This report documents the problem statement of the REENACT experiment, along with its ethics and privacy considerations and the experiment design. An implementation plan is sketched, including requirements and design for the three REENACT subsystems (the REENACT server and the front-ends for administrators, reenactors and experts) and a description of information flows that will exist during the experiment (what information will be collected, by whom, for which purposes, for how long, etc). Appendices are included documenting the initial conception of the experimental scenario of the Battle of Thermopylae, including the scripts and the catalogue of roles and actions for the live recreation of the event by a community of users, as well as sets of challenges and questions for collective games and quizzes.
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1. Executive Summary

This document summarizes the work carried out by UVIGO regarding the design of the REENACT experiment, prior to its implementation, execution and evaluation. First of all, a detailed description of the experiment is given, followed by the methodological questions related to the VIA and PIA meta-methods put forward in previous EXPERIMEDIA deliverables. The integration of the software needed by REENACT with the components of the EXPERIMEDIA facility is discussed, first considering the design expected for the latter by the end of the project, and then considering the state of development of the facility by the end of Year 1. Risks and opportunities registries are included, too. Finally, the Appendix documents the initial conception of the experimental scenario of the Battle of Thermopylae, including the scripts and the catalogue of roles and actions for the live recreation of the event by a community of users, as well as sets of challenges and questions for collective games and quizzes.
2. Introduction

The goal of the REENACT experiment is to investigate a new approach to improve the understanding of battles and wars that became milestones in human history. This will be done by taking advantage of the technological features provided by the EXPERIMEDIA facility, and of the spaces, equipment, personnel and contents available at the Foundation of the Hellenic World (FHW).

As regards battles and wars, History is commonly taught in a way that we are only told about who were the belligerent forces, how long the fights lasted for, and who ended up winning. This way, major historical events are put down as occasional events that just happen, that involve two sides (often appearing as the good and the evil forces) and that apparently end fortuitously, as by tossing a coin. Nothing is that simple in reality, and so the common pedagogical approach neglects many facts about the reasons for the battles, alliances and supporters, why things went on the way they did, what were the winning or losing choices, what were the consequences in the short, medium and long terms, etc. As a result, the general awareness of History in our society is rather partial and deficient.

The REENACT proposal is to engage groups of people into an immersive collective experience that will make them learn about a certain battle or war both from the inside, as reenactors, and from the outside, as historians. They will learn about the prelude, the course and the aftermath of the event with the aid of multimedia contents and experts. The experiences will be organised in three stages:

- **Stage 1 (reenactment)** is about involving groups of people and educators/guides in the reenactment of battles. They will be moving around in a room, playing the actions defined for a given role by a script of the event. Tactile mobile devices will provide the participants with an augmented reality vision resembling a multiplayer role-playing game (RPG).
- **In stage 2 (replay)**, the participants will be taken to a projection room to analyse what has been happening. They have already lived the battle from inside, with a very partial vision, and now it is turn to learn more by watching things from outside, and to see how their recreation compares to the real historic events. The explanations will be given by one expert, who may be physically present at the projection room or appearing on the screen from a remote location.
- **Finally, in stage 3 (debate)**, the expert will drive a collective brainstorming about the consequences of the conflict in the short, medium and long terms. The projection screen will become a dynamic big board to display comments posted by the participants, which can be rearranged by the expert as the debate goes on. At any time, the expert will be able to choose multimedia contents to illustrate the different points that are raised.

This general approach will be instantiated in the specific scenario of the Battle of Thermopylae. This is a propitious scenario because the Foundation of the Hellenic World has produced its own multimedia contents about this battle, which is invaluable material for the three stages. This event is quite popular as a symbol of courage against overwhelming odds, but it is not really well
understood due to non-rigorous treatment in movies and comics. Fortunately, the details reported by Herodotus and other historians provide sufficient scenes to yield both a didactic and enlightening experience to explain such facts as the advantages of training, equipment, and good use of terrain as force multipliers.

2.1. More about the reenactment stage

The REENACT experiences will start out with a brief projection explaining the historical context of the battle. Then, the participants will be armed with their tactile mobile devices and assume a given role in the battle, fighting for whichever side. Each participant will choose to be represented by a customisable avatar or by a close-up photograph.

The reenactors will follow the actions and make the decisions allowed by the scripts of their respective roles, which will make them move around in a room with a number of zones identified by markers on the floor or on the walls. Using the tactile mobile device, each participant will visualise his/her position in the scenario of the battle, where the rest of the people will be characterised as per their avatars and the roles they have assumed. Augmented reality technologies will be used to enhance the immersion, e.g. by providing 360º views of Thermopylae from one side of the other or by linking 3D contents with the markers laid on the floor or on the walls. Additionally, the tactile mobile devices will be providing the participants with the actions they may make at any given moment: to advance on a certain stand, to retreat, to take some message to someone, to fight one way or another, to surrender or not, etc. The choice of possible actions will be a function of each individual’s choices, of the orders delivered by the respective commanders, of decisions made collectively by voting, … as determined by the script of the battle. As explained in the Appendix, if the character played by a user dies in the course of the battle, he/she will be given the opportunity to pick up a new role in order to continue in the game.

To enhance the feeling of a collective experience, it will be possible to use any big screens or projection boards available in the reenactment space to display the visualisation of the scenario of the battle, along with video footage that may serve to illustrate what is going on, and even pictures or textual comments coming from the reenactors’ tactile mobile devices. If available, loudspeakers will play accompaniment music and sound effects for further immersion.

The use of tactile mobile devices has great potential to make the reenactment a playful experience. For example, when it comes to fighting, soldiers may choose one of different weapons to use by means of different gestures: if they take a sword, the tactile mobile devices will make sounds when shaken; if they pick a bow, they will be able to shoot arrows by dragging a slingshot. The interfaces will be highly intuitive to ensure that the visitors will feel comfortable using them.

2.2. More about the replay stage

Once the recreation of the battle has finished, the participants will be taken to the Tholos projection room of the Hellenic Cosmos (a venue belonging to the FHW) to analyse what has been happening. They have already lived the battle from inside, with a very partial vision, and
now it is turn to sit down and learn more by watching things from outside, to see how their recreation compares to the real historic events.

The second stage of the REENACT experiences will be driven by one expert, who may be physically present at the Tholos or appearing on the screen from a remote location. The expert will rely on a record of the movements and actions of each participant during the reenactment. Combining this record with the script of the battle, the expert will be able to identify specific situations lived by the reenactors that could serve to explain important facts about the course of the fights (e.g. to illustrate the technological superiority of one of the opponents, the war tactics employed, etc).

The expert’s interfaces will show a timeline of what each one of the participants has done, decided and watched during the reenactment stage. The sequence of contents displayed on the big screens of the reenactment space will be displayed, too. This way, the expert will be able to choose the most suitable contents to support his/her explanations, which will be projected on the top half of the Tholos screen. Additionally, the bottom half will be displaying the video feed from the expert’s webcam and some additional material, like a map of the battle with the avatars in place or textual comments typed by the reenactors.

The important point of the replay stage is to relate the reenactors’ experiences with the historical facts, which should help them to realise and memorise facts that usually go unnoticed in traditional History teaching. Therefore, the expert must devote some time to explaining what aspects of the reenactment diverge from the real facts, either because the script makes some allowances or because the participants have made the opposite of the real characters’ decisions. Nevertheless, to keep it a playful experience too, there will be quiz games to appraise the reenactors’ understanding of the prelude and the course of the battle. Additionally, there may be features for pure entertainment like awards to the best soldiers of each side, rankings of participants ordered by how long they have survived, galleries of user-generated pictures, etc.

2.3. More about the debate stage

After the replay stage, also in the Tholos projection room, the expert will drive a collective brainstorming about the consequences of the conflict in the short, medium and long terms. The Tholos screen will become a dynamic big board to display comments posted by the visitors, which can be rearranged by the expert as the debate goes on. At any time, the expert will be able to choose multimedia contents to illustrate the different points that are raised. Participants will type their comments using the tactile mobile devices, and, if chosen by the expert, they will have the possibility to explain their ideas or viewpoints to the whole audience as in an audio- or video-call. Some arguments can be voted upon, or socially rated as “possible” or “impossible”, “likely” or “not likely”, “interesting”, “absurd”, “original”, … so that the some of the most active visitors get some kind of recognition. Likewise, there will be quiz games to appraise the visitors’ understanding of the importance and impact of the battle.
3. **Methodology**

The REENACT experiment will be carried out in four main phases:

- **PLAN (PM13 to PM15, completed).** The goal of the PLAN phase was to fully work out the problem statement and the experiment design, bearing in mind the advance of Activity 3 (construction of the EXPERIMEDIA facility). An initial review of the ethics and privacy considerations has been conducted, too, and an implementation and experimentation plan has been sketched to drive the rest of the work.

- **PROVISION (PM15 to PM20).** The PROVISION phase will deal with the realisation of all the processes required to obtain the IT and human resources needed to run the experiment at the FHW. From PM15 to PM18, the effort will be devoted to the implementation of the elements of the REENACT system, which will be integrated and deployed between PM19 and PM20.

- **RUN (PM21 to PM23).** During the RUN phase, between PM21 and PM23, the goal will be to collect as much data as possible for the evaluation of Quality of Service, Quality of Experience and Quality of Community, as explained later in this document. In parallel with the running of the experiments, UVIGO personnel will examine the feedback gathered in order to prepare new releases of the software, solving bugs and implementation defects.

- **EVALUATE (PM22 to PM24).** Finally, the EVALUATE phase will be devoted to analysing the data gathered during the RUN phase, to produce the final reports expected by the VIA and PIA meta-methods put forward in Deliverable 2.1.1, “*First EXPERIMEDIA methodology*”.

Throughout the year, the experiment will be conducted in accordance with the EXPERIMEDIA meta-methods put forward in Deliverable 2.1.1, “*First EXPERIMEDIA methodology*”: Value Impact Assessment (VIA) and Privacy Impact Assessment (PIA). Details about each meta-method are given in the following subsections.

