D9.1 –Evaluation Framework and Guidelines

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Abstract
This deliverable presents the framework for evaluating the EMOTIVE experiences and related guidelines for carrying this out at the different stages of the project. It includes both the formative and summative stages of evaluation work, as well as detailed plans for the evaluation of the alpha, beta, and final release EMOTIVE tools and experiences. It is divided in two main parts: a) the evaluation of EMOTIVE authoring; and b) the evaluation of EMOTIVE experiencing. The framework integrates qualitative and quantitative methods and empirical studies. The evaluation plans are a 'living document' in the sense that they are not set in stone but can be adjusted if the future evaluation work brings up the need for adjusting or extending the framework.

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[1]UGLA (leader)	3.7
[2]YORK	0.5
[3]ATHENA	1.5

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

LIST OF ABBREVIATIONS

AW: Antonine Wall
AR: Augmented Reality
CHESS: Cultural Heritage Experiences through Sociopersonal Storytelling project
EAT: EMOTIVE Authoring Tool
HCI: Human Computer Interaction
UI: User Interface
UX: User Experience
VR: Virtual Reality
WP: Work Package
WHS: World Heritage Site

1 Executive summary

This deliverable provides the overall evaluation framework which will guide both formative and summative evaluation of EMOTIVE experiences in the last two years of the project, as well the integration of evaluation data which were created as part of the year one activities. This forms the basis for the effort to capture the use and impact of EMOTIVE tools and experiences on both EMOTIVE target groups, authors of experiences and visitors of cultural heritage sites.

Summary of contents

The document outlines the aims of EMOTIVE evaluation (section 3) and the scope of this activity within the project (section 4). It refers to the two main directions that evaluation activities will focus on: a) the evaluation of EMOTIVE authoring, and b) the evaluation of EMOTIVE experiencing. The first focuses on the authors of experiences, the cultural heritage and creative industry professionals who are the targeted users of the EMOTIVE tools and methodologies (4.1.1). The latter is centered on the end users of EMOTIVE experiences, the visitors of museums and heritage sites, whether onsite or online and how they engage with the stories, the surrounding space (in the case of the onsite experiences), the other visitors, as well as how they are affected intellectually, physically, and primarily emotionally (4.1.2). The document explains how evaluation is linked with the overall design philosophy of the project (4.2.1) and analyses how all evaluation work is split into the two main stages of evaluation, depending on when in the development process this is undertaken: formative (during the design and development phase), and summative (after it has been completed) (4.2.2). It also explains the project's evaluation methodology (4.2.3) and explains the role of usability (4.2.4) and user experience evaluation (4.2.5). Section 5 covers evaluation implementation and discusses the different methods (5.1) and instruments (5.2) employed. Finally, the document provides guidance for organizing future evaluation activities (5.3) which will feed into the development of the beta and final releases of the EMOTIVE Authoring Tool, as well as the design of the range of EMOTIVE experiences for both cultural sites. It also outlines the timeline to be followed for all evaluation work and the key deliverables of each stage (5.5). Section 6 concludes the deliverable with a brief account of next steps.

Methods of research and analysis

EMOTIVE subscribes to a reflective, participatory, experience-oriented, user-centred design methodology, which means that the research methods we employ place real users at the centre and involve them in all key activities throughout the design process and the life-cycle of the project. Evaluation is a key tool underpinning all this effort in order to ensure that users' needs are perfectly addressed in real world situations and respecting the conceptual and practical characteristics of the cultural context in which the EMOTIVE tools and experiences will be implemented. Evaluation work supports the iterative design model of the project, with formative evaluation being undertaken throughout the design process and feeding directly into the implementation of all key components. A variety of methods are detailed in the different sections of the Evaluation Framework, combining both quantitative and qualitative approaches to allow triangulation of the results.

Key findings summarised

Preparatory evaluation activities showed the need both for: a) tools which will allow creative and cultural industry professionals to author, by themselves, effective and emotionally-engaging experiences that draw on their skills and understanding of cultural contexts; and b) experiences which engage visitors emotionally. Little work has been done to date to capture visitors' emotional engagement in cultural heritage settings and it is in this direction that the EMOTIVE evaluation work will focus in the future, filling an important gap.

2 Introduction

The principal objective of EMOTIVE is to research, design, develop and evaluate methods and tools that can support the cultural and creative industries in offering their diverse audiences effective emotive storytelling. This means storytelling that can engage visitors, trigger their emotions, connect them to other people around the world, and enhance their understanding, imagination and ultimately, their experience of cultural sites and content. EMOTIVE aims to do this by providing authors of cultural products with the means to create high-quality, interactive, personalised digital stories.

Central to the project is a user- and visitor-centric design approach and an iterative collaborative design and evaluation process which places both visitors and cultural stakeholders at the centre of defining the experience, and skilling them in deploying the EMOTIVE methodology and tools.

For this, reason, evaluation is a key aspect of the EMOTIVE approach. The evaluation work at EMOTIVE includes developing a methodology for the meaningful, well-rounded evaluation of tools and experiences, evaluating the usability and functionality of individual EMOTIVE tools, and evaluating the quality and effect of the EMOTIVE experience.

The evaluation framework presented here underpins all the users' work in EMOTIVE, as well as the development and testing of tools, methodologies and experiences. It is a flexible, living document that will be updated as necessary as the design and evaluation work of the project progresses.

The main work package overseeing evaluation work within EMOTIVE is WP9 which coordinates the extensive evaluation activities undertaken throughout the project. This assesses the impact and effectiveness of the whole approach and of the resulting prototypes with respect to the fulfilment of the objectives set by each of the two main user groups and scenarios proposed. Evaluation work is held throughout the project, but is systematised at key stages of the project's life as outlined in this document, and is always involving end-user partners from the cultural sites and other partners, as well as appropriate end users beyond the consortium. As is appropriate to the complexity of what EMOTIVE aims to achieve, the evaluation work employs a variety of methods and covers the whole design continuum, from evaluating the development stages of tools, methodologies and experiences (formative evaluation) to final prototypes (summative evaluation).

In order to capture the impact of EMOTIVE tools and experiences and their multifaceted influence in the creative industries and cultural sector, it is necessary for the evaluation work to employ a holistic triangulated multimethod and multilevel approach, covering not only usability of EMOTIVE authoring, but also the little-researched area of evaluating emotional engagement with cultural heritage experiences. Our evaluation methodology not only requires designers to analyse and foresee how users are likely to use an interface, tool, or experience, but also to test the validity of their assumptions with regards to users' behaviour in real-world situations with actual users. In EMOTIVE this takes place at two key phases:

- **Formative evaluation** which takes place throughout the design and development process of both authoring tools and methodologies, as well as experiences; and
- **Summative evaluation** which is undertaken at key stages after the alpha, beta, and final release of the tools, as well as after experiences have been finalised at both cultural sites at specific evaluation events with the appropriate user partners.

These two phases are very closely linked with the formative evaluation feeding directly into the summative one. This framework outlines the context and main parameters within which both phases will take place but the following deliverables will cover in greater depth the key components:

- Deliverable 9.2 Formative evaluation results (M15, January 2018)
- Deliverable 9.3 Summative evaluation of beta release (platform and experiences) (M24, October 2018)
- Deliverable 9.4 Summative evaluation of final release (platform and experiences) (M36, October 2019)

Although the two key targeted areas of EMOTIVE activity, authoring and experiencing, have been clearly outlined, it is also implicit in the whole evaluation framework and related work that they are closely interlinked and interdependent.

In this deliverable, we lay out the structure, key stages, methodological approach and practical guidelines for the evaluation of the EMOTIVE tools, methods and experiences. By definition, this needs to be adaptable throughout the project's development and adjusted as new evaluation results emerge.

3 Overarching aims of EMOTIVE evaluation

An important objective of EMOTIVE is to study, assess and analyse the effect that the tools and experiences designed as part of the project have on both authors and end users/visitors. The project also aims to evaluate how the overall interpretative philosophy underpinning it and the power of 'EMOTIVE storytelling' engages different types of users and in different contexts and situations.

The objectives of the EMOTIVE evaluation activities (co-ordinated within WP9) form the basis of this framework and are:

- to evaluate the usability and user experience of the EMOTIVE tools and applications for authors and visitors
- to evaluate the tools, both as individual components and released as an integrated whole in beta and final versions, during formative evaluation activities in order to provide user feedback for further development
- to examine the effectiveness and suitability of the overall project methodology, from user-centred design stages to final versions
- to link with WP3 to support the user requirements and co-designing process, established together with cultural partners and stakeholders.

The focus of the evaluation work to be undertaken is quite different for the two main areas of evaluation activity: a) evaluation of EMOTIVE authoring which is targeted towards cultural heritage and creative industry professionals designing EMOTIVE experiences, and b) evaluation of EMOTIVE experiencing which addresses the end users and visitors to museums and cultural heritage sites. The emphasis in the former is more on design choices and usability of the tools and methodologies, while the latter examines the effect of the whole interpretive approach of EMOTIVE, the type of engagement (emotional, intellectual, physical, social) that the EMOTIVE experiences encouraged and the impact they had in relation to both cultural sites. These are analysed in sections 4 and 5 below.

A note about the scope of the EMOTIVE evaluation: the main activities that the framework focuses on are the usability and impact of the authoring tools and processes, as well as the impact of EMOTIVE experiencing. Performance evaluation and technical validation of the authoring tools and components is not covered here; this will be undertaken by the technical partners and is covered in the deliverables referring to the related technical tools.

4 Evaluation Scope

4.1 Users

4.1.1 EMOTIVE authors

The target users of EMOTIVE authoring are cultural heritage and creative industry professionals. As storytelling, particularly in digital interactive form, is becoming increasingly popular for engaging diverse audiences in the cultural sector (Bedford, 2001; Springer et al., 2004, Pujol, et al., 2013), the need for flexible and easy-to-use authoring tools and methods that do not require specialised programming skills is becoming equally pronounced. It is important for the range of cultural heritage and creative industry professionals working under that umbrella, such as educators, curators, archaeologists, and designers to be able to use their expertise and skills to design effective stories without requiring continuous support from computing experts.

The key authoring roles we identified in D3.1 (5.2.1) were further refined at our discussions at the Dublin EMOTIVE plenary meeting (1-2 November 2017) and are as follows:

- Domain experts
- Experience designers
- Storytellers
- Developers

Although we acknowledge that these roles often overlap or may be combined, we agree that it is important for the evaluation to address all of them when examining the effectiveness of the EMOTIVE tools and methodologies.

We identified a set of key criteria to guide this type of evaluation, as well as the three key stages when this needs to be undertaken during the lifetime of the project, which are described in the following two sections, 4.3 and 4.4.

EMOTIVE involves a range of end-user groups, both within and beyond the consortium, who have been asked to evaluate the EMOTIVE Authoring Tool (EAT) (and some of whom will continue to do so for the duration of the project) in their capacity as authors:

From the EMOTIVE consortium:

- University of Glasgow / Hunterian Museum team (UGLA) - in their role as museum and cultural heritage professionals, domain experts in museology, curators, educators, audience engagement professionals
- University of York / Çatalhöyük team (YORK) - in their role as domain experts in archaeology, heritage professionals, subject specialists, interpretation specialists, audience engagement professionals
- NOHO - in their role as creative industry professionals, storytellers, experience designers, developers

In the first year of the project the following experiences started being authored and will be evaluated for the authoring element (with the experience covered in the following section): The UGLA and NOHO teams authored the EMOTIVE Onsite Experience for The Hunterian, assisted by the ATHENA and DigiNext teams in the use of the EMOTIVE Authoring Tools (primarily, the Storyboard Editor). The YORK team authored the Çatalhöyük onsite experience (with assistance from ATHENA on the use of the Storyboard Editor); the Çatalhöyük off-site collocated experience; the Çatalhöyük off-site VR experience (with assistance from ATHENA and INRIA) and the Çatalhöyük chatbot (with assistance from ATHENA).

Beyond the EMOTIVE consortium:

- EMOTIVE User Group

- This is an active, diverse and open User Group consisting of, on the one hand, different cultural organisations, and, on the other hand, creative companies (SMEs) which partake in the design of digital technologies and applications for the Experience Economy. This was initially formed by leading international cultural heritage and creative industry specialists who supported and engaged with the ideas of EMOTIVE from the initial conception of the project, most of whom provided support letters for the proposal; after the project initiation, this group expanded to include more members from this sector (such as museum educators, interaction designers, game developers, exhibition designers, curators, digital engagement and interpretation specialists), with all EMOTIVE users in the consortium proposing members from their own networks who were discussed with all before invitations were issued. The first EMOTIVE User workshop in Glasgow in February 2017 (D.3.4) was the first occasion when a large part of the external EMOTIVE User group was invited to participate and assist in the user requirements and front-end evaluation phase as is described below.

- Additional ad hoc external users will also be recruited as the need and opportunity arises at key stages of the project development, in the same way this occurred in the first year of the project. e.g. after the First Users' Workshop in February 2017, the Hunterian Antonine Wall personas and design methodology were tested again with a group of MSc in Heritage Visualisation students from the Glasgow School of Art who had a class session at The Hunterian in March 2017; also, the initial prototype of the Çatalhöyük collaborative experience was tested with a group of archaeology students and staff at the University of York in June 2017 using the Storyboard Editor.

4.1.2 EMOTIVE visitors

These are the end users of EMOTIVE experiences, i.e. the online and/or onsite visitors of museums and heritage sites. The main focus of the evaluation related to this group is the user experience. At both the formative and summative stage of the evaluation, the visitors will be mainly drawn from the actual visitors of the two cultural sites, the Hunterian Museum in Glasgow and the archaeological site of Çatalhöyük in Turkey and the networks of the Çatalhöyük Interpretation and Visualisation team at the University of York. As more of the prototype experiences are designed and are further developed, a wider pool of visitors will be used to draw the evaluation participants from, taking advantage of all partners' networks, as well as the EMOTIVE User Group.

Visitors are the users who will be experiencing the cultural site through a 'world' created with the EMOTIVE Authoring System. They will join in the available experiences when entering the site or when remotely connecting to the site online. When online, they can use their desktop computer, mobile or other device; when onsite, they can use their mobile device as a basic means to participate in the experience, connecting to other users, if they wish, and receiving information from the system according to the plot, their geographic position, their personal profile, but also contributing information in response to the system's solicitations.

