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<http://www.mingei-project.eu/>

Executive summary

In this deliverable, we have compiled the **prerequisites** and **preliminary requirements** for a user-centred, inclusive approach to develop technology and experiences for the Cultural Heritage Contexts, specifically focussed on the **representation, presentation and preservation** of Heritage Crafts (HC).

First, we will discuss the general **co-creation strategy**, and subsequently the more specific strategy outlined for the pilot process for the development of applications and interventions ('experiences') in the Mingei project. This covers the co-creation sessions hosted on the pilot locations, as well as the sessions performed amongst the project partners.

The section that follows shows how the various disciplines validate the work in the project, how these developments connect, and how the work is represented in the various work packages. This is to give an overview of the timing of the co-creative nature of the project.

The final sections outline the preliminary requirements for the continuation of development in the project. We first give an overview of the types of stakeholders that should be involved in this process. This is followed by a short overview of a methodology, previously used in the MeSCH project, to help define requirements for heritage professionals and visitors. We then continue with the sets of preliminary user requirement for 'experiences', provided by each of the pilot partners.

Considering the timeframe of the project, technical development, co-creation, and iteration will run sometimes in parallel. Each new activity in the project will produce new insights and improvements of the requirements. Clear communication and collaboration between partners is essential in capturing all available insights.

The Mingei Methodology is a 'living strategy', which means that it will continue to evolve during the lifetime of the project. With that in mind, the 'living document' *Co-creation for concept design*, developed for the pilot partners, will continue to be improved and new insights will be added. At the end of the project that document will result in a best practice guide for the general public.

Keywords

Co-creation, design research, requirements, community, experts, development, users, technology, interventions, experiences, strategy, workshops, collaboration, user-experience.

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Abbreviations

HC	Heritage Craft
CCN	Co-creation Navigator
CCCD	Co-creation for Concept Design ('Living Document')
CH	Cultural Heritage
CrO	Crafts Ontology
MNO	Mingei Narratives Ontology
CHI	Cultural Heritage Institution
MoCap	Motion Capture
IMU	Inertial Measurement Unit
RDF	Resource Description Framework
NLP	Natural Language Processing
AR	Augmented Reality
VR	Virtual Reality
MVI	Motion Vocabulary Item
MV	Motion Vocabulary
MR	Mixed Reality
IRI	Internationalized Resource Identifier
HCP	Heritage Craft Professional
HCI	Heritage Craft Institute
HCV	Heritage Craft Visitor
ICH	Intangible Cultural Heritage
SDK	Software Development Kit

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1. Introduction

Mingei explores the possibilities of representing and making accessible both tangible and intangible aspects of craft as cultural heritage (CH). In the project, we intend to provide means to establish Heritage Craft (HC) representations based on digital assets, semantics, existing literature and repositories, as well as, mature digitisation and representation technologies.

To maximise the impact of the development the project adopts *co-creation* as the central methodology, to introduce technological solutions in the heritage domain. This methodology will ensure a practice-based, iterative and intuitive approach. Co-creation activities are not hypothesis-led, but guided by a process of continuous discovery, where participants undertake a quest, based on intuitions and experiments. This could lead to unexpected insights and views.

One of the main challenges is to ensure that the activities that take place at different phases of the project are consistent with the co-creation methodology, and truly acknowledge the insights and input provided by stakeholders and users. Therefore, we put in place a strategy, for continuity between activities and ensuring a progression of results.^[LSEP]

There is a direct connection between this overarching, co-creation strategy and the work on content mapping and content collection, technological development, and the case studies in the project. The adopted strategy coordinates the iterative design to ensure the development is in line with the user and project requirements and proposed changes derived from the participative mechanisms, if needed.

This deliverable will report on the definition and implementation of Mingei's co-creation strategy, and outlines the linking of work packages and the parallel development. In line with the strategy, it also describes the approach on eliciting user requirements for CH presentation and representation in the project's pilots, and outlines the preliminary user requirements for each of the pilot contexts.

2. Co-creation strategy

The Mingei project will operate in two fields: technology development for the platform and tools that will support the processes involved in the six steps of the Mingei protocol¹ and concept development for the heritage presentations that will be implemented in the three final pilots. The co-creation strategy below describes in first instance the scope and goals of the second field as this would involve more external ‘co-creators’². The connection between the two fields will be made more clear in sections 2.2.1. and Chapter 4.

This co-creation strategy is essential to three elements of the project. First, it helps us understand the *context of practice* in which Heritage Crafts are used, transferred and adapted. Secondly, it shapes our *understanding of the (heritage) context* in which crafts are captured, preserved and performed. Third, it allows us to *conceptualize methods of knowledge transfer* across audiences, communities, and generations, which will be in part facilitated by the interventions and technology introduced by Mingei. The outcome of the co-creation activities will provide information for the specification, formalization and representation of the user and system requirements in the form of prototype installations at the museum sites involved in the project.

Considering this context, in Mingei, co-creation is conducted in two ways:

1. **Project based co-creation, amongst project partners.** There are co-creation workshops during each consortium meeting, tailored to the needs of the project at that moment in time. In these workshops, all project partners participate (pilot partners, technical partners and social design partners). The goal of these workshops is to share and align insights, outcomes and approaches amongst partners, and to adjust the (technical) development accordingly. This includes any type of development that would arise over the course of the project. Additionally, in between the physical meetings, online co-creation sessions with the consortium partners are conducted if a need calls for it. WAAG is facilitating those online sessions, in collaboration with the relevant partner(s).
2. **Pilot based co-creation, with local stakeholders.** Each pilot partner (CNAM, PIOP, and HdS/FORTH) will host several co-creation sessions on site, with local stakeholders, experts and users, to collect knowledge, experiences and insights on each craft individually, and to develop concepts for pilots. WAAG supports each pilot partner in their preparation of these sessions, but *each pilot partner is responsible for the execution on location, and reporting on outcomes*. This is to ensure ownership and iterative learning with the pilot partners.

¹ To be explained in detail in Deliverable 1.3

² Co-creators are people participating in a co-creation process, who are not members of the core (design) team and are invited to the process based on their experience, knowledge and/or expertise.

As there was no time or budget allocated to fully train the heritage partners in co-creation, the following tools and supportive measures have been put in place, to help facilitate the implementation of co-creation in Mingei:

1. A 'living document' called *Co-creation for concept design* (CCCD henceforth), containing the outlined strategy and related methods/materials/tools, will serve as a reference guide for all partners³, as well as a place to document results and progress. WAAG will keep this document up-to-date throughout the project, fed by the input and needs of each project partner.
2. WAAG hosts tri-weekly (every three weeks) 'co-creation calls'. These calls are set up to support the pilot partners in their process of hosting and facilitating co-creation sessions, but also to learn from each other's experiences and to exchange ideas. These calls are specifically meant for the three pilot-partners, but other partners can be invited when needed for specific expertise.
3. WAAG has identified a variety of co-creation sessions (see Section 2.2.3.) created to tackle different phases in the co-creation process. A minimum of 4 of these sessions need to be performed over the course of the project by the pilot partners. WAAG provides basic materials and exercises for each session, and will support the customization of these sessions for each context on demand. The materials are added to the CCCD document.
4. Each pilot partner will get one-on-one coaching by WAAG, when needed. Depending on the needs of this partner, this could include site-visits, on-site coaching, support with session design via video-conferencing, etc.
5. WAAG hosts a co-creation program during each consortium meeting. The content of this program is adjusted to the project flow and needs of the project partners. The first four meetings are hosted in the first year of the project by FORTH (December 2018), and by pilot partners HdS (April 2019), PIOP (September 2019), and CNAM (December 2019).

³ See Annex 1 and Annex 3.

2.1 About co-creation

2.1.1 Co-creation basics

Co-creation is a design method in which *end users*⁴ and other people with specific *relevant knowledge and experience* are involved in a design process. In co-creation, creative and inspiring work forms are used to arrive at new, innovative insights. The goal of co-creation is to create *shared values, contextual knowledge and understanding* and *support* with and alongside those involved - and it can be applied in *any context*.

By involving end users and experts, *relevance* is created, as it connects with an existing dialogue on a specific topic. A topic needs to resonate with the audience that is meant to be reached, and it has to be important to the experts involved.

When solutions are co-created, it generates *agency*, which means that the people involved develop and co-design a concrete view of their options. They get to see how things could be handled or changed, which gives them perspective to make informed choices that are most fitting to their circumstances. *Ownership* will emerge when people feel that they are part of something, or when they have made or contributed to something themselves. When people, co-creators, experience a sense of pride, they are more likely to commit to the future of outcomes.

Finally, experimenting with designs, together with co-creators, will generate *sustainable (durable) design* options. Testing, (re)iterating and improving designs and solutions, will eventually result into the best end product⁵ for a particular audience, in a particular context.

Co-creation starts from the premise that everyone has knowledge and experience, especially about their own lives. This diversity of knowledge is valuable; participants build a relationship, and ideas and shared values arise in the dialogue with each other.

'Co-creation is not a one-off event, like a referendum in which the community decides what should be done. [...]

Nor is co-creation just a question of formal consultation in which professionals give users a chance to voice their views on a limited number of alternatives.

It is a more creative and interactive process which challenges the views of all parties and seeks to combine professional and local expertise in new ways'

Hillary Cottam, Charles Leadbeater (2004) [3]

Outcomes of co-creation can be surprising and can lead to innovation, but that also means that room for uncertainty needs to be allowed. Co-creation is thus an inclusive process that requires

⁴ 'End users' refers to the persons that will (potentially) be using a product, service or application.

⁵ 'End product' refers to a product, service, or application.

clear communication, but also requires time to grow, and opportunity to create ownership. To use co-creation effectively and efficiently an organization and its people should learn to facilitate this bottom-up process, and give some freedom for the project to change course (based on the outcomes of the co-creation and intermediate results).

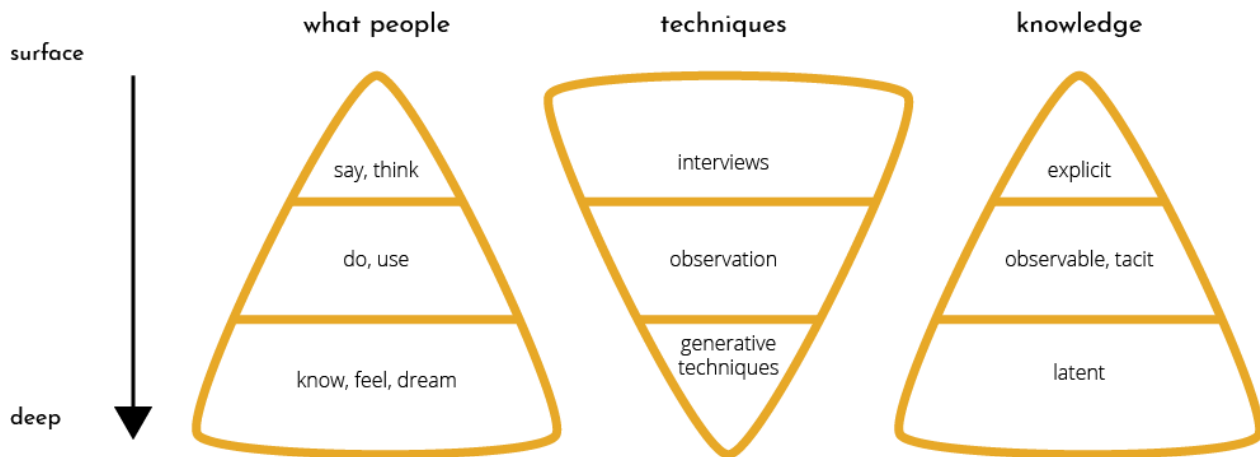


Figure 1. Different levels of knowledge are accessed by different methods – Sleeswijk Visser, et. al. 2005 [20]

Co-creation is what we call a ‘generative technique’ when it comes to gathering information and knowledge. This is visualized in the bottom tiers in Figure 1. The way we approach people will influence the type of information we can collect.

Co-creation is an elaborate participatory design practice as it goes beyond doing interviews and observing people – as happens in focus groups or in general user-centred design or design thinking consultancy. It uses active, hands-on, social activities and methods that help trigger *latent knowledge* by accessing different parts of the human brain: this is knowledge that is not on the surface and easily accessible, but knowledge that is in someone’s body; retention of motor skills, knowledge of routine, knowledge of unspoken tradition and knowledge of the subconscious. This means that co-creation can lead to unexpected results - and inspire completely new, but very relevant, design and research directions.

To guide co-creation, it is important to understand the process and have sufficient tools and methods to set up the process. As a process facilitator of co-creation, one must be comfortable with uncertainties, and know how to improvise and develop or nurture specific social skills, or mindsets.

2.1.2 Co-creation process structure

The Mingei project bases its co-creation approach on the process structure presented in the Co-creation Navigator; WAAG’s main outlet on co-creation methodology⁶. This methodology is based on years of experience and research, and perfected and validated in earlier EU projects like

⁶ Co-creation Navigator: <https://ccn.waag.org>

BigPicnic⁷ and Cities4People⁸. The Co-creation Navigator (CCN) guides people through the different stages of co-creation, from preparation to execution, and directs users to tools and methods that can help in each stage. It starts with ‘how to build a project's foundation’, and ‘how to get in the right frame of mind’, and then proceeds to help users remain innovative throughout the co-creation process.

This structure for co-creation (as visualized in Figure 2) allows room for flexibility and is adaptable to individual specifications and contexts. It is presented as a linear process, but needs to be considered a guideline, which allows for reflection, iteration and revision of previous stages.

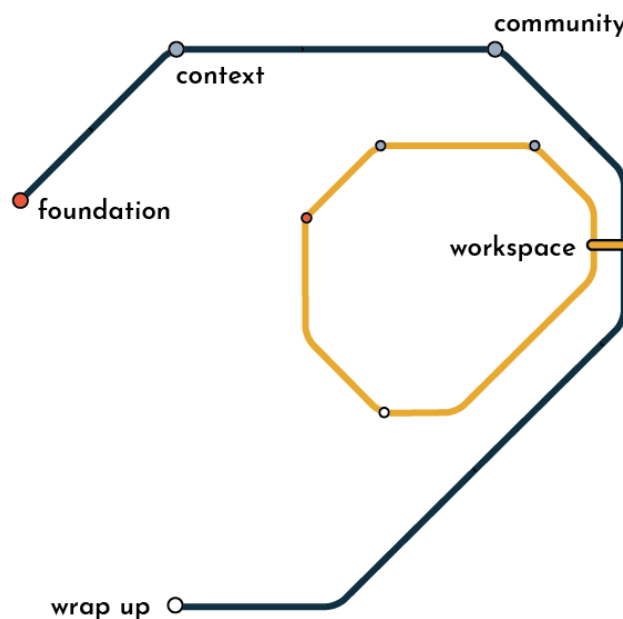


Figure 2. Co-creation structure (Waag's Co-creation methodology).

FOUNDATION

The first stage of co-creation is laying the foundations for a constructive project: creating a balanced team, considering the position and profile of a hosting organization, understanding the project's scope, and its limitations, mandate, and rules and regulations for cooperation.

CONTEXT

In the second stage the context of the project is researched in more detail, which will help identify alternative agendas, different perspectives, and contributing communities and stakeholders.

COMMUNITY

Each co-creative process will require the involvement of stakeholders and communities who represent different types of expertise. The third stage focuses on the involvement of these groups and people.

⁷ <https://www.bigpicnic.net/>

⁸ <https://cities4people.eu/>

WORKSPACE

The workspace is the actual development and iteration stage, in which workshops and sessions are performed with communities, stakeholders and users to create new ideas and solutions. This is the most time-consuming stage, which can continue as long as there is a need to improve designs and/or development.

WRAP UP

At the end of a project, evaluating will help pay attention to new insights, and at the same time will help reflect on assumptions and ambitions, which can lead to clear ideas for next steps.

A more elaborate description of these stages, and the accompanying mindsets, can be found in *CCCD*⁹.

⁹ Provided in Annex 1 – pages 7 and 8.

2.2 Co-creation strategy Mingei

2.2.1 General strategy

The Mingei project is working towards different (technical) solutions to document and share Heritage Crafts (HC). What these solutions are, needs to be conceptualized; made into concrete ideas to test and experiment with. In the Mingei project the distinction is made between the conceptualisation of solutions for the documentation process of a craft ('representation') and for the process of sharing knowledge ('presentation') – this would include providing information, thematic tourism and to some extent craft training. In this project a significant focus for 'presentation' is on the tourism-aspect: presentation towards museum-visitors and tourists, since three museums are involved to present the three craft-instances. Co-creation is particularly used in explorative stages of the project and in the concept development for 'presentation' purposes, and in support of and to improve the general User Centred Design approach. Co-creation is introduced as a way to better *understand* the *crafts* and the *context and needs* of their representation, and *capture knowledge*, but also to *develop concepts for potential solutions in and around the museum context* – and their accompanying requirements.

Over the course of the project, Mingei will work on three separate, but connected, results. The co-creation strategy is meant to connect the development of these three – but each will follow their own development process and approach. These three results are:

1. The Mingei Protocol
2. The Mingei Platform
3. The Mingei 'Experiences' in the Heritage Partners' museum context (pilots)

Each item is created with different end-users in mind, and different stakeholders will be involved in the development process. Not all items will be developed in full co-creation in the way it is described above. This is due to the limited time this project has to produce its results, and the nature of the development. All items are, however, developed with the particular end-user in mind, and end-users are at a minimum involved in the development and testing as a consultant (User Centred Design).

In the visual below it is showcased which design method (User Centred Design or Co-creation) is generally used in which part of the development.

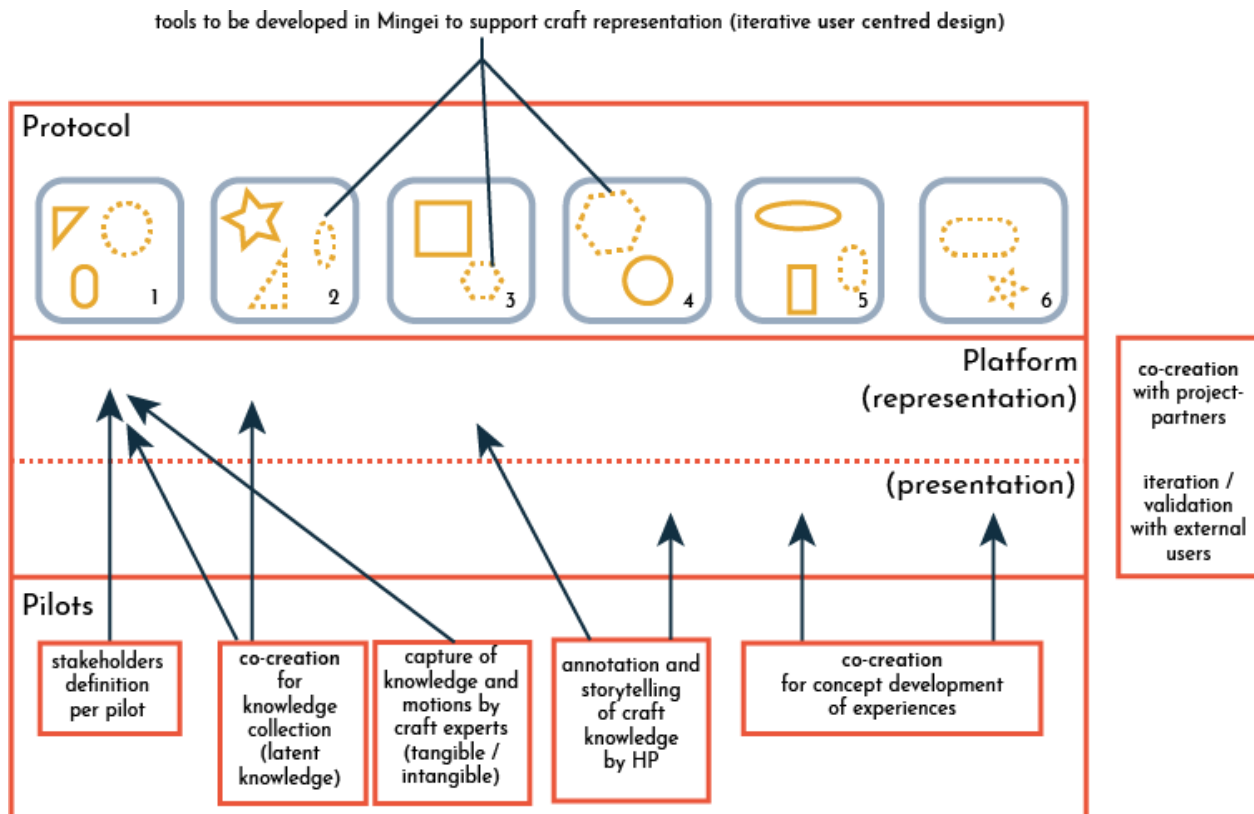


Figure 3. Project results and design methods

2.2.1.1. The Protocol

The Mingei Protocol, as described in D1.3, sets up a full process description for the representation and presentation of heritage crafts. The main steps of the protocol have been described in the project's Description of Action. The Mingei project validates this protocol on its realisation and pilot application in the context of three craft instances.

This means that by going through the steps themselves using the contexts of the three pilot-crafts, the (technical) project partners, together with the craft experts involved, are able to experience which tools are available to perform the needed actions for each step – and which are missing. Based on that information the technical project partners (particularly FORTH, ARMINES and MIRALAB) are able to create new tools that can aid in that part of the process of craft-representation.

