

# Optimising Environmental Educational Narrative videogames: the case of 'A Night in The Forum'

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In May 2019, A Night in the Forum videogame was published in the Sony PlayStation store, for PS VR. It was the final result of the REVEAL eu project, whose goal was to identify strategies, features and tools to develop educational titles in a more efficient, cost-effective and valuable way, exploiting their educational, cognitive and engaging potential for schools and cultural tourism. Environmental Narrative videogames was chosen as a genre suited for this purposes. The paper presents how known issues in the production of videogames have been faced, the solutions identified and results obtained.

CCS Concepts: • **Human-centered computing** → **Interaction design**; • **Applied computing** → *Arts and humanities; Education; Archaeology*; • **Theory of computation** → **Solution concepts in game theory**.

Additional Key Words and Phrases: Environmental Narrative Videogames, Virtual Archaeology, Playstation VR, serious games, applied games, story grammar, storytelling, game design

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## 1 INTRODUCTION

In May 2019, 'A Night in the Forum' (NiF) videogame was published in the Sony PlayStation store. NiF is a 3D applied game for PS VR, produced by a game company [VRTRON], co-designed by a research institution [CNR ISPC], in cooperation with a museum (Museo dei Fori Imperiali in Rome). It is an Environmental Educational Narrative (EEN) video game. EEN is a genre of games whose peculiarities are the realistic environments, in most cases unpopulated, and the story that often is a mystery to solve or a situation that needs to be understood, using the many hints scattered around and typically communicated through written objects or voiceovers. One of the most famous and awarded game of this type is Dear Esther by the Chinese Room (2012). The story takes place in an archaeological site in Rome. It has been developed as second case study of the REVEAL H2020 EU project (2017-2019: <http://www.revealvr.eu>). REVEAL, Realising Education through Virtual Environments and Augmented Locations, has been aimed at exploring immersive VR games for educational (schools and universities) and cultural tourism (museums and historical sites) purposes and at strengthening their production workflow through ad-hoc tools and templates. The goal was to use a very popular platform, such as Playstation VR (PSVR), as a way to increase knowledge around a cultural site, reaching a high number of players in the world, already owning a PSVR. Globally, PSVR has sold until March 2019 4.2 million of devices [6], while in Italy, the country where the cultural site is located, 16.3 million users, 37% of the population between 16 and 64 years old, plays

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videogames and PS4 is the most sold platform, with 3.3 million of Italian players [33]. This has lead also the Italian Ministry of Cultural Heritage (MIBACT) to introduce videogame experiences in the new strategic lines on digital innovation, as a way to promote museums and cultural locations [37].

In order to reach this goal, the following objectives were set: (obj. 1) simplify the work of game company and designers, reducing costs of production and limiting extra needed researches (starting from the assumption that CH sector has usually limited budget); (obj. 2) identify cognitive and learning approaches and tools for immersive games.

Two pilot case studies have been selected and developed to verify to what extent the objectives were reached, within REVEAL. The first case to be developed in 2018 was The Chantry videogame. This game was used to define a complete framework and the methodology that would then have been evaluated, re-defined and re-applied in the second game: NiF. The complete description of the framework can be found in [30].

The following chapters describe and discuss these objectives. We anticipate that an extensive educational evaluation of NiF game and of the recall of the learning concepts has started in February 2020, but was stopped due to the worldwide COVID situation, and therefore could not be included in this paper.

## 2 ISSUES IN GAME PRODUCTION

The creation of a videogame includes typically a three-phase process: a longer pre-production phase (in which most of the design effort takes place), a development phase (programming and preparation of the assets) and a post-production phase (testing and deployment) [16].

In the pre-production phase of the first game, a longer time was spent to identify gameplay and functionalities most suited for educational titles with specific characteristics, focusing on possible inconveniences and trying to avoid them. The idea was to re-use them in other games with similar characteristics, such as: a) the use of reality-based and source-based assets, b) the connection of the game with a physical site, c) the availability of the game in public spaces and not only for home entertainment, d) the adoption of story-telling approach and e) the edutainment scope. The fact that the two cases were quite different (one game was taking place inside a 19th century house and was dealing with the history of doctor Jenner, the inventor of the vaccine against smallpox, the second in a wider and open-air context such as the forum of the emperor Augustus in Rome and was dealing with the story of Roman justice and daily life during imperial times) helped to identify common characteristics and to better extend the framework.