4.2 EMOTIVE Evaluation approach and terminology

4.2.1 Overall design philosophy and role of evaluation

EMOTIVE subscribes to a reflective design methodology that looks before it leaps; one that responds to users' real needs and respects the conceptual and practical characteristics of each context it will operate in. In EMOTIVE we strive to take full account of the relevant ecosystem, i.e. the targeted end users and the context of the cultural spaces in which our systems will be deployed.

In line with this conceptual stance is the EMOTIVE platform's architecture, which will support the authoring, presentation, and personalisation of interactive, collaborative stories in a responsive manner. The technological systems that we will design will never exist in a vacuum; in any meaningful sense, they only have meaning, or relevance, if they address their users' needs and are embedded in the physical and cultural ecology within which the interactive experience will take place. It is only with extensive evaluation

that we will further ensure that design and implementation indeed caters to EMOTIVE's intended audiences.

User-Centred Design Methodology

The driving force of EMOTIVE is its experience-oriented, user-centred approach, which aims at ensuring that its users' needs are perfectly addressed, thus maximising the acceptance of this highly innovative system and its potential for use in pragmatic situations.

To support this approach, a user-centred design philosophy will be realised throughout the entire course of the project, both in the design and the evaluation phases. The main tenets of the EMOTIVE philosophy include:

- An iterative design and development process. This involves a continuous process of requirements gathering, design, implementation and then evaluation and re-design (Figure 1). This process began at EMOTIVE with a comprehensive analysis of the needs, wants, and limitations of our end users (visitors and authors), realised in collaboration with our institutional partners (consortium members and associate partners - User Group) and individuals (WP3) (see Deliverable 3.1 User Requirements & Scenarios – alpha). The definition of the functional specifications of EMOTIVE and all subsequent research and development will be driven by this comprehensive user needs analysis, which will also be taken into account for the evaluation guidelines.
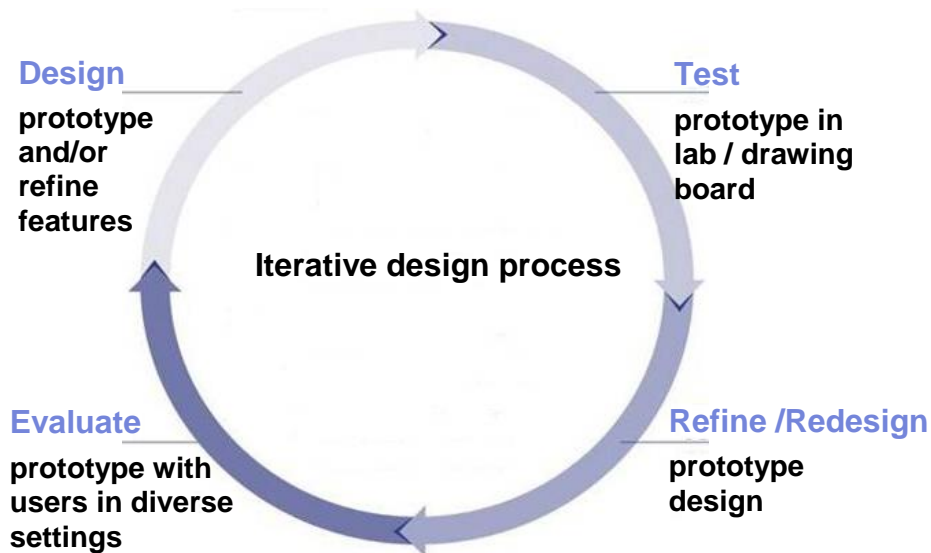
Figure 1. EMOTIVE's user-centred design methodology

- A participatory design methodology (Taxén, 2004), implemented with a group of typical users who, in addition to the consortium members, will actively participate as design 'partners'. Participatory design groups directly involve users in the planning and design of the scenarios from the outset, aiming at ensuring that the final products will address the users' needs. For EMOTIVE, the design partners may be extracted from the User Group (see below) and therefore include cultural and creative authors as well as a small but representative end-user group (visitors).

- An active, diverse and open User Group (see Section 4.1.1), consisting of, on the one hand, different cultural organisations, and, on the other hand, creative companies (SMEs), which partake in the design of digital technologies and applications for the Experience Economy.

- A multi-tiered evaluation methodology (WP9) that not only requires designers to analyse and foresee how users are likely to use an interface, but also to test the validity of their assumptions with regards to user behaviour in real world experiments with actual users.

4.2.2   Evaluation stages: Formative and summative evaluation

The widely accepted evaluation practice in museum and heritage visitor evaluation identifies three key stages of evaluation work: front end, formative, and summative (Borun and Korn, 1999; Diamond, Horn, & Uttal, 2016: 3-4; Miles et al, 1988: 198), while some authors identify also a fourth remedial or meta-evaluation stage (Miles et al, 1988: 198).

Front-end evaluation, as the term is used in museum and heritage visitor evaluation, is typically conducted early on in the exhibit development phase, before displays or exhibitions have been designed and is based on discussing with potential visitors in focus groups their interests and needs in terms of the display (McLean 1993: 58; Ambrose, 1993: 82-83). In the HCI field, the equivalent is the user needs' analysis and requirements elucidation stage (e.g. Preece et al 2002). In the case of EMOTIVE this has been reported in the first period in deliverable D3.1 User Requirements & Scenarios – alpha.

The other two stages of evaluation, formative and summative are identified as key in both the visitor studies and interaction design fields and are the main focus of the EMOTIVE evaluation framework.

Formative evaluation can be used to test the prototypes of an exhibit or system as it is being developed. This provides information about how well it works, how well it communicates to its intended audiences and users, and what changes would lead to better outcomes (Diamond, 2016: 3.). Additionally, it identifies what changes can be made to make the exhibit component more accessible both physically and intellectually to the museum's target audience (Screven 1991: 9) and is the same process that is also applied for digital applications or programs. Formative evaluation consists of testing the effectiveness of displays, exhibitions, or products while under development and before the designers commit funding to a final design solution. Simple mock-ups of sections of displays or prototypes are developed and tested on a sample of visitors or users. In formative evaluation it is important to enlist the help of the people who will be experiencing the final results. Modifications and additions can be carried out in the light of their comments and reactions (Ambrose, 1993: 83). Formative evaluation should ideally be an ongoing activity for cultural institutions but also design teams, as is the case with EMOTIVE, whereby it is a continuous iterative process of feedback from visitors/users and improvement throughout the life of an exhibit or display (Diamond, 2016: 4).

Once an exhibit is complete, a summative evaluation can be used to determine how successfully it communicates its message to its targeted users or how it affects their overall experience. In the case of system or components, summative evaluation can determine how it is being used by end users and the impact it has on them. Summative evaluation focuses on looking at how visitors interact with exhibits and applications and how visitors engage with them physically, intellectually, and emotionally. This is normally the evaluation of the finished displays, products, and experiences. There is a variety of techniques involved in summative evaluation from the more sophisticated (video-recording of visitors' behaviour and specialist analysis) to the simple and straightforward (personal interviews with visitors) (Ambrose, 1993: 83). Summative evaluation attempts to understand the impact of a project after it is completed. It is conducted after the exhibit has been opened to the public or a system has been officially released and iterative design is complete. It can be as simple as documenting the number of people who visit the display or use the interactive or it can be as complex as understanding how an exhibit experience changes the way in which visitors reason about a topic (Diamond, 2016: 4).

The overall evaluation approach of EMOTIVE centres around support of a constant feedback loop and iterative design process, with the front-end analysis feeding directly into formative evaluation, and that in turn informing the summative evaluation work (Figure 2).
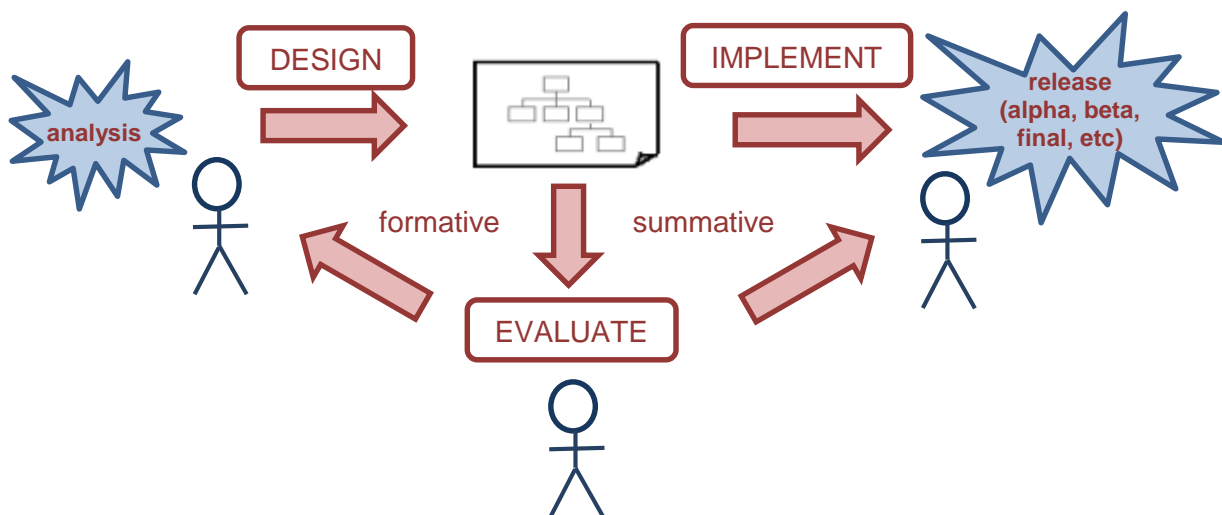
Figure 2. Formative and summative evaluation in the EMOTIVE design cycle

4.2.3 Evaluation methodology and approach

We propose a multi-part, qualitative and quantitative, mixed-methods evaluation framework, which draws upon and combines approaches applied over many years in museum studies, psychology, media, education, cultural studies, and HCI. In order to evaluate both authoring and experiencing aspects of EMOTIVE and the complex set of parameters which affect both, a mixed-methods approach was required, employing both qualitative and quantitative techniques. This is especially useful to understanding complex phenomena and can provide a more holistic understanding of different facets of a project (Greene & Caracelli 1997; Allen et al 2008).

EMOTIVE evaluation will examine both usability and user experience of tools, methodologies and experiences. The relationship between usability and user experience, although closely interlinked, remains ambivalent (Raita & Oulasvirta 2014). For EMOTIVE, we will regard usability evaluation as the testing which focuses on examining authoring tools and user experiences according to three traditional usability metrics (effectiveness, efficiency, and users' satisfaction), extended and adapted appropriately to fit the EMOTIVE context. This will focus mainly on EMOTIVE authoring.

Usability evaluation has dominated the literature in digital heritage evaluation, to the detriment of understanding all other possible outcomes and impacts of digital experiences on cultural heritage visitors and end users. This is where we hope that EMOTIVE will make a significant contribution by extending the usability evaluation to include user experience evaluation, suitably adapted to the complex cultural heritage settings and experiences.

User experience evaluation within EMOTIVE will refer to primarily qualitative evaluation which will combine a mesh of psychological, social, and physiological concepts (Vermeeren et al 2010; Hassenzahl 2013) and will focus mainly on end users' experiencing of EMOTIVE.

4.2.4 Usability evaluation

The International Organisation for Standardisation defines usability as the 'extent to which a product can be used by specific users to achieve specified goals with effectiveness, efficiency and satisfaction in a specific context of use' (ISO 9241-11 1998: 2). Usability evaluation essentially refers to discovering the appropriateness of a system for the purpose for which it was designed. Its purpose is to measure the ability of a system to be useful to people who are actually going to use it (White 2000). The three measurable attributes of usability as defined by ISO refer to:

- **Effectiveness:** the ability of users to complete tasks using the system, and the quality of the output of those tasks
- **Efficiency:** the amount of effort expended in performing tasks
- **Satisfaction:** Users' subjective reactions to using the system

Human Computer Interaction (HCI) researchers have defined over the years several usability attributes. For example, Shackel (1986), refers to ease of use, effectiveness, learnability, flexibility, and user attitude; Reed (1986) to ease of learning and ease of use; Bevan et al. (1991) to usability measurement based on product, user, ease of use, and acceptability of product; Dumas & Reddish (1993) to users, productivity, tasks, and ease of use; Nielsen (1993) to learnability, efficiency, memorability, few errors, and satisfaction; Lecerof & Paternò (1998) to users' needs, efficiency, users' subjective feelings, learnability, system's safety; and Dilon (2001) to effectiveness, efficiency, satisfaction, process (as actions and processes involved in users' interaction with the system), outcome (variables measuring what users attain from the system), and affect (attitudinal, emotional, and mood as related elements of experience).

Effectiveness, efficiency and satisfaction are recurring attributes among several authors and will be used for evaluating the EMOTIVE Authoring Tool (EAT). In our case, effectiveness and efficiency will be tested in relation to authoring all EMOTIVE use cases at both formative development stage as well as with final prototypes (summative). As this will cover long periods within the lifecycle of the design of the different experiences, it will also cover the robustness of the EMOTIVE authoring tool and methodologies, their reliability over a period of time and under intensive use, evaluating whether they perform consistently. The evaluation of efficiency and effectiveness will also include the ability of users (and the amount of effort required) to:

- customise the EAT to meet their needs and particular context
- adapt it to both large and complex experiences, as well as small ones with relatively simple structure and limited multimedia assets
- combine the EAT with existing tools and methodologies used by authoring professionals / compatibility with other systems

Although these three can be examined under efficiency and effectiveness, they are also close to Shackel's flexibility attribute.

Users' satisfaction with the EAT is a key component of the authoring evaluation as acceptance by end users from the creative and cultural heritage industries is crucial for the dissemination and exploitation of the project's results. This will examine how the EAT and methodologies are perceived by the users and how they see their impact on their work. This will also include satisfaction with the overall design and aesthetics of the EAT (i.e., is the look and feel of it appealing to authors? Do they find its aesthetics suitable for the context that they are using it in?)

In addition, other usability attributes that we will use in our evaluation of EMOTIVE authoring are:

- **ease of use** - how easy is the EAT to use? Is it intuitive? Is it easily usable by all types of authors identified above, and with different level of skill and experience, i.e. both novices and experts? Ease of use of managing media assets
- **learnability (or ease of learning)** - how easy is it to learn how to use?

Following EMOTIVE's user-centred design approach, the usability evaluation of the different components of the EAT and methodology will be conducted in several iterative cycles.