Those particular tools are developed with the particular users in mind (varying from craft-people to heritage professionals to technical experts). These initial developments are based on earlier research and the capabilities of the technical partners involved. The development is done in iterations, involving the specific users, following a User Centred Design approach. This is not done in full co-creation, as the majority of these tools are to be used within the run-time of the Mingei project to document as much craft-knowledge as possible.

Additionally, there will be some technical presentations ('demonstrators') from the technical partners, that showcase technical possibilities that serve as input and inspiration for the co-creation activities in the concept development stages for 'presentation'.

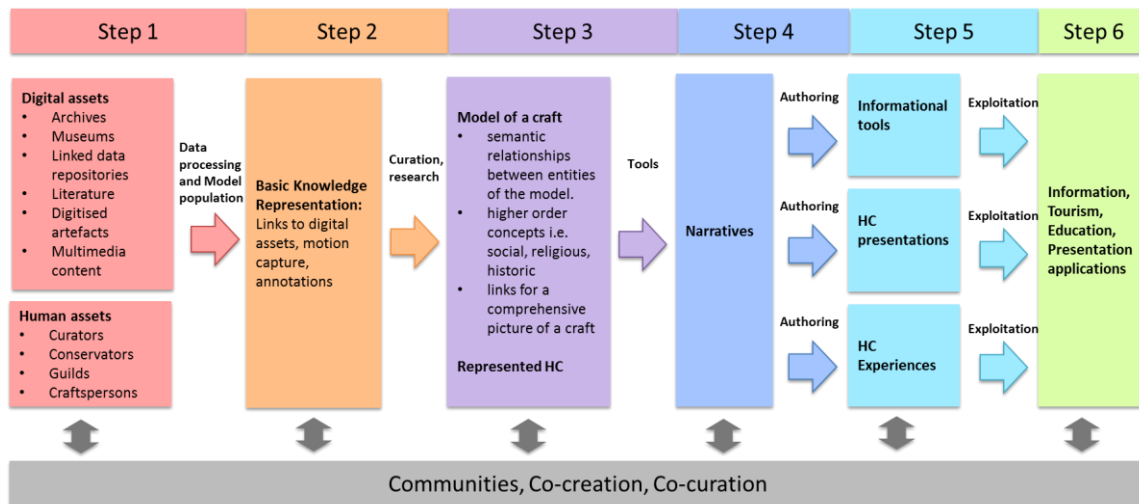


Figure 4. The Mingei protocol

2.2.1.2. The Platform

The Mingei platform will serve a two-fold use: On the one hand, it will be a repository for both the description of the protocol as well as the access to the various tools that could be used in different steps of the representation process. Some of those tools have been developed within the Mingei project (as mentioned above).

The platform could be considered a toolbox for future users. It is worth noting that users will not necessarily go through all the steps of the protocol – as not every type of user will have the same skillsets required to perform the action in that step, or operate the tool provided. Similarly, not every tool would be relevant to every user. The Mingei project aims to provide a basic set of tools and an overview of steps through the protocol – but acknowledges that it will not be a complete set at the end of the project. Users would include, but are not limited to, craft practitioners interested in documenting their craft, historians and archivists looking to document knowledge, heritage professionals to explore technological options for knowledge presentation. It is worth noting that for certain tools, the user would need assistance of an expert in that particular technology.

The second function of the platform is a semantically annotated collection of information and materials, that was gathered in the representation stage (text, visuals, models, etc.) on the specific crafts involved (glass, mastic and silk), which can be used as content for future craft presentation purposes. Users would include heritage professionals interested in creating exhibitions, films, books, or other presentations on specific crafts, but also (technical) developers of (interactive) applications, installations and experiences, and even interested general public.

The intention of the Mingei platform is that it will continue to grow with both content and tools after the Mingei project is finished. With that in mind, the project aims to involve external craft experts and other potential users to test the usability of the platform in the final year of the project.

2.2.1.3. *The experiences*

The development of the pilot experiences focusses on the way the information on a specific craft can be shared with the public in the context of the three museums involved. This development focusses on the particular needs of the museum professionals involved and their audiences – and how they are able to share knowledge on crafts, using the information gathered in Mingei. The development of these experiences will be done in co-creation with the heritage professionals which include curators, researchers, educational experts, and with craft experts, creatives, (technology) developers, museum audiences (different types of visitors including craft enthusiasts, parents, teachers, children and international tourists), tourism experts and general public. The goal of these experiences is to test the options for new (technological) interventions and applications using the content collected within the project, fitting an existing museum and/or tourism context.

In three pilots, Mingei's heritage partners (PIOP, HdS and CNAM, *pilot partners* henceforth) will host several technical interventions ('experiences') of their respective HC. To achieve this, several co-creation-sessions with multiple combinations of a wide spectrum of partners and stakeholders will be organized over the course of the project.

Each pilot partner representing one of three craft instances is in the lead to organize their own local co-creation process that will result in insights into each pilot's needs, but will be supported in their effort by the methods and templates provided by WAAG. The specific technology and research partners that are involved in the technical development of the 'experiences' (FORTH and IMA) use these needs and requirements that follow from the co-creation sessions in their development, and they also take part in this iterative process.

Even though all project partners ideally would work together on all three results at the same time, some parts would need preparation and research, that would be more efficiently done by the assigned partners. Therefore, during the first year of the project some of the work is done in parallel tracks. It is, however, the goal to bring these tracks slowly together at the beginning of the second project year. In co-creation, amongst project partners, the three results mentioned above will be aligned. In Figure 5 we visualised the parallel development that will come together over the course of the project. In Chapter 4 we will go into more detail on each track, which relates to work in other work packages.

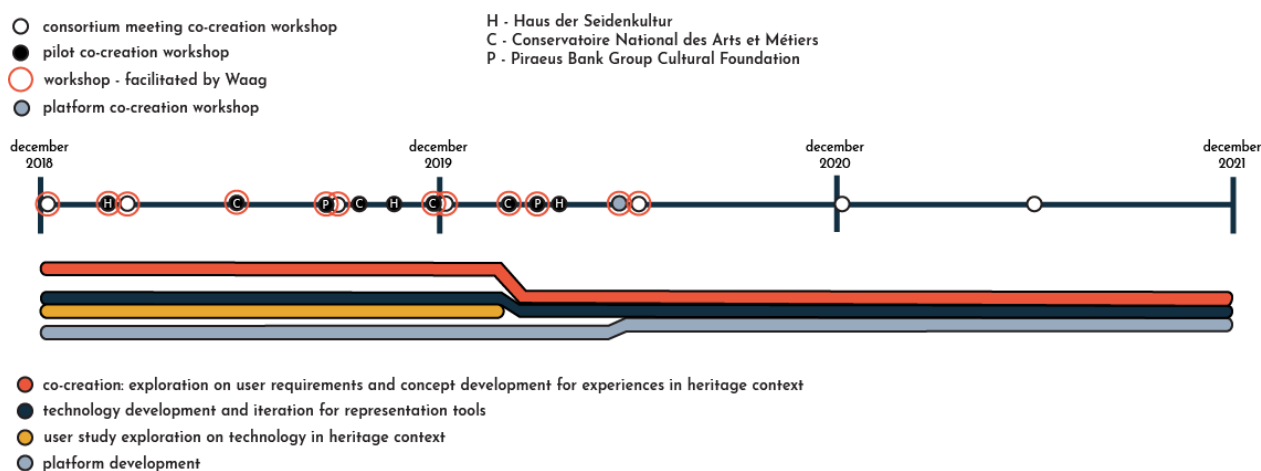


Figure 5. Parallel development & preliminary co-creation timeline

2.2.2. Knowledge collection and Concept development

During the first year of the project the focus of the co-creation process is on better understanding the crafts, and the needs and context of the heritage partners and the stakeholders involved – this would be reflected in the first 3 ‘preparation’ stages of the co-creation methodology mentioned above (FOUNDATION, CONTEXT, COMMUNITY). This effort will identify the first sets of user requirements for the ‘experiences’ that will run during the pilot period in each pilot location. At the end of the first year, first strides are going to be made into concept development – which will continue and will be iterated upon throughout the rest of the project period.

Concept development is a vital part of the co-creative process: it is important to think of, and experiment with, multiple conceptual directions to extract the requirements to be able to design the most fitting solution. As there are many working definitions of the term ‘concept’, we outline the term below, the way it is used in this project. A concept includes:

1. An (innovative) idea or product description
2. An intended audience
3. An intention / goal
4. A clear idea of stakeholders
5. Scope
6. User requirements
7. Technical requirements

In order to build the required knowledge base, each co-creation session will have a different goal. WAAG created a general guideline for these sessions. This guideline describes the topic of each session, the general order in which these sessions should be performed and a timeline. Over the course of the project, WAAG will provide methods and coaching for each type of co-creation session. It is purposefully a guideline, instead of an instruction. Context, timing and situational occurrences are all factors in the process, and can change the course.

2.2.3 Preparation for co-creation

Half of the co-creation work in Mingei will be done locally, at the pilot sites, and would include the workshops and co-creation sessions with local stakeholders, users and experts. To make these run smoothly, some preparative work needs to be done within each pilot organization, to make sure there is a good understanding of scope, mandate, and ambitions.

WAAG provides the pilot partners with tools and methods to extract this type of information. More specifically, there are instructions included in the ‘Materials’ section of *CCCD*¹⁰ for each pilot partner to do the below mentioned activities (see Figure 4). There are more tools available on the Co-creation Navigator (ccn.waag.org) to help explore the facilitation of co-creation in all phases.

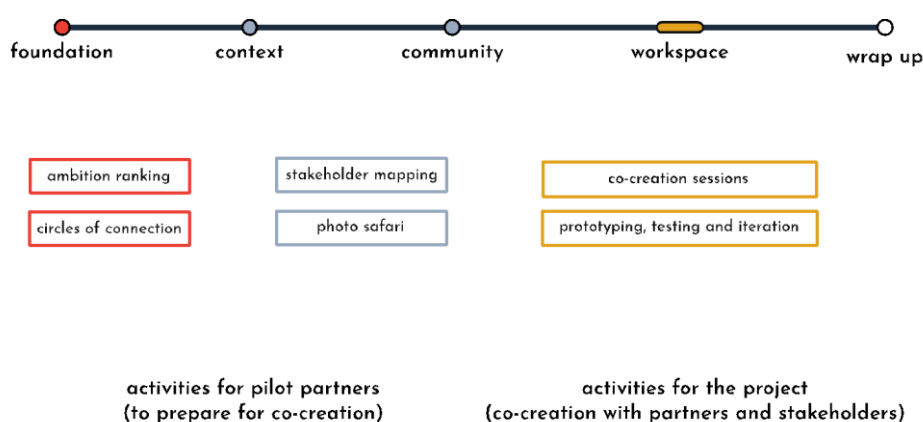


Figure 5. Co-creation activities for project partners.

2.2.4 Co-creation sessions

WAAG has outlined general guidelines for six different types of co-creation sessions that the pilot partners should host – with or without the help from WAAG. The first four should be done in the first year of the project. There is a general order to these sessions, but it is not strictly necessary to follow that order. Sessions could be done in a different order or run simultaneously. Ideally all four sessions are performed at least once by the pilot partners, but preferably some types are repeated, for iteration purposes.

Below we present the six types of the sessions for each pilot partner. WAAG will assist each pilot partner in setting up the sessions during the tri-weekly conference calls, during one-on-one coaching calls, and via e-mail. For each individual session WAAG has provided a more detailed instruction, including a guideline for documenting the outcomes in the *CCCD*¹¹. These instructions will be updated throughout the project, as more information will come to light, and sessions need to be adjusted to context.

¹⁰ See Annex 1 and 3

¹¹ See Annex 1 and 3

Co-creation session type 1: IN SCOPE (define the scope of the craft)	
This co-creation session should be organized with craftspeople, educators and professionals working with the selected crafts.	
Goal	<p><i>Understanding the craft.</i> Define the scope of the craft, and the needs for documentation and knowledge transfer.</p> <p>What to include and exclude?</p> <p>What is the most important and what is a bonus in relation to the craft?</p> <p>What do we need to know from the intended target group (end-users)?</p>
Concrete result	Scope of a craft, ambitions of craft people, anchors for narratives

We have defined some general ideas on crafts in our project proposal and Deliverable 1.3. However, these definitions were not formed by, and shared with, the (local) stakeholders (participating in sessions). They might have different interpretations of the context and scope for each craft. Project partners, and specifically pilot partners, need to take that into consideration, hosting the co-creation sessions. Helpful questions for this are:

1. How do we, in each specific context, define the relevant 'craft'? What is considered a craft, and where does it meet art and/or industry?
2. Who has the knowledge and expertise on a specific craft, and how do we get them involved; who do we need to transfer this knowledge to, and how do we get them involved?
3. How can intangible aspects be identified and captured?
4. How can we digitize knowledge and expertise that is so inherently practical and how will people access them?
5. What is the best way to transfer knowledge to specific audiences, in a specific context?

Co-creation session type 2: STATE OF THE ART (understanding opportunities)	
This co-creation session should preferably be done more than once. It should be organized with professionals working with the selected crafts in the context of industry, the heritage sector and/or tourism and experts in technology and storytelling.	
Goal	<p><i>State of the art.</i> Getting insight in the 'state of the art' in art, technology, heritage and tourism on sharing (heritage) knowledge, exploring options for new applications for old crafts, and gaining a better understanding of the opportunities within the project.</p>
Concrete result	Scope of workspace for sharing knowledge (practical limitations and requirements), ambitions of heritage / tourism professionals, anchors/first ideas for narratives and applications.

Co-creation session type 3: PUBLIC PERSPECTIVE (including end-users / audiences)	
This co-creation session should preferably be done more than once, and should be organized with end-users; visitors, school groups, tourists, the general public, and students / aspiring crafts people.	
Goal	Understanding the needs and interests of the end-users.
Concrete result	A set of requirements for applications or interventions for the intended context.

Co-creation session type 4: SHARED PERSPECTIVES	
This co-creation session should preferably be done more than once, and should be organized with a mix of stakeholders, who participated in earlier sessions.	
Goal	Bringing all the views together / reflection and iteration on first concepts/ (paper) prototypes.
Concrete result	Feedback and iteration on progress so far.

After these first exploratory sessions that can be done in any context, and that are performed in the first year of the project, pilot partners are invited to host sessions that are more specific to the local context. Using the newly found knowledge on requirements and needs, pilot partners are now better able to start developing concepts and work together with the technical partners. To that end, two additional types of sessions can be added to the list above. More detailed instructions for these sessions will be developed in collaboration with the pilot partners - when they are ready to work on their designs.

Co-creation session type 5: CONCEPT DEVELOPMENT	
This co-creation session should be done more than once, and should be organized with a mix of stakeholders and (project partners) experts.	
Goal	Developing concepts and first prototypes.
Concrete result	1 or 2 concept ideas

Co-creation session type 6: ITERATION	
This co-creation session should be done more than once, and should be organized with a mix of stakeholders and (project partners) experts.	
Goal	improving concepts and first prototypes.
Concrete result	An improved concept to be tested in a pilot

3. Community of experts for co-creation and for user centred design

As we have highlighted in the descriptions of the co-creation sessions in the previous chapter, we need to involve different people, in different stages of the project to go through a balanced design process.

For Mingei, we have defined the different types of stakeholders, people with specific types of expertise and (end-)users. On the whole, these people are connected to the studied crafts (craftspeople, but also historians, curators, etc.), technology (developers, designers, etc.), the purpose (e.g. education, storytelling, tourism, entertainment, etc.), and the ‘end-users’ of the project final technology implementations (for each pilot). These stakeholders form the community of experts for our co-creation and user centred design process, and can be called upon in different stages of the development process and/or for different research questions. Involving these people in the project will ensure the relevance, ownership, agency and sustainability of the project results.¹²

The Mingei project aims to deliver three different results. With that each item will have different end-users, and for each item different stakeholders need to be consulted and/or involved.

The list below showcases the community of experts, the full list of stakeholders, for all development. This would include development done in general User Centred Design, as well as more specific co-creation. This list matches the lists used in the DoA and in the parallel deliverables. For some categories, further specification is added. They are broken down into sub-categories with the purpose to improve the diversity in expertise during co-creation.

Not all stakeholders are involved in all aspects of the development. And in not all instances the stakeholders are the end-users. The particular development they could be involved in, and the type of involvement was therefore added to the list. The table below lists the value of these people, and when in the development process their expertise would be most relevant. Additionally, it is highlighted whether a certain stakeholder could also be the intended end-user.

It is worth noting that we are aware that this is a very extensive, and general list. It is up to each pilot partner to identify the experts that take precedence over others, as the objectives for each pilot will differ.

¹² The effect of co-creation, as is described in Section 2.1.1.

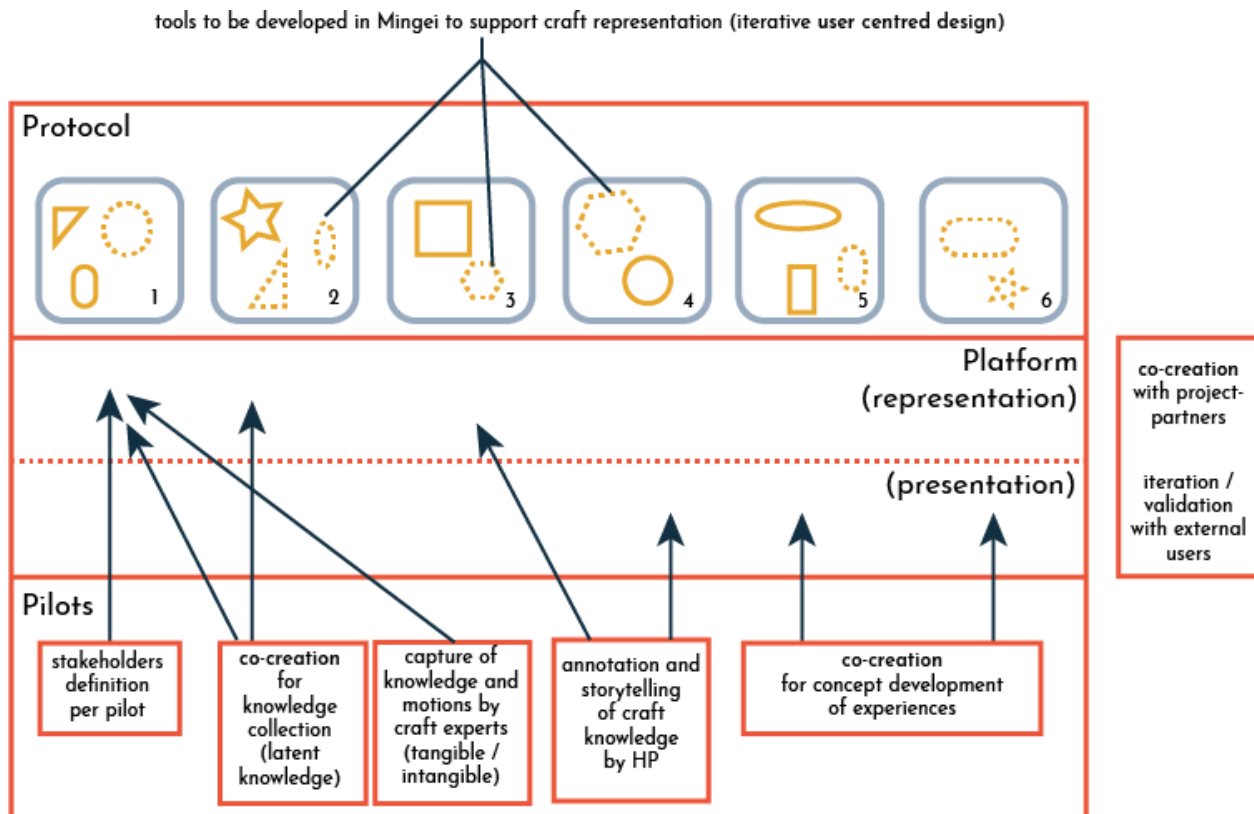


Table 1. Overview of experts and their value and purpose.