3.1. **Value Impact Assessment**

The VIA framework is organised into three phases, designed to incrementally move towards industrialisation and large-scale trials. Due to the time constraints, the REENACT experiment will focus on the first phase (Opportunity Assessment), with the goal of studying the opportunities and risks behind the proposal. The main research question is whether the REENACT approach to illustrating and explaining facts about major historic events could make it into the market as an additional attraction for History museums or as an additional educational resource for primary and high schools.

The RUN phase of the work plan (from PM21 to PM23) will involve collective experiences of small groups of people, aiming to obtain sufficient reports and insights from the experimental scenario of the Battle of Thermopylae. The script proposed for the reenactment of this battle (see Appendix) requires a minimum of 6 participants per experimentation session, while the characteristics of the spaces available for the reenactment stage in the Hellenic Cosmos (the
venue provided by the Foundation of the Hellenic World) suggest a maximum of 15-20 people per session. Based upon the feedback gathered during these experiences (plus the results of additional experimentation sessions carried out in the University of Vigo), Deliverable 4.9.4 will include a roadmap for the Opportunity Validation/Modelisation and Industrialisation Assessment phases of the VIA meta-method, including guidelines for bigger communities, other historical scenarios and other venues than the FHW.

As explained in Deliverable 2.1.1, “First EXPERIMEDIA methodology”, VIA focuses on defining, measuring and assessing business release value at specific milestones during the lifetime of an experiment. The business release value was first defined in terms of key performance indicators derived from Quality of Service (QoS) and Quality of Experience (QoE) metrics. Another dimension of evaluation was proposed in Deliverable 2.1.3, “First blueprint architecture for social and networked media testbeds”, namely Quality of Community (QoC). The REENACT experiment will assess these three dimensions as explained below.

### 3.1.1. Quality of Service metrics

QoS data typically reflects direct, objective measurements of physical characteristics of the environment of an experiment or the performance characteristics of software or hardware components. The most important aspects identified thus far are:

- The responsiveness of the interfaces offered during the reenactment stage. This will be a function of the memory and computing power of the mobile devices, especially in what concerns the augmented reality features and the reproduction of locally-stored or streamed videos.

- The responsiveness of the communication with the different pieces of software lodged remotely in the EXPERIMEDIA facility. The critical points are the following ones:
  - **[AVCC]** The quality and the latency of the pre-recorded videos served to the mobile devices and the projection room.
  - **[AVCC]** The quality, latency and synchronization of the audio and video feeds from the expert’s webcam.
  - **[PCC]** The latencies in the communication with the “Live games” element during the reenactment stage, which might be a function of the number of participants.

- The battery consumption of the participants’ tactile mobile devices. The obvious requirement is to be up for the whole duration of the three stages, regardless of how much the users interact with the mobile application.

- The delays incurred in processing the user-generated contents during the replay and debate stages.

- The ability to capture and decode QR codes (or similar markers) to deliver augmented reality material in the face of different lighting conditions and using different devices (with different camera resolutions, software and computational power).

- The promptness of the interfaces provided to the expert to locate relevant material to illustrate situations arisen during the replays and arguments raised during the debates.
3.1.2. Quality of Experience metrics

To understand the experiential aspect of the REENACT experiment, QoE data will include both quantitative and qualitative measures:

- On the one hand, the software will keep track of all the movements and actions of the participants during the reenactments, and also of their interactions during the replay and debate stages. Likewise, the application running on the tactile mobile devices will be providing stats about how and when the participants use its different features and interfaces.

- On the other hand, the mobile application will provide brief questionnaires to gather opinions about the REENACT approach and to rate different features of the experience: educational value, level of entertainment, convenience of the interfaces, quality and completeness of the contents, preferences for certain types of contents, etc. Those ratings will be matched against anonymous information about the participants’ educational background and interest in specific topics.

Halfway between quantitative and qualitative, the voting and quiz games offered during the replay and debate stages will be used as sources of information about the participants’ level of engagement and learning about the historical events.

As a research question, it will be checked whether any of the aforementioned parameters depends on the roles played by the participants during the reenactment stage, since it might happen that the QoE measurements are better for someone who has played a main role (say, King Xerxes in the Battle of Thermopylae) than for someone who has played a secondary role (e.g. a Persian infantryman), or maybe that differences appear between winning and losing sides.

3.1.3. Quality of Community metrics

QoC measurements, again, may reflect both quantitative and qualitative aspects of the community of people that participate in a REENACT session. To this aim, the experimenters will primarily look at the interactions among the participants during the replay and debate stages, e.g. counting the number of ratings and analyzing the length, mood and depth of the comments they exchange using their tactile mobile devices. Special attention will be paid to what happens among people who did not know each other before, for which they will all be asked to tick out the nicknames of their acquaintances right before starting the reenactment stage. Thus, it will be possible to address questions like whether strangers keep distances during the reenactment, whether they comment on the others’ arguments, whether there is any apparent bias in the ratings given to acquaintances and strangers?

Some subjective input from the administrators will also be sought over the different experimentation sessions, to rate the general mood of the participants during the reenactment stage: were they engaged? Were they apparently bored or having fun? Did they dare to talk aloud when required by their roles?
3.1.4. Value Impact Assessment

The experimentation is ultimately intended to evaluate the impact of the REENACT proposal for venues like the Foundation of the Hellenic World and the different people involved in the experiences. The data gathered about the aforementioned QoS, QoE and QoC metrics will be used to assess the potential truth of the following claims for end users:

- **Museum educators** will be able to participate in a new type of collective experience, supplementing the expertise and knowledge provided by the experts in replays and debates.

- **Museum visitors** will enjoy new edutainment experiences aimed at improving the understanding of historic events, relying on social networking functionalities and augmented reality capabilities. They will also have the opportunity of interacting with one another, and also with geographically distributed experts via user-friendly interfaces. The most likely target group is that of schoolchildren accompanied by their teachers.

- **Experts** will be able to offer their services to collaborate with museum educators in new pedagogical experiences, interacting more closely than ever before with people interested in knowing more about major historical events. They will be able to efficiently browse repositories of multimedia contents to relate historical facts to specific situations lived by museum visitors during the reenactment of the events, providing annotations, images, diagrams, animations, video clips, etc. Besides, they will be able to conduct live debates about the consequences of the fights in the short, medium and long terms.

- **Content creators/providers** will find an additional outlet for the multimedia contents they produce, which will be usable to provide historically-meaningful explanations to the situations arisen during the reenactments and to the arguments raised during the debates.

- Last but not least, the **experimenters** will draw useful conclusions from metrics proposed to assess QoS, QoE and QoC from the data gathered during the experiments, about the ease of use of the game-like interfaces provided for the reenactment, the didactic value of the different stages, the interest of engaging in social discussions, etc. This valuable insight will serve to enhance their ongoing research activities in the area of information services, which deal with various flavours of technology-enhanced distance learning.

The main venue for REENACT experiences would be History-related museums like the FHW, for whom the potential value of the proposal may include the following facets:

- First-hand experimentation with an innovative FMI (Future Media Internet) application that makes the most of the (possibly unused) spaces, technological facilities, contents and personnel.

- Offering of a new kind of collective experience to reinforce the understanding of events that have shaped the history of a certain area of the world.

- New means for remote interaction with geographically-distributed actors towards the organisation of new exhibitions, projections of multimedia productions, collection of opinions about new contents and activities, etc.
Yet, the experimenters will try to assess whether the REENACT solution could be taken out of the museums, for example, to enable new pedagogical experiences in primary and secondary schools. Commercial exploitation of the solution could also happen through the selling of the technology, its implantation in the venue, training courses for professors, implementation of reenactment scripts and production of multimedia contents.

3.2. Privacy Impact Assessment

The PIA meta-method focuses on the formal assessment of privacy risks and ensures that experiments conducted using the EXPERIMEDIA facility take into account ethical concerns, mainly relating to the protection of personal data and the privacy of the users involved in such experiments.

Deliverable 2.1.1 provides broad guidelines as to how to assess the potential risks that may arise from the REENACT experiment. The privacy implications of the REENACT experiment are deemed very simple, among other reasons, because it does not involve processing of personal data, because people will take part in a one-day session only, and because no data will be linked to a natural person. Further details are given below.

The PIA of the REENACT experiment will be developed progressively, with the final documentation of identified risks and mitigation strategies published for review on PM24. It goes without saying that the experimenters will fully acknowledge existing legislation as regards ethical issues related to privacy and personal data protection, which has been a focal point of the European Community actions since Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995, on the protection of individuals with regard to the processing of personal data and the free movement of these data. Likewise, they will do their best to adhere to the framework for social and networked media published as Deliverable 5.1.2 of the EXPERIMEDIA project, “Ethics, Legal and Social Framework”.

3.2.1. Participants/recruiting

There will be three types of participants in the REENACT experiment: reenactors, experts and administrators. The requirements for them will be as follows:

- **Reenactors** need not have any specific background to participate in the experiment apart from an average level of English and familiarity with tactile mobile devices. They will only participate in one experimentation session, that will typically last between 60 and 90 minutes (including preparation, reenactment, replay, debate and delivery of questionnaires).

- The role of **expert** may be played by invited historians, FHW guides and experts or by some of the experimenters. Nevertheless, knowing the difficulties faced by the people from the FHW to involve real experts in their embedded experiment (as documented in Deliverable D4.3.2, “Experiment progress report including intermediate results”), it is expected that this role will be played by one of the experimenters in most of the sessions.

- The **administrator** will always be a member of the experimentation team.
Both experts and administrators may participate in several sessions to support different groups of reenactors.

The core of the experimentation will be done in the Hellenic Cosmos (the venue provided by the Foundation of the Hellenic World in Athens), but this will be supplemented with trials in the University of Vigo, both _ex ante_ (to get early feedback and thereby fix defects in the software or in the experiment design itself) and _ex post_ (to gather further evidence for the evaluation or to assess questions that remain unanswered).