Formative usability evaluation will help to drive the development of the Alpha, Beta and Final releases of the EAT. Summative evaluation on the other hand, will gather and analyse data that allows an assessment of EMOTIVE authoring's fitness for purpose, that is, the effectiveness, efficiency, users' satisfaction, ease of use and learnability of the different components and integrated versions that make up the overall EMOTIVE authoring system.

In order to accommodate the geographically dispersed user partners and the collaborative nature of the EMOTIVE authoring work, the usability evaluation will include remote techniques, together with more traditional ones, expanded further in the methods section below.

4.2.5 User experience evaluation

Beginning in the 1990s and especially in recent years, a whole range of new concepts and measures – like emotional usability (Logan, 1994), pleasure (Jordan, 2000) or hedonic qualities (Hassenzahl, 2001) – were developed to evaluate non-utilitarian qualities of products and services, subsumed in the research field of User Experience (UX). While these concepts and models are still very diverse, a common understanding of the elements determining UX is taking shape. Unlike usability, which is concerned mainly with the attributes of the product and the prevention of obstacles and errors, the focus of UX is on the user and the construction of a positive user experience and its expression in the emotions, attitudes and values resulting from the interaction with a product (Zimmermann 2008). In interaction design, user experience evaluation investigates how a person feels about using a system, product or service. In this type of evaluation, user's motivation and expectations affect the experience more than in traditional usability (Mäkelä & Fulton Suri 2001). It is a complex undertaking as user experience is subjective, context-dependent and changes dynamically over time (Vermeeren et al 2010).

Although laboratory testing might be used for evaluating specific identifiable elements of the user experience, most authors recommend a holistic approach that studies use over a long period of time with real users in a natural environment (Vermeeren et al 2010; Law 2011).

Parameters taken into account in user experience evaluation often include:

- affective (motivational, emotional) response, and whether the user feels stimulated, engaged or fatigued and bored
- immersion (in the sense of suspending disbelief and supporting the feeling of presence in the experience)
- cognitive or conceptual change, or even pedagogical value, as a result of the user's creative encounter with the system being evaluated
- perception of value - whether the system is important to the users and what is its value for them
- aspirational - whether the system inspires the user, whether it delivers 'wow' experiences

Apart from usability, Soegaard (2016) refers also to useful content, desirable/pleasurable content, accessibility, and credibility, as core areas of the user experience. Within EMOTIVE, we are interested in combining effectively in our evaluation activities usability with more complex user experience goals, focusing primarily on affective user responses. The attributes in the outer use experience circle in figure 3 below indicate some of user experience goals that would be relevant to EMOTIVE. These would be adapted depending on the experience that was designed and evaluated.
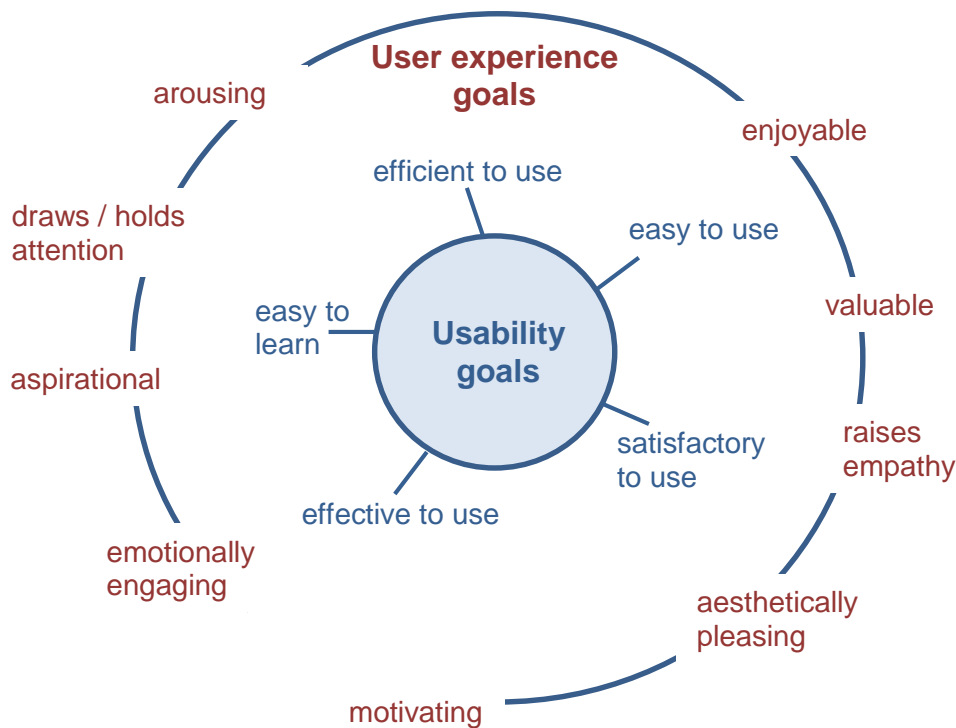
Figure 3: Relationship between usability and user experience (adapted from Preece et al 2002)

EVALUATING EMOTIONAL ENGAGEMENT

As EMOTIVE is grounded in the idea of encouraging an emotional response from users, this is also reflected in our user experience evaluation methodology, which is focused on assessing the emotional impact of heritage experiences, as reported by users and as observed by researchers. Emotion has been conceived in varying fashion across fields of practice, but there is no general consensus among scholars in the literature on the definition of emotion (e.g. Ekman 1992; Reisenzein 2007, Mulligan & Scherer 2012).

In response to their recognition that cultural heritage visitors may have 'a range of emotional responses to heritage, and a range of intensities in those responses' Smith and Campbell developed the idea of 'registers of engagement' (2016: 444). However, the nature of these registers and the specific means by which they are evaluated have been defined only in a very general way by the authors. This lack of specificity is common within the cultural heritage sector, and EMOTIVE aims, in part, to fill this gap.

Our definition of emotion is shaped primarily around the notion of 'numinous experiences'- a concept that has been explored for at least the past two decades within the context of heritage sites. Wood and Latham (2014: 85) describe as 'a meaningful, transcendent experience that results in a deep connection with the past'.

Cameron and Gatewood's (2000, 2003, 2004) research on people's motivations for visiting historic sites suggests that more than a quarter of visitors to these sites report experiences that are characterised by deep engagement, transcendence, empathy, awe or reverence. As identified by Latham (2009), these are recognisable through visitors' own descriptions, typically referring to the following:

- **Unity of the moment –** this describes a very specific, vivid experience in the moment with (an object in) the museum when emotions, intellect, experience, and object unite.
- **Object link –** the (tangible) object triggers the experience that links the experiencer to the past through both tangible and symbolic meanings (proximity, intensity, immediacy).
- **Being transported –** the experience is felt as if being transported to another time and place; this affects the experiencer temporally, spatially, and bodily:

- o In time: time slows or stops/freezes
- o In space: tunnel vision, feeling of moving toward or away from object, being alone
- o In one's lived body: physical sensations related to the experience – cold, hot, shivers, butterflies, blood rush, tingling.
  - **Connections bigger than self** – deeply felt connections are made with the past, self, and spirit:
    - o To the reflective self: sense of purpose, being, leading to life change
    - o To people of the past: through imaginative empathy
    - o To higher things: meaning of life, spiritual world, epiphany

We aim to build on this body of work and adapt it for evaluating the effect of EMOTIVE experiences on our users. To do this we borrow from Bradley and Lang (1994), Iturregui-Gallardo et al. (2017), De Bruijn (2014), Wood and Latham (2014), Reason (nd), and Smith (2016), to create an evaluative model which will allow us to externally report on user experience (e.g., via observation of visitor emotional and bodily expression), and internally report on it through both verbal and non-verbal visitor self-reports (e.g., via both visual and word-based questionnaire, and spoken interview).

EMOTIVE aims to move away from privileging didactic learning outcomes to explore other ways audiences feel and experience cultural heritage. EMOTIVE will engage visitors emotionally and establish a framework for evaluating this. Watson (2013: 286), summarizing the work of Pekarik (2002), expresses the problem succinctly: 'more attention needs to be paid to what visitors feel…it is this that they remember after their visit, rather than any 'learning' they have undertaken'. Indeed, as Watson (2013: 284) herself notes, the situation is more complicated than a simple divide between learning and feelings, because both are entirely entangled. As Smith and Campbell describe it (2016: 299) 'emotions are both evaluative and an essential part of reasoning'. To account for one without concern for the other is to fundamentally misunderstand human nature. Ample research (e.g., Staus & Falk 2017) demonstrates that emotions trigger attention and memory, which are critical to learning itself. This research goes further to suggest that the key challenge is thus in managing the balance—providing emotive experiences that enable learning rather than eclipsing or privileging it, therein ensuring impact.

For more information on the intellectual context of our approach, see the paper we presented at VSMM2017 conference in Dublin (Section 9. Appendix II).

Physiological measurements

Over the last few years, UX evaluation has also looked at physiological reactions as measurements of the intensity and quality of an individual's internal affective experience (Zimmermann 2008). Empirical work has provided evidence for a correspondence between a number of physiological variables (e.g. skin conductance, heart rate, facial muscle activity, cortical activity, startle reflex or eye blink magnitude) and the emotional dimensions of valence and arousal (e.g. Ekman, Levenson, & Friesen, 1983; Bradley & Lang, 2000; Bradley, Codispoti, Cuthbert, & Lang, 2001).

Physiological signals are measured with a wide variety of instruments and sensors. Unfortunately, using physiological signals requires specialized and frequently expensive equipment and technical expertise to run the equipment which makes this method suitable for lab experiments but not for applied use in the natural field settings of the cultural sector. As it requires sensors to be attached directly to the body, it can be considered obtrusive or even invasive by many subjects. Additionally, it can be quite difficult to separate confounding factors influencing physiological reactions in order to attribute significant changes to the experimental variable (Kramer, 1991). For all these reasons, physiological measurements will not be used as part of EMOTIVE's evaluation work.

5 Evaluation Implementation

5.1 Methods

Using multiple methods, and triangulating them wherever possible, will permit a more detailed understanding of how both authors and visitors negotiate and experience the EMOTIVE tools and platform from various perspectives.

5.1.1 Qualitative and quantitative methods

Qualitative methods will allow us to go in depth and summarize people's responses and interpretations. Qualitative methods emphasize depth of understanding over the generalizability of the data. They allow the evaluator to examine individual cases or events in depth and detail. These methods may emphasize overall trends, but they may also seek out exceptions, particularly how special cases differ from the mainstream. Qualitative methods utilize direct quotations, open-ended narrative, detailed reporting of events and behavioural observation. Qualitative studies can be especially helpful when starting to examine a problem, and also whenever the important issues are not yet clear. They are also very effective as a way of understanding complex phenomena that cannot be easily summarized into discrete categories, so are particularly useful for evaluating aspects of EMOTIVE experiencing.

Quantitative methods, on the other hand, will allow us to categorise, compare and confirm the results. Quantitative methods attempt to classify diverse opinions or behaviours into established categories. Quantitative studies are designed to look for numerical patterns in data, summarizing the reactions of many people to a limited set of variables. They often make comparisons between categories of data by using statistical tests to establish the nature of relationships among variables. They may include experiments, observations, surveys or other means of comparing the responses or behaviour of different groups. A primary advantage of quantitative methods is that they provide findings that can be generalized to larger populations.

We will use quantitative and qualitative methods in tandem, so that we can take advantage of the strengths of each approach. A single evaluation study, for example of how specific EMOTIVE use cases are experienced, may use qualitative methods to generate ideas, categories, questions, while at a later stage quantitative methods, where appropriate relevant measures exist, will be used to verify those results for a larger population.

Where rigorous measuring instruments have not been developed for a particular variable and psychological measurements still lack precise values, it is often more appropriate to record descriptive information when evaluating digital applications rather than use a scale which has the merit of being quantitative but the validity and reliability of which are suspect.

The EMOTIVE evaluation approach will utilize a mixture of qualitative and quantitate methods, according to the evaluation needs of each phase and each target user group. Formative evaluation will be based on more qualitative approaches that may offer valuable insight for re-design while summative evaluation will use both approaches.

5.1.2 Heuristic evaluation

In a heuristic evaluation usability experts review the product or site's interface and compare it against accepted usability principles (Nielsen 1994; Faukner 2000). The simplicity of heuristic evaluation is beneficial at the early stages of design, as it does not require user testing but usually only one or a small number of experts, reducing the complexity and expended time for evaluation. In EMOTIVE we have been using heuristic evaluation at the early stages of development prior to user testing, formative and summative evaluation, in order to reduce the number and severity of design errors discovered by users.

5.1.3   User performance measurement

User performance measurement is another technique for usability testing which normally takes place in a controlled setting where the users are asked to perform specific tasks and their performance and reactions are recorded. This process is to be differentiated from the system performance measuring and evaluation procedures, which will be undertaken by the EMOTIVE technical partners for the different components of the EAT. EMOTIVE user performance measurement will be combined with the Think Aloud Protocol, during which authors are asked to verbalize their thoughts, comments, emotions, with the process being observed and recorded by one or more evaluators. It will also be combined with remote usability testing, when the evaluators are physically located away from the users (section 5.1.7).

Authors will be briefly trained in the use of the EMOTIVE authoring system before being asked to complete the predefined tasks. After the completion of the tasks during the user performance measurement, there will be a semi-structured interview (section 5.1.5), in some cases performed remotely. The discussion will be directed by a questionnaire (see section 5.3.1) designed for this purpose where the user is asked to rate several aspects of the experience and discuss positive issues, problems, and suggested solutions.

In the same way, such a guided approach will be used also for the first phases of end-user experiences design and evaluation in order to identify issues in the experiences' main functionality.

5.1.4   Observation and tracking

Observation by evaluators of authors using the authoring tool to create their own EMOTIVE stories and of end users using the final EMOTIVE experiences will allow us to gather additional valuable feedback. Observation is a traditional cultural heritage evaluation method typically used to evaluate temporary or permanent physical exhibitions (Borun & Korn 1999; Diamond et al 2016). It can provide both quantitative and qualitative data: observation and counting can show how many visitors visited the exhibition in a defined time slot; and following visitors can show how long they spend at particular points in the exhibition. It can also provide data about visitor circulation, paths and orientation in the space and show which exhibits people are engaging with and how they are interacting with them as well with their social groups and other visitors or staff in the gallery or heritage site. The route taken and time spent can be recorded on a floorplan of the exhibition or site if deemed appropriate for the experience under evaluation. However, observation alone cannot tell us the reasons for this behaviour. For this reason, within EMOTIVE, observations will be triangulated with other methods, such as interviewing, system logs analysis and focus group discussions to provide a more complete understanding of the users' experiences.