1. **Representation tools and Platform** are primarily developed in an iterative User Centred Design practice
2. **Knowledge collection** (for the platform) is partly done in co-creation, but also through literature review and interview techniques
3. **Concept development** for experiences is done in co-creation

No	Stakeholder	Value	Development
1	Craftsperson: Individuals or members of local & online communities. This includes Living Human Treasures		
	Professional craft practitioners (art)	1) Knowledge on craft 2) Understanding of artistic possibilities craft 3) Understanding of the (artistic) market 1) Understanding of levels of difficulty craft	1. Representation tools (potential user) 2. Knowledge collection 3. Platform development 4. Concept development experiences

	Professional craft practitioners (industry)	<ol style="list-style-type: none"> 1) Knowledge on craft 2) Understanding of industrialisation of craft 3) Understanding of the (industry) market 4) Understanding of levels of difficulty craft / tasks 5) Insight on domain specific needs for learning 	<ol style="list-style-type: none"> 1. Representation tools (potential user) 2. Knowledge collection 3. Platform development 4. Concept development experiences
	Artists	<ol style="list-style-type: none"> 1) Creative / artistic input for concepts 2) Experience in presentation 	<ol style="list-style-type: none"> Concept development experiences (potential user)
	Art school students	<ol style="list-style-type: none"> 1) Understanding artistic context 	<ol style="list-style-type: none"> Concept development experiences (potential user)
2	Museum & CH institutions: showcasing crafts and craftsmanship		
	Exhibit maker / designer	<ol style="list-style-type: none"> 1) Knowledge on spatial and design possibilities in museum context 2) Experience with institutions 	<ol style="list-style-type: none"> Concept development experiences
	Communicators, public outreach and communication programmes and activities	<ol style="list-style-type: none"> 1) Knowledge on type of visitors 2) Knowledge on outreach and audiences 3) Awareness of the communities 	<ol style="list-style-type: none"> Concept development experiences
	Museum guides	<ol style="list-style-type: none"> 1) Experience with interacting with audiences 2) Knowledge on most asked questions and interests of audience members 3) Knowledge on (spatial and interaction) needs for good presentation of information 	<ol style="list-style-type: none"> Concept development experiences

	Front desk operators	<ol style="list-style-type: none"> 1) Knowledge on the museum context 2) Knowledge on type of visitors 3) Understanding of FAQ 	Concept development experiences
3	Conservators: conservation departments and conservators	<ol style="list-style-type: none"> 1) Knowledge of (historical and cultural) context 2) Knowledge and experience on current methods of conservation, semantics search tools, etc. 	<ol style="list-style-type: none"> 1. Knowledge collection (potential user) 2. Platform development 3. Concept development experiences
4	Curators: museum and CH professionals	<ol style="list-style-type: none"> 1) Knowledge about the hosting institution and its mission 2) Knowledge on scope of presentation (in museum) 3) Active knowledge on needs and wishes visitors 	<ol style="list-style-type: none"> 1. Platform development 2. Concept development experiences
5	Museum educators: staff in charge of educational, public outreach and communication programs and activities for different types of public, community managers.	<ol style="list-style-type: none"> 1) Experience in development of educational programs 2) Active knowledge on needs and wishes visitors 3) Knowledge on (spatial and interaction) needs for good presentation of information 	Concept development experiences (potential user)
6	Guilds: Associations active for the safeguarding and promotion of crafts and craft artefacts	<ol style="list-style-type: none"> 1) Knowledge on craft 2) Understanding of industrialisation of craft 3) Understanding of the (industry) market 4) Understanding of levels of difficulty craft / tasks 5) Insight on domain specific needs for learning 	<ol style="list-style-type: none"> 1. Representation tools (potential user) 2. Knowledge collection 3. Platform development

7	Archivists: In possession of materials on crafts and craftsmanship	<ol style="list-style-type: none"> 1) Knowledge of (historical and cultural) context 2) Knowledge and experience on current methods of conservation, semantics search tools, etc. 	1. Knowledge collection (potential user)
8	Content owners & Creative Industries: portal, repository, collections owners, artefact creation businesses. Storytelling professional Filmmaker Animators Game designer Writer	<ol style="list-style-type: none"> 1) Creative / artistic input for concepts 2) Experience in storytelling 3) Experience in presentation and visualisation 	<ol style="list-style-type: none"> 1. Concept development experiences 2. Platform development (potential user)
9	Researchers and academics		
	Researchers and in technology	<ol style="list-style-type: none"> 1) Knowledge on functional design 2) Validation of technology use 	<ol style="list-style-type: none"> 1. Representation tools (potential user) 2. Platform development (potential user) 3. Concept development experiences
	Technology professional <i>Mingei project partners</i> (front/back-end) developers Graphic designer Motion capture AR/VR	<ol style="list-style-type: none"> 1) functional design options 2) input for experiments 3) concept development 	<ol style="list-style-type: none"> 1. Representation tools (potential user) 2. Platform development (potential user) 3. Concept development experiences
	Design professional	1) functional design options	1. Representation tools

	Mingei project partners Concept developers	2) input for experiments 3) concept development	2. Platform development (potential user) 3. Concept development experiences
	Researchers and academics (in heritage)	1) Historical and cultural knowledge 2) Validation of research questions	1. Knowledge collection 2. Platform development (potential user) 2. Concept development experiences
10	Policy makers and governmental bodies: Working on developing and applying policing regarding the digital preservation of tangible and intangible CH	1) Knowledge on existing policies 2) Understanding of influencing policy 3) Access to decision makers 4) Information on alternative locations for presentation 5) Knowledge on (cultural) policies	1. Knowledge collection 2. Concept development experiences
11	Tourism businesses: companies that operate in the tourism domain (i.e. tour organisers). Includes retail professionals (selling craft products)	1) Understanding of clientele 2) Understanding of the market	Concept development experiences
12	Tourism professionals: Working in the domain of tourism information, tour guides, etc.	1) Knowledge of needs tourists 2) Knowledge on local lore and legend 3) Experience with agencies	1. Knowledge collection 2. Concept development experiences
13	Visitors / Tourists: (Families, Parents, children, grandparents): Interested in traditional crafts and	1) input on ideal tourism/museum experience 2) idea of general interests 3) insight on needs for different types of visitors	Concept development experiences (potential users)

	members of the communities in which the museums are active, of all ages and backgrounds. A finer classification can of this population, based on speaking language, location of origin, age, etc.		
14	Craft enthusiasts: Members of the general public interested in traditional crafts. These can finer classify in (hobby) practitioners and people that are interested in craft as an observer.	<ul style="list-style-type: none"> 1) Baseline knowledge on craft skills 2) Understanding of levels of difficulty craft 3) Input for research questions 6) Insight on domain specific needs for learning 	<ul style="list-style-type: none"> 1. Knowledge collection 2. Concept development experiences (potential users)
15	Museum volunteers: Volunteers that help a CHI or makers that demonstrate a craft	<ul style="list-style-type: none"> 4) Knowledge on the museum context 5) Knowledge on type of visitors 6) Understanding of FAQ 	Concept development experiences
16	Craft students and apprentices: a person who is learning a trade from a skilled employer, having agreed to work for a fixed period at low wages and art school students that learn a craft.	<ul style="list-style-type: none"> 1) Understanding of the craft 2) Baseline knowledge on craft skills 3) Understanding of levels of difficulty craft 	<ul style="list-style-type: none"> 1. Knowledge collection 2. Platform development 3. Concept development experiences (potential user)
17	Craft masters/educators:	<ul style="list-style-type: none"> 1) Knowledge on craft skills 	<ul style="list-style-type: none"> 1. Representation tools 2. Knowledge collection

	persons that practice and teach a craft	2) Understanding of levels of difficulty craft	3. Concept development experiences (potential user)
18	Primary educators (School teachers): communicating the craft to students in educational programs of a CHI or in class, as CH, history, technology and other.	1) Understanding of interest of children 2) Educational expertise 3) Storytelling abilities	Concept development experiences (potential user)
20	Maker educators	1) Understanding of interest of children 2) Educational expertise 3) Understanding the 'new' crafts	Concept development experiences (potential user)
21	General public	1) Understanding of general interests	Concept development experiences (potential user)

As an early exercise, each pilot partner has created a list of expert stakeholders, relevant to the context of the specific crafts, but also relevant to the context in which the craft will be presented to the outside world (museum, tourist agency, etc.)¹³.

¹³ See Annex 2.

4. Interdisciplinary collaboration

As was mentioned in Chapter 2, which discusses the general co-creation strategy, partners in Mingei have started working on parallel tracks of development. Mingei is an interdisciplinary project, with ambitious goals. To achieve these goals in the time set for this project, not every part of the project could be done in chronological order, and not everything could be done in a co-creative fashion in the first year - as co-creation is a time-consuming practice.

We have defined four tracks that have run parallel in the first year of the project. Working this way, we created a baseline of knowledge and expertise, which would then feed the co-creation process in year 2 and beyond. As is visible in Figure 5, particularly in the enlarged section, the parallel tracks are being merged into one track starting at the beginning of year 2. The co-creation activities in that time-period are designed to that end.

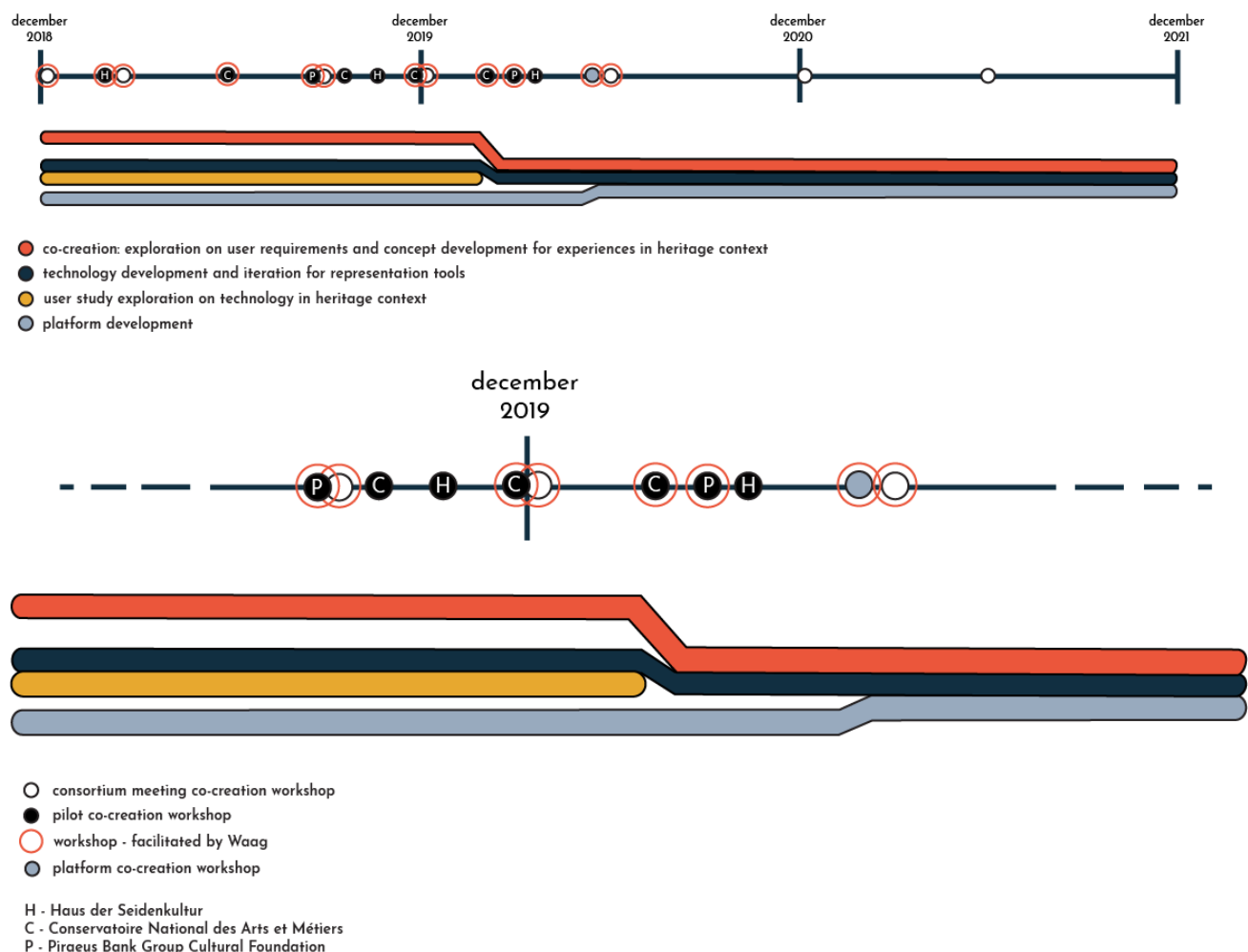


Figure 6. Tracks of parallel development.

4.1 Track 1: Co-creation: exploration on user requirements & concept development for experiences in heritage context

The first track (the red line in Figure 5) describes the main effort associated with WP1, and the approach for this work is well established in the previous chapters of this deliverable. The first part of this exploration, which results in a better understanding of the crafts – will feed into the tasks that are performed in WP2. WP2 is concerned with basic knowledge collection on each of the studied craft instances, which in turn determines the direction of development in WP3. In general, the work packages that rely heavily on the results and input from the co-creation activities in WP1 are WP2, WP3, WP4, and WP6.

The added value of co-creation, as mentioned in Section 2.1.1, is that it also has the ability to extract ‘latent knowledge’ from the persons involved. This information is a valuable addition to the literature and archive research for the content mapping and knowledge collection activities in WP2. Particularly co-creation session types 1 and 2 that are described above (Section 2.2.3.) are designed to support that effort.

The type of sessions that focus more on concept development and iteration (types 2 – 6) will provide input for both the technical development in WP3 and WP4, and the narrative and storytelling activities in WP6. For the latter, even session type 1 is informative, as it determines the scope of context – which is essential for creating specific storylines for concepts.

All sessions indirectly influence the development of technology: both the storytelling aspects in WP6 and the content mapping in WP2 provide input for the design directions for technological interventions in WP3 and WP4. The connections between the various WPs and the co-creation sessions are illustrated in Figure 6.

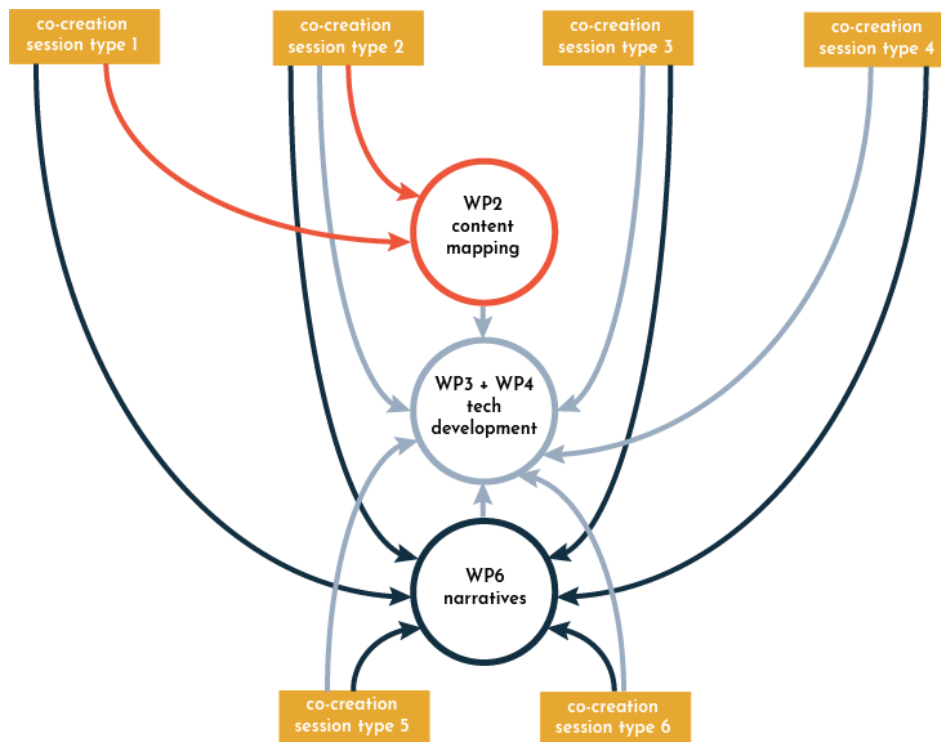


Figure 7. Input of co-creation sessions to WPs.

In turn, the experiments, stories and designs developed in WP3, WP4, and WP6 will also provide input for the sessions. In later stages, the focus of the co-creation sessions will shift from exploration to creation to iteration; the information from the development WPs provides input for the process of creation and iteration.

During the first year of the project co-creation activities are mainly centred around understanding the crafts and the heritage contexts, and exploring the first steps towards concept development.

Year 2 will mark a shift in focus of the co-creation activities. From that point on, the knowledge and expertise that has been collected to set up the baseline for Mingei in the other 3 tracks, will be merged with the needs, requirements, and ideas stemming from the co-creation sessions with the heritage and craft people. Co-creation sessions for, and hosted by, the local heritage partners will now start to involve more stakeholders and experts from outside of the local context to work on experiences and interventions.

4.2 Track 2: Technology development and iteration for representation tools

The second track, visualized by the dark blue line in Figure 5, involves the explorations and research of technology development. This includes extensive research on the motivation and rationalisation of the choices for the technology outlined in the project proposal, analysis of the technologies in context of their uses and an outlook on the future implementation and adoption of these technologies in the heritage context Mingei is operating in.

In this section an overview of the technology explorations of Mingei is presented, and focuses on the first year of the project. We consider that these explorations can be categorized as follows:

- *Fundamental technologies* are the ones promised by the consortium during GA preparation and are considered the building blocks of the Mingei solution for craft representation and presentation. Although the technical requirements were not set in stone, in the majority of the cases Mingei followed the planned activities as these analysed were in depth and researched prior to the submission of the project proposal. Adaptations occurred only in areas where new technologies have been proven to be more appropriate and reliable for the goals of the project adhering to the formulated risk analysis.
- The selection of fundamental technologies was complemented by *new developments* as required by the Mingei protocol for craft representation and presentation. Such developments complement existing technologies, but also result in requirements regarding their adoption by CH stakeholders.
- Finally, Mingei explores the possibility of using the *available technologies for Craft presentation and Craft Experiences*. In these contexts, more technologies come into play in order to formulate meaningful experiences both on site but also remotely.

This section concludes with the outcomes of these explorations at the end of the first year of the project. These are presented as demonstrators during first project review meeting.

4.2.1. Fundamental technologies in Mingei

2D and 3D digitisation (WP2, T2.3): In the context of the formulation of the craft representation protocol, Mingei is exploring a number of multimodal scanning technologies both for 3D and 2D digitisation. The objective is to create a comprehensive methodology that includes commercial and free software products and commercial hardware with a wide range of pricing to support a wide range of users; from the amateur to the expert. Through pilot recording within the project this methodology was enhanced to support different forms of 2D and 3D digitisation, including multimodal scanning. The following playlists present results achieved during the first year of the project.

- **Aerial scanning:** <https://www.youtube.com/watch?v=9xNlrGSBfIE&list=PLQZAktGyYNim-iX8aAmXNhParQOUfFy9F>

- **Garment**

scanning:

<https://www.youtube.com/watch?v=IhIKIM4BxXw&list=PLQZAktGyYNikWES21GVdNzDrRQ-teYRx>

Ontology Models (WP3, T3.1): The main requirement for the formulation of the crafts ontology is the strong interconnection and the extension (meta-modelling) of existing knowledge representation ontologies and standards of the CH sector. It was a conscious decision stemming from the need of re-usability, interoperability and compliance with existing European online repositories and digital libraries such as Europeana (e.g., EDM is compatible with CIDOC-CRM). As a result, Mingei's CrO was formulated in the form of an application ontology obtained by integrating several existing ontologies, notably: (a) the CIDOC CRM, a top ontology and an ISO standard forming the conceptual backbone of the CrO, (b) the Narrative Ontology, a domain ontology focused on the representation of narratives, (c) the FRBRoo, a domain ontology for bibliographic records, resulting from the harmonization of FRBR with CRM, (d) OWL Time, a domain ontology recommended by W3C for the representation of time and (e) Dublin Core for simple resource description. *Explorations concluded in July 2019, reported in 'D3.1 Mingei CrO and online authoring platform'.*

Craft processes modelling (WP3, T3.2): For the representation of schemas (ideal craft processes) and execution of schemas (execution of ideal craft processes in a specific time and space) Mingei is extending the CrO with a new form of representation capable of conceptualising craft in the semantic model and thus correlating semantic knowledge, recordings and craft products. *Explorations concluded in December 2019, reported in 'D3.3 Mingei Narratives and Storytelling authoring tools'.*

Basic technology for the formulation of the Mingei Online platform: After an in-depth review of existing technologies in the digital CH sector and in collaboration of knowledge representation partners with the UI developers, Mingei took the decision to base the developments on top of the ResearchSpace. Explorations were done through weekly bilateral meetings between FORTH and CNR in the context of which the architecture document was co-formulated as an internal project document to drive technology development (co-edited online and available in [Google Docs](#)). ResearchSpace is an open source platform designed at the British Museum to help establish a community of researchers, where their underlying activities are framed by *data sharing, active engagement in formal arguments, and semantic publishing*. Using Semantic Web languages and technologies, the innovations of the system are shaped by a social conceptualization of the graph-based representation of information. This is employed by integrated semantic components aimed at subject experts that offer mechanisms to create, annotate, assert, argue, search, cite, and justify data-driven research [14]. *Explorations concluded in August 2019 and are available in [Google Docs](#).*

Motion Capture technologies: In Mingei, both a commercially available sophisticated motion capture system (NanSense suit) and state of the art visual tracking technologies are explored. The suit is used to record crafts in the context of dedicated MoCap sessions in all Mingei pilot sites. Visual tracking has a dual purpose. First, it can be used on video recording done simultaneously with the MoCap sessions in the pilot sites to produce results for cross validation. Second, it can

be used to enhance the repurpose of existing digital assets (e.g. video documentaries) by producing motion capture data from archived material. Furthermore, the visual tracking approach is selected due to the low cost; i.e. it can be employed on a simple video recording of a craft instance and thus no purchase of expensive equipment is required. Finally, taking into account that crafts include dexterous hand movements and manipulation MaCap accuracy is essential. Mingei supports dexterous movement capturing through both the suit but also with an additional visual tracker that focuses only on hand-based manipulation. Using these technologies Mingei claims that it can support the majority of MoCap needs while also being capable of exploiting existing content. *Explorations concluded in March 2019, first successful usage of the suit and the visual tracking technologies was done during the Krefeld plenary meeting, resulting in a complete digitization of the Silk weaving craft.*