In the production phase, a game engine was chosen by REVEAL consortium: the Sony PhyreEngine. This choice was guided by the fact that this engine is open and free for DevNet developers and could be easily extended to include new features [30]. The game engine is only one of the many costs and problems of production has to face. Productions, in fact, could be really expensive and time consuming, requiring a high number of technical staff, that could exceed in some cases film industry. It is the example of well-known titles, such as Grand Theft Auto 5, one of the most expensive games, with realistic city scenarios, that costed more than 250 million dollars (including marketing), with a team of up to 1000 professionals working on it for four years, and with a profit of more than 800 million dollars, or such as Assassins Creed that costed only 20 million dollars. These examples are very far from small independent productions, aimed at producing educational titles for Cultural Heritage, but they help to identify elements that raise costs and time and to find solutions to limit them.

Typical elements that raise costs of production are *character animation* (from facial animation to body motion), *gameplay design and programming*, *CG rendering*, *hand-crafted artistic graphic*, *visual effects*, *quality control and marketing* [38]. The high costs, on the other side, *have made publishers timid, preferring to serve up more of what their customers like rather than risk tens of millions of dollars on something new and untried* [4]. Applied games, on the other side, require taking risks with limited budgets. In this field, the narrative and scientific backbone is as important as game mechanics, thus unveiling new issues such as *the alignment of gameplay with stories*, *the*

*alignment of stories with educational or cultural contents, reality-based asset optimisation, and when it comes to VR also the avoidance of problems such as motion sickness.*

REVEAL has studied an approach that simplifies game production and at the same time, faces many of above-mentioned relevant problems of the domain. Not all issues could be solved, such as testing and marketing costs or the role of hand-crafted digital artworks, but it is possible to find strategies and solutions for a number of others, as:

- (a) character production and animation,
- (b) 3d asset optimization,
- (c) visual effects and gameplay design and development,
- (d) motion sickness,
- (e) alignment of gameplay with story
- (f) alignment of story with educational content.

The REVEAL framework included: identification of EEN as a genre suited for CH (2.1); definition of an optimal workflow for the creation and optimization of reality-based 3D scenarios (2.2); development of game mechanics and locomotion suited for a wide range of players using an Head Mounted Display (such as that required by PSVR) (2.3); development of an interconnected structure of story hints and pre-defined learning concepts (2.4). Most of the features were built in PhyreEngine or as separate tools, and they are freely available for developers interested in creating new games, cutting down time and costs.

## 2.1 Character production versus EEN (a)

One of the most expensive activities in game industry is character production and animation. Having a limited budget could therefore result in very poor result, thus obtaining a video game pretty far from what players are normally used to. There are techniques and design strategies to limit this problem: in some cases, games might include video inserts with real actors (shot in green screen), or have cartoon style / simplified version of characters [5], or completely avoid characters by limiting the project to a simulation or real time exploration with no gameplay and little narrative [38]. In our case, we needed to adopt a solution which could include storytelling of the CH or historical content, to better develop a playful experience. For this reason we have decided to adopt a game genre particularly suited for the domain: Environmental Narrative video games. They became quite popular after successful titles such as Dear Esther. This genre is completely based on the involvement provided by the narrative, without the need of characters or of other elements that might distract users. Our assumption has been that they could be a solution for educational titles and therefore we adopted EEN genre as a way to answer to the narrative needs, to enable scientifically grounded assets and, at the same time, to limit production time and costs.

## 2.2 Reality-based asset creation and optimisation (b)

One of the problems in game production is the creation of digital assets, due to the aesthetic work needed and to the management of big teams. Complex asset management systems and collaborative approaches are used in game productions [8]. Being applied games (for cultural heritage) different from standard videogames, their production requires a co-design strategy [44], precautions and a tailored efficient workflow for creating and validating historical 3D models, especially when the game is based on hypothetical reconstruction of monuments and sites characterized by gaps and uncertainty.

Indeed this work requires extra effort in terms of time and could be different, due to the potentially very long and complex creation of 3D environments and objects, based on real monuments, remains or collections, and to the team involved. The team of an applied game usually requires a smaller group in comparison to a major production, but their collaboration is crucial to achieve robust and scientific results. The team should include: Cultural Heritage experts (data collection, interpretation, historical descriptive information); Digital Heritage

Team (3D survey, interpretation, 3D reality-based modelling and virtual reconstruction); 3D Asset Manager (storage and optimization); Historical Writers; Videogame Developers (programmers); Videogame Artists (3D modelers, 2d graphics artists); Videogame Story Writers; Actors for audio and Music composer/Sound experts. Typically these professionals are grouped in three different teams: Cultural institutions (CH), Digital Heritage (DH) and Video Game (VG) company teams.