At observations, the observer usually selects a suitable spot for their study and remains more or less at that location. Tracking follows the same principles as observation, with the difference that the researcher followers the visitors they are studying as they circulate in the space and is usually carried out in larger spaces when trying to understand movement, circulation patterns and visitors' behaviour through the whole building or heritage site.

Recording users (with their permission, see D1.6 Guidelines for Societal Acceptance and Ethical Considerations and D10.1 & D10.2 Requirements) while they use the EMOTIVE tools and experiences will be used in conjunction with observation. Users will be accompanied by one or two observers, in some cases taking photographs and filming them as deemed fit, recording notes on standardised observation sheets adapted for each cultural heritage partner site. For some evaluation activities, single users or groups of users may be fitted with a Dictaphone or other recording device attached by lapel mic and placed in a pocket in order to ensure minimal intrusion in the experience. In this way a record of what users say, their physical movement, facial expressions, interaction with each other, the physical environment, the exhibits and EMOTIVE tools and apps can be gathered and analysed later. One-to-one accompanied observation sessions will also allow the observer to note down user decision-making points, any difficulties the users had and positive and negative reactions.
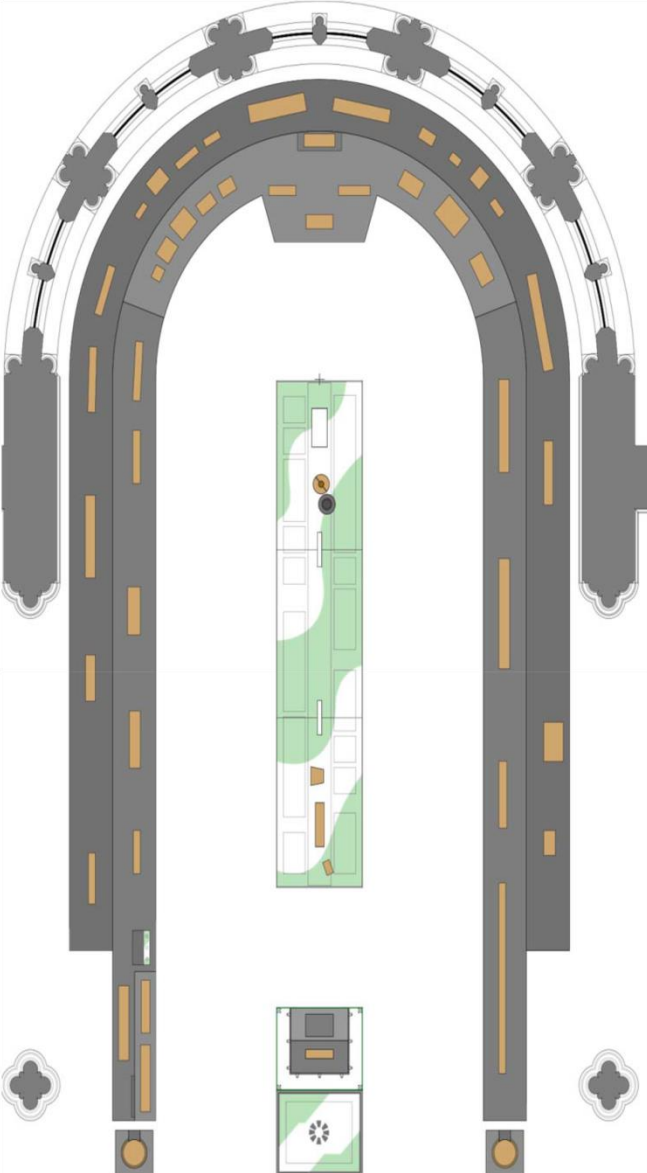
Observation Sheet – EMOTIVE Antonine Wall

Observer: Date: Time: Sheet #;

Group composition:	# Adult Females		#Girls		(ages)
	#Adults Males		#Boys		(ages)

Time entered exhibition: _____   Time left exhibition: _____

Mark on plan below with a **C** where group has **conversation**, **R** where they stop to **read** any text. Note any intriguing conservation or interesting behaviour in margins (e.g. H-off and H-on for Headphones). If you can discern facial expressions, use **E** for **excitement** and **F** for **frustration**. Later tally up the behaviours and expressions in table below.

	Adult Fem	Adult Male	Girls	Boys
Convers				
Read				
Excitem				
Frustr				

Figure 4. Observation sheet used at the Hunterian Antonine Wall exhibition during Explorathon 2017

Observation is a good first choice of evaluation method and will be used extensively at formative evaluation as it can feed into the development of future evaluation questions to focus on. For EMOTIVE experiencing in particular, it will help us externally track end users' verbal and nonverbal behaviours while they participate in their experiences, including their movements, and facial and vocal expressions as indicators of attention, arousal, and engagement.

The observation sheets will record key points, such as:

- facial expressions
- gestures
- conversations
- interaction with the environment
- interaction with others

These will be adapted for each site and particular evaluation activity. For example, the model was tested at the formative onsite evaluation session at Çatalhöyük in August 2017 and evidence of sharing was one of the points that had to be added to accommodate the aims of that case study. For the Antonine Wall onsite formative evaluation at the Explorathon European Researchers' event at the Hunterian Museum on 29 September 2017, an early version of the observation sheet was adapted to fit the needs of the evaluation of that case study (Figure 4).

5.1.5 Semi-structured Interviews

Interviews are usually carried out during or at the end of an experience or authoring process, one to one, either in person, by telephone or online (see section 5.1.7 on remote usability testing). Interviews can include questions about personal feelings, understanding and experience. For the purposes of the EMOTIVE evaluation, most interviews will likely be semi-structured. In a structured interview the same questions are asked of each respondent. However, semi-structured interviews allow more flexibility and can provide an opportunity for participants to ask for further clarification if required and to raise issues which are relevant to them including ones that the interviewers may not have predicted. These types of interviews are based on a questionnaire which is not presented to the interviewee but rather used by the interviewer as a guide to structure the conversation. However, questions are not determined completely in advance and the interviewer needs to be responsive to the interviewee. The style of interview is conversational and allows for probing of specific topics of interest.

EMOTIVE interviews will include a combination of open-ended questions to ease the interviewee into the process and encourage them to reflect, as well as structured questions focused on the specifics of the EMOTIVE tools and end-user experiences. Whenever possible, interviews will be recorded, with permission, and later summarised and coded. The interviewers from the EMOTIVE users group will be careful not to influence the respondents' answers while simultaneously actively listening for research areas to probe further.

In the parts of the evaluation which seek to uncover the deeper empathetic and human engagement impacts of EMOTIVE experiences, in-depth one-on-one interviews will be carried out with end users. These will draw primarily on Smith's (2016) 'registers of engagement', Wood and Latham's (2014) 'numinous museum experiences', and de Bruijn's (2014) analytical model for historical empathy. Specifically, we will examine ways to measure depth (ranging from actively disengaged to deeply engaged) and nature (from banal to ground-breaking) of engagement, and degree and nature (conservative to progressive, passive to active) of response. Moreover, and as described in section 4.2.5 above, we seek to explore users' 'numinous' experiences, which can only be captured through self-reporting in the form of in-depth interview-based dialogue.

5.1.6 Focus groups

Focus groups are an established method for gathering multiple participants' opinions on a product under development. The focus group elicits information about feelings, perceptions, ideas and experience – all qualitative data. A focus group consists of a small number of people, usually between five and ten people, who have been brought together to talk about a particular experience, for example a new exhibition theme or interpretation tool (Rubenstein 1989). Focus group interviews usually last from one to two hours. The participants do not usually know one another. People can be selected to represent particular user groups or may be drawn from a group of users already known to the project, for example people

who have participated together using the tool (EMOTIVE authors) or end users of an EMOTIVE group experience. Participants are usually told in broad terms the topic of discussion (but do not receive questions in advance). A facilitator guides the in-depth discussion using a set of guidelines drawn up in advance, listing the topics to be covered and the sort of questions which might be asked. Questions are usually open-ended. Often pictures or objects are used to stimulate discussion and responses. The discussion can be recorded to facilitate analysis later (with permission). The focus group proceedings can be transcribed. Focus group discussion methods can uncover and explain issues and reactions which may not be expected, anticipated or even have surfaced during general quantitative surveys or questionnaires and can provide rich and insightful information, data and feedback (Krueger & Casey 2009). Focus groups have already been implemented in the context of the development of a prototype for the onsite Çatalhöyük collaborative experience (which will be further described in D9.2).

5.1.7 Bodystorming

Bodystorming is a technique sometimes used in interaction design or as a creative technique (Oulasvirta, Kurvinen & Kankainen 2003; Oppegard & Still 2013). The idea is to imagine what it would be like if the product existed, and act as though it exists, ideally in the place it would be used. Individual solutions to design problems are brainstormed and discussed by the participants onsite. The group of participants can be made of those people who represent a mix of authoring roles and end users. This technique is often applied to designing physical spaces but can be successfully applied also to design products and services. Within EMOTIVE bodystorming is used as part of the user experience design methodology in relation to both EMOTIVE tools and experiences. The approach was first deployed in the first EMOTIVE user workshop for the Hunterian Antonine Wall experiences (see Deliverable D3.4, section 6.1) and has also been used for the development of a prototype for the onsite Çatalhöyük collaborative experience (which will be further described in D9.2).

5.1.8 Remote usability testing

Remote usability testing is a key tool for usability professionals and researchers. This takes place synchronously, with the participants separated spatially from the moderator(s) but conducted in real time (e.g. Castillo et al 1998; Thompson et al 2004; Andreasen et al 2007), or asynchronously, in which the participants are separated from the moderator(s) in both space and time (e.g. Tullis et al 2002; Brush et al 2004; Bruun et al 2009). In synchronous remote usability testing, the evaluator is watching the user performing tasks and communicating directly via telephone, email, chat, remote sharing of the users' screen and work environment or a combination of these, while in asynchronous remote testing, methods frequently used are longitudinal diaries, 'user reported critical incidents', online forums, online questionnaires, and interviews (usually semi-structured or structured) over email, chat, or telephone (Tullis et al 2002; Andreasen et al 2007; Bruun et al 2009).

At EMOTIVE a combination of these will be used, with interviews with authors, online and face to face surveys, and analysis of notes, diaries and reports being the most common methods. Remote usability testing of the EMOTIVE authoring tool and experiences will provide quick and informative data regarding author and users behaviours and usability of the tools and will be particularly suitable for evaluating the off-site use cases. Due to the EMOTIVE partners and cultural sites being geographically dispersed across different countries, these remote observations may take the format of screen sharing with the researcher talking directly to the participant as they use the authoring tool or application, making notes and gathering rich qualitative data.

5.1.9 Goal-free evaluation

Software evaluation has traditionally meant measuring goal attainment, based on a carefully pre-specified set of measurable goals as was described in section 4.2.4 above on usability evaluation. In contrast to this common approach to evaluation, Scriven (1991) has proposed the idea of 'goal-free evaluation'. This refers to gathering data directly on software effects and effectiveness without being constrained by a narrow focus on stated goals. This type of evaluation lends itself particularly to qualitative methods

because it relies heavily on description and direct experience with the software. Moreover it requires the evaluator to suspend judgment about what it is the software is trying to do and to focus instead on finding out what it is that actually happens in the program and as a result of the program. The evaluator thus can be open to additional data and insights that may possibly emerge from the use during the evaluation.

This approach will be used in the context of EMOTIVE both to explore creativity aspects of the authoring tools and to support the evaluation of the end-user experiences.

5.2 Evaluation instruments

5.2.1 Questionnaires

Questionnaires as data capture methods are based on psychological data gathering protocols and are transformed versions of more standard survey type instruments. The majority of questionnaires use the following structures:

- **Likert scales**. Degrees of user agreement with a proposition (e.g. affinity, agreement, enjoyment) captured on an integer scale. The majority of data capture approaches seeking to gather what is effectively attitude or perspective are of this form. These are frequently either bipolar or unipolar of the range 0 to 5 where 0 is a lack of agreement and 5 is total agreement. Analysis of this data is usually comparison of means (e.g. t-test).

- **Multiple-choice.** Often used as a scope-limited version of free text input. Users can choose from a set of pre-set words that express their disposition. For coding purposes the responses are enumerated as integer values. Mean comparison is obviously meaningless in this case as the values are entirely nominal. The categorical nature of the data makes Chi-square analysis possible, often by first combining responses to form a smaller set of categories.

- **Free text.** Users are allowed to write whatever they feel is relevant as a response to that question. Analysis of these responses requires the data to be coded into a numeric form. This is usually done by either: mapping responses to a polar scale based on magnitude (e.g. where words like 'very' are mapped to higher values) for relevant responses or by establishing a set of relevant categories and tallying utterances into those categories. For example, counting every time reference is made to the categories 'family', 'friends', 'famous people'. There are often considerations, for example whether to treat a sentence as one utterance, that are domain specific but meaningful data can be gathered this way.

In developing instruments to support EMOTIVE's evaluation activities, we have been following a mixed approach: in some cases, standard measuring instruments that have been used (more or less widely) in the community will be adopted, for instance the UEQ questionnaire (http://www.ueq-online.org/) is being considered for the usability/UX assessment of the authoring tool. In other cases, such as those where standard measures are not widely available due to the innovative nature of the developed tools, or are not relevant to the context of use dealt with by EMOTIVE, we will need to synthesize or adapt existing tools, or create new ones. An example questionnaire under development which illustrates this approach is provided in Section 8. Appendix I.

Furthermore, EMOTIVE is concerned to quantitatively record self-reported evaluations of emotive experience, using multiple means that allow users to participate both through graphic-only, visual response and through traditional open-ended questions. We aim to cater to users' varying needs through enabling participation by, at once, graphic and written means. In order to satisfy all these needs a multi-part approach may be required. For example, we will explore the potential of this for initially assessing a users' ability to recognise their own emotions, then to measure their visceral reactions to the experience (as has been explored by Iturregui-Gallardo et al. 2017) using and adapting the Toronto Alexithymia Scale (TAS-20) (Bagby et al 1994). This needs to be complimented by an affective impact survey so we will examine adapting the Narrative Engagement Scale or a modified version of one of the affective impact surveys that other projects have been using (e.g., Damala et al., 2016). The second part of the survey may

combine the well-known SAM (Self-Assessment Manikin) with a modified version of Reason's (2015) «Where in Your Body» audience questionnaire and Betella & Verschure's (2016) Affective Slider. These privilege visual expression and non-verbal communication of emotional impact.