Gestures recognition and Gestures sonification: Gesture recognition output can be used for real-time human-machine interaction, where different modalities are mapped to motion parameters to augment human movement in different contexts (learning, artistic performances, rehabilitation, etc.). When using such additional modalities that use human senses to augment human motion we talk about augmented sensorimotor feedback. The benefits of using such feedback especially for learning purposes have been underlined by various studies [19]. In MINGEI project we focus on exploring movement sonification. The term is used when variables are mapped to sound parameters by a function [19]; for example, each change in velocity results in a defined change of the sound's pitch or frequency. To sonify human movement, different sound to gesture mapping techniques can be used such as the explicit and the implicit [13] [1] ones. In both the implicit and the explicit sound to gesture mapping, reinforces user's motivation to complete all his tasks/gestures by also reaching a musical goal. For example; following the tempo of the sounds is a helpful feedback on how well the gestures have been performed and in which way they need to be improved (more details may be found in Deliverable 5.3). In sports or in rehabilitation context the user appreciated the sonification and stated that this feedback technique helped them to improve their motor skills [10] [12]. In MINGEI the museum's visitor will thus have the possibility not only to observe the way the craft is performed but also to experiment it and to learn practical aspects of expert's gestures (where to place the hands, how to turn the pipe etc.), through a "learning by doing" process, passing from a passive to an active position. Movement sonification will guide him/her and will reinforce the experience-based museum's visit. *The impact of movement sonification on visitor's experience and learning will be evaluated and presented in the updated version of the D5.3.*

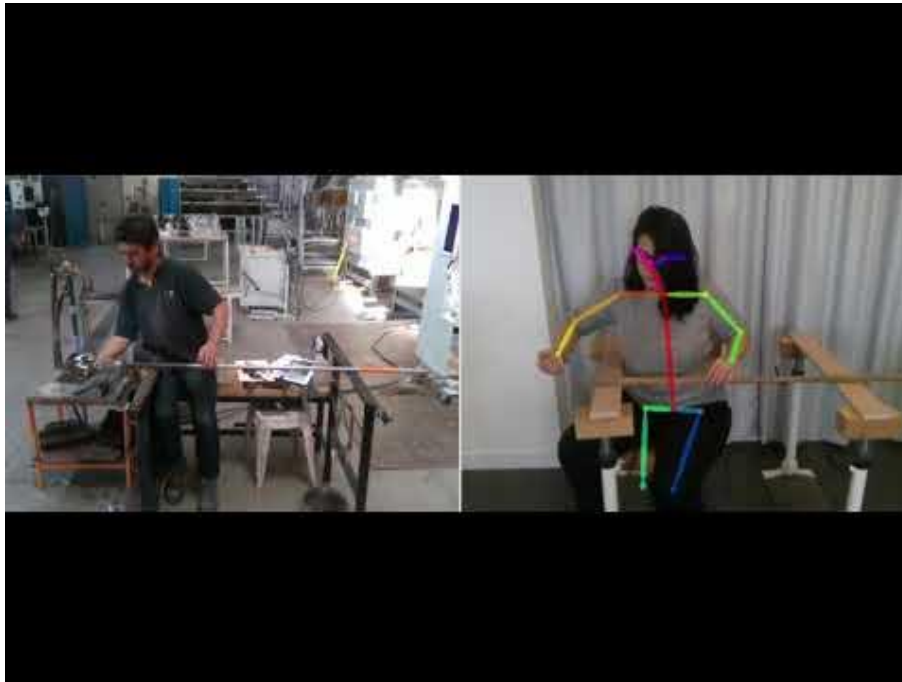


Figure 8. Hyperlink video: gesture recognition & sonification

Craft visualisation (WP5, T5.2): For craft visualisation a number of alternative options are available in Mingei stemming on the implemented technologies (e.g Representation by Virtual Humans, Video presentations, Animated illustrations, Instruction manuals, etc.). The selection of the modality will be based on personal preference, co-creation outcomes and technology usage. The most demanding in terms of technology and developments is the approach where the practitioner is represented by a Virtual Human (VH) and objects through their 3D reconstructions. Craft persons' actions are reproduced by animating the VH based on Motion Capture (MoCap) recordings, while the motion of machines and tools is induced by the recorded human motion. The appropriate simulation of VHs is an important aspect, since crafts are practiced by humans and machines are designed for use by them.

The added value to the use of a virtual humans is that:

- a) users can be immersed in the scene and have a feeling of being there;
- b) such illustration can be complementary to craft training where users are experiencing the craft themselves. The scientific added value of the approach comes from the accuracy of the capturing data and presentation technologies in terms of craft representation.

In Mingei several alternatives are offered to cope with the issue that in some cases people may feel more detached from the subject if there is an avatar/virtual human instead of an actual person in a video. To this end Mingei will support personalization of the experience based on user preference so as to ultimately provide the best alternative for each specific user.

At the centre of the proposed approach is a conceptual, twofold decomposition of craft processes into actions, and of the machines used into components; this is essential in the systematic transfer of craft practice from the physical to the virtual domain, while retaining realism and allowing the semantic representation of craft processes. As an application of this approach, Mingei is implementing the MoViz

platform, allowing users to create and experience craft usage scenarios. In particular, MoViz enables users to author their own scenes, where actions (from MoCap data) and machine parts (results of 3D reconstructions and 3D modelling) are assigned to VHs, in order to create Motion Vocabularies, representing the craft process. *Explorations concluded in December 2019, the first version of Weaving craft re-enacted by a VH (see D5.2).*

Craft VR training (WP6, T6.3): For VR training a sophisticated Software Development Kit (SDK) has been selected by FORTH and MIRALab: the ORamaVR SDK¹⁴. ORamaVR is a spin-off company of FORTH and both FORTH and MIRALab have active licenses. The SDK follows a goal based craft training approach. The main training concept evolves around the virtual demonstration and virtual user action principles. The system is providing a virtual demonstration of a user action and then the user has to try and perform the same action in the virtual world. The system keeps tracks of the success rate of user action in conjunction with ideal virtual demonstration. Using this approach, we are presenting in the VR environment holographic representations of the “ideal” movements of the practitioners. At the same time the tools or machines employed are visualised focusing on the functional parts to be used by the trainee. The user is requested to replicate these movements with his hand and the VR controllers while the system is measuring success rates. Success rates are gamified to provide feedback to the user, provide motivation and assess training outcomes. *Explorations concluded on September 2019, first demo for hammer example, December 2019 first demo for the Mastic Use case.*

AR applications (WP6, T6.2): The Unity3D platform has been selected for the implementation of cross-platform AR applications. These applications focus to augment the museum experience and provide mini-games as demonstrators of craft processes and techniques. *Explorations concluded in December 2019, initial demonstrators implemented for all pilot sites and presented later on in this section.*

4.2.2. Functional tools

All Mingei tools have been developed through a formal process of requirements elicitation and definition, UI design and expert based evaluation (reported in D4.1 and D4.2). Furthermore, during the pilots all tools will be evaluated with end users to assess their usability and user effectiveness and produce the final pre-commercial outputs. In some cases, tools have been co-designed with CH partners (e.g Mingei Online Platform) and will be further developed in co-creation with the intended users and relevant experts for critical parts of the functionality and implementation. Mingei acknowledges that the developed technology combines cutting edge research outcomes and poses implications regarding their adoption by Heritage Partners. To this end the iterative evaluations conducted until M24 and the reporting of the design iterations are expected to present the improvement and simplification of the functionality including domain and non-domain experts in all feedback loops. The following list presents the purpose, motivation and implications of main tools to be implemented by Mingei.

¹⁴ “ORamaVR – from the operating room to VR.” <http://oramavr.com/> (accessed Feb. 24, 2020).

Complementing functional tools (foreseen by the Mingei protocol)

3D annotator (WP2, T2.3, as part of the facilities offered by Mingei to assist knowledge collection): 3D annotator is a promising tool of Mingei that will allow curators to annotate 3D reconstructions and 3D models of CH objects. Although in most of the cases such tools are complex 3D editing environments to be used by 3D experts, 3D modellers and developers in Mingei we try to simplify this process and provide the absolute necessary information and tools. There are implications regarding the take-up of such technologies by the CH sector and some prerequisites in terms of the need to get familiar with the way that 3D objects are manipulated in the virtual space which Mingei tries to compensate through grouping and simplification of functionality and introduction of step by step wizard style process flows in the tool. Apart from that, the provided functionality is as simple and straightforward as possible. The goal to be accomplished by Mingei is to overcome these obstacles, by co-creating with the users – and provide the necessary means to assist their full exploitation by the CH section (wizards, in-house-training, etc.) thus creating an accessible tool for the intended audience.

3D motion analyser and visualizer (WP5, T5.5): The Human Motion Analyser & Visualizer is a tool designed to be used by scientists in order to extract information from motion. As such, in its first version the tool supports (a) velocity visualization, (b) dataset normalization and (c) movement visualisation. Currently the following visualisations are supported: (a) single joint trajectories visualisation where users may select the joint to be visualized in order to produce analytics for a single joint and (b) multiple joints trajectories visualizer that offers the possibility to select multiple joints for visualisation (for example all the joints of the right hand or all only the fingertips). The tool is presented in depth in D5.5.

AnimIO (WP5, T5.1): Animation Studio (AnimIO) is a software for post-processing of MoCap animation files. In the context of Mingei, video MoCap files and processed MoCap files stemming from visual tracking methods (discussed in D5.4) are available. In order to generate multimodal datasets it is important to have an approach to segment these data streams synchronously. Such a tool, to the best of our knowledge, does not exist in the literature or as a commercial product. Such a tool could be used for scientific purposes, as well as by CH (specifically curators and ethnographers) to segment recorded craft processes into craft actions, and to create and annotate craft motion vocabularies. These will be then used as input for the Online Platform for craft representation and MoViz for craft presentation. *First version was due December 2019, second version is due August 2020 (see D5.1).*

Mingei Online Platform (WP3, T3.4): The heart of this platform is the craft(s) representation. The representation contains data and information on the referenced (signified) tangible items. It maintains knowledge on the intangible components of the Heritage Craft it represents. For these components, the representation contains semantic representations of processes and stories that are required to describe craft practice and craft socio-historical context, respectively. The platform is designed and being developed on top of Research Space (RS), enriched with features for representation, digital preservation and dissemination of this content. Towards the goal of representation, intuitive, secure, and co-designed UIs are provided seamlessly across platforms. The engine of the database offers seamless treatment of heterogeneous data and implements a

repository of content created in the project, inherited as legacy from archives, as well as links to knowledge and assets created by third parties, and are available online. Towards the goal of dissemination, the MOP maintains a semantic representation of content that allows semantic search, in international query standard, so that it is semantically organised and semantically accessible, both by humans and computers. All UIs of the platform have been developed in collaboration with CH partners and are constantly improved through design iterations resulting from expert based evaluations. The final platform will be the output of iterative design and co-creation and will be evaluated in the context of the pilots with end-users (*due December 2020*). The platform in its current state is presented in D4.2 and its development in D3.2.

Mingei Narratives and storytelling authoring tools (WP3, T3.5): These have been initially designed in accordance with the knowledge model. In the next stages functionality, will be improved by employing a co-creative approach. This will help identify different expectations and needs of diverse user groups (e.g. museum educators, teachers, etc.) (*due December 2020*). The current state of the Narratives and storytelling authoring tools are presented in D4.2 while the development and rational are presented in D3.3.

Tools to produce craft presentations

MotiVo (WP5, T5.5): MotiVo is about 2D visualisation which serves tasks that fall in-between content management and accurate 3D volumetric reproduction of the human body in motion (typically through a skinned avatar). It is a way to summarise the motion of persons over longer time intervals and present multiple steps of a process. MotiVo, tries to mimic the techniques employed by artists through centuries. Upon these techniques Mingei filters only the ones that have a confirmed physiological response and uses them to produce visualisations. For example, 2D abstractions, such as motion lines, can provide insight in understanding the motion that the observer wishes to reproduce. 2D visualisations are particularly useful for conveying motion and instructions on printed matter and physical surfaces, opening a wide avenue on applications that involve physical objects and surfaces (i.e., mixed reality). We acknowledge that approaches that use the real world are more appropriate for creating vivid experiences and understanding physical (or “embodied”) aspects of craft, rather than a completely digital virtual environment (in addition, see discussion on qualia and limits of our representation, in D1.3). MotiVo, is, based on findings from: (a) History of art, (b) Neurosciences, (c) Findings in computational vision (see D5.5). During its development, we had fruitful discussions with both artists as well as practitioners of dance and martial arts. These discussions confirmed our interpretation of the art history literature and technical literature on computation vision and neurosciences. *First version was due December 2019, second version is due August 2020*. The current version of MotiVo is presented D5.5.

MoViz: Is a platform that allows creative industry professionals and curators to create and experience craft usage scenarios. In particular, MoViz enables users to author their own 3D scenes, where actions (from MoCap data) and machine parts (results of 3D reconstructions and 3D modelling) are assigned to VHs, in order to create Motion Vocabularies, representing the craft process. Users can also experience playback of the created scenes, through simulation in a VE, either in 3D or in Virtual Reality. Mingei argues that through the iterative design process presented in D4.2 MoViz greatly simplifies a very demanding task which is the coupling of MoCap

vocabularies with Virtual Humans and tools/machines to create craft demonstrations. Until now and to the best of our knowledge there is no platform that can simplify this process to the extent done by MoViz thus improving the possibility of CH professionals employing technology for the creation of craft presentation scenarios (*initial version due December 2019*). Furthermore, during the second year of the project further features will be added such as for example the integration of virtual storyteller in craft presentation making thus, the resulting 3D presentations more friendly for end users (*due December 2020*).

4.2.3 Demonstrators

This section discusses the Mingei demonstrations that are presented at the review meeting in February 2020. These are the outcomes of the various technology explorations that happened during the first year of the project, based on the original objective of the project and early explorations with the pilot partner. They are presented in relation to the Mingei pilots – and will serve as inspiration for further co-creative development.

Silk weaving – Krefeld

Web based narrative: As an outcome of the work in the Mingei Online Platform and on the narratives and storytelling authoring tools, a web version of a narrative regarding the Krefeld Textile industry was created showcasing the semantically rich representation of the silk weaving craft instance. Alternative compilations of narratives will include, craft presentations, books, illustrated presentations, AR visualisations, etc.

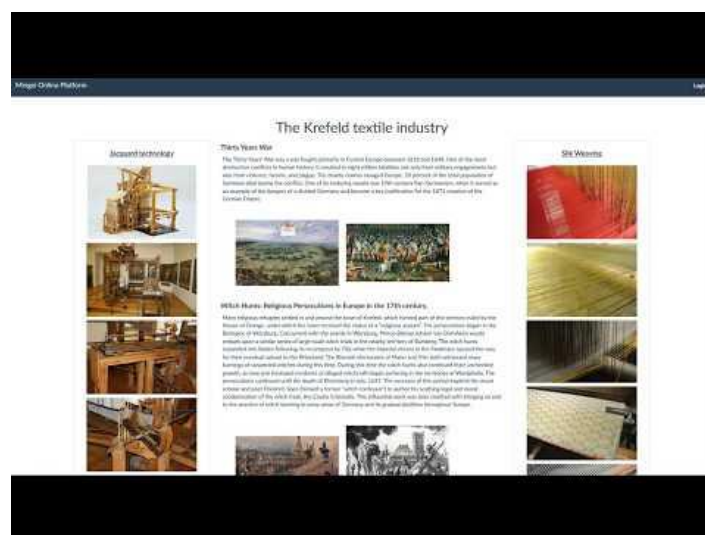


Figure 9. Hyperlink video: web based narrative

Garment scanning methodology: In the early stages of the project it soon became apparent that ecclesiastical garments are important in the context of the Silk pilot because:

- a) many garments of HdS are not in display;
- b) garments are tricky to photograph due to their texture and material;
- c) 3d reconstructions can be integrated in multiple experiences such as Virtual Museums, games (e.g. be worn by Virtual Humans), online immersive content, etc.

Scanning textiles is not a trivial issue as standard techniques based on photogrammetry, which is the common practice in 3D reconstruction today, produce results that are not able to reproduce accurately all the faces of the garment. To cope with this situation a process was implemented by Mingei that is based on photogrammetry and manual enhancement of textures based on original photographic documentation of the garment. In this context Mingei also followed the guidelines set by the 3D icons project (<http://3dicons-project.eu/>). This process will be evolved and is considered to result in a methodology for the Creative Industry Sector to produce 3D textile digitizations. The results of the methodology can be found on the following links:

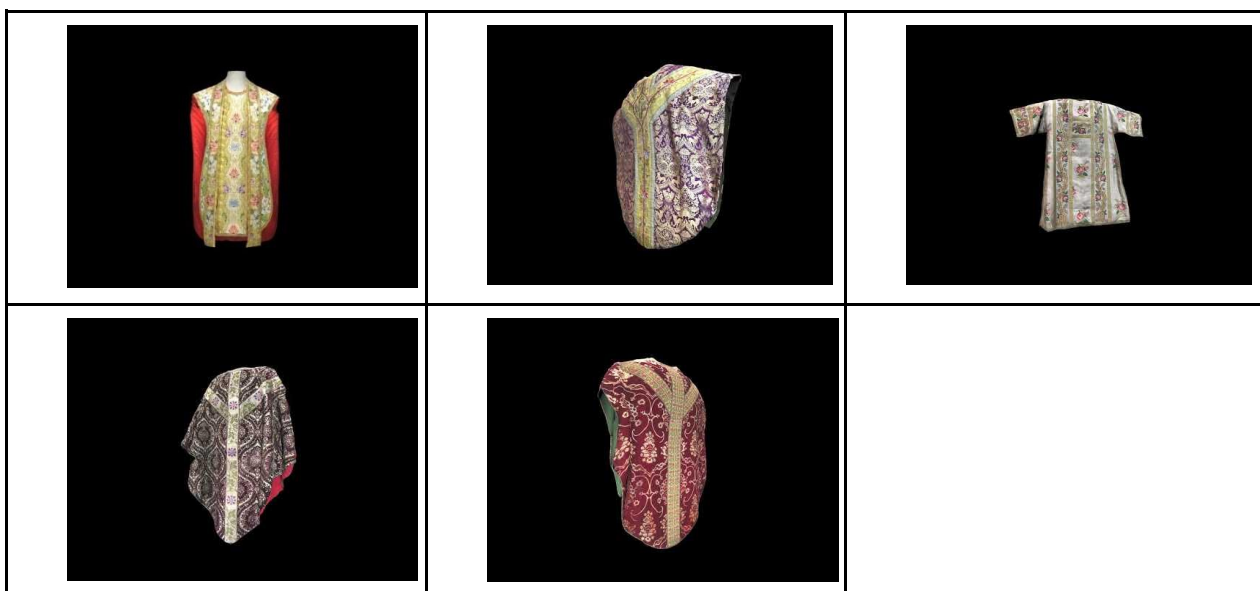


Figure 10. Hyperlinks videos: garment scanning

Textile scanner: A mixed hardware and software project focusing on producing ultra-high resolution digitisation of garments addressing the requirements of the SilkNow project (<https://silknow.eu/>) regarding the need for ultra-high resolution digitisations as input for their virtual loom prototype. At the same time for Mingei the Textile scanner is a great opportunity to achieve progress in the current state of the art in textile scanning, relevant to the silk pilot, and produce digitisations of unprecedented quality. Furthermore, the hardware infrastructure together with the textile scanning software are considered one of the exploitation results of the project with a great market potential.

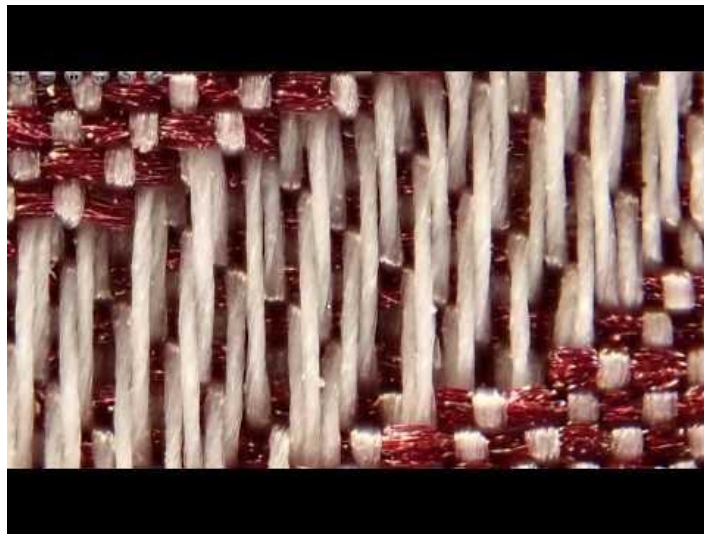


Figure 11. Hyperlink video: textile scanner

Ecclesiastical textiles virtual museum: HdS is a small museum, and is unable to showcase all the available treasures to the public. Mingei created a virtual application in the form of a VR museum exhibition, and digitised the hidden treasures of the museum for it. This exhibition can be hosted either as a physical installation at the museum (to extend and complement its physical collections) or can be provided as a web based version accessed through the Mingei online platform and the museum's web site.

