to learn from Stakeholders about their needs and expectations [10]. The interest of Stakeholders for 3D modelling and learning about cultural heritage assets' significances via digital media guided the project progress and strongly influenced the type, content and applicability of final products.

In order to apply a User Centered Design methodology to the project of the INCEPTION's User Experience (UX), the last Stakeholders meeting was organized in June 2018, and it has been conceived as an interactive workshop. The main aim was to focus effectively on two topics: new tools for modelling Cultural Heritage, and how to make Heritage more accessible and understandable by different kind of users.

1.1 INCEPTION Project Overview

As part of 3D integrated survey applied to Cultural Heritage, digital documentation is gradually emerging as effective support of many different information in addition to the shape, morphology and dimensional data. The contribution of INCEPTION in increasing knowledge is based on the improvement and optimization of data collection processes and the development of semantically enriched 3D models, accessible by different Cultural Heritage experts, users and different disciplines through an open-standard Semantic Web platform [1].

Among several related projects dealing with Heritage 3D modelling, INCEPTION is relevant and differentiates from these projects because it is focused on heritage "spaces" (complex architectures and sites), on semantic enrichment - creating 3D models for multiple purposes, needs and level of knowledge of the end-users – and on the collection of all information in a unique Platform [2].

The overall project workflow starts from requirements (what kind of data, information and visualization issues can be collected and managed by a 3D model according to specific users and needs), the integrated data capturing and holistic heritage documentation, the semantic enrichment via 3D modelling in H-BIM environment, and the models deployment and valorization through the INCEPTION platform. Model formats accessible by the platform to the users are openBIM formats, and textured models (Collada files). 3D models are based on open standards in the BIM, GIS, Semantic Web and point cloud area (including IFC - ifcOWL, gbXML, CityGML, E57, etc.) [3].

According to the overall INCEPTION workflow, the H-BIM modelling procedure starts with documenting user needs, including experts and non-experts.

The identification of the Cultural Heritage buildings semantic ontology and data structure for information catalogue allows the integration of semantic attributes to 3D digital geometric models for management of heritage information within the INCEPTION platform. So the main innovations under INCEPTION will be delivered through an open standard platform to collect, implement and share digital models. Platform interface and functionalities will allow users to download and upload models, work with H-BIM models with different level of details, enrich contents and information linked to geometric models in an interoperable way and explore a wide range of data and contents.

1.2 Stakeholders Involvement Toward a Broad Accessibility of 3D Digital Models

The INCEPTION project established a broad Stakeholder Panel with participants of different countries, disciplines and potential professional users, involved in several stages of the project, starting from the analysis of needs and requirements. A part of the Stakeholder Panel has been involved more closely providing Demonstration Cases, supporting the consortium in data collection for data modelling and on-site or off-site demonstration activities [9].

The INCEPTION platform is already structured through a general architecture, and a first prototype has already been elaborated based on the macro-needs analysis carried out in the first phase involving users and Stakeholders and developed through the definition of invariants and technological and system constraints [4].

According to Human Cantered Design's principles, an iterative process has been applied to the first prototype in order to evaluate and implement it together with users and Stakeholders for new versions' development.

The objective is not only to gain opinions on the current state of development of the INCEPTION platform by users, but also and above all to participate with them in the experimentation and re-elaboration of the opportunities offered by the platform as defined through the first analyses [5].

The aim of this activity, which takes the name of Co-Design, is to understand if the first prototype allows the understanding of the instrument, if this understanding allows a greater awareness on the needs focused during the first analysis, and if this awareness helps to reconsider the structure of the current prototype, improving it.

The purpose is not only to analyse the requests of users and Stakeholders, but also to work together to the design of a new set-up of the platform, so that it responds to needs that have not yet been identified, and it's easy to navigate and interesting for each type user, common visitors or specialized technicians.

2 Co-design Workshop

2.1 Definition of Co-design Experiences

Co-design is a well-established approach to creative practice, particularly within the public sector. Co-design is often used as an "umbrella" term for participatory, co-creation and open design processes [8].

The co-design approach enables a wide range of people to make a creative contribution in the formulation and solution of a problem. A key tenet of co-design is that users, as "experts" of their own experience, become central to the design process.

A wide range of tools and techniques are available to support the co-design process. Potential solutions can be tested through prototyping and scenario generation techniques. Two techniques are usually applied:

- Storytelling/Storyboards is a tool that helps visualizing the experience that the user will experience through the design of key passages for a type of story usage [7].

- The Experience Map is a visual map that graphically describes the experiences through the different steps and touchpoints. The compilation of the map is exploding on different floors all the steps that the user does, so that they have a unified view from the top of the experience.

2.2 The INCEPTION Co-design Workshop

Six Stakeholders participated in the Co-Design workshop, from different countries (Italy, Belgium, Slovenia, Greece, Spain and Germany) and from different Heritage fields. Members from institutions such as the Geodetic Institute of Slovenia, the General Hellenic Archives-Historical Archives of Epirus, the Institute of Cultural Heritage of Spain, the firm Energy Efficient Architecture Renovation Conservation, the Italian Association of Local and Institutional Museums, the Institute for Diagnostics and Conservation of Monuments in Saxony, represented several skills and expertise.