5.2.2 System log files

A continuing problem with the evaluation of ubiquitous computing systems is that of making the invisible visible. This is a particular problem when investigating user interactions with small, mobile devices in environments where people are moving, using invisible sensing systems, and switching attention between different objects and people within the environment; in short, just the kind of dynamic context that the end users will be faced with when interacting with the EMOTIVE-authored experiences. Along with the observational data, system log files will be a significant source of information. They can prove useful for supplementing the data collected while observing the user as well as the data collected during the focus groups and interviews. Log files may include different types of time-stamped information, such as how long visitors spent interacting with specific elements of the digital tool; what features were used most or least often as well as geo-localization information, activities, time spent in a specific place, user input, narrative path taken through the experience and at what narrative point the user ended the experience.

System logs present an opportunity for the automation of data collection for evaluation via the EMOTIVE platforms. This usually requires special programming for setting up and careful implementation for the analysis of data in order for these to be collected and analysed in a meaningful way, but once organised, allows for 100% of the sample of users and their interactions to be recorded.

5.3 Organizing evaluation events

Organizing evaluation events is central to the EMOTIVE evaluation framework. EMOTIVE authors are called to familiarize themselves early on with the concepts of evaluation, so that they can be in a position later on to organize their own evaluation actions for their authored experiences. Evaluation events comprise of three key components:

- the evaluation purpose
- the evaluation methods and instruments
- the evaluated prototype

The evaluation event development involves the following procedural stages, which may be iterative.

5.3.1 Stage 1: Evaluation event initiation

The creation of an evaluation event begins by specifying the following parameters:

- **Purpose of the event**: the main themes / issues that the team wishes to evaluate and explore with users.
- **Prototype status**: this identifies the degree of fidelity and interaction potential of the prototype available for the evaluation event (e.g. low fidelity storyboard, alpha version of the prototype, etc.). This helps to identify constraints and realities for user interactions and related data capture with the prototype.
- **Intended Participants**: who should participate in the event, age group, group composition, numbers, etc.

CHECKPOINT:

Is the purpose of the evaluation clear?

5.3.2 Stage 2: Specify R&D requirements: Instruments & Analysis

During the evaluation event specific objectives are defined, resulting in a list of focused issues that require user evaluation input. These are mapped to potential data capture and analysis approaches, in line with the constraints imposed by prototype fidelity.

CHECKPOINT:

- Have mappings to existing methods and instruments been made?
- Are data being captured to enable a response to all of the identified issues?
- Does the analysis approach provide sufficient data to meet the issues?
- Do all captured data contribute towards the issues?

5.3.3 Stage 3: Define user role and select participants

The critical issue for the success of the evaluation event is to clearly define user roles that will be evaluated and select the appropriate users to form the participants group. The number of participants is also crucial, along with their profiles.

CHECKPOINT:

- Has a consistent, coherent user role been created for the evaluation experience?
- Does this role allow coverage of all of the required issues?
- Is the selected participant group representative of that role?

5.3.4 Stage 4: Transform evaluation instruments

Each of the data capture points (expressed as an instrument/activity and an analysis approach) are then considered in terms of their capture method, with the aim being to maximize data collection which is not intrusive and is as transparent as possible to the user.

Each evaluation instrument is then developed and assessed in terms of evaluation objectives, with piloting where necessary. This requires that each instrument is developed with an age-appropriate aesthetic, in-role branding on tasks and consistency with in-role activities.

CHECKPOINT:

- Has the amount and visibility of data capture been minimized for the user (e.g. focus on hidden data capture and on removing duplicative data capture)?
- Is the role of the user clear and reflected in the data capture?
- Have instruments and approaches been identified, enhanced and/or created, incorporating user perspective and expectations?

5.3.5 Stage 5: Logistics

The evaluation scenarios are developed in parallel with the evaluation instruments. The actual evaluation event as with any such activity requires considerable organization. Further, such events typically require a significant lead time to ensure participant recruitment. Thus, in parallel with evaluation artefact development, the logistics of the event are organized.

CHECKPOINT:

- Have all stages been completed?
- Is all documentation prepared?

5.4 Evaluation phases and timeline

As has been clearly outlined in the document, for EMOTIVE, formative evaluation activities will be organized throughout the duration of the project in order to support its iterative design and user-centric philosophy, as well as constantly improve the EMOTIVE novel approach and technologies. Formative evaluation will start early on, as the first design prototypes become available and continue as the software releases are completed and new functionality is added to them.

Summative evaluation will be carried out for the authoring environment and for mobile experiences, once the first prototypes are complete and become available. During summative evaluation, the overall quality of the interfaces will be assessed, either by comparing alternative designs, or testing definite performance requirements, i.e. collecting quantitative measurements of performance, such as how long did users take, were they successful, how many errors did they make, etc. Summative evaluation of the beta and final release of the authoring environment, as well as of the end-user experiences, will take place after the completion of each prototype and serve also as an indication of improvement of features between each release.

For the organization of the most appropriate formative or summative evaluation events, a combination of the methods presented in Section 5.1 will be employed.

The evaluation work will include the organisation of three user workshops corresponding to important milestones in the development of the project. End users (authors as well as visitors) will have access to two versions of the *integrated* EMOTIVE system (beta and final), as they become available, rather than just a final version at the end. The goal is to help us refine the requirements and specifications, evaluate the systems (in terms of both usability and user experience), but also to collect valuable information for both the dissemination and the future exploitation of the system.

The end-user workshops, which closely support all evaluation work, have been and will be organised at the following milestones:
- Month 4: focus on initial user requirements and early scenario and story development work (UGLA)
- Month 24: to initiate the summative evaluation of pilot experience(s) created with the beta release of the integrated tools (ATHENA)
- Month 35: focus on the evaluation of pilot experience(s) created with the final release (YORK)

The following table shows all evaluation deliverables and summarises all key evaluation activities and phases, showing how they intersect and relate to user workshops and releases of the EMOTIVE platform and experiences.

Evaluation Phase	Del. #	Deliverable name	Brief description	Delivery Month
Phase A: formative evaluation (M4-M19)		*Formative evaluation activities*		*M4-19*
		1st User workshop		*M4*
	D9.1	Evaluation Framework & Guidelines	Living document with updates when needed for methods & instruments that may need to be adjusted	M12
		Alpha release of platform and experiences		*M12*
	D9.2	Formative Evaluation results	Description of formative evaluation activities performed, and analysis of respective results	M15
		Beta release of platform and experiences		*M19*
Phase B: formative & summative evaluation (M20-M36)		*Summative evaluation of beta activities*		*M19-24*
	D9.3	Summative Evaluation of Beta release (platform and experiences)	Description of summative evaluation activities performed, and analysis of respective results	M24
		2nd User workshop		*M24*
		Refine evaluation framework & formative evaluation of final release activities		*M25-30*
		Final release of platform and experiences		*M31*
		Summative evaluation of final release activities		*M31-36*
		3d User workshop		*M35*
	D9.4	Summative Evaluation of Final release (platform and experiences)	Description of the summative evaluation activities performed, and analysis of the respective results	M36

Key to the table:	User workshops	Evaluation activities & phases	Deliverables	Releases of EMOTIVE platform & experiences

Table 1: Evaluation deliverables, main activities and phases

5.4.1 Evaluation Phase A

The first phase of the EMOTIVE evaluation process (Table 2: Phase A evaluation activities timetable) commenced with the 1st User Requirements Workshop (M4), which informed the development of the Evaluation Framework, and will cover formative evaluation activity of the alpha release. The results of this formative evaluation work feed into the beta release (M19), with which Phase A concludes. As the system components are not developed but are being defined at this stage, the nature of the EMOTIVE evaluation efforts will be formative and focus on the design iterations of the authoring tool and experiences as they become available. Formative evaluation will include at this stage focus group meetings, observations interviews, questionnaires, combined with heuristic style evaluation, leading to concrete designs for the beta release.
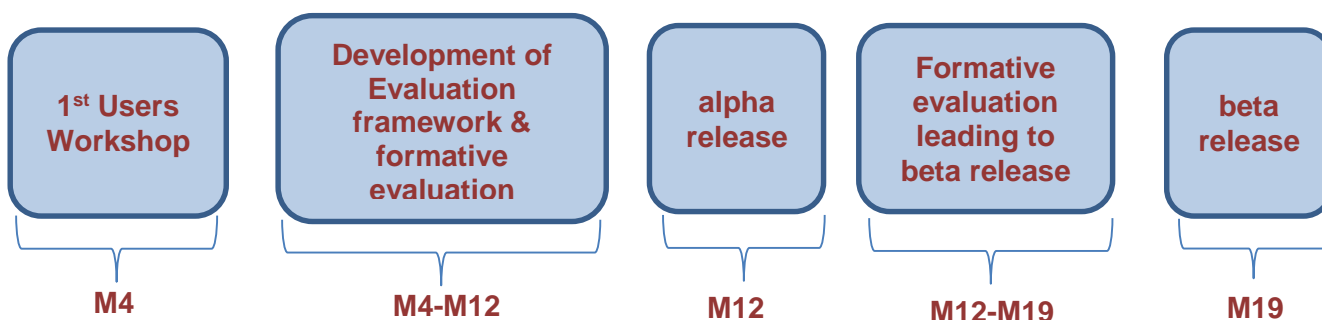
Figure 5: Phase A evaluation activities

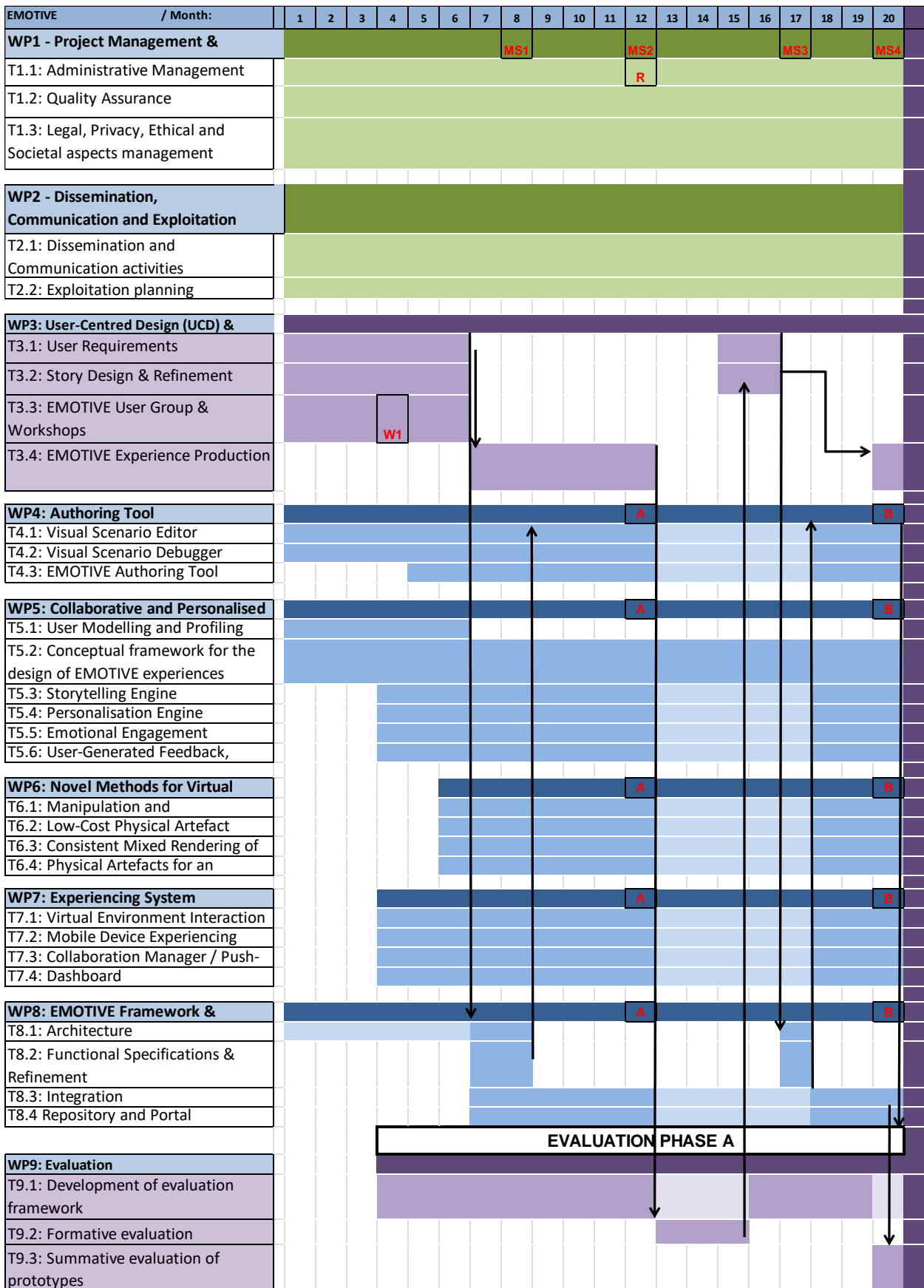| EMOTIVE / Month:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
WP1 - Project Management &								MS1				MS2					MS3			MS4
T1.1: Administrative Management												R								
T1.2: Quality Assurance																				
T1.3: Legal, Privacy, Ethical and Societal aspects management																				
WP2 - Dissemination, Communication and Exploitation																				
T2.1: Dissemination and Communication activities																				
T2.2: Exploitation planning																				
WP3: User-Centred Design (UCD) &																				
T3.1: User Requirements																				
T3.2: Story Design & Refinement																				
T3.3: EMOTIVE User Group & Workshops	W1																			
T3.4: EMOTIVE Experience Production																				
WP4: Authoring Tool												A								B
T4.1: Visual Scenario Editor																				
T4.2: Visual Scenario Debugger																				
T4.3: EMOTIVE Authoring Tool																				
WP5: Collaborative and Personalised												A								B
T5.1: User Modelling and Profiling																				
T5.2: Conceptual framework for the design of EMOTIVE experiences																				
T5.3: Storytelling Engine																				
T5.4: Personalisation Engine																				
T5.5: Emotional Engagement																				
T5.6: User-Generated Feedback,																				
WP6: Novel Methods for Virtual												A								B
T6.1: Manipulation and																				
T6.2: Low-Cost Physical Artefact																				
T6.3: Consistent Mixed Rendering of																				
T6.4: Physical Artefacts for an																				
WP7: Experiencing System												A								B
T7.1: Virtual Environment Interaction																				
T7.2: Mobile Device Experiencing																				
T7.3: Collaboration Manager / Push-																				
T7.4: Dashboard																				
WP8: EMOTIVE Framework &												A								B
T8.1: Architecture																				
T8.2: Functional Specifications & Refinement																				
T8.3: Integration																				
T8.4 Repository and Portal																				
							EVALUATION PHASE A													
WP9: Evaluation																				
T9.1: Development of evaluation framework																				
T9.2: Formative evaluation																				
T9.3: Summative evaluation of prototypes																				

Table 2: Phase A evaluation activities timetable

5.4.2   Evaluation Phase B

Phase B commences with the release of the beta version of tools and experiences (M19) which are summatively evaluated by month 24 (D9.3) and includes the final release of the platform (M31) whose summative evaluation will be completed by the end of the project (M36, D9.4). The summative evaluation of the final release will include, apart from an analysis of the evaluation activities carried out, also an analysis of the respective results and policy briefings to inform future EU policies. Glasgow will lead this phase of the evaluation with support from York and ATHENA.