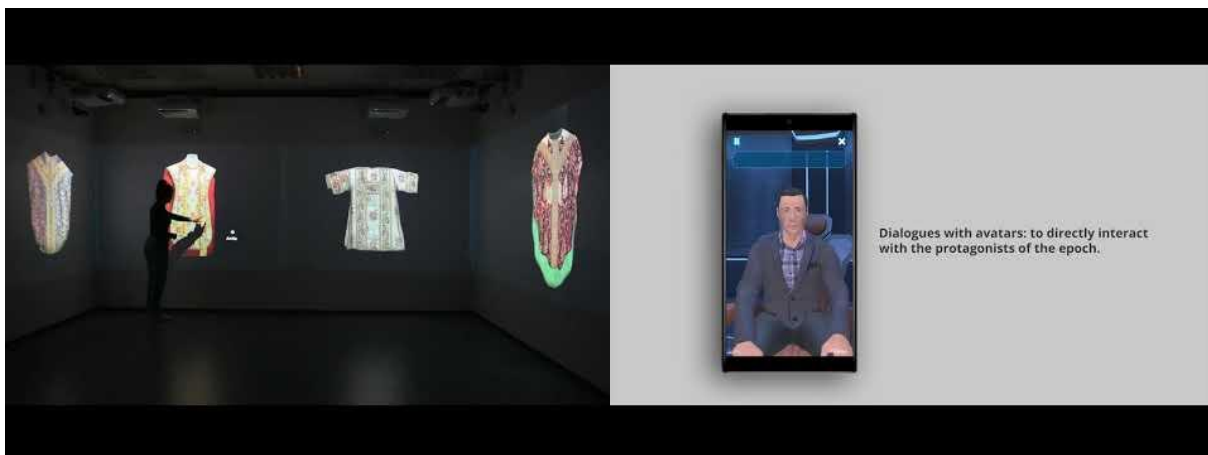


Figure 12. Hyperlinks videos: virtual museum + mini games

AR application and mini games: The AR application developed was based on the following requirements (a) technology implied by the submitted proposal and the GA and (b) requirements stemming from craft understanding, knowledge collection and co-creation sessions. Regarding the second it was clear that it was considered important for the community at HdS to transmit knowledge and techniques on pattern making and punch card creation. This was considered the hidden art of silk jacquard weaving. Apart from the representation of the craft, taking into account these requirements, Mingei developed mini games that are focusing on the hidden art of point

paper design. In the first mini game the user creates a pattern themselves on point paper. The application gives a preview of the result on a virtual garment. The second mini-game is about gamifying the punch card creation process through an action game where the user is the 'piano machine' operator and has to copy the shown pattern by pressing the appropriate buttons on the machine to create the punch card. The applications were reviewed and assessed by HdS practitioners and educators and are aligned with the vision of the museum and the museum educational programs currently in place. Further co-creation with the community at HdS will happen in order to align these applications with the complete Mingei vision of exploiting technologies in the Krefeld area both within the museum but also online and in the context of thematic tours in the city.

Online version of narratives: Possibly the simplest compilation of semantic representation of narratives is in the form of web content accessed by anyone anywhere through an internet browser. This is the first presentation modality explored by Mingei in the context of the Silk pilot as seen in the following video:



Figure 13. Hyperlink video: online narratives

Mastic cultivation - Chios

Airborne!: this prototype was inspired by the results of 3D reconstructing locations in the island of Chios and in particular the museum and mastic villages. The design entails a virtual flight over Chios where the landscape is augmented with information and content to augment the storytelling experience. Pertinent narratives will relate the rural space, the land and sea with human activities of cultivation and architectural characteristics of mastic villages stemming from the rich history of the island and how the landscape and architecture was affected by the maona occupation of the island. The experiences could be delivered in the museum in the large multimedia projection hall but also through the internet, mobile devices and the Mingei Online platform.



Figure 14. Hyperlinks videos: Airborne demo & 3D game demo

Chios exploration 3D game: This is an exploration game done in Unity3D that has the main concept of mixing reality with fantasy gaming and real world 3D reconstructions. The game takes place in a terrain replicating the physical structure of the Chios island scaled to host a game that someone can explore the entire island on foot. In this landscape the medieval period of the island is explored through stories, testimonies, phantasy representations of the part and actual 3D reconstruction of the medieval villages in a game to explore, learn and experience the impossible.

AR application: In this application Mastic cultivation becomes an AR gaming experience. In this context, mastic cultivation concepts are gamified and users are requested to replicate the appropriate gestures to perform certain cultivation activities. Interaction can happen both when in front of an actual mastic tree in the museum but also as a pure AR game projected within your room.

VR training in mastic cultivation: This experience is about becoming a mastic cultivator in a VR simulation environment. In this environment cultivation objectives and tasks are presented and users should perform these tasks in order to proceed to the next activity in a sequential training experience. Each object entails the usage of mastic tools (results of 3D reconstruction and 3D modelling activities of Mingei).



Figure 15. Hyperlinks videos: AR application demo + VR training demo

Glass blowing - Paris

The comic book: This is an illustrated book documenting the creation of the glass carafe based on the ethnographic research conducted by CNAM in collaboration with CERFAV, and the video recording done on site with the glass blowers. The results were post processed by CNAM and articulated videos were created together with key poses of the craft creation process. Videos and key poses were edited in MotiVo to generate comic based illustrations that were then edited to create the comic book (reported in D5.5.).

The interactive comic book: Based on existing technology by FORTH for interaction with printed matter a demonstration application was implemented that allows users to access more information while interacting with the physical comic book as presented in the following video:



Figure 16. Hyperlink video: interactive comic book

The carafe AR simulation: This is a fluid simulation AR game where the users can actually use the carafe to virtually serve. This was created as a technology exploration of fluid dynamic in AR.

4.3 Track 3: User study exploration on technology in heritage context

To validate our choices regarding the technologies and applications used in Mingei, we introduced a third track (yellow line in Figure 5) that runs only during the first year of the project: user study exploration on technology in heritage context. In the context of this track, we investigated past user studies and projects with a tourism and heritage context and drew valuable information and knowledge from them that further supported our choices. The results of this track are discussed next.

The SmartSociety FP7 FET project (2013-2017) investigated the context of a Smart Society where people meet machines and collaborate seamlessly. Mingei partner IMA was involved in this FET project and was responsible for designing scenarios and eliciting user requirements. One of these scenarios was based on tourism and the 3 pilot settings in Mingei can easily be seen as focused sub-scenarios of those previously studied cases. During activities in SmartSociety, IMA investigated what was already available in terms of digital games for a smart society and explored serious games and immersive technology design space.

Digital urban games with educational purpose in a city context were also examined [8] [11] [21]. To avoid working with static scenarios which could easily be made redundant or irrelevant by technological or societal developments, an iterative, evolutionary approach was adopted as a basis for the user centric collection of data and insights. This approach helped to guarantee the elicitation of the broadest possible collection of system requirements.

Specifically, as far as the work around tourism was concerned, preliminary investigations were carried out, a survey was carried out in order to gain insights and opinions about present solutions and needs of future potential users. Around 100 people answered questions related to their present use of tools and their personal opinion on a potential future smart tourism system. The survey sample was composed of 69% aged between 18 and 34, 28% between 35 and 54 and only 3% aged over 55. The people comprising the sample population are from multidisciplinary backgrounds and 91% of them travel. In this survey, together with general enthusiasm, two main concerns were raised by users, which are still very actual.

The biggest problems they faced when travelling were Internet accessibility and transportation. To solve these issues, they mostly need to use the Internet. This was however not always at their disposal, creating difficulties. When asked about digital solutions in a tourism/visit setting, the negative aspects most cited were its privacy violation¹⁵.

These two shortcomings bring us actually in the same direction as a very practical and concrete organisational need coming from Mingei end users: the fact that if they allow visitors to use their own mobile technology, this means a huge investment in maintenance and sustainability of a digital solution, giving technology obsolescence and the continuous need to update apps and similar software solutions to be always able to offer access to the newest mobile devices. Putting

¹⁵ <http://www.smart-society-project.eu/wp-content/uploads/pdfs/year1Delivarables/D9.1.pdf>

the two perspectives together, Mingei pilot sites should offer “own technology” (i.e. owned by the institution) to their visitors where possible.

The FP7 i-treasures project aimed at the use of multi-sensory technologies for the preservation and transmission of Intangible Cultural Heritage (ICH). Motion capture with sensors and also with cameras were used to record motion data of experts and to develop interactive mechanisms for learning the gestural patterns of these dexterous skills (dancing, singing, making wheel throw pottery and creating contemporary music). The i-Treasures project focused on some Intangible Cultural Heritages (ICH) and investigated whether and to what extent new technology can play a role in the preservation and dissemination of these expressions. To this aim, the project developed a system, based on cutting edge technology and sensors, that digitally captured the performances of living human treasures, analyses the digital information to semantically index the performances and their constituting elements, and builds an educational platform on top of the semantically indexed content [17]. A participatory approach to define user requirements of a platform for intangible cultural heritage education has been designed and implemented in the framework of this project as described in the paper of Dimitropoulos, Kosmas, et al [5].

Several user studies were conducted to investigate the role that the motion capture could play to achieve the objectives of the project as well as of the digital platform where all the data and findings would be stored together with the training tools developed in i-treasures. A participatory approach was adopted to define user requirements of this platform for intangible cultural heritage education where ICH experts, performers and different types of users (adults, young populations etc.) were actively involved through surveys and interviews, and extensively collaborated in the complex tasks of identifying specificities of rare traditional know-how, discovering existing teaching and learning practices and finally identifying the most cutting edge technologies able to support innovative teaching and learning approaches to ICH. One of the principle findings of this approach was the fact that project's stakeholders were willing to use motion capture technologies, they found the hardware (sensors) and software (interfaces) "user friendly" and were extremely curious and excited about the possibility a) to preserve their knowhow (for the experts) and b) to test highly innovative technologies during the learning process (learners).

After the implementation of the technologies an evaluation study has also been done confirming the interest, the effectiveness and usability of the platform and the technologies it involves [4]. More precisely, 43 individuals responded to a questionnaire, following a specific protocol (e.g., establishing meaningful relations with local communities; creating accounts for all users involved; workshops including demonstration, use of platform according to instructions, explanation and completion of questionnaires).

In some particular use cases, underlined limitations concerned the 3D environment of the games developed. For example, the realistic rendering of the vocal tract motion is a challenging task. The I-treasures research offered an innovative and dynamic evaluation method, where evaluation is not restricted on the static elements of the data collected by questionnaires, but goes beyond and proposes a structural equation methodology, where the performance of the platform is

evaluated by the components that constitute the platform and by the relationships that exist between these components.

The project has also explored the possibility to capture the artists' movements and performances using ad hoc sensors. In these particular cases the general conclusion is that there is still room for further research, especially to improve usability and exportability of these sensors, but at prototypal level—i-Treasures has proved the feasibility of using these kinds of technologies to support teaching and learning processes in the field of ICH.

Another interesting study has been done in Greece in the framework of the "ArtiMuse" project where motion capture with inertial sensors were used to record and analyse and consequently preserve the kinematic aspects of professional potters [14]. Similar to I-treasures different stakeholders were actively involved in the project through a participatory approach. Seminars in local communities were organised to underline the potential of the over mentioned technology to attract the interest of young populations for traditional crafts but also of tourists for experience-based tourism. More precisely, 2 expert potters were involved in the recording process while the final technological paradigm developed was evaluated by 11 users. The qualitative study reveals the beneficial effects of multisensory technologies to learners' motivation and concentration while it permits them to improve their gestural performance by approximately 20% when receiving sensorimotor feedback [9].

The knowledge and experience from these previous projects has served as a basis to build on some of the concepts of MINGEI. To list some of the concrete conclusions from these projects that have been used to form the choices in MINGEI:

- a) they permitted to define which motion capture technologies are the most suitable in terms of accuracy, costs and usability for recording the experts
- b) they allowed to confirm that the sensorimotor feedback brings a considerable assistance for exploring dexterous gestures.

The ambition of MINGEI project is to continue using motion capture technologies for the digitisation of manual know-how and to go beyond the limitations underlined by previous projects.

4.4 Track 4: Development of platform

The fourth track that Mingei explores in the first year of the project is the development of the Mingei online platform (MOP) - which is visualised in Figure 5 by the grey line.

The main requirements for this platform were set as a starting point of implementation concerned:

- a) the alignment with existing standards of the CH sector and possible extensions to support HCs;

- b) the implementation of the authoring environment that is aligned with the expectation of CH professionals;
- c) the provision of new facilities over knowledge models that enhance knowledge representation, such as the creation of multimodal narratives and the modelling of processes.

A detailed description of the outcomes of interdisciplinary collaboration in these topics is presented in the fundamental deliverables of WP3 and more specifically D3.1 regarding the Craft Ontology, D3.2 regarding the Mingei Online Platform and D3.3. regarding narratives and storytelling authoring tools.

The approach followed in Mingei was to build on existing knowledge models and tools that are approved by the CH and digital CH communities and have been extensively tested in research and development efforts. Beyond that, the aim was to extent and improve these technologies in collaboration with CH partners. This was elaborated through visits of CH professionals from the CH organizations participating in Mingei to FORTH (who is the responsible for the development of the front-end of the aforementioned platform). At the same time, recurring visits of personnel of CNR to FORTH ensured a structured knowledge representation part of the platform. Professionals from the CH organizations contributed to the alignment of the online platform with the expectation of the CH sector and professionals from CNR with the CrO and knowledge representation standards.

In the context of WP4, iterative expert based evaluation was conducted for the platform to assess usability and user experience as reported in deliverable D4.2. Overall three expert based evaluations were conducted to produce the first version of the platform that is expected to go through a co-creation process to deliver concept design, based on the supported functionality. This will further involve CH professionals. The focus for this co-creative process is on the formulation of stories, narratives and their delivery to diverse user populations, and the usability of the platform itself.

To summarize this interdisciplinary approach for platform development the following main actions can be identified:

- Iterative and collaborative formulation of platform architecture concluded within the first three months of the project. This was carried out through extensive review of existing technology and standards, weekly bilateral meetings between FORTH and CNR and iterative online collaborative formulation of the architectural model (*until March 2019*).
- Formulation of the CrO, in the form of an application ontology obtained by integrating several existing ontologies, notably: (a) the CIDOC CRM, a top ontology and an ISO standard forming the conceptual backbone of the CrO , (b) the Narrative Ontology, a domain ontology focused on the representation of narratives, (c) the FRBRoo, a domain ontology for bibliographic records, resulting from the harmonization of FRBR with CRM, (d) OWL Time, a domain ontology recommended by W3C for the representation of time and (e) Dublin Core for simple resource description (*until December 2019*).

- Implementation of the Mingei Online Platform facilitating the ResearchSpace platform which is a new type of contextualising knowledge system¹⁶. Based on this CH friendly platform the Mingei Online platform was implemented and fine tuned with the participation of CH professionals from the consortium (*until December 2020*).
- Production of the first prototype of the platform with the participation of CH professionals. (*until December 2019*).
- Iterative expert based evaluation to assess usability and user experience as reported in deliverable D4.2 together with instances of design iterations (*until December 2019*).
- In parallel implementation of the narratives authoring environment was built on top of the same contextualizing knowledge system with the objective to support the creation of narratives and their transformation into stories. The storytelling authoring tools include tools that facilitate the definition of how a narrative will be presented to end-users, for example what media files should be played and when. The automatically built narrative page is also presenting the narrative based on presentations defined by curators (*until December 2020*).
- Programming of co-creation activities for the second year of the project to deliver concept designs, based on the supported functionality, that will further involve CH professionals especially regarding the formulation of stories, narratives and their delivery to diverse user populations (*until September 2020*).
- Deployment of the first validated version of the platform (*until December 2020*).
- Continuous evaluation, validation and improvements until the end of the project.

¹⁶ <https://github.com/researchspace/researchspace>

5. User requirements for pilot experiences

In the Mingei project we are working with two types of requirements: user requirements and technical requirements. In this section, we will primarily discuss the user requirements, and specifically the user requirements for the pilot experiences based on the co-creation sessions with the local partners, and their relevant stakeholders. Following those user requirements concepts will be developed for each of the pilot context. An analysis towards the technical requirements for each of these concepts will be outlined in Deliverable 4.1., along with the use cases. They are, however, also included as Annex 4 for this document.

In an effort to limit cross-posting, this deliverable will not document the user requirements for the individual tools developed for the representation stages and the user requirements for the platform as they will be outlined in WP3 and WP5 deliverables – along with the conceptual descriptions of each of the tools developed. All developments are to be improved and fine-tuned in co-creative activities with the entire consortium and heritage professionals, over the course of the project.

In Mingei we aim to provide usable representations and tools/experiences to be of service to the Cultural Heritage domain. In this we distinguish two directions that elicit requirements:

- 1) **Craft representation**
- 2) **Craft presentation and preservation**

The requirements for **Craft representation** relate to the way artefacts and events are documented in the domain of Craft Heritage. In the first stages of development, these requirements are more of a technical nature. For that reason, these requirements are discussed in more detail in Deliverable 4.1. In the second year of the project the additional needs and requirements of users will be collected - so that development can be tweaked and improved.

The requirements on **craft presentation and preservation** deal with the content and the way that this content is presented to stakeholders and end-users. These requirements are relevant to the pilot experiences (whether on a physical location, a virtual world, or online), and they are developed in co-creation with the local heritage professionals, museum personnel, end-users, local stakeholders, technical partners and design partners. They are supported in WP1 and implemented in WP6.

As we have mentioned in the strategy in Section 2.2, the first sessions are to provide the **stories** that present a craft and the way that this craft is **documented** or **taught**. The following sessions will additionally elicit requirements for the **narration** of this story and the design of the **experiences** to be provided.

The experiences developed for the pilots are both presentational and educational and could vary in form, based on the needs and requirements of the content, the host, the visitors/users, and the context. They can result in interactive experiences, online and visual presentation of knowledge, printed matter or electronic documents (i.e., a book or a guide of an exhibition), visual

representations (i.e. interactive, storytelling timelines and maps), annotated 3D animations and reconstructions that provide better insight in craft understanding, as explained by practitioners, curators, and CH professionals.

Naturally, as individual craft instances are studied in more depth it is expected that:

- Additional user requirements will emerge.
- The entire set of requirements will emerge gradually and particularly during evaluation of pilots.

At the time of writing we can outline the preliminary requirements for each pilot, stemming from the first co-creation outcomes on the understanding of the craft, and the needs and requirements of the organisations that will host the pilot. In this case, the pilot (heritage) partners can be classified as 'Cultural Heritage Professionals' (CHP). In later stages, we will add the user requirements of the primary end-user group of the prototypes; 'Cultural Heritage Visitors' (CHV).

5.1 Cultural Heritage Professionals and Institutions

The preliminary user requirements for the prototypes and experiences are based on the input from the local hosts, and their respective institutions. To get a better sense of the needs and wishes of these people, who we have classified as ‘Cultural Heritage Professionals’ (CHP), we adopt the roles / responsibilities outlined in the research of the FP7 project MeSch¹⁷. Each of these roles will inform user requirements in more detail, as for each role different aspects are important. Depending on the size of the institution, one or more persons could cover each of these roles, or take on multiple roles.

Storyteller	The person that is responsible for the content of the exhibition, often the curator or an expert on the specific subject of the exhibition.
Educator	When an exhibition has an educational purpose or component, a specific set of activities or specific presentations are created around the core material to better connect to the audience. The educator is the person that is responsible for this aspect of the exhibition.
Communicator	The content as selected by the Storyteller needs to be prepared for the public. Aspects of language, combination of text and images, type of media, etc. are some of the decisions taken by the Communicator.
Designer	The person or group of persons that is in charge of the visual appearance, the physical layout of the exhibition, and the overall experience of the visitors.
Maker	The person or group of persons that implement the plan created by the designer.
Manager	A key character in the process of creating and setting up an exhibition, the manager has to ensure that the project progresses and milestones are met.
Technician	The person that is responsible for the set-up and/or subsequently for the day-to-day maintenance of the exhibition, including installation, periodic check-ups, and possible maintenance.

In the context of Mingei, the design and making of the ‘experience’ are most likely outsourced to the technical partners, who may also provide the maintenance for the prototype, while the ‘experience’ is open to the public during the pilot.

This is a practical solution, when there is a lack of technical expertise within the institution, or

¹⁷ Material EncounterS with digital Cultural Heritage – <http://www.mesch-project.eu/>

when the duties might seem daunting to the local host. This is however also a strategic choice when it comes to durable design. It should be considered in the requirements, as by outsourcing this responsibility, the institution does not have the chance to grow internal expertise and overcome an existing technical gap.

Additional factors will inform the preliminary user requirement. All of these must be taken into account when choosing the type of technology and conceptual choices for the 'experience'. We will consider the following factors below:

Institution: visitors and collection

The type of museum or heritage institution influences the way visitors behave and what they will expect. Both the target audience as well as the type of collection influence the options for an experience. When an institute caters mostly to families with children, it is expected that the exhibits are noisy and hectic but can also offer opportunities for enactments and live storytelling. Such large, crowded spaces could, however, offer limitations when it comes to soundscapes, single-user experiences, and long-form content. More traditional museums that target a more mature audience, are usually quiet and have strict rules on interaction, but provide opportunities for longer attention spans and in-depth information. Institutions that offer a combination of activities, such as workshops and talks, provide opportunities to customize the same content for different audiences in the same institute.

The type of heritage institution directly impacts on the chances of interacting with authentic objects, on the feasibility / appropriateness of augmenting them with technology and in what form. For this, the type of oversight – by (security) personnel or volunteers, needs to be considered a factor.

Location: indoors, outdoors, and online

We should also consider the expected location for the 'experience' that is to be developed. This includes technical considerations like power supply, availability of WI-FI connections, (interference of) existing technology, location based-markers, but also more functional considerations of the general infrastructure like weather conditions, expectation of surroundings, building regulations, and accessibility. When it comes to accessibility – it is also important to consider whether or not there are supportive measures in place for people with disabilities.

Historical buildings, or larger institutions, often pose challenges as there may be stronger restrictions for the installation of power supplies, or a piece of technology that is highly visible. Outdoor locations face their own set of challenges, dealing with regulations of public space, privacy issues, nuisance, and vandalism.

Space: size and set up

The size of a site is important to consider as small museums may be covered in one visit, while medium and large museums would need multiple visits to experience the collection in full. Size is

also a factor in terms of the number of objects / information on display per square meter, or in terms of the physical site size, and the opportunity to move around in a space.