In late November 2012, UVIGO personnel had a meeting with representatives of the FHW and the University of Peloponnese (UoP) in the Hellenic Cosmos, with the purpose of getting to know the venue and discuss early questions relevant for the realisation of the REENACT and BLUE experiments. Besides taking note of the technology and the spaces available, UVIGO and UoP could check that most of the visitors to the Hellenic Cosmos are children who come with teachers and/or their parents, so it would be rather difficult to gather a sufficient number of volunteers to run the group experiences proposed in the two experiments while complying with the decision of the EXPERIMEDIA consortium of not involving minors. Therefore, both partners agreed to join efforts so as to ensure that the REENACT and BLUE experimentation sessions could be successfully completed:

- On the one hand, knowing their physical proximity to Athens, the representatives of UoP agreed to command the recruitment of participants for the two experiments from among its community of students, professors, researchers and other staff (plus their acquaintances), with the incentive of catching a glimpse of what the Internet of the Future may look like.
- On the other hand, UVIGO and UoP agreed to run the REENACT and BLUE experimentation sessions in parallel during the summer of 2013. While the exact dates are yet to be decided, coordination efforts will be done to ensure that each one of the participants will need to go to the Hellenic Cosmos only one morning, which is more convenient than moving to Athens one day for one experiment and another one for the other.

The point of running REENACT and BLUE experimentation sessions in parallel was later refined in a meeting with representatives of the Henri Tudor Public Research Centre (TUDOR) in Luxembourg in the first week of December 2012, where it was agreed that REENACT experiences could be offered within BLUE experiences as yet another attraction (in addition to the museum exhibits) that people would be able to join at certain points.

The recruiting procedures will not consider any payments to the participants, and it will be made sure that participants do not feel pressured in any way by the experimenters or peers.

### 3.2.2. Informed consent

All the participants in the REENACT experiment will be informed about the purpose of the experiment and all the aspects around the usage of the corresponding systems and interfaces to ensure that they are willing to participate. This communication will be done in written and signed
during the recruiting process. The terms will be reminded before the activation of the interfaces; the users will have to agree on them by ticking a checkbox upon startup.

3.2.3. Confidentiality

Key features of the REENACT experiences are enabled by having a detailed record of the actions made by participants during the reenactment stage, as well as of the comments and ratings they enter during the subsequent replay and debate stages. Some demographic information (e.g. age and educational background) will be used to assess some QoE and QoC parameters, but names, home addresses, telephone numbers, e-mail addresses and other pieces of information that might serve to identify a given individual will not be needed. The experiment will be self-contained inasmuch as the aforementioned records will not be linked to any other data.

One major measure to protect the participants against any uses of the data beyond the mere experimentation goals will be to ensure that the records of actions and responses are totally anonymous, for which the data will be linked to the participants’ nicknames in the augmented-reality world of the reenactment, not to any personal data that may serve to identify a given individual. The avatars created at the beginning of the reenactment stage will be used only during the experimentation session, and deleted immediately afterwards along with any data cached or stored by the REENACT software in the participants’ devices. To cover possible cases of unattended switch-off, any cached data surviving from previous experimentations will be deleted automatically upon startup of a new one.

Data collected or logged during the experiment will only be available to the experimenters and to whoever else should be granted access according to the rules and terms of the EXPERIMEDIA project. Any data stored out of the EXPERIMEDIA facility will be kept in computers belonging to the experimenters’ research group in the University of Vigo. Contents uploaded to social networks will be kept within events/groups created ad hoc for REENACT. Integrity of the data will be protected by hash codes to prevent any kind of undesired alteration.

In principle, the experimenters’ group will keep the fully-anonymized data indefinitely, only for research purposes. There is no commercial intention behind the collection of this data, so no third parties will ever be allowed to access the data, and no transfers will be permitted.

During the course of the experiment sessions in the Hellenic Cosmos or in the University of Vigo, all of the activities will only be offered to people who are physically present at the venue, even though it might be technically feasible to involve people connected over the Internet in the replay and debate stages. These facts serve to avoid important confidentiality issues while not affecting the research potential of the proposal —yet, those issues will be discussed in Deliverable 4.9.4 due to the potential interest of involving remote visitors.

3.2.4. Deception

The information collected from participants will not be deceived, mislead or withhold over the purpose and general nature of the experiment.
3.2.5. Withdrawal
Participants will be informed about their rights to withdraw from the experiment and to require the destruction of generated data collected with their contribution.

3.2.6. Other ethical issues
The REENACT experiment will comply with the Audiovisual Media Services Directive (AVMSD 2010/13/EU) to the extent it is applicable, as indicated in Deliverable 5.1.2 of the project, “Ethics, legal and social framework”. Due to the focus on historical conflicts, special attention will be paid to Art. 6 “Prohibition of incitement to hatred”, by which the experiment must not contain any incitement to hatred based on race, sex, religion or nationality. In this regard, the vision of UVIGO is that “education is awareness and understanding, not indoctrination”. Therefore, the experiment will seek to promote the understanding of battles and wars from an objective and neutral presentation, far beyond the traditional (partial and simplistic) approach that labels good and evil forces. Presentations, reenactment scripts, footage delivered by experts and debates will all be designed so as to promote in-depth thinking about the reasons and motivations that the different PEOPLE might have had to engage in the battles, what would have been “different” (not “better” or “worse”) if things had happened in other way, etc. In this line, as it is also in the spirit of the FHW itself, Hellenic forces will not be favoured to the detriment of any other cultures.

Individual participation during the replay and debate stages will be promoted, but no one will ever be forced to take part in an audio or a video call aimed at the whole audience present at the Tholos projection room. Participants incurring in foul language or disrespectful/offending comments will see their comments discarded by the experts (even to the point of disabling any further input), but the process will be driven by identification of the device in question, not the person.

3.2.7. Consortium partner responsibility
Consortium partners will be free to monitor the experiment and deliver suggestions and concerns to ethically review the experiment design and procedures throughout the different phases of the plan. Those requests will be treated in the realm of future progress in an adequate manner.

3.2.8. Checklists
The next subsections provide further details about the privacy aspects of the REENACT experiments, following the checklists provided by KU Leuven during the preparation of Deliverable 5.1.4, “1st open call ethics review report”.

3.2.8.1. Checklist for general ethical issues
- **What are the key values behind the service/application?** The key value of the REENACT proposal lies within the didactic value of its approach to the presentation of historical events.
- **What are the conditions for participating?** The experiment will not require any specific background from the participants. Only a basic level of English and familiarity with tactile mobile devices.
Where will the data be located? Any experimental data stored outside the EXPERIMEDIA facility will be kept in computers belonging to the experimenters’ research group in the University of Vigo.

What is the content of the processing of data? UVIGO will be handling a record of the actions each participant makes through a tactile mobile device during the reenactment stage. The same goes for the comments and ratings he/she enters during the subsequent replay and debate stages, plus the final questionnaires needed to assess some of the QoE and QoC parameters.

What is the purpose of the processing of the data? The purpose is to evaluate different Quality of Experience and Quality of Community parameters, involving both quantitative measures (such as interaction logging or task monitoring) and qualitative measures (often self-reported data, such as psychometric scale responses, elicited from the user via a human-computer interface).

What is the data lifetime? In principle, the data will be stored permanently in servers of the experimenters’ research group. Any information that might serve to identify a specific individual (e.g. e-mail addresses) will be deleted at the end of the experiment.

How is the informed consent obtained? All participants will be informed about all the privacy issues related to the treatment of information. Informed consent for the use of the aforementioned data under all the restrictions imposed by privacy legislation will be signed.

Must the consent be written or not? The experiment’s goals, the overall procedure, their role in the experiment, the nature of the gathered data, the handling of the data, … will be explained in detail to every participant, both aurally and in writing. A written consent will be acquired.

Who are the participants of the experiment? They will be mainly voluntary students, professors, researchers and other staff of the University of the Peloponnese and the University of Vigo —the initial aim was to involve people who visit the Hellenic Cosmos, but most of them are children who come with teachers and/or their parents, and it was agreed by the EXPERIMEDIA consortium not to involve minors in the experiments. FHW guides and experts might be involved, too.

3.2.8.2. Checklist for location data issues

Is it necessary to store the personal data? Some demographic data (like age and educational background) will be needed to assess some Quality of Experience and Quality of Community parameters. Names, home addresses, telephone numbers or e-mail addresses will not be needed.

When should the data be stored? The data will be gathered automatically during the REENACT experiences.

Does the user have any choice? None is envisaged or deemed important.

Can the consent be withdrawn? Yes.

Will the data be erased after use? Or after a certain period? The preference of the experimenters’ group would be to keep fully-anonymised data indefinitely for research purposes.
• Is it possible for the user to opt-out for one day or is such an opt-out a permanent choice? And in the former case, how long will you keep the information when the server is switched off? Non-permanent opt-out apparently makes no sense in the context of the REENACT experiment.
• Is it possible for the user to change its pseudonym on a daily basis? The REENACT experiences will last for one day only, so the question is not applicable.
• Who can access the data? The members of the experimenters’ research group and whoever should be granted access according to the rules of the EXPERIMEDIA project.
• Is there an admin log for every data file? Who can change these logs? Who can access them and who can delete them? There will be admin logs, with access granted only to the members of the experimenters’ research group and whoever should be granted access according to the rules of the project.
• For what time period are the data stored? As noted above, the preference of the experimenters’ group would be to keep fully-anonymized data indefinitely.
• Can the administrator manipulate the data? The integrity of the data will be protected by hash codes.

3.2.8.3. Checklist for profiling issues
• Is it possible to connect the data from different locations? The question is not applicable in the context of the REENACT experiment, inasmuch as the data from each participant will be gathered in a one-day, one-location session.
• Is the data being used for profiling? Is location data used to reach other inferences: e.g. is the person rich? Does he live nearby? No.
• Is the processing of the data only for improvement of content? Or also for tracking characteristics/traits of persons? There will be no tracking of characteristics or traits.
• Does the service need to know the real identity of the users? Are nicknames enough? Nicknames are enough.
• To which other data will the users’ feedback be linked to? None. The experiment will be self-contained in this regard.
• Who can access the ECC? The members of the experimenters’ research group and whoever should be granted access according to the rules of the project.