For the summative evaluation of both the beta and final release of the EAT, it is envisioned that heuristic evaluation in combination with observation evaluation will be employed, asking the authors to complete more complex tasks as well as to freely experiment with the authoring system, giving them only the main idea of the final experience they need to author. Other methods used will be interviews and focus group discussions, following demos and walkthroughs, as well as task-based evaluation to examine the effectiveness and usability of the tool and the way its various components will have been integrated, according to the criteria outlined above (section 4.3). Authors from the Glasgow, York, and NOHO teams, together with ATHENA and DigiNext, will evaluate it while feedback will also be sought from stakeholders and professionals from the networks of the consortium partners and the external EMOTIVE Users Group.

The beta versions of the EMOTIVE end-user experiences will be fairly close in look, feel, and function to the final release and will be tested with a variety of users in real conditions using all the methods described in 5.1 above, including body-storming techniques as in some cases the whole functionality will not be yet in place. Following the completion of the final version of the experiences, end users at the two cultural sites will be observed experiencing them (*in situ* and remotely) while feedback will also be sought from stakeholders and professionals. The end users will participate in interviews and focus group discussions in order to examine the effectiveness of the developed approach in terms of its museological and communicative goals, as well as the assessment of usability and broader user experience issues.
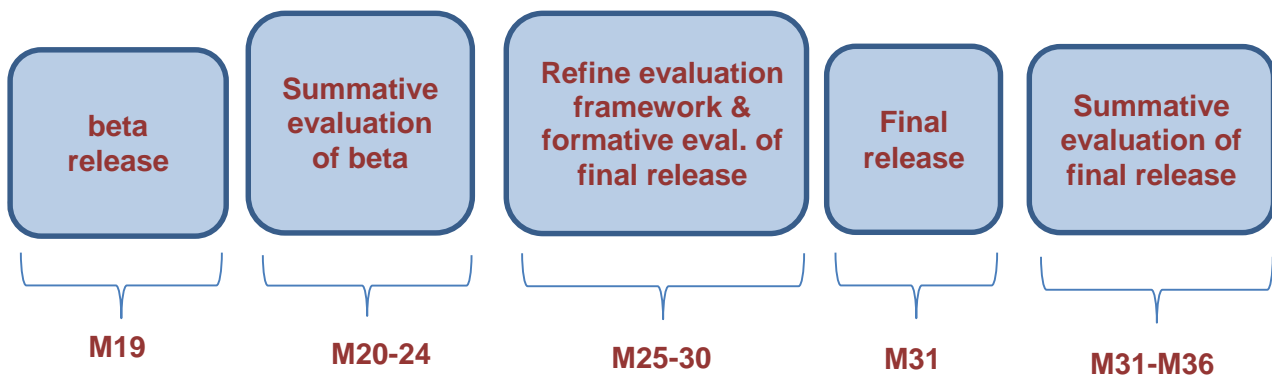

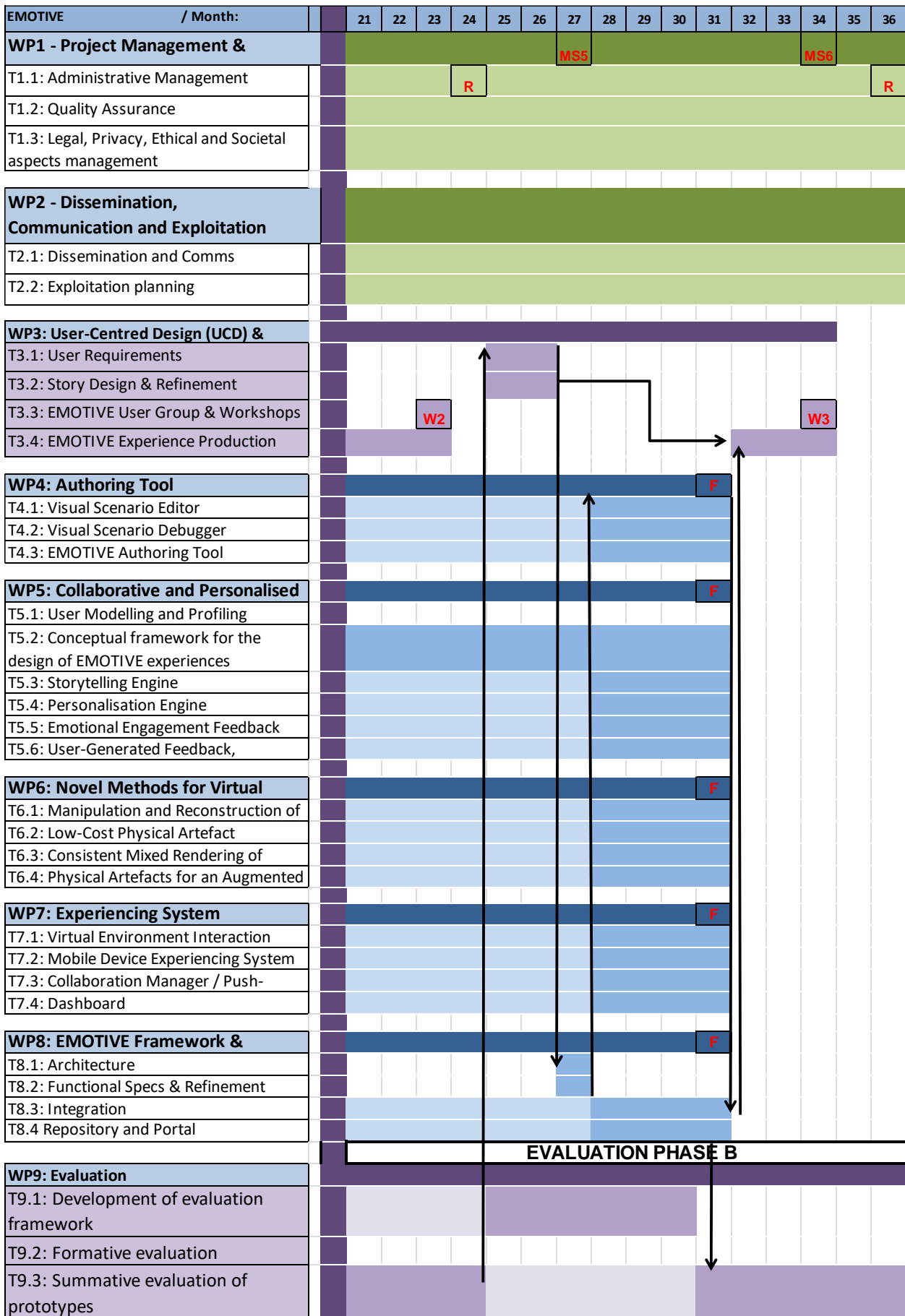Figure 6: Phase B evaluation activities

EMOTIVE / Month:			21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
WP1 - Project Management &											MS5						MS6	
T1.1: Administrative Management						R												R
T1.2: Quality Assurance																		
T1.3: Legal, Privacy, Ethical and Societal aspects management																		
WP2 - Dissemination, Communication and Exploitation																		
T2.1: Dissemination and Comms																		
T2.2: Exploitation planning																		
WP3: User-Centred Design (UCD) &																		
T3.1: User Requirements																		
T3.2: Story Design & Refinement																		
T3.3: EMOTIVE User Group & Workshops					W2										W3			
T3.4: EMOTIVE Experience Production																		
WP4: Authoring Tool													F					
T4.1: Visual Scenario Editor																		
T4.2: Visual Scenario Debugger																		
T4.3: EMOTIVE Authoring Tool																		
WP5: Collaborative and Personalised													F					
T5.1: User Modelling and Profiling																		
T5.2: Conceptual framework for the design of EMOTIVE experiences																		
T5.3: Storytelling Engine																		
T5.4: Personalisation Engine																		
T5.5: Emotional Engagement Feedback																		
T5.6: User-Generated Feedback,																		
WP6: Novel Methods for Virtual													F					
T6.1: Manipulation and Reconstruction of																		
T6.2: Low-Cost Physical Artefact																		
T6.3: Consistent Mixed Rendering of																		
T6.4: Physical Artefacts for an Augmented																		
WP7: Experiencing System													F					
T7.1: Virtual Environment Interaction																		
T7.2: Mobile Device Experiencing System																		
T7.3: Collaboration Manager / Push-																		
T7.4: Dashboard																		
WP8: EMOTIVE Framework &													F					
T8.1: Architecture																		
T8.2: Functional Specs & Refinement																		
T8.3: Integration																		
T8.4 Repository and Portal																		
EVALUATION PHASE B																		
WP9: Evaluation																		
T9.1: Development of evaluation framework																		
T9.2: Formative evaluation																		
T9.3: Summative evaluation of prototypes																		

Table 3: Phase B evaluation activities timetable

6 Summary and next steps

This document has presented the scope and overall approach of the EMOTIVE evaluation plan, which extends from October 2016 to the deployment of the final release in M36. The evaluation plan outlines the framework, methodologies and instruments that will be used in an iterative, participatory design approach where target users form the core of the design activity. The overall aim of the evaluation activities is to assess and gain feedback and understanding for on-going development of the user-centred design of both EMOTIVE authoring tools and user experiences.

The evaluation effort focuses on two key groups; firstly, EMOTIVE authors including creative and cultural heritage professionals with significant domain knowledge (though are not necessarily IT experts) who identify the rationale for the experience and create the content; and secondly, experience users, namely museum or cultural heritage site visitors who may either be using the EMOTIVE experience physically onsite or participating remotely (either collaboratively or alone) online.

The work on evaluating the emotional engagement is still exploratory and will develop accordingly for each evaluation activity and specific use case. This will be refined in the next few months and tested and is an area of EMOTIVE research which will make a significant contribution as it will fill a gap in this area.

Using this framework together with the following deliverables (D9.2 Formative Evaluation results due M15, D9.3 Summative Evaluation of Beta release due M24, and D9.4 Summative Evaluation of Final Release due M36), EMOTIVE will develop robust evaluation guidelines and a methodological approach for creative and cultural heritage professionals (as well as researchers working on cognate fields) for evaluating how users both author and experience digital cultural heritage.

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8 APPENDIX I

We present here a draft questionnaire to illustrate EMOTIVE's approach in creating instruments that are purposefully designed to relate to the users and contexts within which the tools will be used. This questionnaire forms part of the activities planned for evaluating the Çatalhöyük chatbot experience.

Proposed questionnaire for a first formative evaluation of the ChatCat Çatalhöyük chatbot experience

Engagement and absorption level
1. Did you enjoy conversing with the bot?

    Not at all |_____|_____|_____|_____|_____| Very much

2. While interacting with the bot you felt…

    Uninterested |_____|_____|_____|_____|_____| Interested
    Indifferent |_____|_____|_____|_____|_____| Curious
    Bored |_____|_____|_____|_____|_____| Excited

Personal resonance and emotional connection
1. Did you feel that the bot was…
    Stupid |_____|_____|_____|_____|_____| Clever
    Impolite|_____|_____|_____|_____|_____| Nice
    Conservative|_____|_____|_____|_____|_____| Open-minded
    Boring|_____|_____|_____|_____|_____| Interesting
    Predictable|_____|_____|_____|_____|_____|Provocative

2. Did you feel that the bot could understand you?
    Not at all |_____|_____|_____|_____|_____| Yes, completely

Learning, provocation and intellectual stimulation
1. Conversing with the bot helped me better understand the site
    Completely disagree |_____|_____|_____|_____|_____| Completely agree

2. Conversing with the bot helped me learn something new about Çatalhöyük
    Completely disagree |_____|_____|_____|_____|_____| Completely agree

3. Conversing with the bot got me thinking about things differently
    Completely disagree |_____|_____|_____|_____|_____| Completely agree

4. While conversing with the bot, I felt challenged and provoked
    Completely disagree |_____|_____|_____|_____|_____| Completely agree

5.   While conversing with the bot, my eyes were opened to new ideas
    Completely disagree |_____|_____|_____|_____|_____| Completely agree

Additional interview questions
1. Briefly describe what you remember from the interaction with the bot.
2. Which was the most interesting part (or parts) of this interaction? (if any)
3. Do you think other archaeological sites or museums should adopt chatbots? Why?
4. Elaboration on the specific evaluation objective: for example, picky vs not picky.

Moving Beyond the Virtual Museum: Engaging Visitors Emotionally

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Abstract—**In this paper, we firstly critique the state of the art on Virtual Museums (VM) in an effort to expose the many opportunities available to enroll these spaces into transformative and engaging cultural experiences. We then outline our attempts to stretch beyond the usual VM in order to connect it to visitors in a measurably emotional, participatory, interactive and social fashion. We discuss the foundations for a conceptual framework for the creation of VMs, grounded in a user-centered design methodology and related design and evaluation guidelines. We then introduce two main cultural heritage sites, which are used as case studies at the core of our efforts, and conclude by describing the many challenges they bring for pushing the boundaries on the human-felt impact of the virtual museum.**

Keywords— virtual museum; emotive storytelling; user-centered design methodology

I. INTRODUCTION

The concept and components of Virtual Museums (VM), even though they may not have been coined this way in the past, have a relatively long history. Nearly 90 years ago, Kiesler [1] described the possibilities of the 'telemuseum' in terms not dissimilar to the VM of today. Since its later definition as a real museum represented in a digital form [2], the Virtual Museum has grown to become an all-encompassing term, referring to all types of digital representations of both digitized physical objects and born-digital ones that can be related to the physical objects [3]. To date, most VMs offer object-centered online exhibitions using primarily images and text, but also three dimensional reconstructions of entire archaeological or heritage sites[1]. In many cases, their representations of artworks and sites are of very high-resolution[2].