Knowing the difference in curation style between large, medium and small institutions with respect to their holdings will help define a space to work in.

When we look at the set-up of an 'experience', we consider the context in which that 'experience' is placed. The following questions are considered. Are there additional objects on display, in the same room? What is the level of interaction expected in that place? When the rest of the gallery is a 'no-touch zone' adding a highly interactive installation is confusing to the visitor. What level of attention is needed? Crowding of objects in a room will affect the ability of visitors to quickly locate exhibits of interest or the exhibits referred to by labels, panels and audio guides. Is there a need for a stationary experience, or is flexibility and motion required? In what way, should there be a link with tangible / historic items?

Objectives

Each pilot partner has specific objectives with their pilot. These determine additional user requirements for prototypes (which can be multiple). Below we provide an overview of general directions, which will be more specified over time, based on the co-creation process in the upcoming months.

1. Experience of a 'location' (simulations of a 'workshop', factory visit, sensory aspects, etc.).
2. Experience of a movement (physical actions in space, mirroring, interactivity, etc.).
3. Information about /details of an object (tactile interaction, object-based, etc.).
4. Focus on historical / cultural significance (storytelling, adding perspectives, role play, etc.).
5. Personal experience (making, collecting, etc.).

Exhibit: story, objects and interaction

For any type of experience, knowing the story or objective of the exhibit is essential. What is the purpose of the exhibit? Is it to inform, or to experience? Is it a 'think piece' or tangible interaction? For this it is important to know the type of content that is going to be used: Is it part of a permanent collection? Is it object based? Is it a story? And also: does the content already exist?

We also have to consider the type of exhibition: Will it be temporary, or is it part of the permanent set up? Is it going to be used in workshops, or in guided tours, or with groups? How many people can experience the exhibit at the same time? Are there (mobile) devices or other aids to enhance the experience?

It is helpful to define the starting points for the creation of an exhibition: a set of objects from the collection; the spatial arrangement (floor/building plan); a general theme/idea proposed by a curator or specialist; or the adaptation of content from previous exhibitions.

5.2 Cultural Heritage Visitors

For the preliminary user requirements, we focus on the input from the CHP, as mentioned above. However, following our co-creation strategy, in later stages these requirements will be improved and specified by the input from the other stakeholders and users, taking part in the co-creation sessions hosted by the local heritage partner. One of the most important users to mention are the visitors of the experiences / exhibits.

When we talk about ‘visitors’, we cannot treat them all as one user-group. Individuals and groups arriving at a heritage site or museum have different motivations to be there and therefore we have to consider different needs for different experiences. [1][SEP]

A useful classification of visitors is the one Falk introduces in [4] and his follow-up paper [3]. Falk provides real-world examples and suggests how, for each visitor type, their visit evolves in time. This classification splits visitors based on their objective on a heritage site. When it comes to prototyping these distinctions will help us develop different experiences for the different groups.

Falk’s classes:

1. *Facilitators* are socially motivated. Their primary goal is to enable the experience and learning of others in the accompanying group. Examples of such group are parents and teachers.
2. *Rechargers* seek to have a contemplative, spiritual and/or restorative experience. They use the heritage/museum as a refuge from the work-a-day world.
3. *Explorers* are curiosity-driven with a generic interest in the content of the heritage content/museum. They expect to find something that will attract their attention and fuel their learning.
4. *Professionals/Hobbyists* feel a close tie between the museum/heritage content and their professional or hobbyist passion. Their visits are typically motivated by the desire to satisfy a specific content-related objective.
5. *Experience Seekers* visit because they perceive the heritage/museum as an important destination (e.g. “been there, done that”).
6. *Respectful Pilgrims* visit out of a sense of duty or obligation to honour the memory of those represented by the institution/memorial.
7. *Affinity Seekers* visit because a particular museum/heritage or more likely an exhibition speaks to the visitor’s sense of heritage and/or personhood.

The last two classes could in some cases be considered sub-classes of the earlier classes.

In the upcoming co-creation sessions, we intend to use this list of motivations as an anchor, to come up with sensible user requirements for the experiences.

5.3 Preliminary ambitions and user requirements per pilot

The descriptions of the scope of each pilot can be found in Section 1.1.2 of the Mingei proposal. Below we outline each pilot based on the factors mentioned above, and extract the preliminary user requirements, based on the existing knowledge in the project.

5.3.1 Haus der Seidenkultur - Krefeld



Figure 17. The double-doored entrance of the museum Haus der Seidenkultur in Krefeld.

Institution

The Haus der Seidenkultur is a small museum and weaving workshop in Krefeld, which showcases Krefeld's silk industry. The museum is housed in a former silk weaving factory that specialised in producing liturgical vestments. The museum houses a rich archive, containing objects related to silk and jacquard weaving; tools, patterns, sample books, and (operational) looms. The museum has maintained parts of the set-up of the old factory – which are the parts that invite visitors to interact with the collection. People can touch fabric, looms and materials, but the looms are operated by volunteers. The other parts of the museum are set up more like galleries.

The museum is run by volunteers and has a community of former weavers that demonstrate weaving and fabric creation skills, and a volunteering Association of Friends strives for the safeguarding of this endangered HC. The ticket office is located in a shop, in the front of the house, which sells silk items (produced in the nearby factory – but based on designs developed in the museum).

The educational program of the museum includes workshops and programs for children of all ages and school groups. The educational program is coordinated by the sub-director of the museum¹⁸. The museum has a press spokesperson who is handling the communication affairs of the museum with the local press. A dedicated volunteer technician maintains the fire protection and security system and performs any computer support related tasks.

The museum is housed in a historical building but the power outlets and infrastructure are up to date. HdS has a Wi-Fi network. However, the network's bandwidth and strength will have to be examined in regards to its capability to support concurrent server requests for data by multiple users.

Requirement 1: The installations and their respective applications, physical and mobile, should enhance the current storyline of HdS, by adding value to the exhibits they currently support.

Requirement 2: All the installations and applications used in the pilot experiences should be easily initiated and run. Given that HdS associates are conventional technology users, all technological installations, physical and/or mobile, should be accompanied with user manuals that will have clear and simple instructions on how the system works, how to turn it on/off (e.g. one-button start), and how to perform simple troubleshooting (e.g. FAQ over the phone).

Requirement 3: All the installations and applications used in the pilot should be easy to maintain and update. Full technical support should be provided by the technical partners for the entire duration of the pilot (e.g. remote connection, automatic monitoring of functionality and reporting of errors).

Requirement 4: Automatic maintenance mechanisms should be put in place to reduce the need for technician labour. Support, outside Mingei, should also be provided upon request and with an arrangement.

Requirement 5: WI-FI network strength and bandwidth tests should be carried out to examine the network's capabilities and limitations.

Requirement 6: No significant bandwidth should be required from the applications.

¹⁸ The analytical program of educational workshops and activities can be found in the webpage of HdS https://seidenkultur.de/images/Presse/160119_splchenprogramm_e_2_.pdf

Requirement 7: Maintenance should only take place during times that the museum is closed.

Requirement 8: Mingei should pursue the minimization of data transfer requests from all system applications that will run in the pilot installations, physical and mobile applications.

Requirement 9: Network security will be established to ensure privacy and GDPR requirements.

Visitors

The general public visiting the museum are often school groups (with teachers), families ((grand) parents with children), and craft enthusiasts:

- Professional craftspeople with a deep understanding of craft knowledge and the museum collection;
- General public with a personal relation with craft (family relation mostly);
- Craft students and teachers

The majority of the visitors are German. The main additional nationality is Dutch, as the museum is located close to the Dutch border.

Referencing the Falk classes above we could classify the majority of the visitors as *Facilitators, Explorers and Professionals/Hobbyists*. In the context of Mingei, an additional class could be added as an aspirational target group: *Affinity Seekers*.

Requirement 10: Experiences should be educational to both adults and children – though they do not necessarily have to be one and the same experience. This would be relevant for the *Educator (CH Professional)*.

Requirement 11: Installations/experiences should be entertaining for children. This would be relevant for the *Storyteller (CH Professional)*.

Requirement 12: Installations/experiences should allow space for group viewing/experience, considering that school groups are one of the main target audiences.

Requirement 13: Content and instructions for installations/experiences should be primarily in German. Additional preferred languages are Dutch and English. This would be relevant for the *Communicator (CH Professional)*.

Location and Space

The HdS Museum is located in a building that dates back to 1868 and consists of two floors. The ground floor hosts the entrance, the cash register, two areas for temporary exhibits, and the museum shop. In general, the ground floor can support limited flow of visitors. There is also a meeting room used for lectures, films, workshops, and social get-togethers on the ground floor. The first floor houses the office with the library and the archives and the weaving hall with the

handlooms and the actual Jacquard handlooms dating from the 19th century. The latter area has limited free space and fire security considerations. You can visit all areas during one visit. The museum has a small garden that is currently not explicitly used in exhibitions – but could be opened up to future visitors – though weather conditions should be taken into account. See Figure 6 and Figure 7 for a visual representation of the spaces.

The museum has very limited available space for additional physical installations. The loom area can't be used for installations due to safety regulations (fire). More space is available in the office room, but as it contains the library and sensitive items, care must be taken. If used, this room could host individual or few person experiences. The meeting room could be used – but desks and chairs can only be moved to a certain extent.

In the first instance the focus of the pilot is on the HdS Museum building, but the context of the city of Krefeld should be taken into consideration – as there is an ambition for stronger collaboration with the municipality, other museums and the tourism agencies.

Requirement 14: Any installation/experience should fit the style and colours of the museum. This would be relevant for the *Designer (CH Professional)*.

Requirement 15: Installations/experiences should be developed for the areas with available space and more relaxed regulations.

Requirement 16: Installations/experiences should not interfere or obstruct the natural flow of the visitors of the museum creating traffic bottlenecks. This would be relevant for the *Designer and Maker (CH Professional)*.

Requirement 17: Installations/experiences that require unusual to a museum setting interaction modes (i.e., touch, gestures, etc.) should have clear notifications informing the visitors appropriately. This would be relevant for the *Communicator (CH Professional)*.

Requirement 18: Installations/experiences that require the use of a camera and other sensors to capture images will follow the European General Data Protection Regulation (GDPR) to ensure privacy and data protection. This would be relevant for the *Communicator (CH Professional)*.

Requirement 19: Installations/experiences will follow the building's established fire, security, safety, and health protocol.

Requirement 20: Precautions should be taken not to damage any sensitive items in the rooms. This would be relevant for the *Manager (CH Professional)*.

Requirement 21: An installation/experience at the meeting room should use the same area on the wall used for projection, or at least make sure that desks and chairs do not have to be moved. This would be relevant for the *Manager (CH Professional)*.

Requirement 22: Installations/experiences should be developed to fit the context of the physical space of the museum. This would be relevant for the *Manager (CH Professional)*



Figure 18. The weaving hall with handlooms and Jacquard handlooms.



Figure 19. The meeting room of HdS

Objectives

Due to the endangered nature of this craft, the primary focus of the pilot regards the *digitisation of the craft for conservation and preservation purposes*. This focus can be split up into the following ambitions:

- Support the representation of silk thread creation, machinery preparation and operation, pattern design and implementation on textiles.
- Provide presentation of corresponding explanatory information and instructions on the purpose and order of craft processes.
- Support the presentation of the museum's history, its relation to the church, its impact and significance in correlation with industrialization and urbanization.
- Explore and establish connections with thematic tourism operators and hotels and strive to include HdS in their location of visits (i.e., Rhine cruises, thematic hotels).
- Provide tools that support development of new activities like educational workshops, tours, etc. that will attract new visitors and/or returning visitors.
- Attract new volunteers

Requirement 23: installations/experiences should be developed in collaboration with stakeholders in tourism to ensure adaptation. This would be relevant for the *Communicator (CH Professional)*.

Requirement 24: installations/experiences should be developed in collaboration with potential volunteers, from a younger generation. This would be relevant for the *Manager (CH Professional)*.

Requirement 25: *Storytellers and Educators (CH Professionals)* would need easy access to content and materials to build a story or educational program on any of the subjects mentioned in the objectives.

Exhibit

Considering the above-mentioned objectives, the 'experiences' to be developed for the pilot, could provide different types of knowledge for different audiences. The museum has not yet determined which objective takes priority over others. This means that there is not only a need for multiple experiences, but also a need for different versions of certain experiences depending on the audiences. However, a simulation of a workshop/factory is on top of the list, as well as the possibility to present items in storage that can't be exhibited due to lack of space This would be relevant for the *Manager (CH Professional)*.

How people could experience the 'installations' would depend on the chosen space. Even though the museum is small, it is not often over-crowded with visitors, so experiences could cater to one of two persons at a time.

Technological applications considered so far, for the silk weaving presentations of the pilot include mobile and Mixed Reality (MR) applications. However, the criteria for the selection of the

appropriate technologies and applications that will be used in the pilot will derive from the pilot co-creation sessions.

Requirement 26: Applications that will require the use of mobile devices in the museum will be designed to incorporate data so that they are downloaded once, at the time of downloading with the corresponding application.

Requirement 27: An installation/experience should showcase how a silk workshop would operate.

5.3.2 The Mastic museum - Chios



Figure 20. The Chios Mastic Museum, with its mastic field.

Institution

The **Chios Mastic Museum** (see Figure 8) is located near the village of Pyrgi in the Mastichochoria (literally: mastic villages), a group of medieval villages in Southern Chios. Southern Chios is the only site in the Mediterranean where the mastic tree (Skinos), or *Pistacia lentiscus var Chia* is cultivated. The Museum aims to highlight the productive history of mastic cultivation, processing, and industrialization and integrate it into the wider social, economic, and cultural landscape of Chios. The building was constructed by the Kizis Architects Office and bears the architectural distinction of the Domēs Awards 2019¹⁹. The architectural design highlights the landscape in which the human element lives, creates, works, and develops. This creates a built-in constant dialogue with the earth, where visitors of this museum building are in direct contact with the specific character of mastic cultivation and rural landscape.

The integration of traditional mastic cultivation in the Representative List of Intangible Cultural Heritage of Humanity of UNESCO in 2014²⁰ gives a different attraction to this museum. Through the prism of UNESCO's inclusion of traditional mastic cultivation on its Representative List of the ICH, an emphasis is given to the diachronicity and sustainability of this product of Chios.

The permanent exhibition centres on Chios mastiha as a unique natural product. The introductory module provides information on the mastic tree and mastiha, its resin, which in 2015 was recognized as natural medicine. The first module presents the traditional know-how of mastic cultivation. The second module focuses on how the management of the cultivation and its

¹⁹ <http://www.kizisarchitects.gr/english/index.php/en/>

²⁰ <https://ich.unesco.org/en/RL/know-how-of-cultivating-mastic-on-the-island-of-chios-00993>

production have shaped the agricultural landscape and the settlements of southern Chios and the Mastichochoria historically. The third module is dedicated to mastiha resin's cooperative exploitation and processing in modern times, which marks an important chapter in the productive history of Chios. Notable mention is provided to the uses of mastiha, underpinning why mastiha has a worldwide presence today. The museum experience is completed in the outdoor exhibition, where the visitors meet the plant itself and the natural habitat it prospers in.

The museum is professionally run, with security measures in place, a manned front desk / ticket office. There are separate departments for curation, education, and communication. The “Skínos” hall (multipurpose hall) serves to host temporary exhibitions, organize events and hold cultural activities, while educational programs are held in the smaller “Kentitíri” hall.

There are no audio-tours available but other tools enabling a better comprehension of the permanent exhibition, such as:

- Multimedia applications
- Documentaries
- Models
- Original machinery in functioning order

There is general access to Wi-Fi within the museum, but the Wi-Fi will be unstable due to the weather conditions. Technical maintenance personnel are available.

The museum is relatively new, as it opened its doors to the public in 2016. It has been founded on land owned by the Chios Mastic Growers Association, and is run with the help of Piraeus Bank Group Cultural Foundation (PIOP). PIOP is the responsible partner for the co-creation process and pilot for the ‘experiences’ developed in Mingei. PIOP has its main offices in Athens, on the main land.

Requirement 1: The installations and their respective applications, physical and mobile, should enhance the current storyline of the museum, by adding value to the exhibits they currently support.

Requirement 2: All the installations and applications used in the pilot should be easily initiated and run. Given that there is limited technical support, all technological installations, physical and/or mobile, should be accompanied with user manuals that will have clear and simple instructions on how the system works, how to turn it on/off, and how to perform simple troubleshooting.

Requirement 3: All the installations and applications used in the pilot should be easy to maintain and update. Full technical support should be provided by the technical partners for the entire duration of the pilot (remote connection, automatic monitoring of functionality and reporting of errors).

Requirement 4: Automatic maintenance mechanisms should be put in place to reduce the need for technician labour. Support, outside Mingei, should also be provided upon request and with an arrangement.

Requirement 5: WI-Fi network strength and bandwidth tests should be carried out to examine the network's capabilities and limitations.

Requirement 6: No significant bandwidth should be required from the applications. Maintenance may require dedicated connections and should only take place during times that the museum is closed.

Requirement 7: Network security will be established to ensure privacy and GDPR requirements.

Requirement 8: An experience cannot rely solely on wireless internet connections, due to the problems with the Wi-Fi during bad weather conditions.

Visitors

The general public visiting the museum consists mostly of families (parents with children), couples and groups; primarily tourists. The school groups visiting the Museum either partake in a simple tour to get familiarized with the Museum's theme or participate in the PDOP Training Programs, which are prepared by Museum staff. Conferences and activities for young and senior persons also take place at the museum.

The majority of these tourists (about 70 – 80 %) are Greek residents, the rest of the people are international. It can be assumed that the basic knowledge on Mastic is more widely known amongst Greek nationals than amongst the international crowd. There is an ambition to reach more European audiences.

Another group of visitors are people looking to explore the medicinal properties of Mastic, like beauty professionals, pharmacists and botanists.

Referencing the Falk classes above, we could classify the majority of the visitors as Facilitators, Explorers, Professionals/Hobbyist, Experience Seekers and Affinity Seekers.

Requirement 9: Since the Museum's audience consists mostly of Greek visitors, pilots should be in Greek language. Indicative Languages: English, Greek, Turkish and Spanish. This would be relevant for the *Communicator (CH Professional)*.

Requirement 10: Experiences should be educational and entertaining for both adults and children, and different types of visitors – though they do not necessarily have to be one and the same experience. This would be relevant for the *Educator, Storyteller, Designer, and Manager (CH Professional)*.

Requirement 11: Installations/experiences should be attractive for children and young adults. This would be relevant for the *Storyteller (CH Professional)*.

Location and Space

In the context of the Mingei pilot we are looking at three possible locations within the institute and around it that could host ‘experiences’.

- Complex of the museum: indoors

When the visitor enters the Museum, there are panels with information about the mastic tree and the mastic element. This information is supported by physical object that people can interact with, as well as objects in show cases.

There are audio-visual materials and large scale video-screens available for presentation of content. The gallery is spacious, with a high ceiling, and a lot of natural light due to glass on either side of the venue.

Their gallery is divided into three sections – each dedicated to a different aspect of Mastic (cultivation, historical and social context, exploitation). The third section showcases machines that are operational, used in the gum-making process.

- Complex of the museum: outdoors

The museum experience is completed by outdoor exposure, in which the public is exposed to the “raw material”: the plant and the natural environment in which it thrives. The outdoor exhibition includes ‘statues’ of people from other eras (outlines in metal). These statues are supported by panels with text. The outdoor tour in the mastic trees leads the visitor to gain an overall picture of traditional mastic, and shows a view of the island from above.

- Southern part of the island of Chios: use the landscape

Mastichohoria Municipal Unity is the largest attraction of visitors in the last year, in its medieval villages (Mesta, Olympoi, and Pyrgi).

For the development of the ‘experiences’ there is no limitation to the indoor part of the museum. As the craft is part of the cultural heritage of the entire island, the entire island presents opportunities to be used. Wi-Fi would not be available on the entire island. Tourist offices could be involved, as well as the local government. This would open up the possibilities to the use of mobile devices owned by tourists, and location based applications (use of GPS, beacons) – provided there is little need for data-downloads. In Figure 9, the floor plan of the museum and its mastic field is provided and in Figure 10 indoor locations of the museum are shown.

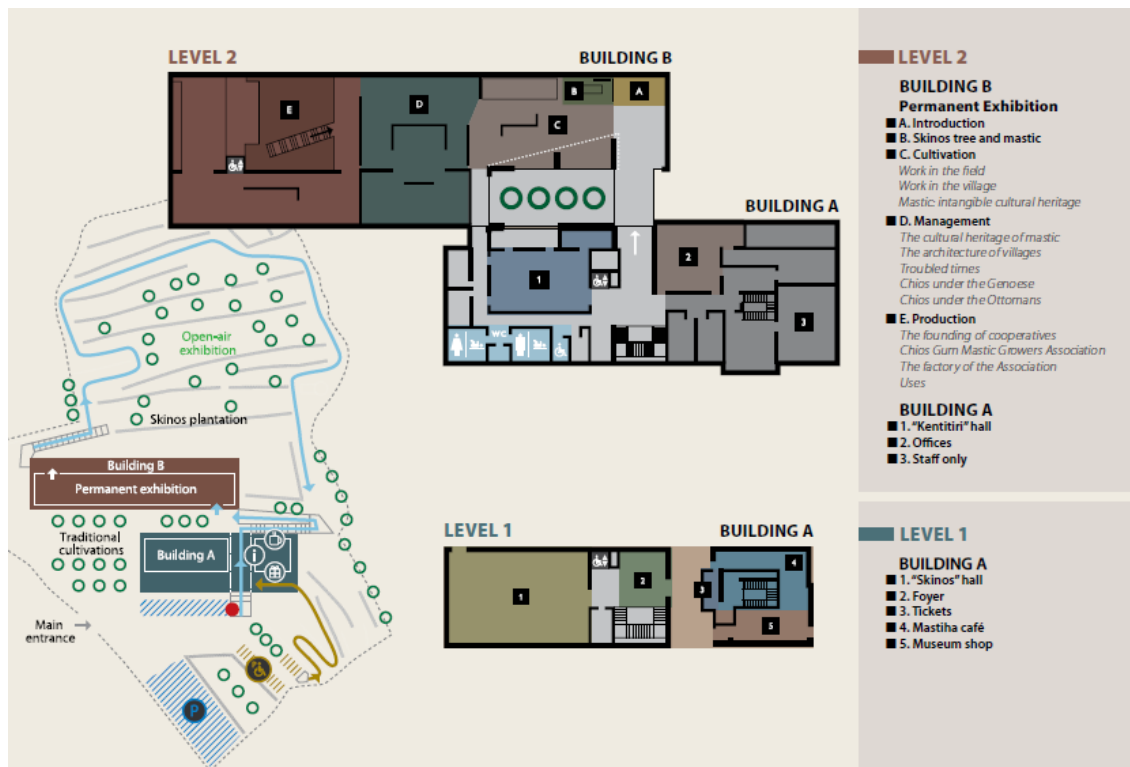


Figure 21. Floor plan of the Chios museum.