The aim of the Co-Design workshop was to create an informal experience (Fig. 1) to exchange considerations regarding INCEPTION functionalities within the platform, providing a specific service able to fulfil different needs of different user categories. To gather information about users' needs, the collaborative work session with INCEPTION Stakeholders allowed pointing out what kind of tools and facilities they would need to achieve requirements and opportunities.

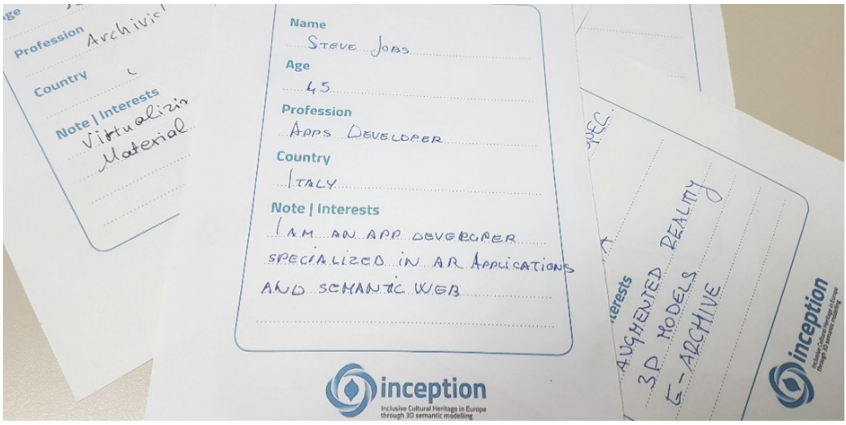

Fig. 1. In order to gather personal information from the Stakeholders in a confidential way and establish a mutual knowledge, a sort of game was developed in which each participant indicated in a card its own data and interests, using an imaginary identity.

During the first step, Stakeholders were asked to be not so closed to reality, in order to outline an overall picture of user needs through an inclusive and dynamic parallel session. In this first phase, the Co-Design session involved all Stakeholders around a worktable. Thanks to the presence of a moderator, every participant became familiar with the activity of brainstorming, namely a creative technique based on associations of ideas. Every single member was stimulated to freely share his/her own suggestions and

Table 1. Summary of the results gathered during the Co-design workshop.

	Contents	User experience	Interface
Tourist and specialized users	Hyperlinks to external platforms	Storytellers to relate the real site and the virtual model	Accessibility and inclusion even to people with special needs or disabilities
	Update the models with related data and information	Possibility to print virtual models into 3D physical models	Intuitive and hierarchical interface
	Examine the model in different historic periods	Knowledge about building by showing historical events	Information available even on smartphone and by AR
Governments and decision makers	Information about events and exhibitions and info about the physical place	Bridge the gap between real and virtual experiences	Do not waste time to find data during researches
	Download models for related activities	Make users updated on last modifications of their visited models	Provide users the % of browsed elements of a visited model
	Reliable data for scientific researches	Provide augmented reality during a visit	Give users few and clear information
Technicians and professionals	Split the elements of a building in order to visualize different historic phases	Keep in memory information already visited Real-time work sharing	Private area for not accessible models and filter research bar
	Store data of previous interventions and documents available even on mobile devices	Download 3D models with different scales of details	Timeline of interventions and last updating
	Interoperability among several external databases	See missing parts of the buildings	Comprehension of different parts that compose the building

opinions about the topics of INCEPTION's platform, in term of functionalities, graphic interface, etc. Every single idea was transcribed by the design team on many post-its and sorted on a specific whiteboard. Only at the end of brainstorming activity, the performed work was discussed and analysed, making a qualitative and quantitative selection and organization of the developed ideas.

It was chosen to consider three main significant user categories: *tourists and specialized users* (*academic and researchers*), *governments and decision makers*, and *technicians and professionals*. The criteria for defining users were based on the concept

of inclusion and on the maximum possible spread of 3D models for different uses applied to the knowledge and conservation of Cultural Heritage.

Thoughts, comments and ideas resulting from the brainstorming among partners and Stakeholders were collected in three categories:

- contents,
- user experience and
- interface,

where "contents" are data and information relevant according to the opinion of the Stakeholders; "user experience" are opportunities in browsing 3D digital models and interacting with specific information; and "interface" are all the possible platform functionalities (Table 1 and Fig. 2).

Fig. 2. View of the co-design workshop.

3 INCEPTION Platform Interface and Accessibility

Within Co-Design session, a journey map was defined. INCEPTION platform has a high number of functions and different modalities of interaction, so the card-sorting methodology was applied to represent schematically the complex architecture of the web platform in a user centered approach, facilitating shared representations of work through a tactile and visible experience of the possible interaction tools. Thanks to Stakeholders different skills, different feedbacks from wide-ranging experiences, abilities and needs were collected. Different contents of the INCEPTION platform were hierarchized and it was analyzed what interaction modalities were more usable for final users, in order to reach an intuitive and accessible navigation.