Nevertheless, over the past 20 years, while technological possibilities have progressed and understanding of museum visitor needs and expectations have diversified, developments, at least conceptually, in the VM sector have stood comparatively still. Despite their endurance and promise, virtual museums seem generally to have escaped complex engagement with recent museological theory and practice, for example the growing interest in participatory models [4] and co-creation [5], in social and activist and decolonizing methodologies [e.g., 6], and in challenging the supremacy of the object and physical collections. Recent studies show that online museum collections are among the least popular features of a museum website [7, 8]. Moreover, despite their radical potential, VMs arguably privilege traditional didactic educational objectives [9]; they take little, if any, account of repeat visitors or group visitation; and they may ignore the significance of both the visitor agenda (after [10]) and the pre- and post-visit user experience. In this sense, they could be viewed as still rather immature cultural constructs, while their relevance and resonance for everyday visitors can be debatable.

To date, the majority of self-described VMs have primarily foregrounded the delivery of informational content, solitary visitor engagement, limited (mostly navigational and hot-spot based) interactivity, and the rather conventional curation of digital content. There are some innovative recent examples which diverge from this model (e.g., [11, 12]) but these exceptions tend to confirm the general rule. In some of these examples, we can see experimentation with the foundations of more affective and engaging encounters with virtual museums, including storytelling, personalization, adaptation and social

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[1] A History of the World in 100 Objects, www.bbc.co.uk/ahistoryoftheworld; Theban Mapping Project www.thebanmappingproject.com; Eternal Egypt

[2] www.eternalegypt.org
[2] Te Papa Tongawera collections, collections.tepapa.govt.nz

media connectivity [13], yet there is more work to be done in this direction if the VM is to realize its rich potential.

The four-year European Commission-funded V-Must project (Virtual Museum Transnational Network, 2011-2015) carried out significant work capturing and recording the various VM projects around Europe and beyond [14]. As a result, it proposed a general framework, based on the concept of the "responsive museum" [15], which captured the general aim of museums as participative nodes of communication built around collections. The framework provided some guidelines for implementation, such as interactivity, personal experience, rich content, narratives, and coherent display of exhibits, but it did not delve deeper to elaborate on the problem of the interpretative approach of VMs. This lack of engagement with the interpretative content underpinning VMs has largely hindered their impact and development. Here we explore the issues in greater detail in relation to VMs produced for cultural heritage sites.

In this paper, we firstly critique the state of the art on virtual museums in an effort to expose the many opportunities available to enroll these spaces in transformative and engaging cultural experiences. We then outline our attempts to stretch beyond the usual VM in order to connect it to visitors in a measurably emotional, participatory, interactive and social fashion. To do this we have drawn current museological theory and practice together, integrating these with diverse digital innovations, creating meaningful experiences for both individuals and groups in on-site, off-site and hybrid (simultaneously on-site and off-site) environments, as well as in synchronous and asynchronous situations. We offer a glimpse at an emerging conceptual framework for the creation of VMs, grounded in a user-centered design methodology and related design and evaluation guidelines. We introduce two main cultural heritage sites which are used as case studies at the core of our efforts – a remote prehistoric site in western Asia and a city-center based exhibition of a Roman site in a European museum – and describe the many challenges they bring for pushing the boundaries on the human-felt impact of the virtual museum. We then describe our user-centered agile design process, reflecting on the unique means we have adopted, such as "group personas" [16, 17, 18], for defining collaborative and

affective user experiences delivered through different technologies, at different times, in different places. Finally, we put forward preliminary evaluation results from our earliest project use cases, highlighting the still mostly untapped potential for VMs to be emotionally-transformative vehicles for the cultural heritage sector.

II. STATE-OF-THE-ART IN VIRTUAL MUSEUMS

A critical mass of researchers and practitioners in the field of digital heritage consider a VM as a cohesive, yet distributed set of tangible objects and intangible concepts held together by overarching themes [3]. This definition essentially includes anything, from online digital libraries of cultural content, e.g. in Europeana, to 3D reconstructions showcased as pre-rendered films or as part of real-time virtual reality installations, mobile guided tours, and in-gallery interactives. Even museums' Web 2.0 presences have been regarded as virtual museums.

In most cases, an object-centered, information-heavy approach is assumed. Indeed, the first cultural heritage-oriented VMs of the nineties were web-based repositories focusing on the presentation of collections of objects[3]. Later, 3D technologies started to often be deployed to represent both objects and spaces, some with annotation capabilities, short explanatory videos and background information[4]. A common approach to VMs uses photorealistic representations of physical spaces, i.e., photographic, panoramic self-guided presentations of closed spaces[5 6 7] or open-air archaeological sites[8 9 10]. In the past, these types of VMs were mostly implemented with VRML, QTVR, and Adobe Flash[11]. Recent advances include high resolution Gigapixel panoramic aerial photography[12 13] or various other combinations of photographs and visualization[14]. The popularity of inexpensive cardboard viewers has led many cultural organizations to offer stereoscopic versions of these (augmented with informational hotspots) panoramas[15]. The 3D space may also be a digital representation of a real location[16 17 18] or even a representation of imaginary physical spaces which look and operate as real museums, yet where no physical museum exists[19 20]. Interactive capabilities in VMs of this type are usually limited to navigation and the selection of 'hotspots'. Some VMs add features that provide a relative sense of visitor personalization, control and sharing, e.g. the ability to compare and add to one's collection[21 22], or to even add high resolution

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[3] National Gallery of Art, www.nga.gov/Collection.html

[4] 3D Petrie Museum, www.ucl.ac.uk/3dpetriemuseum; Digital Dead Sea Scrolls, dss.collections.imj.org.il/project; Brandenburg Gate model, cyark.org/projects/brandenburg-gate

[5] Museum Thyssen-Bornemisza Tears of Eros exhibition, www2.museothyssen.org/microsites/exposiciones/2009/Lagrimas-de-Eros

[6] The Vatican Cappela Sistina, www.vatican.va/various/cappelle/sistina_vr/

[7] Smithsonian National Museum of Natural History permananent exhibits, http://naturalhistory.si.edu/VT3/

[8] The Virtual Tour of the Acropolis, Athens, acropolis-virtualtour.gr/

[9] Carcer Tullianum, Roman Forum, archeoroma.beniculturali.it/carcer-tullianum/

[10] Pompeii, web1.netribe.it/pompei/mappa/cartina.html

[11] Nu.M.E City of Bologna. project, www.cineca.it/en/progetti/new-electronic-museum-city-four-dimensions-virtual-bologna

[12] Great Pyramids of Giza, www.airpano.ru/files/Egypt-Cairo-Pyramids/2-2

[13] Google Streetview Treks, Petra, www.google.co.uk/maps/about/behind-the-scenes/streetview/treks/petra/

[14] The New York Times Reshaping New York, www.nytimes.com/newsgraphics/2013/08/18/reshaping-new-york/?ref=nyregionspecial

[15] Brighton Royal Pavilion Panorama, brightonmuseums.org.uk/royalpavilion/history/3d-history/

[16] Palace of Versailles, Chaos to Perfection interactive stroll, www.chaostoperfection.com

[17] Giza 3D, org-www.3ds.com/

[18] La Grotte de Lascaux, www.lascaux.culture.fr/#/fr/02_00.xml

[19] El Pais Virtual Museum of Art, Muva, muva.elpais.com.uy/

[20] Food Museum, www.foodmuseum.nl/#en/

[21] Barcelona Museum of Contemporary Art, www.macba.cat/en/itineraries

[22] El Pais Virtual Museum of Art, Muva II, Uruguay, muva.elpais.com.uy/

images of whole artefacts or their details and later use them for customized printouts to share on social media[23]. An early approach to personalization was Walker Art Center's "Through your eyes", presenting the views of the collections by specific visitors.

The advent of mobile technologies has resulted in an explosion of mobile multimedia guides, mostly used for on-site guided tours[24] [19]. Such guides are object-centered audio descriptions (commentaries) by a friendly yet authoritative voice, providing a visual exploration of objects, and, in more recent examples, a basic personalization approach (e.g., "time", "language", "interest", with the latter allowing the creation of a digital souvenir). In some cases, due primarily to the nature of the cultural content, there are mobile guides with more story-like descriptions, e.g., the collection of audios by the Anne Frank Museum[25] [26], for use by the large number of visitors queuing outside the museum waiting to enter. In one example the mobile guide is also used for data collection in order to personalize both the onsite as well as the post-visit experience[27]. During the physical visit, visitors are given a mobile device, which provides information on each exhibit as well as a customized post-visit experience. Data is collected using location sensing on the mobile guide to present the visitors with everything they have seen and not yet seen. Every bit of rich media accessible in the gallery is accessible post-visit, as is a 3D rotational view of each visitor's visit path through the galleries. Visitors can save, 'like', 'hate' content, etc. There is a requirement to visit the actual museum before making content accessible. Upon finishing, visitors provide an e-mail address and can then use it to access the post-visit experience on the web. Moving more decisively towards a story-centered approach, the CHESS experience placed emphasis on the on-site presentation of museum objects through personalized interactive stories [16, 17, 20].

III. VIRTUAL MUSEUMS' INTERPRETATIVE APPROACHES

Despite offering tools for personalization and even when they adopt storytelling approaches, VMs have largely followed the wider tendency in the cultural heritage sector to use narrative narrowly, as a method to communicate to the public the findings and research conducted by the domain experts of a cultural site or collection. In the same fashion that museums, for instance, "tell stories" through the informed selection and meaningful display of artefacts and the use of explanatory visual and narrative motifs in their physical exhibits [21], VMs have attempted to do so in the virtual realm. This interpretative process, whether in the physical or digital context, is at the heart of the museum as an unassailable institutional authority [22, 23]. Nevertheless, storytelling as applied by museums, including VMs, has for the most part been limited to descriptive, scholarly prose. Despite the continuous improvement of their technological features, the underlying interpretative approach of most VMs has followed the traditional example of many cultural heritage collections and sites whose meaning is typically communicated *in situ* in didactic fashion, disconnected from the

emotions, evocations and morals which inspire and motivate the larger world [24].

Where emotive forms of storytelling have been engaged in heritage and museum interpretations, whether in digital form or not, these have often been regarded suspiciously by domain experts as part of the so-called "Disneyification" or commodification of the past [25]. Despite decades of reflection on the power of 'resonance', 'wonder', 'provocation' and 'feeling' for cultural sites [26, 27, 28], as well as related evidence that indicates personal experiences at these sites lead them to be more lastingly remembered [29], restorative [30] and sometimes transformative [31], emotion has generally been avoided in discussions of heritage and museums until relatively recently [25]. Even where such discussions have been initiated, they regularly amount to purely theoretical reflections (e.g., [32]). When experienced, their impacts seem to be oriented towards the individual visitor (even in cases where they specifically seek to create "people to people encounters" [33], and even knowing that most sites are visited in groups). And when developed, they are usually directed at sites from recent or historic times which have relatively robust material and ethnographic data to support them.

This is critical because many heritage sites have few remnants that are either visible or relatable to the broad public. As such, they may not have enough resonance to engage visitors on their own or through standard interpretational means. Archaeological sites and objects, for instance, are often remote, poorly preserved, always fragmentary and therefore difficult to understand, let alone humanize. Intangible heritage, by its very name, is also often elusive or abstract, hence difficult to pin down in typical museological fashion. Even those conceptual frameworks which have been established specifically to enable emotive storytelling in cultural heritage (e.g., Uzzell and Ballantyne's [34] 'hot interpretation') appear hostile to the possibility that such sites might be tailored for intimate emotional encounters.

More recently, the introduction of VMs in the form of multimedia guides and, especially, mobile augmented and virtual reality has sought to improve this predicament [35]. However, current digital tools often convey information or display empty reconstructions that, in contrast to filmic and literary engagements, fail to bring these sites and artefacts back to life on an emotionally-evocative level [36, 37]. Similarly, most also fail to use their dynamic nature to gather and cross-culturally evaluate details about visitors themselves (their inspirations, their common narratives, their drivers for engaging with the past), except for on simple quantitative levels (e.g., [38]).

Research that attempts to push on the boundaries of VMs and their surrounding constructs has begun to recognize the promise of evocative digital experiences for heritage locations, including fragmentary sites [39, 40]. We aim to push even further in this direction, working from the premise that museums and archaeological sites are, in fact, highly emotional places if we

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[23] Rijksmuseum, Amsterdam, Rijkstudio, www.rijksmuseum.nl/en/rijksstudio

[24] British Museum Audio Guide, www.britishmuseum.org/visiting/planning_your_visit/audio_guides.aspx

[25] Anne Frank Museum, Stories for Young People, izi.travel/en/f087-anne-frank-stories-for-young-people/en

[26] Anne Frank Museum, The Secret Annex Online, www.annefrank.org/en/Subsites/Home/Enter-the-3D-house/#/house/20/help/

[27] The Museum of Old and New Art, Tasmania, mona.net.au/museum/the-o

leverage their visiting audiences and their dramatic potential. We believe that heritage and museum visitors' experiences can only contribute to 21st century cultural affairs if the emotional aspects of their visit, including their interactions with other visitors (who may be online, on site or both), are taken into account. Moreover, we believe that all cultural sites, regardless of age, location, state of preservation, etc., are seedbeds not necessarily of knowledge alone, but of human connection, introspection and collective future-building, made possible via shared encounters. We thus propose *emotive storytelling* as the conceptual glue that should be set forth by VMs. Through the EMOTIVE project we have begun to test, in practice, the nature and impact of such an approach. Ultimately, EMOTIVE emphasizes the creation of drama-based or otherwise affective narratives that contain careful references to cultural content, manifested with rich digital media and applications.

IV. TOWARDS AN EMOTIVE VIRTUAL MUSEUM

Our approach extends beyond the traditional offerings not only of VMs, but of museums and cultural sites more generally. In all cases, these sites typically aim first (as summarized by [41], [42] and others) at providing meaningful learning experiences for their visitors, privileging education at the expense of other forms of audience outcome. Especially problematically, these approaches to learning still often deploy what Franklin and Papastegiadis [43], drawing on the work of Hanquinet and Savage [44], call an "older, culturally paternalistic form [of] 'educative leisure' that appeals only to a very narrow band of the educated middle classes."