3.2.8.4. Checklist for tracking issues
• Will the user be followed between two usages of the service? No. Each participant will only be involved in one experimentation session.

3.2.8.5. Checklist for consent issues
• What happens when the mobile phone (or other device) is given to someone else? The REENACT application will delete all locally-stored information and caches at the end of the session.
• Real name? e-mail address? Real names or e-mail addresses will not be recorded.
3.2.8.6. Checklist for anonymisation issues

- Will the data be anonymized? Yes.
- Where will the data be kept? Is this a territorial location? Is there a cross-border exchange? The data will be kept in computers owned by the experimenters' research group, which are all physically deployed in the Vigo campus. There will be no cross-border exchanges.
4. System Architecture and Conceptual Links to the EXPERIMEDIA Facility

This section describes the technological resources needed to deliver the REENACT experiences, considering the current design of the EXPERIMEDIA facility, put forward in Deliverable 2.1.3, “First blueprint architecture for social and networked media testbeds”. This design is a theoretical one, inasmuch as the EXPERIMEDIA facility is still being developed and it may undergo some refinements over the next few months. Yet, the modules and interrelations described below may be useful in the conceptual understanding of the experiment and towards the evolution of the facility itself. The actual implementation plan will be explained later, taking into account the current state of the work in the project.

The REENACT experiences will be delivered by one server and three main interfaces that will rely on the single back-end provided by the components of the EXPERIMEDIA facility: the reenactors’ front-end, the expert’s front-end and the administrator’s front-end. The implementation of these components will be linked to the components of the EXPERIMEDIA facility and to some of the resources available to the venue of the Hellenic Cosmos, most critically the Tholos screen.

The REENACT server will be deployed to centralise access to pre-recorded contents and live streaming through the Audio Visual Content Component (AVCC) of the EXPERIMEDIA facility, to store the records of events raised during the reenactments (in the element called “Reenactments repository”) and to control what is displayed on the different areas of the Tholos screen during the replay and debate stages. The material displayed in the top half of the screen will be necessarily handled by a media server that is hard-wired to the Tholos installation, but the three parts of the bottom half will be controlled directly by the REENACT server through a triple video output. To finish, the REENACT server will include an “Images and text repository” element to store the static images and the text documents that may be used for illustration purposes at any time during the REENACT experiences.

The reenactors’ front-end will be provided by a mobile application that will deliver the interactions envisaged for the participants during the reenactment, replay and debate stages. Considering the framework of the EXPERIMEDIA baseline architecture, this component of the REENACT system will go through the interactions represented in the diagram of Figure 1. First, it will rely on the Pervasive Content Component (PCC) to render the augmented reality vision of the reenactments on the participants’ tactile mobile devices, and on the Social Content Component (SCC) to support messaging, ratings and so on during the replay and debate: on the one hand, the “Common social network interface” will be used for publishing and accessing to contents over different social networks; on the other, the “Social network analytics” element will be used in the analysis of the ratings and comments, as needed to draw conclusions in terms of QoC. The front-end will also interact with the AVCC to control the flows of text, images and audio entering and leaving each tactile mobile device. All the quantitative and qualitative data gathered for the evaluation of QoS, QoE and QoC will eventually be sent to the Experiment
**Control Component** (ECC) for later evaluation, in collaboration with the “Social network data management” element of the SCC.

The expert’s front-end will be a web application (accessible through a web browser) providing the functionalities needed by the expert to conduct the replay and debate stages. Conceptually, as shown in the diagram of Figure 2, this application will interact primarily with the AVCC, to allow the experts not to be physically present at the FHW and to retrieve the multimedia contents to illustrate the situations arisen during the reenactments. The expert’s participation will be realised through the SCC as for the other participants. Finally, the expert’s front-end will provide means to manage the arguments raised during the debate, including some features of real-time parsing (e.g. to highlight key words), searching, and filtering of text messages in cases of foul language or disrespectful/offending comments.
Finally, the administrator’s front-end will provide the interfaces needed to supervise the operation of the rest of the elements during the REENACT experiences, including manual control over the orchestration of events during the reenactment stage (in cooperation with the “Live games” and “Location tracking” elements of the PCC) and the gathering of information for later evaluation (in cooperation with the ECC). Its interactions with the EXPERIMEDIA facility would be as depicted in the diagram of Figure 3.
Figure 3. Conceptual links of the administrators’ front-end with the EXPERIMEDIA facility.
5. Implementation Plan

In the implementation of the design presented in the preceding section, UVIGO will strive to make use of the components listed in Deliverable 2.3.3, “First major software release”. The following subsections summarise the findings and expectations about some of the pieces of software included in the baseline components of the EXPERIMEDIA facility. Later on, a summary of risks and contingency plans is given, followed by a presentation of the requirements considered for the choice of tactile mobile devices to use in the experimentation sessions.

5.1. Usage of the Pervasive Content Component

The live game of the reenactment stage requires means to orchestrate events entering and leaving the reenactors’ front-ends according to a given script. Those means will be provided by the Creator environment contributed by the Interactive Institute. This is a software platform for creating, setting up and running pervasive games, or more generally location-based activities. Initially, UVIGO personnel tried to use the environment on their own, guided by some early documentation, but this turned out to be problematic because the Creator has been developed during Year 1 of the project and, even though most of it should be already working, the documentation is still insufficient. UVIGO and Interactive had a telco in the second week of November 2012, and they agreed on a way out of the situation, by which UVIGO would provide the detailed scripts of the game for the scenario of the Battle of Thermopylae, and Interactive would implement them directly in their tool, even though UVIGO might have to implement some specific extensions for such features as the logic to distribute roles among the reenactors. To begin with, in addition to the script included in the Appendix of this document, UVIGO will be providing Interactive with a formal description in the form of labeled state machines.

REENACT also requires means to track the movements of the participants during the reenactment stage, at least to recreate the main locations relevant to the event in question. The Tracker service proposed for the “Location tracking” element of the PCC seems to be a tool with which one can keep track of a group of people in real-time, fed by GPS data. This is not suitable for the experiment for two reasons: (i) the precision attained by GPS is generally too coarse for the scale of the movements expected from the reenactors, and (ii) GPS does not work well in indoor environments, which is the first choice of the experimenters. In the absence of precise mechanisms for indoor location tracking, the experimenters have decided to sacrifice the recreation of precise army moves, while maintaining the delimitation of different zones in the reenactment space, which will be identified and recognised by means of bidimensional codes. It does not seem feasible to implement finer location mechanisms with Augmented Reality solutions with people moving around without requiring too much tweaking or manual intervention. This feature was not considered crucial for the experiment, anyway, and doing without it may even make some things easier for the experimenters to implement and for the reenactors to understand, even though the feeling of immersion may be reduced.

As regards the “QoE measurement” element of the PCC, the Interactive Institute has provided the Babylon software, which is a tool intended to evaluate the opinions of the users while they utilise a given game or service. It provides two basic mechanisms for the users to inform about their emotions (“engaged”, “bored”, “stressed”): the classic emoticons and an innovative wheel of
colors, with which the users can choose to represent different sensations by different colors. One iOS application implementing this approach is available, which cannot be integrated with the reenactors’ front-end of REENACT because it will be developed as an Android application. Yet, the reenactors’ front-end will rely on the same methods as the iOS application to record emotions during the reenactment, replay and debate stages.

Finally, the “Augmented Reality platform” element of the PCC seems to rely entirely on the Metaio Mobile SDK, which has already been made to work in a way that does much of what will be needed for the REENACT experiment by the personnel from the Foundation of the Hellenic World, as explained in Deliverable 4.3.2, “Experiment progress report including intermediate results”. UVIGO personnel have already made some tests with Metaio and there were no apparent problems.

5.2. Usage of the Social Content Component

REENACT needs mechanisms to enable interaction among reenactors, experts and optionally the administrators throughout the entire duration of the experiences, but most critically during the debate stage. In this regard, everybody should be able to publish messages/comments, to share pictures, to rate comments or contents provided by other, to participate in votings, etc. Coupled with these required features, the experimenters will also need tools to trace the activities going on in the social networks and to analyse the user-generated contents in order to draw results in terms of quality of community (QoC).

The EXPERIMEDIA facility provides two pieces of software to implement the “Common social network interface”, “Social network analytics” and “Social network data management” interfaces of the SCC:

- On the one hand, the Social Integrator is a Java library for Android applications that enables access to contents published in social networks as well as the publication of new contents. Furthermore, it provides mechanisms to monitor (in real time) the activity of the users in online communities to send data to the “Experiment Monitoring” (EM) element of the ECC.

- On the other hand, the Social Analysis Dashboard is an adaptation of the WeGov project developed by IT Innovation to match the requirements of EXPERIMEDIA. This is a web tool that allows access to contents and contacts in social networks, plus analysis features.

Following conversations with ICCS/NTUA, the experimenters have decided to rely on the Social Integrator to support the features needed in the REENACT experiment. To begin with, the API and the monitoring functions of the Social Integrator could be used to provide virtual chatting rooms in Facebook or Twitter, with access granted only to the participants in the experiment through accounts created ad hoc for REENACT. ICCS/NTUA have provided something similar to the embedded experiment of the FHW, namely private virtual chatting rooms to which only the members of a given group/event in Facebook can access to exchange questions and answers, ratings, comments, etc. The same approach should serve for REENACT,
also considering that ICCS/NTUA are working to provide the libraries to use such functionalities from Android applications.

The monitoring features of the Social Integrator should also serve to measure such parameters as the number of tweets or retweets including a given hashtag, the number of comments posted over time to a Facebook group/event, … which is needed for the evaluation of QoC. The API provided for these tasks could be extended to include new parameters as long as they can be inferred from the social activity of the users and the data are accessible via the corresponding Facebook or Twitter APIs. The Social Integrator API already covers the communication with the “Experiment Monitoring” element of the ECC.

There seems not to be support for sentiment analysis yet, and neither to use the functionalities of the SocIoS platform, which have not yet been integrated due to license problems.