The workshop tried to define tools able to improve user experiences for a first interaction with the INCEPTION platform. To do this, many "cards" were processed and printed, representing through icons and drawings every single operation that the user can perform inside the system. To make the process more practical and accessible, tools were divided into 4 macro groups:

- Cards for the functions related to the BIM model (zoom, clipping planes, change shades, walkthrough, pan, rotate, filter elements, etc.);
- Cards for the functions related to video (play 360°, rotate 360°, rotate, download and upload, etc.);
- Cards for the functions related to the use of images (full screen, zoom, etc.);
- Cards for the functions related to data loading and uploading (download, upload, open metadata).

Then some white cards were printed for each macro group, in order to be able to implement the hypothesized tools based on the specific needs of the Stakeholders involved and increase the available functions. The aim was to create a visual graphic map allowing users to understand and move the tools at their disposal, to imagine a possible conceptual map of tools for knowledge/modification/implementation of the platform [6] (Fig. 3).

Fig. 3. View of some of the used cards.

During this phase, an experience map was elaborated with the aim of understanding the most appropriate and suitable tools for platform navigation and exploration by different users, and to point out possible weaknesses, trying to find accessible and inclusive solutions. Thanks to this methodology, it was also possible to analyze the information flows between activities, making the navigation experience more efficient. The tools considered more relevant are related to basic actions to be performed on the model, such as visualize and download videos and images, select elements of the model, measure distances or surfaces or move within the model. "Missing" cards from

the first survey were not related to operational tools to be applied to the model, but rather to a better contents organization, information flows and navigation.

How to understand and interact with the information shown by the INCEPTION platform interface and how to make it easier to navigate is a relevant point outlined for basic users. Navigation can be carried out by two different ways of interaction: through the 3D model or by customizing contents through research filters. At the first browsing, training instructions may be useful on how to use the platform, as well as a location bar to find buildings to visit. To provide information, it is possible to either receive personal data of users by filling in a short initial questionnaire or by data obtained from previous navigations or already present in the INCEPTION database (user profiling). An additional functionality suggested as relevant is the possibility to run virtual guides: it is useful to know how long the experience is before starting it or to provide both a short and full version and a list of visited or favorite models.

Fig. 4. Proof of concept of a 3D model case of data access to the platform; on the left, possible interactions (BIM model, point cloud, images, documents, videos, etc.).

For each building, a window showing available functions should be useful, also based on different devices (laptop, smartphone, tablet, etc.). Additional suggestions are related to different interfaces for any single typology of users, and the possibility to receive news when models are updated (Fig. 4).

Regarding expert users, the discussion was focused mainly on the creation of contents: who can upload files to be approved by expert evaluators in order to deliver only reliable models, through a moderator who approves the files and authorizes to proceed with the upload. The possibility to have some guidelines explaining how to upload the file with its specific characteristics is a point stressed several times.

Every user should be able to upload data, materials and information in relation to BIM models. The opportunity to relate many developers who work together on a single

file updatable in real time, without having multiple copies of the object, is an additional requirement.

At the end of the workshop, the participants were asked about their perceptions. The general feeling was that the Co-design represented an intensive work session where everyone was feeling free to express the own point of view, with the aim of enriching the users' and Stakeholders' perspectives within the INCEPTION project. The organization of the Co-design Workshop was effectively focused on objectives set by the team, both for obtaining information needed for the application of the User Centered Design process, and to strengthen the sense of being part of a group of people with different backgrounds working for the same purpose.

4 Conclusions

User needs collected during the co-design workshop were grouped and classified in some subgroups more specifically related to the optimization of the platform. Of course, the needs of every user category may interact and influence each other. Requirements have been discussed and pointed out to design different interfaces for each user target. The visitor's interface should be simple and intuitive, and provide immersive experiences according to the user needs in an open access environment.

About technical users, the interface should provide a filter research area in order to avoid wasting time in searching needed information. Technical users need specific and technical tools to be used in their work, so the system should provide a better support in performing their activities rather than focusing on virtual expositions. For decision makers, it is more interesting to provide scientific and reliable sources, involving at the same time touristic users through the activities promoted by the public institution itself. The requirement to provide an easy-to-use platform for upload and download files has been highlighted, as the availability of a private area in order to protect data to be shared with specific partners but not publicly. For the visitor/tourist it would be useful to analyze a tool set that could improve knowledge and involvement of people by virtual experiences. Virtual reality guides are positively considered, but it is crucial providing experiences based on different historic periods and related contents. Through a different user experience map, expert users debated on the importance of policies for data management, data reliability and guidelines for downloading and uploading files.

Based on these results, the platform interface and content management are being updated. The verification of this advanced prototype will be the focus of the next Stakeholders workshop, in November 2018.

Quantitative results on platform interface and accessibility will be delivered after the project conclusion, when the platform will be populated with several heritage models, as well as an estimation of usability of different platform functionalities.

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