While it is increasingly common to see museums seeking more varied and complex outcomes, including the facilitation of attitudinal and value change, social activism and social consciousness amongst visitors, the creation of intellectual and emotional experiences that stimulate people's curiosity, excitement, and empathy for the world today, and even more radical impacts including attention restoration, therapeutic change and personal transformation, the research on these outcomes - including rigorous models of practice to achieve and evaluate them - is disparate and arguably quite weak in terms of the evidence and its generalizability. Watson [45, p. 286], summarizing the work of Pekarik [46], expresses the problem succinctly: "more attention needs to be paid to what visitors feel…it is this that they remember after their visit, rather than any 'learning' they have undertaken." Indeed, as Watson [45, p. 284] herself notes, the situation is more complicated than a simple divide between learning and feelings, because both are entirely entangled. As Smith and Campbell describe it [25, p. 299] "emotions are both evaluative and an essential part of reasoning". To account for one without concern for the other is to fundamentally misunderstand human nature. Ample research (e.g., [47]) demonstrates that emotions trigger attention and memory, which are critical to learning itself. This research goes further to suggest that the key challenge is thus in managing the balance—providing emotive experiences that enable learning rather than eclipsing or privileging it, therein ensuring impact.

In the cultural heritage context specifically, attention to 'what visitors feel' has been highly confined. Here, emotionally-evocative interpretation is almost exclusively limited to 'dark', 'difficult', modern or historic (meaning within the period of written/documentary history) subjects, especially those related to trauma and extreme suffering from the recent past. Premodern and prehistoric heritage rarely feature in these initiatives. As a result, vast swathes of the content of many cultural heritage institutions (including archaeological sites) are seemingly left devoid of affective impact. Moreover and unsurprisingly, best practice guidelines for achieving such impact are very presentist in nature, focusing on the provision of first-hand testimonials, speeches, photo/filmic evidence, oral histories and memories, all drawn from documentary sources to enable visitors to directly access the real 'lived' experience (e.g., [42]). As no such documentary sources exist for the prehistoric context, and as some archaeological sites (not to mention intangible heritage) may have little to no visibility today, these guidelines have debatable relevance.

By our reckoning, then, no coherent framework of practice (neither a conceptual model, nor practical guidelines) yet exists for designing and evaluating emotive experiences for the cultural heritage sector at large. More precisely, and as previously noted, VMs have often escaped critical discussion of their interpretative approaches, meaning that their best practices tend to focus around more functional concerns, such as usability and portability, or else on standard pedagogical objectives. This is in spite of the fact that VMs typically have an express concern for generating positive user experiences (UX). For instance, V-Must [48], adopting the ISO[28] definition, explains UX as "how a person feels when interfacing with a system." Here feeling is only partly understood as emotion. In fact, amongst its nearly 30 quality criteria [49] for VMs, "emotional engagement of the visitor" is but one minor entry, and a topic that is not explored in any depth in the available project reports. Moreover, V-Must's analysis of the quality criteria of international awarding schemes for digital heritage and VM initiatives [49] indicates that these schemes themselves have little explicit or clearly-defined interest in emotional impact. Tellingly, V-Must notes that its own overarching "museological quality" category (under which "emotional engagement of the visitor" is considered one of six measures of VM museological best practice) seemingly falls entirely outside of the brief of such awards schemes. Instead, the awards appear to bestow their honors upon initiatives which are premised on traditional matters of pedagogy, technology and visualization quality [49].

Solid frameworks for developing and evaluating emotional engagement in VMs thus appear slim on the ground. Outside VMs, in the museums and cultural sector more broadly, multiple such frameworks exist, but of varying quality and applicability for heritage sites and collections. These include very loosely conceived approaches focused primarily on design, such as Witcomb's [42] "pedagogy of feeling", which advocates for the deployment of certain aesthetic and narrative interventions in museums (e.g., the juxtaposition of contrasting displays, experimentation with visitor flow and architecture, use of first-hand accounts, etc.) to stimulate visitors' senses and to prompt introspection. Others, like Smith's [50] "registers of engagement", focus primarily on audience evaluation (although its specific components are not reported in any of the published literature to date), using the resulting data to help determine the sources of visitors' emotional or transformational experiences. In Smith's model, visitors are apparently assessed (via open and closed interview questions) on the degree and nature of their engagement or disengagement with sites, and the conservativeness or progressiveness of their responses. Still

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[28] ISO 2009, 9241-210.

others, such as De Bruijn's [51] (also see [52]) analytical framework for fostering historical empathy, and Nilsen and Bader's [53] seven actions for promoting empathy in the museum, narrow in on the design of one specific emotional outcome - in this case empathy. Here interpretative tactics such as role play, reenactment, perspective-taking, experiments with narrative mode and structure, among others, are highlighted as efficacious empathetic devices. In De Bruijn's case [51, also 52], the framework goes further, aiming to articulate a robust evaluation methodology too.

Amongst current evaluation methods, particular tools also exist to measure emotional responses. These include more long-standing and widely-applied tools such as Bradley and Lang's [54] SAM (self-assessment manikin), which entails a non-verbal, picture-based questionnaire to assess a person's pleasure, arousal and dominance-oriented reactions to stimuli. We also see more contained, project-specific tools such as Reason's "Where in your body" online application[29] wherein users denote and explain where exactly inside their bodies they feel they have been viscerally affected by a cultural (performing arts) experience. Similarly, the European-funded meSch project has developed its own 'affective impact survey', wherein visitors rate (on semantic differential scales) their moods and feelings about both the content/narrative of a cultural heritage exhibit and the di gital technology that mediates the exhibit [55, 56]. Here the meSch team draws on UX evaluative models, noting with surprise that "despite the fact that museums are clearly emotional places" there is little evidence of application of these models in museum or visitor studies overall [55, p. 73].

Ultimately, there is a significant, often speculative - but not yet cohesive - body of research about specific triggers of emotional and empathetic engagement in relation to the cultural heritage sector. As well, we see an array of evaluative tools for measuring such engagement, however these too are often poorly reported or deployed in manners which are difficult to fully understand or replicate. EMOTIVE, therefore, aims to synthesize, sympathetically adapt and test these existing models of practice through a program of digital work at two challenging pre-modern and prehistoric heritage sites.

V. PRELIMINARY EMOTIVE PROJECT WORK

Motivated by the premise of designing VMs that focus on engaging their visitors emotionally, the EMOTIVE project has embarked in designing digital experiences which seek to:

- adopt a story-based rather than an object-based approach, supporting interaction between (virtual) characters as well as real visitors, as well as engagement with the objects;

- blend the online with the on-site experience;

- seamlessly integrate the pre-, during, and post-visit activities, and the intangible with the tangible;

- cater to the dominant visiting patterns of museums and cultural heritage sites, which primarily see groups of visitors participating in social experiences with varying - sometimes conflicting - individual motivations;

- integrate exploration of hybrid 2D/3D spaces in meaningful ways which support the storytelling and the social and emotionally-engaging experience of the visit.

Fig. 1   Developing a prototype collaborative visitor experience at Çatalhöyük (Summer 2015).

Two main UNESCO-listed cultural heritage sites provide the testbeds for our work: Çatalhöyük, a neolithic settlement in Turkey (Fig. 1) and the Antonine Wall display at the Hunterian Museum of the University of Glasgow in Scotland. Although very different on many fronts, these archeological and museum sites bring in a variety of challenges when setting out to design digital on-site and/or off-site experiences for their visitors. These include diverse visiting audiences, a majority of whom come in groups and who may have other priorities competing for their attention; a general reliance on traditional forms of didactic, glass-box display; temporal distance of the subject matter from the audience (meaning visitors may have difficulty relating to or conceptualizing the archaeological sites and their occupants); and a present-day context that looks nothing like its past context. For example, the site of Çatalhöyük is today characterized by poorly preserved architecture and a lack of visible artefacts or features; and the Antonine Wall, despite its importance as the northernmost frontier of the Roman Empire, is today characterized by fragmentary remains, meaning that it is challenging to re-contextualize the physical site within the relevant display at the Hunterian Museum. All such challenges are common in different forms and varieties among several, if not most, cultural heritage sites and museums around the world. In the first instance, then, we focus in-depth on these two case studies and their particular contexts to test the storytelling, social, interactive, and emotionally-engaging approach of the EMOTIVE project, and from there we aim to progress to a second stage of synthesis to draw generalizable conclusions and propose a set of methods for both designing and evaluating effective and impactful VMs, building upon the frameworks discussed above.

A. User-Centred Design Methodology

The driving force of EMOTIVE is its experience-oriented, user-centered approach, which aims at ensuring that its users' needs are perfectly addressed, thus maximizing the acceptance of the proposed solutions and their potential for use in pragmatic situations.

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[29] "Where in your body" website, www.whereinyourbody.com

To support this approach, a user-centered design philosophy underpins the whole project, both in the design and the evaluation phases. We started out by defining personas for both sites, adopting different strategies for each based on their common visitor profiles (i.e., at Çatalhöyük visitors never come alone - only visiting as part of formal or informal touring groups). Personas, a construct used in the Human-Computer Interaction field to describe an archetypal user in a compelling and succinct way, have been applied in previous cultural heritage projects with beneficial results [16]. Here we have worked to extend the concept to account for the social dynamics of cultural sites and the group-based nature of most visits to these sites. To this end, we have defined 'group personas,' alongside individual personas, in order to more richly conceive of visitors as social agents within the cultural heritage context.

We tested the personas at our first user experience design workshop in February 2017 and then again in May 2017. During both sessions we split our workshop participants into groups and asked each group to design an EMOTIVE experience for their designated persona or personas (Fig. 2).

Fig. 2   Participant at 1st EMOTIVE User Workshop (University of Glasgow, Hunterian Museum, February 2017) studying the project's personas.

At the end of the design process we asked our participants to dramatize the experiences they had designed. And the groups obliged by actively taking on the character of their personas as well as, in some cases, the EMOTIVE application itself (Fig. 3). This dramatization of ideas using the "entire body" may be referred to as "bodystorming", a technique often employed in interaction design and creative development [57], [58]. The intent was for participants to imagine what it would be like if the product (or EMOTIVE experience, in this case) they designed existed, acting as though they were using it and/or brainstorming its possible applications. Dramatising the experience and personas within the Antonine Wall display allowed the groups to think about how the personas would physically interact together, within the actual display space, and allowed the research team to think further about group experience dynamics. The dramatisation was evaluated positively by participants and allowed the personas to "come to life". The overall experience of using the personas helped all groups focus on real users and, for the research team, enabled us to begin considering the crucial components to developing participatory, emotive stories for cultural heritage VMs.

Fig.3   Workshop participants dramatising the EMOTIVE application they designed for The Hunterian Antonine Wall display in February 2017.

B. *Preliminary Results*

Our early design workshops have led to development of prototype EMOTIVE use cases for both sites, targeting different visiting contexts (e.g., on site versus remote visitation; synchronous versus asynchronous visits; individual versus group experiences), different technological and mobility demands (e.g., mobile-based delivery versus stationary PC-based), and different media assets and communicative priorities (e.g., visualization via virtual reality versus chatting via chatbot). One such use case, a collaborative on-site experience at Çatalhöyük, seeks to introduce and explore the concept and socio-political affordances of egalitarianism (as it is hypothesized to have existed in Neolithic Çatalhöyük) via asking visitors to enact the process of letting go of ownership, giving away possession of something of their own without expectation of anything in return. Pairs of visitors are required to complete a pre-visit questionnaire that matches them to a particular personality (e.g., artist, storyteller, hunter) and object (e.g., figurine, stamp, stone blade) from Neolithic Çatalhöyük. Once on site, the pairs collect their objects, personalize them, embed them with their personal digital data from the questionnaire (via transfer of data from their mobile phones through NFC tags affixed to the objects), and then share them with others through geo-referenced physical and digital transactions. We are interested in the potential for this use case to not only engage visitors in learning about egalitarianism, but, more importantly, to generate emotive experiences among users in the moment, particularly feelings of togetherness, cohesion, connection to the site, and empathy, in relation to the past people of Çatalhöyük and to present-day tourists to the site.

This particular use case grows out of experimentation with several strategies (some more abstract, some quite specific) for fostering emotional connection and empathy in museums. For instance, Savenije and De Bruijn [52] hint at the effectiveness of imitation and replication via verbalization for helping individuals to identify with people from the past. Franklin and Papastegiadis [43] speak more generally about the potential impacts of integrating humor, conversation and body-related themes into exhibitions. And Simon [59] discusses acts of reciprocity in the museum environment. Here we draw these presumed emotive triggers together into an embodied experience of egalitarianism for visitors to Çatalhöyük. Our earliest formative evaluations of the experience (based on observations and interviews with pairs following their participation) are positive. One British participant describes

becoming connected to past inhabitants of the site: "I feel in touch with the people…like, you can actually begin to imagine what their life was actually like." Another speaks of her own introspection, induced as a result of the experience: "It felt it was more about us…placing us in the situation, and making us think about each other and our opinions and our thoughts...I felt…like I was exploring myself in that situation." A Turkish participant is overt about his personal reactions: "I feel emotional…it was the most perfect thing I have ever felt in these houses…It was a lovely thing for me."

While our research is at its beginning and our evaluation framework is under development, the early results hint at the prospects for VM-based emotive interpretation to reconfigure visitors' relations with cultural heritage sites.

VI. CONCLUSIONS

Ultimately, we hope to challenge the digital, heritage and museological communities to take better account of the tremendous emotive potential of the virtual museum. We believe that combining theoretical frameworks which have been tested in practice in real cultural heritage contexts is the key way forward for future 'emotive' work. In this direction, the complexity of issues involved demands a multi-disciplinary approach combining and triangulating different design techniques and evaluation methods. It also necessitates the collection and analysis of a large body of data, combining both qualitative and quantitative tools. While much work has yet to be done, we believe that the development of VMs that resonate with visitors has major intellectual and social implications for the creative industries, cultural institutions and users at large.

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D9.1: QUALITY CHECKLIST

Hara Stefanou
EXUS

Document Review Date: 28/11/2017
Document version reviewed: 1.0

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Criteria	Verified (Y/N)
1) Conformity to Standards and Project templates	
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Table of contents updated	Y
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Explanation for eventual rejections	

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