5.3. Usage of the Audio Visual Content Component

The essentials of the usage of the AVCC in the REENACT experiment were discussed in a telco between UVIGO and ATOS on November 7th. The participants in the REENACT experiences will be faced with audiovisual contents during the reenactment and replay stages:

- During the reenactment stage, the tactile mobile devices will be displaying material to explain to each participant what is his/her situation at the moment, including text, images and short video clips whenever possible/available.
- During the replay stage, the expert will pick successive pieces of content to show to the audience from among the superset of the contents presented to the different reenactor roles.

Text and static images will be stored in the Android application of the reenactors’ front-end or in the “Image and text repository” of the REENACT server, whereas video clips will be streamed from the AVCC. Inasmuch as there may be at least 6 different roles (with different related audiovisual material) and the “Transcoder” element of the AVCC only supports 2 simultaneous streams, the videos will be stored directly in the “AV repository” module in the format supported by the AVCC (H.264+ACC), so that no transcoding will be needed. Yet, the quality of the videos displayed during the reenactment stage may be decreased depending on the bandwidth available (the Internet connection at the FHW is limited to 10 Mbps).

The AVCC will also handle the audio and video feeds from the expert during the replay and debate stages. The same goes for the audio and video feeds coming out of the tactile mobile device of any reenactor that is allowed by the expert to address the audience during the debate.

The interface of the AVCC with the Tholos screen will be controlled by the REENACT server. In the absence of a suitable place in the AVCC itself (the “Live metadata acquisition management” element is still missing), the REENACT server will also provide a “Reenactments repository” module to store the records of events of the reenactments, which is the main source of information for the expert during the replay stage.
5.4. Usage of the Experiment Content Component

The ECC serves as a central point for experimenters to define and configure the experiment architecture, as well as to gather all the relevant information about the experiment results. The three front-ends of the REENACT system will interact with the ECC along the reenactment, replay and debate stages. The interactions between these components, both among them and with the EXPERIMEDIA Facility, will be quite diverse. While the expert’s front-end will not be used during the reenactment, all three components will play important roles in the other stages. As a result, deployment and correct configuration of all software modules will be an important task that must be fully accomplished to guarantee the seamless integration and execution of the experiment components. Additionally, the correct execution of all the components, the adequate interaction among them, and how all these events impact in the users’ valuation of the experiment, must be assessed and offered to the experimenters for them to draw conclusions about the adequacy of the experiment framework and the level of achievement of the service goals.

Both tasks, deployment/configuration and monitoring, receive special attention in the EXPERIMEDIA facility in order to provide support for experimentally driven research and system testing, looking for ensuring “efficient operations and robust/accurate results”. In fact, the ECC may be considered the cornerstone of the whole framework, that coordinates the tasks of deployment/configuration and monitoring, offering to the experimenters a centralized point to control the setting of the framework and to gather all the relevant information registered all along the different phases of the experiment (the QoS, QoE and QoC parameters enumerated in preceding pages of this document).

With respect to monitoring, the EXPERIMEDIA facility provides support both to receive messages from the integrating components (status indicators and metrics) and to store them in a permanent way. Two main modules are provided for the management of the two-way communication (EM – Experiment Monitoring) and to store the received data in a PostgreSQL database (EDM – Experiment Data Management). The communication protocol is the AMQP (Advanced Message Queuing Protocol) and the Facility makes use of the RabbitMQ tool to implement such a communication, formalizing the process of the actor’s registration in well-known access points and to send and receive data messages through the RabbitMQ queues. Both modules will be heavily used and tested by the REENACT experiment, to collect and store the metrics defined in previous sections as well as to check and monitor the correct functioning of all the integrating components.

Regarding specification and deployment, the EXPERIMEDIA facility defines the ES (Experiment Specification) and EDC (Experiment Deploy and Configuration) modules that bring together a set of configuration files with open-source tools as Juju and oinstall. Both elements permit an easy and decentralized software packaging, distribution and installation procedure, with plenty of possibilities to make easier the set-up and configuration of all the components of the experiment. It is sure that the REENACT experiment will make use of these modules to install and set up the integrating components, but it is difficult at this time to provide a precise and detailed description of this process as the software of the involved elements is still under specification. It is not possible to properly assess the support provided by
EXPERIMEDIA for these tasks without the complete knowledge of the used software, being this developed or integrated, as installation and configuration details can be quite diverse and dependant on specific issues as can be license agreements.

Finally, an additional support to be provided by the EXPERIMEDIA facility is related to the assessment of the security and privacy concerns. To this aim, the EXPERIMEDIA framework intends to adapt the SAM tool “to allow for the assessment of security countermeasures configured to protect different types of content included in an experiment”. Since this adaptation to the EXPERIMEDIA goals and procedures is still ongoing work, the REENACT experiment has postponed its evaluation till more advanced phases, focusing only on the specification/deployment and monitoring aspects of the ECC in this initial stage.

5.5. Other software
While, in principle, the reenactors’ front-end will be put to the test only using Android devices (following majority trend in EXPERIMEDIA), UVIGO will consider the option of developing the front-end as a cross-platform application using cocos2d-x, a particularly versatile and well-documented environment to create videogames and other applications that interact heavily with the users. In addition to Android, the code developed with cocos2d-x can be compiled to HTML5, iOS, Blackberry and Windows Phone platforms, which would make it possible to let the participants in the experiments use their own devices instead of limiting to the ones provided by the experimenters (see below). Yet, as explained next, the priority will be to make everything work properly in a set of Android devices that will have the reenactors’ front-end pre-installed.

5.6. Risk and opportunity registries
Risks related to the REENACT experiment will be constantly analysed, evaluated and treated following the methodology explained in Deliverable 1.1.2, “First risk assessment and contingency plan”. As done by the Foundation of the Hellenic World in their embedded experiment, the priority in REENACT is not to put participants in any risk. Therefore participant risks are treated with the AVOID option, where applicable, which has the result of moving the risk from the participants to the experiment.

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Probability</th>
<th>Impact</th>
<th>Proximity</th>
<th>Response</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Mobile device damaged during the installation of the mobile application of the reenactors’ front-end.</td>
<td>low</td>
<td>high</td>
<td>RUN phase</td>
<td>avoid</td>
<td>Instead of using the participants’ own devices, the experimenters will supply their own for use during the experimentation sessions.</td>
</tr>
</tbody>
</table>
The risks for the experimenters would be as indicated in the table below.

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Probability</th>
<th>Impact</th>
<th>Proximity</th>
<th>Response</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Experiments cannot be run because most of the visitors to the FHW are minors, which goes against the Ethical Oversight Measures of EXPERIMEDIA.</td>
<td>high</td>
<td>high</td>
<td>RUN phase</td>
<td>avoid</td>
<td>Participants will be recruited in the social environments of the University of Vigo and the University of Peloponnese (in the latter case, to participate in both REENACT and BLUE experiments).</td>
</tr>
<tr>
<td>E2</td>
<td>Language barriers and participants’ technological background cause problems during the experimentation sessions.</td>
<td>medium</td>
<td>high</td>
<td>RUN phase</td>
<td>avoid</td>
<td>Within the strategy of point E1, it can be expected that the participants will not have trouble using mobile devices, and also that they will have a decent level of English.</td>
</tr>
<tr>
<td>ID</td>
<td>Description</td>
<td>Probability</td>
<td>Impact</td>
<td>Proximity</td>
<td>Response</td>
<td>Comment</td>
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</tr>
<tr>
<td>E3</td>
<td>No expert historians are available to participate in the experimentation</td>
<td>high</td>
<td>high</td>
<td>RUN phase</td>
<td>reduce</td>
<td>The experimenters will try to involve historians from the University of Vigo or working for the Foundation of the Hellenic World. If none can participate, the role of expert will be taken up by one of the experimenters.</td>
</tr>
<tr>
<td>E4</td>
<td>Mobile devices are damaged during the experimentation sessions.</td>
<td>low</td>
<td>high</td>
<td>RUN phase</td>
<td>reduce</td>
<td>Indications will be given on how to grab and handle the mobile devices. Suitable pad straps or similar holding accessories will be sought.</td>
</tr>
<tr>
<td>E5</td>
<td>Required EXPERIMEDIA components not available on time or not working as expected.</td>
<td>low</td>
<td>high</td>
<td>PROVISION phase</td>
<td>reduce</td>
<td>The PROVISION phase should be long enough to allow time to deal with any unforeseen difficulties. Experiments will work in an incremental development / integration cycle.</td>
</tr>
<tr>
<td>E6</td>
<td>Changes to the APIs of social networking sites affect the correct operation</td>
<td>medium</td>
<td>high</td>
<td>PROVISION phase</td>
<td>fall-back</td>
<td>A minimum implementation of the social networking features would be provided by the experiments if the EXPERIMEDIA components could not be updated in time.</td>
</tr>
<tr>
<td>E7</td>
<td>of the SCC or other components.</td>
<td>low</td>
<td>medium</td>
<td>PROVISION phase</td>
<td>accept</td>
<td>If the PCC or the REENACT software cannot be updated in time, the immersive experiences would be discarded and an alternative approach would be used to confirm movements between zones in the reenactment space.</td>
</tr>
<tr>
<td>E8</td>
<td>The Creator environment is often down or does not work in a consistent</td>
<td>low</td>
<td>high</td>
<td>PROVISION phase</td>
<td>fall-back</td>
<td>An ad hoc implementation of an event distribution / orchestration engine for the specific scenario of the Battle of the Thermopylae would be provided (running on the REENACT server).</td>
</tr>
<tr>
<td>E9</td>
<td>The AVCC is down or not working properly during the experimentation</td>
<td>low</td>
<td>high</td>
<td>RUN phase</td>
<td>fall-back</td>
<td>Video contents would be delivered from the REENACT server instead of the AVCC.</td>
</tr>
</tbody>
</table>

Finally, the register of opportunities included in the following table gathers the experimenters’ current stance on certain features that could be provided by the REENACT software.
### ID Description Probability Impact Proximity Response Comment

**O1** Live camera recordings in the reenactment space are technically possible to handle, acceptable in terms of privacy and deemed interesting for the didactic value of the REENACT proposal.