Requirement 12: Due to the abundance of light, installations/experiences would have limited possibilities to capture movement of visitors. This would be relevant for the *Design, Maker, and Technician (CH Professional)*.

Requirement 13: Due to the high ceilings, sounds can echo. The third section (the operational machine) will also produce quite a lot of noise. For the development of installations/experiences this should be a consideration. This would be relevant for the *Designer, Maker, and Technician (CH Professional)*.

Requirement 14: Due to the many pieces of text in the exhibition space, improvements could be provided to more digital applications, creating more interactive experiences for the visitors.

Requirement 15: An installation/experience should improve the third section of the exhibition – there is opportunity to add (virtual) layers to the existing storylines, or improve the gallery flow.

Requirement 16: There should be a minimization of data transfer requests from all system applications that will run in the pilot installations, physical and mobile applications.

Requirement 17: For the outside-exposition, when using a portable application; it should withstand exposure to the natural elements (weather).

Requirement 18: Installations/experiences should both cater to groups and individuals.

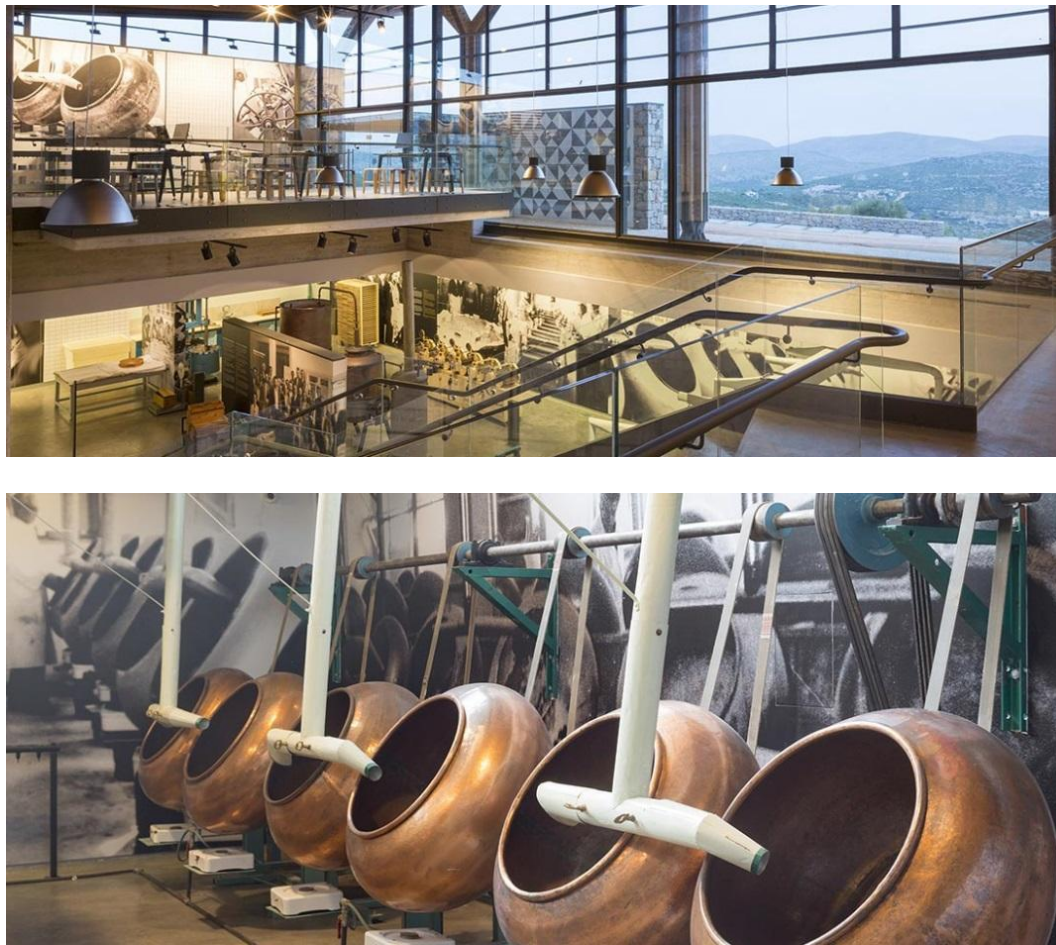


Figure 22. Indoor spaces of the Mastic museum.

Objectives

The pilot partners of PIOP have outlined the main objective of the pilot to highlight the *cultural significance of the craft (in European context)*. This focus can be split up into the following ambitions:

- Support the representation of mastic cultivation and its industry.
- Provide presentation of corresponding explanatory information and instructions on the purpose and order of craft processes.
- Support the presentation of the island's history, its tradition, myths, and the impact of mastic on its culture and economy.
- Support the presentation of geographical and environmental aspects that render mastic cultivation exclusive in the northern part of Chios Island.
- Support thematic tourism (ecotourism, agrotourism) of Chios Island, particularly focussed on the European market and connect with thematic tourism operators.
- Support awareness and media and marketing representation of mastic products.

- Provide tools that support development of new activities like educational workshops, tours, etc. that will attract new visitors and/or returning visitors.

Requirement 19: installations/experiences should be developed in collaboration with stakeholders in tourism to ensure adaptation. This would be relevant for the *Communicator (CH Professional)*.

Requirement 20: *Storytellers and Educators (CH Professionals)* would need easy access to content and materials to build a story or educational program on any of the subjects mentioned in the objectives.

Exhibit

Considering the above-mentioned objectives, the ‘experiences’ to be developed for the pilot, could provide different types of knowledge for different audiences. PIOP has not yet determined which objective takes priority over others. This means that there is not only a need for multiple experiences, but also a need for different versions of certain experiences depending on the audiences.

The interface for providing content for the experiences should be open and accessible to the local pilot partners responsible for the narrative of the concept.

Considering that the museum caters to a large group of visitors, and the fact that multiple people often populate the Museum at the same time – it should be avoided that experiences serve only one person at the time.

Requirement 21: There needs to be a clear connection between the “original” object, the replicas and the digitalization.

5.3.3 The museum of the Conservatoire National des Arts et Metiers – Paris



Figure 23. The old entrance of the museum of CNAM.

Institution

CNAM is host to a large museum with an extensive collection of objects and tools – displayed in galleries – related to multiple types of crafts and (artistic) occupations. Due to the historical value and fragility of the objects on display, the museum allows for little interaction with the original objects. The museum reaches an international audience. Signs and instructions are available in different languages, but the majority of the visitors speak primarily French.

The museum is professionally run, with security measures in place, a manned front desk/ticket office and a documentation centre, also manned by personnel. There are separate departments for curation, education, and communication. At the time of writing the curation department is primarily involved in the Mingei project. Collaboration with the education department is in the works – and will expand the opportunities for the development of prototypes. There is limited technical maintenance personnel available (no *Technician (CH Professional)*).

There is no general access to Wi-Fi within the museum. There are audio-tours available, which work with manual input of numbers by the user, not with location based beacons. The museum is housed in a historical building but the power outlets and infrastructure are up to date.

Requirement 1: Due to the scale, CNAM is a relatively slow moving organisation. Prototypes for Mingei ‘experiences’ need to be non-invasive in the existing infrastructure – that way implementation of experiences won’t require elaborate bureaucratic processes.

Requirement 2: Again, due to the scale, visitors might not always visit the entire museum. Front desk and security personnel have limited time to hand out additional information for (interactive) experiences or devices. Instructions for experiences need to be either short and on location, or the experiences need to be self-explanatory.

Requirement 3: All the installations and applications used in the pilot should be easily initiated and run. Given that there is limited technical support, all technological installations, physical and/or mobile, should be accompanied with user manuals that will have clear and simple instructions on how the system works, how to turn it on/off, and how to perform simple troubleshooting.

Requirement 4: All the installations and applications used in the pilot should be easy to maintain and update. Full technical support should be provided by the technical partners for the entire duration of the pilot (remote connection, automatic monitoring of functionality and reporting of errors).

Requirement 5: Automatic maintenance mechanisms should be put in place to reduce the need for technician labour. Support, outside Mingei, should also be provided upon request and with an arrangement.

Requirement 6: An experience can’t rely on wireless internet connections, as there is no Wi-Fi available in the museum.

Visitors

The general public visiting the museum are often families ((grand)parents with children), school groups (with teachers or mediators from the museum) and enthusiasts. Craft enthusiasts know the museum for its historical craft collection and can be outlined as:

- Professional craftspeople with a deep understanding of craft knowledge and the museum collection;
- People working in the craft network (such as private or public organization dedicated to the dissemination of craft knowledge and practice) that use the museum as a place for dissemination;
- General public with a personal relation with craft (family relation mostly);
- Craft students and teachers (from the different schools dedicated to glass teaching in France)

Most visitors speak French.

Referencing the Falk classes above, we could classify the majority of the visitors as Facilitators, Explorers and Professionals/Hobbyists. In the context of Mingei, an additional class could be added as an aspirational target group: Affinity Seekers.

Requirement 7: Experiences should appeal to all types of visitors – though they do not necessarily have to be one and the same experience for each type. This would be relevant for the *Communicator (CH Professional)*.

Requirement 8: Since the majority of the visitors speak French, content in French would be the first preference. It would be desirable to also have English content for an international audience. This would be relevant for the *Communicator (CH Professional)*.

Requirement 9: The experience should provide a strong knowledge transmission aspect to be able to reach school audience and to be a driven education experience. This would be relevant for the *Educator (CH Professional)*.

Location and Space

In the context of the Mingei pilot we are looking at four possible locations within the museum that could host ‘experiences’.

- Materials gallery: relatively spacious rooms, with showcases and roped off objects. There is little room for interactive experiences – as most objects are too fragile to touch. There will be however, replicas of objects available.
- Workshops for visitors: most of them situated in the Education and Public zone, but recently a space has also been made available in the permanent display.
- Documentation centre: library like space, with seating areas and book-cases.
- CNAM website: space for additional information and access to the collection, available also for people who did not visit the museum itself.

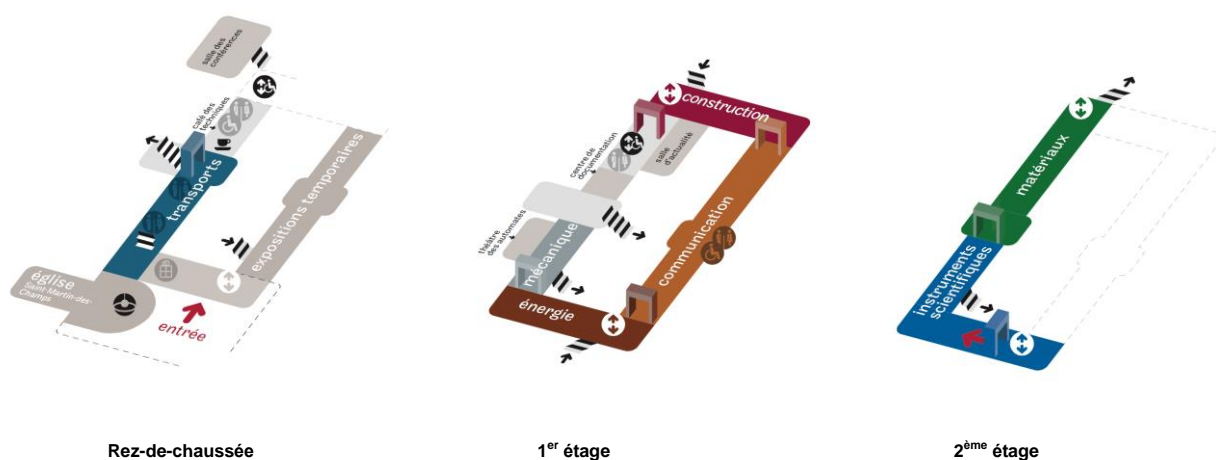


Figure 24. The floorplan of the museum of CNAM, with, in green, the ‘materials gallery’.



Figure 25. The gallery space at the museum of CNAM where the Bontemps' carafe is exhibited.



Figure 26. The Documentation Centre at the museum of CNAM.

Requirement 10: In order to not disrupt the ‘rules’ of the materials gallery, an experience in that space should limit its tactile aspects.

Requirement 11: When used in the workshop an experience should be movable and easily stored – as these spaces are only in use when workshops are hosted (often in weekends only).

Requirement 12: When used in the workshop an experience should be integrated in the educational programme developed by the educational staff hosting the workshops.

Requirement 13: When using the online space of the existing CNAM website a consultation with the web developer of the institution is required.

Objectives

The pilot partners of CNAM have outline 2 preliminary objectives for the Mingei pilots:

Objective 1: Considering the history of the museum, it is important to keep a strong relation with tangible objects.

Requirement 14: Using replicas as a pedagogical tool and a source of mediation with the original object in the experience.

Requirement 15: There needs to be a clear connection between the ‘original’ object, the replicas and the digitalization.

Objective 2: The pilot has to serve as a pedagogical tool and not only as a mediation one.

Requirement 16: The experience should match as much as possible with a “real” glass workshop aesthetic and visual aspect. A strong requirement is to transcribe the heat and sound of the workshop in the experience. This would be relevant for the *Designer and Storyteller (CH Professional)*.

Requirement 17: The pilot / experiences should have strong pedagogical elements.

Exhibit

The experiences to be developed for the pilot should provide multiple levels of knowledge for different audiences. This means that there is not only a need for multiple experiences, but also a need for different versions of certain experiences depending on the audiences. The interface for providing content for the experiences should be open and accessible to the local pilot partners responsible for the narrative of the concept.

Considering the scale of the museum, catering to a large group of visitors, and the fact that a gallery is often populated by multiple people at the same time – it should be avoided that experiences serve only one person at the time.

The curation team of CNAM has already identified a starting point for the pilot: the production of one specific decanter. This would inspire both content on production, movement and technique, as well as cultural, historical and contextual content.

Requirement 18: The interface for adding content to an experience (most likely an adaptation / plug-in for the Mingei platform) should be easily accessible for curators and educators.

Requirement 19: Ideally, there should be different versions of the experiences depending on the audiences to which they are addressed.

Requirement 20: An experience should cater to multiple people at the same time.

Requirement 21: The experience(s) should be able to showcase the various aspects of production of the one specific object.

6. Next steps

In this report, we described the main components of the methodology and strategy, specifically for co-creation, and the first sets of requirements for the conceptual and technological developments envisioned in the Mingei project. We have outlined the way the work in the project is structured, and connected to each other. As a consortium, all partners are dedicated to collaborate, work together, learn from each other and extend knowledge beyond the project partners.

In the first year, a baseline is set, and a lot of the (technical) experiments have been performed. The first year is a diverging year: we explore as much of the subjects and (technical) possibilities, to be able to make informed choices in the second and third year.

Co-creation will be more prominently utilized in the second stage of the project – as it will serve as a connecting methodology to bring together the explorations in the project's heritage crafts and their contextual reality (both from the craft perspective as from the heritage institution perspective), in technology, and in the connecting field between heritage presentation and the use of technology.

As was outlined in Chapter 4, technical development, co-creation, and iteration sometimes run in parallel. This will start to change from the beginning of the second year, as the first strides toward converging are made. Technical project partners will start to align their work with the needs and wishes of the heritage partners, and are supported in this effort by partners like WAAG and FORTH. Applications and experiences are to be tried and tested in local pilots, and iterated upon. Each new activity in the project will produce new insights and improvements of the requirements. Clear communication and collaboration between partners is essential in capturing all available insights.

In conclusion; The Mingei Methodology, as it is presented in this deliverable, is a 'living strategy', which means that it will continue to evolve during the lifetime of the project – and will be responsive to temporal and local occurrences. This is one of the reasons it was decided to develop a so called 'living document' on strategy and methodology for co-creation: '*Co-creation for concept design*'. Throughout the project, this document will continue to be improved and new insights will be added. At the end of the project that document will result in a best **practice guide** for the general public.

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ANNEX 4: Requirements Addressed by Mingei

ANNEX 4.1 Technical requirements for Step 1 – Digitisation of assets

In this step, the digital assets and human resources that can provide information on the HC are identified. Digital assets such as archives, literature, documentaries, testimonies, artefact reconstructions, and documentaries, will be sought in existing archives of cultural organizations, guilds, museums, as well as in linked data repositories. Information on tangible dimensions, concerns craft materials, craft artefacts, and tools. Thus, acquiring existing digital assets is an important part of Step 1. The following sources should be considered:

- **Literature and printed matter**, i.e. literature articles, books, and monographs.
- **Digital documents and records**, i.e. population or economic records.
- **Catalogue and archive information**, i.e. for digital items and physical exhibits.
- **Existing artefact digitisations**, i.e. as results of prior digitisation efforts.

This step is relevant to the following stakeholders: Craftsmen, Museums & CH institutions, Conservators, Curators, Guilds, Archives, Researchers and Academics, Craft enthusiasts, and Museum volunteers.

Requirement 1: Mingei will need to provide technologies (i.e. a system) and techniques (i.e. process descriptions) to link existing digital assets in digital archives of cultural organizations, guilds, or museums, as well as linked data repositories possibly originating from independent digitisation projects²¹.

Requirement 2: Each linked asset should be identified by Mingei in its repository by a unique identifier minted within the Mingei namespace. Such unique identifier will be an IRI (Internationalized Resource Identifier) from the Mingei domain space and will be resolved by the Mingei server to the current Web representation of the asset, either in the project namespace if the resource has been physically acquired, or in the original namespace if the resource is a Web resource. If none of these two options apply, the IRI will be resolved to the most authoritative description of the asset collected in the Mingei space or found externally to it.

Digitisation of objects

²¹ UNESCO's World Heritage Centre and Collection, Europeana, i-Treasures.

As discussed in D1.3 “Scientific protocol for craft representation”, digitisation of objects is typically provided by photographic documentation or 3D reconstruction. There are distinctions in the type of information, and thereby the technical requirements, in both cases. For example, a 2D image may originate from the technically calibrated photography of a 3D artefact (i.e. a vase), or by the 2D scanning of a document we wish to extract textual information by Optical Character Recognition (OCR) software. In the 3D case, surface scanning data may originate from very accurate laser-scan measurements, or by a less accurate (but more cost-efficient) photogrammetric reconstruction.

This step is relevant to the following stakeholders: Craftsmen, Museums & CH institutions, Conservators, Curators, Guilds, Researchers and Academics, and Craft masters / educators.

Requirement 3: Mingei should provide in the protocol, guidelines for 3D scanning using non-contact modalities for the digitisation of cultural heritage, which are based on either active or passive sensors. Both types of sensors fulfil artefact safety requirements, as they both operate without requiring contact with the artefact.

Requirement 4: Mingei should provide in the protocol, guidelines regarding the usage of photographic documentation technologies as a basic and cost-efficient form of artefact digitisation.

Requirement 5: Users involved in this step should have access to a high-end PC with graphics processor for post processing of scanning results.

Requirement 6: Users involved in this step should have access to 3D scanning devices (handheld 3D scanner, laser scanner, RGB-D camera, RGB camera) and software.

Requirement 7: Users involved in this step should have access to 2D scanners and book scanners that can facilitate the digitisation of records, documents, and printed matter.

Requirement 8: Users involved in this step should have good general computer skills and a good understanding on 3D modelling and scanning technologies and 2D scanning technologies.

Digitisation of actions and activities

Crafts include a number of actions and activities performed by one or multiple practitioners with the use of handicraft, tools, and materials to create artefacts. These activities can be digitised in terms of human motion and may be laborious or dexterous.

In the craft workshops where human motion is to be captured, two state-of-the-art technological approaches have been selected in D1.3 “Scientific protocol for craft representation” and used in Mingei, namely Inertial Motion Capture (e.g. using a suit) and Visual Tracking (e.g. using plain RGB camera and post processing through software). In both cases, the organisation of the acquisition requires knowledge of efficient planning (i.e. script, protocol, and storyboards), editing, and organisation of pertinent data streams.

This step is relevant to the following stakeholders: Craftsmen, Museums & CH institutions, Guilds, Content owners & Creative Industries, Researchers and Academics, and Craft masters / educators.

Requirement 9: Users involved in this step will need to have a basic understanding on the appropriate use of storyboards.