- **Probability:** medium
- **Impact:** low
- **Proximity:** PROVISION and RUN phases
- **Response:** enhance

Live recordings are considered a non-priority feature at the moment. Feedback from early experiment may lead to reconsidering this point.

**O2** Integration of the reenactors' front-end with the interaction controls available to each seat in the Tholos dome is technically possible and deemed interesting for the participants during the replay and debate stages.

- **Probability:** medium
- **Impact:** low
- **Proximity:** PROVISION and RUN phases
- **Response:** enhance

Use of the seat buttons is considered a non-priority feature at the moment.

**O3** It becomes possible to use a location tracking system to get precise information about the participants' movements in the reenactment space.

- **Probability:** medium
- **Impact:** medium
- **Proximity:** PROVISION and RUN phases
- **Response:** enhance

UVIGO is collaborating in the development of an indoor tracking solution based on IEEE 802.15.4 technology. If it were available in time (and the privacy requirements, if any, were properly addressed), the system would be used in the REENACT experiment and the results made known to the other EXPERIMEDIA partners interested in monitoring movements indoors.

### 5.7. Requirements for the participants’ devices

The experimenters had originally thought of providing participants with smartphones, but current models with 4-inch screens (at the most) did not seem practical enough for the amount of information to display. 10-inch tablets, in turn, were found too big to move them to and fro during the reenactment stage. The recent advent of 7-inch tablets came as the ideal choice, with
the additional advantage that they are comparatively cheaper than smartphones, because they do not come with a costly functionality that is not needed in the experiment: making phone calls.

Having decided on the most convenient devices, the next step was to find a model in the market featuring rear camera, gyroscope, compass and other sensors, plus sufficient computing power and a recent version of the Android operating system to successfully run the augmented reality features. The Samsung Tab 7.7 was found to be the only device that met all these requirements by early November 2012, and thereby UVIGO purchased six units to ensure the development and testing of the software needed to run the REENACT experiences with the minimum number of participants. UVIGO will continue to monitor developments in the market to buy a few more tactile mobile devices, in order to allow for recreations with greater numbers. Anyway, the development works will strive to keep the software compatible with as many devices as possible, even to the point of allowing people to participate in the experiments with devices of their own.

Apart from the reenactors, it was found convenient to equip the administrator also with a touchscreen device, but since they will not need to move and they might have to manage a greater amount of information, it seemed a good solution to provide him/her with a 10-inch tablet. To this aim, UVIGO purchased one unit of Samsung Tab 10.1.
The experimenters will look for accessories to facilitate the use of the tablets on the move (and, at the same time, to prevent damages). These may be like the ones offered/described in the following links:

- http://www.thepadstrap.com/
- http://www.tablet2cases.com/wiki/styles/hand-strap/
6. Closing Steps

Following completion and delivery of this document, the PLAN phase of the workplan will be completed with the following tasks:

- Elaborating of a list of video clips and 3D contents for the VR department of the FHW to prepare in order to be put into the REENACT front-ends, the REENACT server or the “AV repository” of the AVCC.

- Sending the reenactment script and the points for the replay and debate stages to Dr. Kleopatra Ferla (Head of the Research and Management of Cultural Information Sector of the FHW) for review and feedback, in order to ensure historical rigor in the REENACT experiences.

- Notifying the experiment goals and procedures to the Spanish privacy commission (the so-called “Agencia Española de Protección de Datos”, http://www.agpd.es/).

- Submitting a paper describing the experiment and its technological basis to the 13th IEEE International Conference on Advanced Learning Technologies (ICALT 2013).
7. Conclusions

Much of human history has been shaped by the outcomes of countless battles and wars. Unfortunately, the classical pedagogy of these events neglects many facts that are both engaging and historically relevant and meaningful. Fortunately, Future Internet technologies provide powerful means to make things better and more interesting. The REENACT approach brings together smartphones and tablets, social networking, serious games and augmented reality as a means to engage groups of people into immersive collective experiences that will make them learn about the prelude, the course and the impact of major battles and wars. The experimentation enabled by the EXPERIMEDIA facility is primarily intended to assess the value impact of the REENACT approach for venues like the Foundation of the Hellenic World and the different people involved in the experiences, but efforts will also be made to assess whether the REENACT solution could successfully enable new pedagogical experiences in primary and secondary schools.
Appendix A. Material for the Battle of Thermopylae

A.1. Sample scenario

Barbara and Carl, two 20-year-old students from the UK are visiting the Hellenic Cosmos exhibitions. When they enter the main building, they feel curious about a proposal to engage in an interactive collective experience to learn about the Battle of Thermopylae. They have heard about this battle many times before, but they can barely give any specific information about its context and its impact in History, even though they recall from a recent movie that it was a fight between Spartans (handsome good guys) and Persians (abnormally-ugly bad guys). They also remember that the Persian army was overwhelmingly bigger than the Spartan opponent, so they won this battle after facing heroic resistance for a couple of days. For some reason, however, the Persians were defeated shortly afterwards.

Barbara and Carl decide to participate in the proposed experience, and they are taken to a room with other participants. Once there, a guide gives one tactile mobile device to each participant, asks them to choose a nickname and provides a very brief introduction to the historical context of the battle with the aid of a video and a few static images. Then, the mobile devices offer the participant the possibility of choosing the roles they would like to play in a reenactment of the battle. Barbara bids for the role of Persian king Xerxes, and she gets it. Carl bids for the role of a Spartan soldier, but there are already too many people for this role and nobody for others, so he ends up in the role of a Phocian infantryman — the roles are picked from a pool, and the distribution is supervised so as to have people in all the relevant roles. "What's a Phocian, by the way?" Carl asks to himself.

Barbara and Carl proceed to choose an avatar to represent them in the game: Barbara decides to use a close-up photo of herself with an angry face, whereas Carl chooses one pre-designed picture of a soldier. When everybody is ready, the mobile devices tell each participant to move to a specific zone of the room in order to start the recreation — the different zones are indicated by markers on the floor, which trigger location changes when scanned. Once in their places, Barbara and Carl can see a 360º augmented reality view of a reconstruction of the Persian and Greek camps in the landscape of Thermopylae back in those ancient times. They can also choose to see a map depicting what each one knows at the moment: initially, the map on Barbara's screen only shows the current position of the Persian troops and Athens in the far distance, whereas Carl's depicts the whole area with the two armies in place (the Spartans and their allies knew the place beforehand).

During the next 10 minutes, Barbara moves around certain zones (never too close to the opponents' stand) and makes decisions about the movements and actions of the Persian troops by choosing among sets of options. Barbara’s map is revealed progressively as the Persians get to know new parts of the environment. Carl, in turn, tries to follow the orders decided by the participant who plays the role of Spartan king Leonidas. When he is sent to guard a path above Thermopylae, he engages in a fight against Persian soldiers. At this moment, his mobile devices displays a sword on screen, which Carl can move around to inflict damage on the opponents. Even though Carl notices that his sword is more powerful than the Persians', the Phocian infantryman he represents dies. Nonetheless, the game is not over for Carl, because he can rejoin
the game by picking up another role from a pool. He decides to become one Theban soldier, fighting next to the Spartans—other roles that existed at first are no longer available (“they may have died as well”, Carl guesses). In the end, the Persians are victorious and the battle finishes with a number of Thebans fleeing and all the Spartans dead.

The guide announces that this is the end of the reenactment stage. Now it is time to move to the Tholos projection room, which was one of the major attractions for Barbara and Carl to visit the Hellenic Cosmos. When all the participants are sitting, a woman called Doris appears on the big screen saying that she is an expert in Ancient History and she is going to explain how the participants’ recreation compares to the real happenings. Her explanations are supplemented by animations representing the map of the battle area and the main movements of the troops, plus a number of other videos and images. At this time, the mobile devices given to Barbara and Carl are displaying keyboards that allow them to exchange comments in a virtual chatting room, with the possibility of sending text to specific individuals (identified by nickname or avatar) and posting to Facebook or Twitter. Barbara starts chatting actively with other participants who are sat two rows behind, while Carl posts several comments on his Facebook wall (such as "I don’t think it was fair to depict Persians as orcs in the movie" or "Just learnt that there were slaves in ancient Greece").

The screen also shows a row of emoticons to let Barbara and Carl indicate their mood as Doris delivers her stuff.

At one point during her explanations, Doris proposes a collective quiz game with multiple-choice questions, and they make it to the last round. Later on, nearing the end of Doris’ explanations, she asks the audience what they think could have been the fate of Ephialtes (a man who betrayed the Spartans). Only 30% of the participants (including Carl but not Barbara) are right to guess that Ephialtes did not have time to enjoy any reward from the Persians due to their defeat in a subsequent battle.

When Doris finishes the comparison of the participants’ recreation with the historical facts, she opens a collective debate about the consequences of the battle in the short, medium and long terms. Barbara and Carl find it very engaging to comment and vote on the topics proposed by Doris: "up to what point would there be fewer ruins in Athens if Leonidas had stopped the Persians’ advance?", "would the Parthenon ever have been built?", "would the Persians have conquered the whole of Europe?", "would there have been Persian equivalents to Socrates, Plato and Aristotle?", "what would our languages sound like?", "would we ever have heard of Christianity or Islam?". Barbara typically chooses the options with fewer supporters, but she is happy to see that she is often aligned with Doris’ opinions and arguments. Doris invites "barbie1986" (Barbara’s nickname) to tell all the audience about her thoughts; she accepts to do so through a videocall, with her face appearing live on the Tholos screen. Participant "kickass18" (Carl) is also invited to address the whole audience once, but he is shier and opts to keep typing comments to be posted on the Tholos screen.

After a few minutes, Doris thanks everybody for their participation and finishes the debate. Prior to returning the mobile devices, Barbara and Carl are asked to fill in a questionnaire about how they liked the experience. Both Barbara and Carl provide short and positive responses. Then, they return the mobile devices to the guide and move on to explore the other offerings of the Hellenic Cosmos.
A.2. Reenactment script

The proposed script condenses on concurrent activities of a few minutes events that, in reality, took place in successive stages over months. The goal is to ensure that all the reenactors have something to do at all times. Actually, this is a meta-script, containing a set of alternative paths and endings. Deviations from the real happenings will be points for discussion during the replay stage.

A.2.1. Roles

The description given in the following subsections is ready to accommodate a varying number of reenactors, with a minimum of 6. At the very least, participants will be needed to take up the following roles:

- Xerxes, king of the Persians.
- Leonidas, king of the Spartans.
- Ephialtes, the traitor.
- Two soldiers for the Persian side.
- One soldier for the Spartan side.

If there were more than six participants, they may take the following additional roles (listed in descending order of importance):

- At least one Phocian (to try to monitor the Anopaea path).
- More Persian soldiers (ensuring that there are never fewer Persians than Greeks overall).
- At least one Theban (of those who returned to their homes before the Persians’ final ambush).
- More Spartan soldiers.
- At least one Tespians (of those who stayed until the end with the Spartans).
- Arcadians, Corinthians, …

The distribution of roles will be provided and supervised by an external module to the state machines. That module will be in charge of offering new roles to those who die.

A.2.2. Zones

The reenactors will be moving around in a room that will have markers on the floor to represent the following places:

- Asia Minor.
- Hellespont.
- Corinth (where the Greeks decided to go to war defending Thermopylae on land and Artemisium at sea).
- Sparta, Phocis, Thebes, Arcadia, … (starting locations).
- Thessaly (home of Ephialtes).
- Settlement of the Persian army at Thermopylae.
- Settlement of the Greek army at Thermopylae, beside the old Phocian wall.
- Location of the Persian onslaughts, the other side of the wall.
- Location in the Anopaean path.
- Greek army rearguard.
- The sky of Elysium (for the Greeks who die in act 4 and do not get new roles).
- The Tartarus (the Greek underworld) to accommodate Ephialtes if he dies.
- The Garothman (Zoroastrianism heaven, for the Persians who die in act 4).

The layout of these zones could be as depicted below over a distorted map of Greece.

A.2.3. Act 1: prelude of the war

The first act will be a representation of the prelude of the war: advance of the Persian army from Asia Minor across the Hellespont, decisions of individual city-states on going to war and congress of Corinth (where it was decided to await the Persians at Thermopylae).

While the Persians build a bridge to cross the Hellespont, Xerxes sends an emissary to try to convince the Greek city-states to surrender and join his empire. The emissary announces the Persian intentions at different city-states and finally goes to Sparta, where Leonidas can choose to kill him or not (which does not make any difference globally). The inhabitants of the city-states visited by the emissary, idle until then, vote whether to go to war or not, and if so send a representative to Corinth. There, Leonidas learns who will accompany him to Thermopylae. In the end, all the reenactors are located in the zones of their settlements at Thermopylae.

Ephialtes does nothing in this act: he remains in Thessaly herding cattle and only in the end does he learn of the Persian advance after completion of the Hellespont bridge.
A.2.3.1. Observations

- Phocians, Thebans, Thespians and others may choose not to go to war. If so, they can take up new roles to continue participating in the reenactment. Spartans are not given the choice.
- If there are no people playing the roles of Phocians, Thebans and so on, the Persian emissary will go straight to Sparta.

A.2.4. Act 2: first day of fights between Greeks and Persians

The second act will be a representation of the first day of fights between Greeks and Persians, to illustrate that the knowledge of the terrain and the better weapons carried by the Greeks served to inflict unexpected damage to the Persian army, notwithstanding its overwhelming numerical superiority. The fight is staged to last a couple of minutes, after which the Persians, defeated, go back to their settlement and the Greeks, euphoric, go to theirs.

While the carnage occurs, Xerxes is visited by Ephialtes and chooses to heed him ("that sounds interesting...") or to ignore and kill him ("this may be a trap..."). On the other hand, during the evening celebration, Leonidas learns of the existence of the Anopaean path and decides whether to send someone to protect it ("it's better to take precautions...") or not ("I don't think they will find it, and I need all Greek forces here"). The decisions of Xerxes and Leonidas will determine the happenings of the third act.

A.2.4.1. Observations

- The fights will involve all the soldiers of each side (plus Leonidas, who may not die in this act).
- Death is reported to every soldier on his screen, but the user immediately relives as another soldier of the same type.
- Even though Ephialtes did not come to Xerxes on the first day, we anticipate his arrival to ensure that the user who represents him is not idle for too long.
- Leonidas will only be given the option to protect the Anopaean path if there is at least one Phocian fighting for the Spartan side.
- If Xerxes does not kill Ephialtes, the latter joins the Persian side and guides others through the Anopaean path.
- There will be no specific measures to recreate the phalanx formation used by the Spartans. During the fights, however, a global screen will be showing images depicting the phalanx of one side and the disorganization of the other, next to animated bar charts representing the casualties of each side. Later, in the replay stage, those images will be used to explain how it was that the Greeks resisted outnumbered.

A.2.5. Act 3: second day of fights & kings’ decisions

The third act is a representation of the second day of battling between Greeks and Persians, giving way to alternative endings that derive from the existence of the Anopaean path and the choices of Xerxes and Leonidas.
If Xerxes decided to ignore Ephialtes, he will have lost a great strategic advantage. This yields a way for the Greeks to win:

- If Leonidas did not protect the Anopaean path, he keeps all the Greek forces with him and so manages to repel the Persian onslaught again, as in the second act. The reenactment continues by act 4A.
- If Leonidas sent the Phocians to protect the path, the Greek army will be weaker down in Thermopylae. Things happen like the previous day, but the Greek side will suffer far more casualties. The reenactment continues by act 4B.

If Xerxes decided to heed Ephialtes, half the Persian troops go with him to the Anopaean path zone. Now there are two options:

- If Leonidas decided to protect the path, there will be a clash up there, in parallel with the struggle down in Thermopylae. The Persians win on the path and spend the night right there, while the Greeks win at Thermopylae, returning victoriously to their camp once again. The reenactment continues by act 4C.
- If Leonidas did not protect the path, it will be plain sailing for the Persians to move through it. Yet, the path is long, so they stay overnight. The reenactment continues by act 4C, like in the previous point.

A.2.5.1. Observations
- In the battle of Anopaea, the dead of both sides will relive as Persian soldiers, so the reenactors don’t have to move to another zone.

A.2.6. Act 4A: Greek victory
After two days of fruitless struggle in a quagmire, Xerxes is out of his mind, and his (self-attributed) condition of God-on-Earth makes him pick up a sword and go fight himself. He goes with all of its army, insisting on the error of the previous two days. Xerxes dies in the midst of the battle. The members of the Persian army, once their leader has been killed, give up and go back to their homes running towards the Hellespont. The Greeks, victorious, start jumping at Thermopylae. END.

A.2.6.1. Observations
- In this final act, the dead Persians do not relive, but rather go to Garothman.

A.2.7. Act 4B: Persian victory following a battle of attrition
A third day of fights and Persian victory by brute force is represented. After everyone has reached the site of the fights, Thebans and people from other city-states may choose to flee, in which case they go back to their hometowns. Commanding an exhausted and reduced army, Leonidas falls in the end and the other remaining Greeks die after a while. Yet, many Persians die over one minute and a half, just for the statistics. Xerxes stays celebrating at Thermopylae, while his troops are sent to wreak havoc in different city-states of Greece. END.
A.2.7.1. Observations

- In this final act, the dead Greek do not relive, but rather go to the Elysium.
- One final scene could be added, with someone playing the role of a Greek soldier who appears on the Hellespont while the Persians destroy everything in Greece. The Greek whistles to bring attention to him, announces that the Greek navy has defeated the Persian counterpart and hints that they will destroy the Hellespont bridge. That would leave the Persian army enclosed in Europe, the fear for which made Xerxes retire to Asia Minor with half of his army, leaving behind another half that was eventually defeated in the Battle of Plataea. The precise details would be discussed during the replay stage.

A.2.8. Act 4C: Persian victory by appearing on the Greek rearguard

This act represents the third day of battle with the Persian advantage of moving through the Anopaean path. Right after starting a new attack on the Greek frontguard, half of the Persians come down the Anopaean path and appear behind the Greeks, who remain completely surrounded. Thebans and people from other city-states are given the option to flee. The Spartans, however, are left for death next to his king. The final attack is a massive discharge of arrows. As in act 4B, Xerxes celebrates victory at Thermopylae while the Persian survivors are ordered to go to trample the city-states of Greece. END.

A.2.8.1. Observations

- In this act, Ephialtes dies by slipping on the way down the path and goes to Tartarus area.
- The dead Greek do not relive, but rather go to the Elysium.
- The scene of the Greek soldier greeting from Hellespont could be added here, just like at the end of act 4B.

A.3. Important points for the replay stage

A.3.1. Points about the prelude

One of the main motivations of the REENACT experiment is to present conflicts in a fair manner, by looking at the reasons and aspirations that each one might have had to engage in the battles, avoiding the simplistic dichotomy of “the good against the evil” —which, by the way, would be sheer demagoguery with a majority of Greek people at the Tholos theatre. In this line of thinking, there are a few facts worth mentioning about the Persian and Greek sides at the beginning of the replay stage (the exact words and additional comments will be chosen by the expert, of course):

- On the one hand, it must be explained that the Persians were certainly not the abnormally-ugly bad guys depicted in certain movies, but people from different places of Western Asia (Media, Parthia, Assyria, Armenia, etc) that were ruled by the Achaemenid Persian Empire. Their expansionism had nothing really particular, since those ancient times saw tens of imperial aims and the options were only those of conquering or being conquered. Yet, the Achaemenids were known to respect the autonomy and the ways of life of the territories they conquered.
On the other hand, the ancient Greeks are often surrounded by an idealistic halo that does not actually tell the whole story. To begin with, the different city-states were not friends to each other, since there were frequent battles between them. They did not even join all their forces to fight the Persians: some of them did, but others surrendered, were defeated or were abandoned to their fate by the others. Besides, even though Western culture praises the Greek's principles of freedom, democracy and the like, it is also true that slavery was institutionally recognized in many of the city-states.