Requirement 10: Users involved in this step will need to have access to Motion Capture (or MoCap) technologies. Such technologies can be purchased as equipment (e.g. NANSENSE© R2 suit). Mingei, however, will also provide them in the form of Visual Tracking software. This technology is non-intrusive, but less accurate than the R2 suit. Nonetheless, both can be applied to video archives and documentaries regarding a specific craft instance.

Requirement 11: If the Visual Tracking software is used for Motion Capture access to a high-end PC with graphics processor will be required.

Requirement 12: Fast and rapid motions should be digitised at a sufficient sampling rate, for their proper representation of the digitized action. Signal processing theory avails this rate as the Nyquist frequency. Typically, 60Hz is a sufficient rate to capture human motion and 44.1 kHz is sufficient to digitise human speech.

Collection of metadata

Digital assets are provided with multiple kinds of metadata (descriptions) each characterising a specific aspect of the asset and supporting the corresponding set of functions. Depending on the asset and on the role the asset plays in the craft process, the following categories of metadata are relevant to the technical requirements:

- **Technical metadata**, describing the digitisation process and the resulting digital object from a technical point of view.
- **Semantic metadata**, describing the object from the CH point of view, that is in relation to the craft process, its steps, actors, tools, materials, and the like.
- **Descriptive metadata**, describing the object for interpretation or discovery purposes, such as title, various forms of textual descriptions possibly in different languages, classification of the

object in relevant terminologies, keywords and phrases, and the like.

- **Preservation metadata**, describing the object for the purpose of preserving it in the long-term.

This step is relevant to the following stakeholders: Craftsmen, Museums & CH institutions, Conservators, Curators, Museum educators, Guilds, Archives, Content owners & Creative Industries, Researchers and Academics, Museum volunteers, and Craft masters / educators.

Requirement 13: Users involved in this step should have access to software to extract and analyse metadata standards and formats.

Requirement 14: Users involved in this step should have good general computer skills and be able to use software tools to extract and analyse metadata.

Requirement 15: Since metadata will be used later on in the protocol for populating the project knowledge base, it is essential that the users involved in this process have an understanding on the types and storage of metadata and their mapping to the Mingei knowledge base and ontology.

ANNEX 4.2 Technical requirements for Step 2 – Data processing and knowledge element formation

This step involves the digital representation of basic craft knowledge. Specifically, in this step the digitisations are entered in the Mingei repository, properly classified, and linked to the other entities in the repository. Collectively, the classifications and links formed in this step form the **semantic metadata** (see above).

Authoring basic knowledge elements

From the design of its knowledge base, Mingei has selected a de facto standard in the domain of CH, the CIDOC-CRM²², ISO 21127:2006 for representation of knowledge and semantic information. Furthermore, a WWW-based application for accessing the authoring system will be provided.

This step is relevant to the following stakeholders: Museums & CH institutions, Curators, Museum educators, Researchers and Academics, and Craft masters / educators.

²² <http://www.cidoc-crm.org/>

Requirement 16: Users involved in this step should have access to WWW-based knowledge authoring technologies.

Requirement 17: Users involved in this step should become familiar with the Mingei WWW-based interface and be able to use it. Therefore, Mingei should provide simple WWW-form filling instructions.

Annotation

Content curation is the process of gathering information relevant to a particular topic or area of interest. Curation also entails the extraction of **meaning** from this information and its **presentation**. Digital technologies can assist curation tasks and facilitate the process of semantic representation of content. Annotation and content extraction are central tasks in this goal.

This step is relevant to the following stakeholders: Craftsmen, Museums & CH institutions, Curators, Content owners & Creative Industries, and Craft masters / educators.

Requirement 18: Users involved in this step will need to have access and experience in using analysis tools that aid the digital curation process, such as: OCR, NLP, Translation, image rectification and restoration and other.

Annotation of human motion

Annotation of 3D animation files is the description of each action or action segment by the expert, in order to provide meaning and, then, link to the knowledge that is semantically represented.

For the purposes of annotating 3D animation files FORTH has created an editor called Animation Studio, as initially reported in D1.3 “Scientific protocol for craft representation” Section 5.5. Animation Studio is an application to **visualise**, **edit**, and **annotate** 3D animation files, obtained by motion capture or visual tracking. In Figure 27, the left panel shows a video frame and the right panel a 3D representation of human posture extracted from the video frame. In the case of visual tracking, temporally corresponding video can be also edited. The application allows the user to isolate animation segments and associated video, for further annotation. The application, allows the synthesis of composite animation files and videos from such segments.

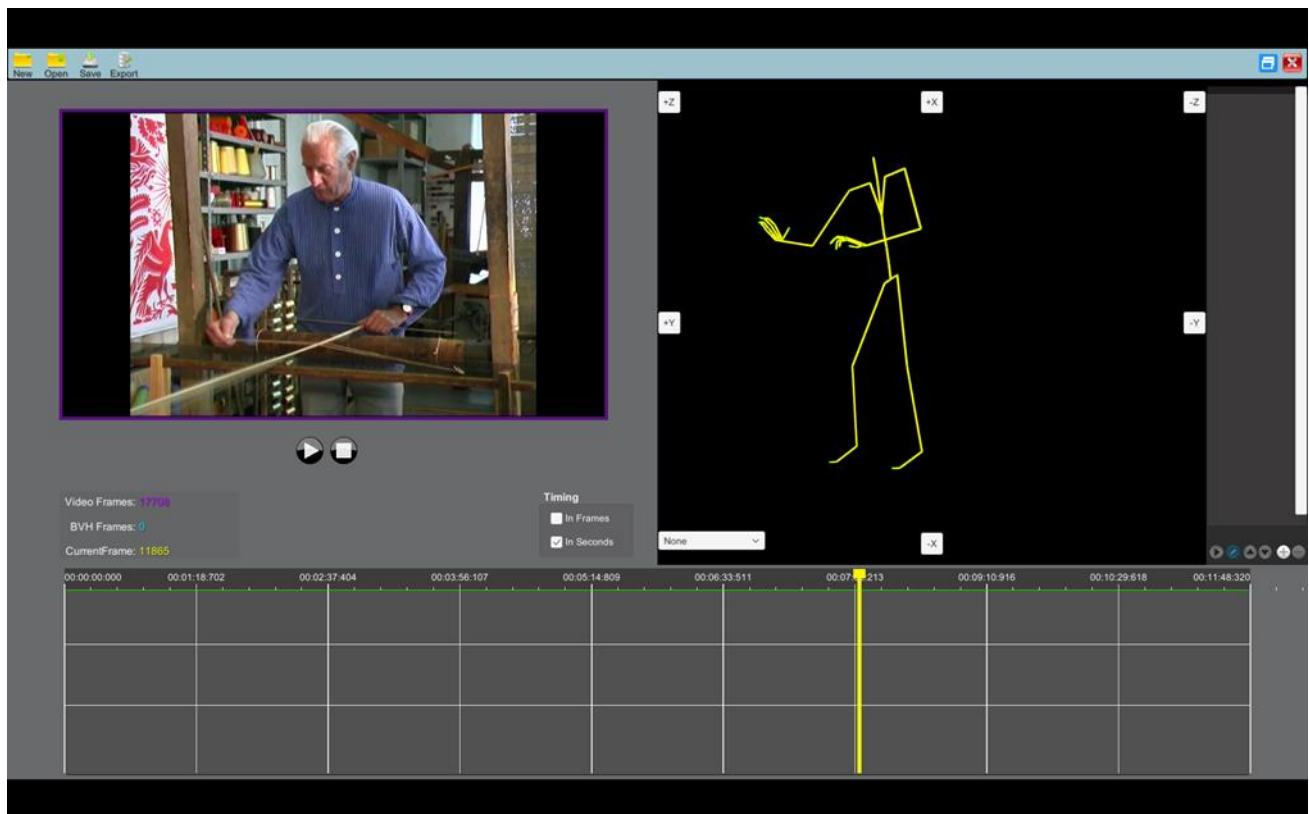


Figure 27. A preliminary version of the Animation Studio editing environment.

This step is relevant to the following stakeholders: Craftsmen, Museums & CH institutions, Curators, Content owners & Creative Industries, and Craft masters / educators.

Requirement 19: Users involved in this step should have basic knowledge on the operation of video editing software and knowledge on video editing concepts.

Requirement 20: Users involved in this step should have basic knowledge on the three-dimensional representation of human motion and corresponding representation formats (e.g. BVH files).

Requirement 21: Users involved in this step should have basic knowledge on segmentation and annotation of video and MoCap data.

Annotation of 3D models

For the annotation of 3D models, FORTH is currently developing a 3D annotation tool. In its current version, point and path annotations are supported (see Figure 28). Point annotation is straightforward as it allows the selection of a point of the surface of the 3D model and the assignment of annotation to this point. Another mode of operation of this tool allows the user to

repeatedly select points in a meaningful way, by drawing a contour on the surface of this 3D object. In this case, the annotation is associated with the group of 3D points produced by this tool. Further types of annotation are to be provided, such as contour and pattern extraction.

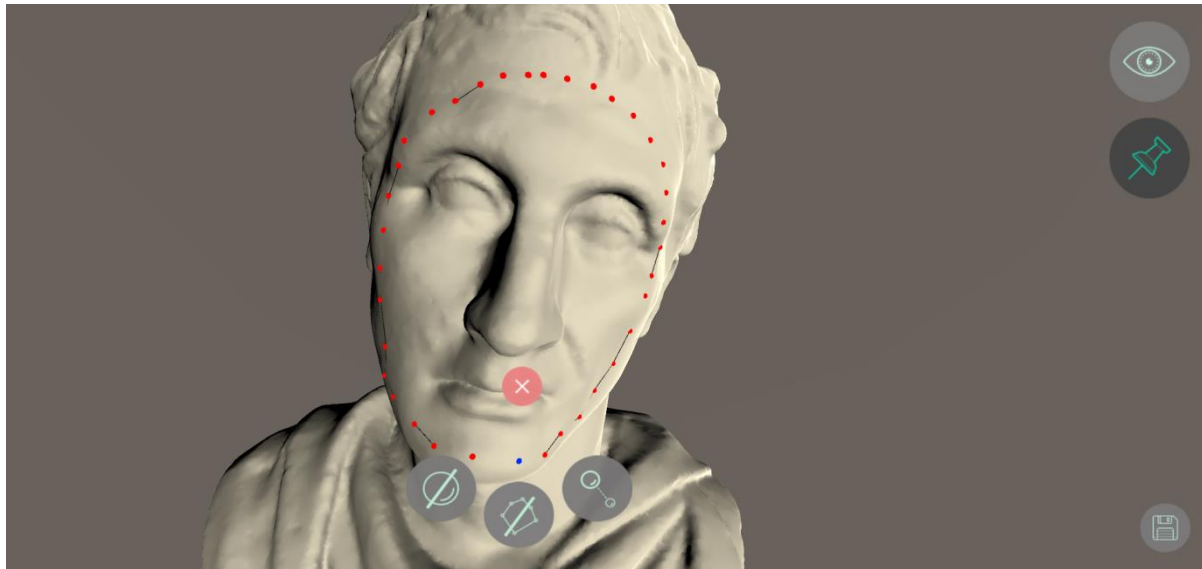


Figure 28. 3D model annotation tool.

This step is relevant to the following stakeholders: Museums & CH institutions, Conservators, Curators, Museum educators, Content owners & Creative Industries, Researchers and Academics, Craft masters / educators, and Primary educators.

Requirement 22: Users involved in this step should have basic knowledge on the operation of 3D editing software (camera manipulation, scaling, rotation, translation of 3D objects, etc.).

Requirement 23: Users involved in this step should have basic knowledge of the concept of 3D annotation, i.e. assigning annotations to locations of parts of 3D objects.

Motion Visualization

Visualization and illustration of human motion is selected in Mingei as a way to produce illustrated instructions on the performance of manual, possibly dexterous task that often involve the use of tools or machines. For this purpose, FORTH is currently developing a motion visualisation. The goal of this tool is to comprehensively present human motion as it flows in time, i.e. see Figure 29.

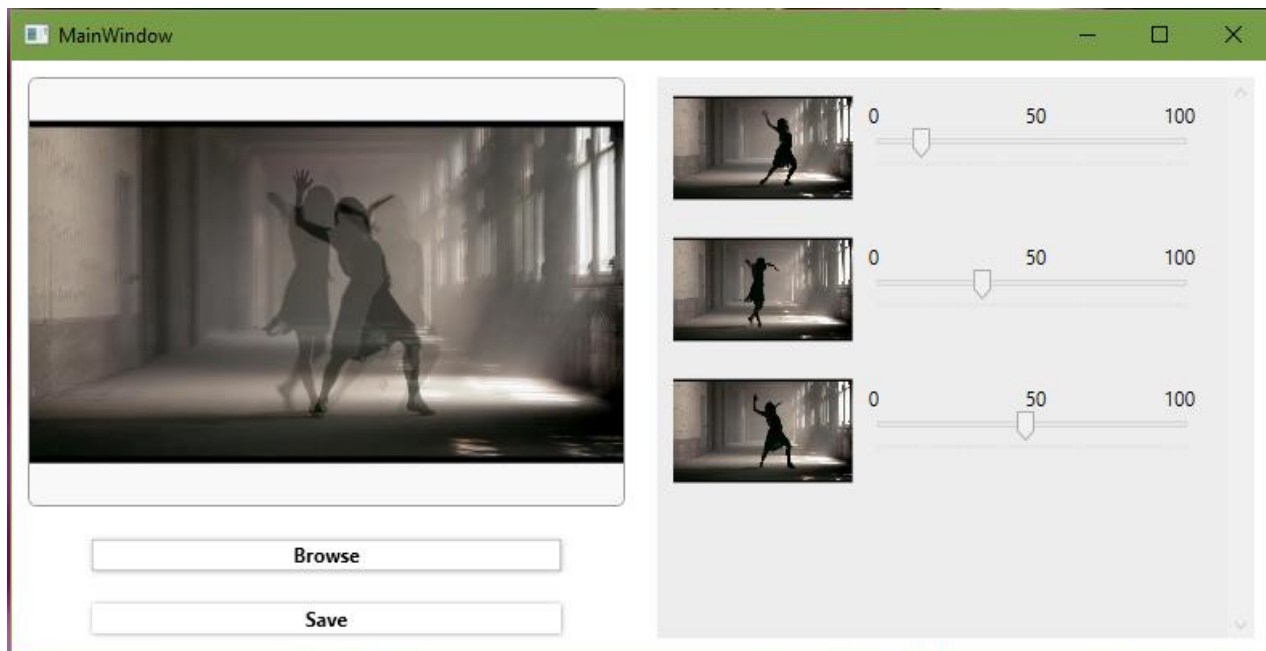


Figure 29. Motion Visualization tool User Interface.

This step is relevant to the following stakeholders: Craftsmen, Museums & CH institutions, Curators, Museum educators Content owners & Creative Industries, Researchers and Academics, Craft enthusiasts, Craft students and apprentices, Craft masters / educators, and Primary educators.

Requirement 24: Users involved in this step should have basic knowledge on motion visualisation through the interleaving of key frames.

Requirement 25: Users involved in this step should have basic knowledge on image processing technologies and image concepts (e.g. image transparency).

ANNEX 4.3 Technical requirements for Step 3 – Craft modelling

In this step, the individual entities represented in the previous steps are linked to one another into an organic representation of the craft instance.

This step is relevant to the following stakeholders: Craftsmen, Museums & CH institutions, and Curators.

Requirement 26: Users involved in this step should have basic knowledge and understanding regarding how entities are modelled.

Requirement 27: Users involved in this step should have basic knowledge and understanding regarding how individual entities are linked.

Requirement 28: Users involved in this step should have basic knowledge and understanding regarding events that are created and their significance to craft representation.

Requirement 29: Users involved in this step should have basic knowledge and understanding regarding the creation of HC vocabulary as well as the usage of online tools to author vocabularies.

Requirement 30: Users involved in this step should have technical knowledge of the WWW-interface of Mingei to create craft instances, model knowledge, establish links between entities and create events.

Requirement 31: Users involved in this step should have technical understanding of knowledge visualization of the WWW-interface of Mingei to be able to cross-check the outcomes of linking actions.

Requirement 32: Users involved in this step should to have high-level understanding of the Mingei HC vocabulary and the CrO.

Requirement 33: Mingei will provide all the necessary documentation material to ensure that the users in this step of the process will be able to acquire the knowledge and understanding needed in order to utilize the tools and the applications provided by Mingei.

ANNEX 4.4 Technical requirements for Step 4 – Narratives

Mingei is implementing Narratives through the Narrative Ontology (henceforth, MNO for brevity). A *narrative* is a network of events, each set in time and connected to the components (people, places, etc.) taking part in the event. The sequence of events in chronological order is called *fabula*. The sequence of events in the order presented by the narrator is called *plot*²³.

This step is relevant to the following stakeholders: Craftsmen, Museums & CH institutions, and Curators, Museum educators, and Craft masters / educators.

²³ Bal, M. Narratology. Introduction to the theory of narrative. University of Toronto Press. 1985.

Requirement 34: Users involved in this step should have technical understanding of how narratives are represented conceptually in the MNO.

Requirement 35: Users involved in this step should have high-level understanding of the Mingei HC vocabulary, the Crafts Ontology (CrO) and the Mingei Narrative Ontology (MNO). These concepts will be described and explained in the ontology documentation.

ANNEX 4.5 Technical requirements for Step 5 – Creating informational tools, HC experiences, and HC presentations

Mingei will provide means to establish representations of HCs based on digital assets and semantic annotations. Meaningful and documented experiential presentations of HC will be based on narratives. These presentations will address a range of uses including, personalized storytelling, interactive Augmented Reality (AR) and Mixed Reality (MR), and through the Internet.

Storytelling applications

In this section, the requirements are divided into two categories. The first one refers to the users that will create the content and experiences through the envisioned Mingei applications, while the second to the target audience of the produced content and experiences.

This step is relevant to the following stakeholders: Craftsmen, Museums & CH institutions, Content owners & Creative Industries, Tourism businesses, Tourism professionals.

Currently Mingei explores the development of a variety of tools that will receive input from the Mingei Online Platform (extracted narrative) together with input such as annotated MoCap, 3D models and video files.

These tools will allow users to author the presentation of such narratives through 3D technologies, to author motion driven narratives through 3D technologies. Such motion driven narratives will be experienced in VR.

A Motion Vocabulary Items (MVI) is used to represent an instance of a movement that is encoded in a BVH file and can be used to represent a specific action or part of an action. MVIs can be combined to represent entire procedures and are considered building blocks of a Motion Vocabulary (MV). The MV in turn can be used to create “sentences” that encode different actions and procedures. The above concepts will be described and explained in the related documentation.

Requirement 36: Users should be familiar with the 3D technologies provided by Mingei for the formulation of VR narratives.

Requirement 37: Users should be familiar with the MVIs and motion Vocabularies (MVs) provided by Mingei for the formulation of motion driven narratives.

Accessing knowledge and experiences

Currently Mingei explores the development of a variety of tools that rely on storytelling. Storytelling applications will acquire content from narrative generation and HC representation. Storytelling could be aided through mobile platforms and a virtual character playing the role of an interactive narrator and, also, through the Mingei Online Platform.

Mingei envisions the implementation of AR applications for mobile devices that will be capable of presenting the craft on site, enriching the place and the exhibits.

The resulted knowledge and storytelling experiences should be seamlessly used by any of the following entities: Visitors & tourists, Craft enthusiasts, Museum volunteers, Primary educators, and the public.

Requirement 38: Users should have access to web-based and/or mobile platforms.

Educational applications

Mingei envisions educational applications utilising instruction and motion-driven narratives will target HC skill-learning, and introductory experiences to HCs. First-person acquaintance applications to basics skills are implemented through the MR Training Surface (WP6, T6.3) which will allow the manipulation of virtual and real objects and tools. The educational scenario will be mediated by an interactive virtual character playing the role of the craft master, while the visitor assumes the apprentice role. A version of the educational applications is adapted for access through the Mingei Online Platform (WP3, T3.4).

This step is relevant to the following stakeholders: Craftsmen, Museums & CH institutions, Museum educators, Tourism businesses, Tourism professionals, Visitors & tourists, Craft enthusiasts, Museum volunteers, Craft students and apprentices, Craft masters / educators, Primary educators, and the public.

The following list describes the requirements for the hardware and software of the systems that will host the educational applications.

Requirement 39: Powerful PC with dedicated high-end graphics processor, motion tracking equipment (RGB-D cameras and RGB cameras), and physical space constraints apply, etc.

Requirement 40: Powerful PC with dedicated high end GPU (General Programming Graphics unit) for parallel processing in order to meet the demanding computational requirements of real-time applications, the VR headset, and the hand tracking equipment.

Informational output

HC representation and narratives are availed through the Mingei Online Platform providing access to general and scientific audiences. Both access types will support appropriate querying and browsing capabilities on the HC representation.

Access to HC communities, makers, tourists and the general public will be available by a portal view of the repository and HC representation (Mingei Online Platform). Co-created applications will provide an opportunity for virtual, promotional exhibitions, which can be included in local tourism industries.

The resulted informational output should be seamlessly used by anyone.

The following list describes the requirements for the hardware and software needed to view the informational output.

Requirement 41: For the Web presentation, users will need to have access to a personal computer with connection to the internet.

Requirement 42: For the e-book presentation, users will need to have basic knowledge and access to e-book browsing technologies.

Requirement 43: For the pdf presentation, users will need to have basic knowledge and access to software for the presentation of downloadable pdf books (pdf reader).

Requirement 44: For the AR presentation, users involved in this step will need to have access to an AR capable device since Mingei envisions the implementation of an AR application that will be capable of presenting the craft on-site.