A.3.2. Points about Act 1

Following this introduction, the expert will tell the audience about the prelude of the Battle of Thermopylae, first mentioning the precedent of the Athenian victory against the Persians in the Battle of Marathon ten years before. The explanations will be related to the events recorded during Act 1 of the reenactment script, including the following points:

- The Persians were ready for a full-scale invasion that required long-term planning, stockpiling and conscription. A vast army was gathered, and the preparations for their moves included the building of a bridge across the Hellespont and the digging of a canal across the isthmus of Mount Athos. These works took years to complete.
- Likewise, the Persian emissaries did not travel through the Greek lands the day before the fights started, but rather months before.
- Representatives of the city-states met at a congress in Corinth to form a confederate alliance. Since the reenactment script allows some of the city-states to vote against going on war, it is necessary to clarify which ones were represented in Corinth and which ones were not.
- The congress of Corinth first considered the possibility of fighting the Persians in the North, but the features of the terrain and the overwhelming numbers made them discard the protection of the city-state of Thessaly. Instead, they chose to protect the route to southern Greece, which would require the Persian army to travel through the very narrow pass of Thermopylae, that could easily be blocked by the Greek hoplites.
- The Spartans (the military leaders of the alliance) were celebrating the festival of Carneia and the Olympic Games, which restricted military activity by the time the Persians were arriving. Thus, Leonidas could only take 300 Spartan men with him, but they were joined by other Greek forces along the way.
- According to Herodotus, they numbered more than 7,000 by the time it arrived at Thermopylae pass, while the Persian army is nowadays thought to have had 70,000–300,000 men. Charts will be prepared to let the audience quickly catch a glimpse of the compositions and sizes of the Persian and Greek armies.
- Leonidas’ goal was to resist until the arrival of the main Spartan army. He chose to defend the narrowest part of the pass of Thermopylae, where the Phocians had built a wall some time before.
- Leonidas was told about the Anopaean path from the very beginning (not after two days of fight), and sent 1,000 Phocians on the heights to prevent the Persians from outflanking the pass.
A.3.3. Points about Act 2
Act 2 (the first day of fights between Greeks and Persians) allows the expert to explain that the knowledge of the terrain and the better equipment carried by the Greeks served to inflict unexpected damage to the Persian army, notwithstanding its numerical superiority. The expert will be able to display the different pieces of armor and weapons of each side, emphasizing the point that a huge army travelling from very far away necessarily had to carry light equipment. Likewise, it is time to explain that the pass at Thermopylae was ideally suited to the Greek style of warfare: a hoplite phalanx would be able to block the narrow pass with ease, with no risk of being outflanked by cavalry. The Persians were unstoppable in open terrain, but their numerical superiority was not advantageous in Thermopylae.

One final point about Act 2 is that Ephialtes (who was motivated by the desire of a reward) did not talk to Xerxes after the first day of fighting, but rather after the second. The reenactment script made him go on the first day just to prevent the reenactor playing that role from being idle for too long. Actually, Act 2 condenses the main facts of two days of fighting in only one day.

A.3.4. Points about Act 3
Act 3 represents the happenings of the third day of fights at Thermopylae, which took place in parallel with the confrontation between Persians and Phocians in the Anopaean path. While the reenactment script allows Xerxes and Leonidas to ignore the path, the truth is that the Persians took great advantage of it, first killing the Phocians who were up the mountains and then making it to the Greek’s rearguard. Ephialtes did not fight for the Persians as he does in the reenactment.

A.3.5. Points about Acts 4A, 4B and 4C
The point about the ending of the battle is to describe the real outcome of the reenactment (more or less following the script of Act 4C) and to suggest that the other alternatives could have happened depending on very specific decisions regarding the Anopaean path.

It must be noted that, contrary to what is enforced by the reenactment script, the Greek were not surprised by the appearance of the Persians on their rearguard, because Leonidas learnt from a runner that the Phocians had failed to protect the path. Indeed, the night before, Leonidas called a council of war, where some of the Greeks argued for withdrawal, but Leonidas resolved to stay at the pass with the Spartans. Many of the Greek contingents then either chose to withdraw (without orders), or were ordered to leave by Leonidas. At least the Thespians are believed to have refused to leave.

The final word could be about Ephialtes, who did not fight for the Persians or die by slipping on the way down from the Anopaean path. He expected to be rewarded when Xerxes started ruling over Greece, but this came to nothing when the Persians were defeated at the Battle of Salamis. He then fled to Thessaly, with a reward in place for whoever killed him. According to Herodotus he was killed for an apparently unrelated reason, around 470 BC.
A.3.6. Points about the aftermath
With Thermopylae opened to the Persian army, the Greeks refrained from protecting the advance of the Persian navy too. The Greek navy was able to retreat to the Saronic Gulf where they helped to evacuate the population of Athens to the island of Salamis.

Following Thermopylae, the Persian army proceeded to burn and sack Greek cities on their way to Athens. Meanwhile, the Greeks (for the most part Peloponnesian) prepared to defend the Isthmus of Corinth, demolishing the single road that led through it, and building a wall across it. The Greek navy staged a simultaneous blockade, barring the passage of the Persian navy across the Saronic Gulf, so that troops could not be landed directly on the Peloponnese. However, instead of a mere blockade, Themistocles persuaded the Greeks to seek a decisive victory against the Persian fleet. Luring the Persian navy into the Straits of Salamis, the Greek fleet was able to destroy much of the Persian fleet in the Battle of Salamis, which essentially ended the threat to the Peloponnese.

Fearing that the Greeks might attack the bridges across the Hellespont and trap his army in Europe, Xerxes retreated with much of the army back to Asia Minor—the fear could have been due to the unexpected strength displayed by the Greek at Thermopylae. This point is represented in the last movement of the script in Acts 4B and 4C, with one Greek soldier threatening the Persians from the Hellespont bridge. Still, Xerxes left a force to complete the conquest the following year. Mardonius, the commander, lured the Greeks (most of them Peloponnesians) into open terrain and the two sides eventually met near the city of Plataea. There the Greek army won a decisive victory, destroying much of the Persian army, and ending the invasion of Greece. Meanwhile, at the near-simultaneous naval Battle of Mycale they also destroyed much of the remaining Persian fleet, thereby reducing the threat of further invasions.

To finish, it must be said that Thermopylae was undoubtedly a defeat for the Greeks, though maybe a morale-boosting one. They might have been somewhat successful at delaying the Persian advance, but the decisive happenings took place later elsewhere. Thermopylae is famous because of the heroism of the doomed rearguard (the Greeks have been the object of effusive praise from many sources) and as an example of the advantages of training, equipment, and good use of terrain as force multipliers.

A.3.7. Questions and answers for quiz games
During the replay, the expert may choose to run a collective quiz game with multiple-choice questions. This may be a qualifying game (the one who misses an answer is eliminated) or a cumulative one (the one who gets the greatest number of correct answers, wins). The questions may involve dates, people, historical context and any other features related directly to the Battle of Thermopylae. Typically, there will be only one correct answer, while at least one other option could make sense and at least one would be ridiculous (just to enhance the entertainment aspect). However, there may be questions in which all the answers are correct, just seeing the same fact from different perspectives. A few examples of questions and answers could be as follows:

- What was the year of the Battle of Thermopylae?
1) The 4th year of the 74th Olympiad according to the Attic calendar. (TRUE)
2) Year 274 *ab urbe condita*. (TRUE)
3) Year 2157/2217 according to the Chinese calendar. (TRUE)
4) Year 23 according to the Achaemenid calendar. (TRUE)

- Who was the predecessor of Xerxes I?
  1) Xerxes 0. (FALSE)
  2) Darius the Great. (TRUE)
  3) Julius Caesar. (FALSE)
  4) Arnold the Great. (FALSE)

- What type of bridge did the Persians build to cross the Hellespont?
  1) A pontoon bridge. (TRUE)
  2) A Roman stone bridge. (FALSE)
  3) A cast iron bridge. (FALSE)
  4) A suspension bridge. (FALSE)

**A.4. Topics for debate**

The debate stage is the moment to talk about the impact of a given conflict in the short, medium and long terms. As noted above, the Battle of Thermopylae was not at all decisive, but rather has to be considered in the broader context of the Greco-Persian wars. The social discussion (supervised by the expert) should deal with the consequences of these wars and what might have been different in History if things had happened differently. The topics could be like the following ones:

- Would Xerxes have feared about being trapped in Europe if the Persians had not found such strong opposition in Thermopylae?
- Would there be fewer ruins in Athens today if Leonidas had stopped the Persians’ advance? Would the Parthenon ever have been built?
- Would the Persians have conquered the whole of Europe? If so, would all European countries be like Turkey today? Actually, would there be countries?
- Would the Persians have conquered the North of Africa, too?
- Who would have been the Persians’ greatest rivals: the Macedons led by Alexander the Great the next century, the Carthaginians a little bit later, the Celts, the Vikings, …?
- Would there have been Persian equivalents to Socrates, Plato and Aristotle?
- Would science have developed better or worse? There would have been no great Greek mathematicians, but maybe neither such a dark period as the Middle Ages…
- Would the industrial revolution have taken place? Would the impact of human on the natural environment be greater or smaller?
- Would the Europeans have discovered America, or would someone from America have crossed the Atlantic Ocean the other way before? If so, who?
- What would our languages sound like?
- What about sports and music?
• Would we ever have heard of Christianism or Islam, or would Zoroastrianism get to be
  the predominant religion in the world?
• Would Iran have been a superpower as the USA are today?

A.5. Other footage

During a visit to Athens between November 19th and November 22th, the VR department of
the FHW agreed to provide UVIGO with the 3D models needed to render augmented reality
content, including soldiers, pieces of armour, terrain models and some 360° views of how
Thermopylae might have looked like in the ancient times. Additional contents (especially text
and static images) will be borrowed from the Encyclopaedia of the Hellenic World. Other
material may be retrieved from the Internet (seeking Creative Commons licenses) or created
directly by the UVIGO personnel.