The first game developed, The Chantry, was a testbed to design and experiment a thorough workflow, that was then successfully applied in the second game, NiF. The planned workflow includes the following steps (with teams involved):

- (1) Understanding phase, aligned to game design (all teams)
- (2) Field Survey and Data acquisition (DH team)
- (3) 3d Modelling of current-state CH (DH Team)
- (4) Interpretation and 3d reconstruction of CH in defined historical period (CH and DH teams)
- (5) Details modelling aligned with story and gameplay (DH team)
- (6) Storage of Raw data with metadata (DH and CH teams)
- (7) 3d models optimization for RT game engine(DH and VG teams)
- (8) Props modelling (DH team)
- (9) Node-based optimization of 3d models and props (DH and VG team)

3D models of cultural object can be pure interpretation, inspired by historical sources, or based on real data as a result of direct surveys. It is thus important to start from a phase of understanding (1) [10]:138-165, where historical/artistic sources and archaeological excavations are studied, CH experts are involved and digital data not available are identified. The Understanding is aligned with the Design of the game, involving an iteration and continuous exchange of information among the teams. Images of sources with references are kept and stored. As for not available digital data, a direct survey on site is planned (2). Different techniques can be used for data acquisition, such as Scanner Laser or Image Based Modelling (IBM combines photogrammetry and computer vision to get 3D models from photos), characterized by different features such as accuracy, precision, portability, cost, automation, etc. [48]. The task of the DH team is to assess, case by case, which techniques are the most suitable for his purposes, taking into account operational problems, financial resources and the final product.

In The Chantry, a Scanner Laser was used, while in NiF the IBM approach. A 3D model of the current state of site or object is than produced at highest possible resolution (3). After this phase, the interpretation activity takes place (4), involving CH and DH teams, based on scientific approaches and principles similar to those defined in virtual archaeology [21], [22]. At the end, an hypothesis of a reconstruction is defined and aligned with the design of the game and story, in an iterative process. As for corrupted texts, also 3D reconstruction requires a similar philological approach, to avoid that the visual outcome is just a result of imagination. The consistency of the philological reconstruction is mainly determined by the meticulousness of data collection and analyses. On the other side, gameplay is used to plan how to divide the models in sub-groups, useful for the next phases. The final 3D model is a representation of a CH as it would have been in a certain historical period. External and internal details of the models are also built (5) and kept in separate groups. In accordance with the time/resources available and with the design, all or parts of the scenario is details. Models in original and in exchange formats are stored in a cloud storage (6), together with relevant information and sources: reality-based reconstruction with metadata on acquisition (method, resolution, accuracy, etc.), CG reconstruction with interpretation metadata (sources, historical period etc.). At this point a two-step simplification task is carried out. Models are firstly simplified through semi-automatic re-topology operations which simplified and optimized the base geometry transforming the triangular unstructured mesh in structured grid easier to manipulate in CG [35]. A second optimization is then performed through baking operations. With this technique, aimed at generating libraries of texture maps that describe the different qualities of the surface of a 3D model in a scene (materials, texture,

color, lighting, shadows, reflections, etc.) [34], is possible to achieve the same visual result as the original models (i.e. [17]). Such a result allowed to save a lot of time in production avoiding modeling team to perform laborious manual sculpting operations. In order to enrich the reconstructed environment with realistic details, several props are also modeled (8). Props are scene dressing elements or dynamic objects that the player can interact with in order to solve or trigger specific events in the game and collect information. In order to obtain historically grounded objects, it is used a comparison approach [27], using as reference elements of the same period/context found or represented in iconography. A further node-based optimization is finally performed (9). Being the PSVR the primary output of the applied VR game, the optimization of geometry and textures for static VE elements and props took into consideration both existing VR guidelines and the EEN gameplay [24]. Given the complexity and philological work needed for such workflow, 3d reconstruction of cultural objects should not only be used for one single game. The creation of digital libraries of reconstructive models of cultural assets - including linked metadata and sources used - could be useful for cultural institution and game companies to speed up production workflow.

### 2.3 Gameplay, visual effects and motion sickness (c) (d)

In order to enable all users (expert and not expert) to play, the gameplay was designed as to be as simple as possible. The initial idea was a one-button only device-based interaction. The gameplay was designed in two iterations, testing it in two different contexts and with two stories requiring an increasing number of actions. The gameplay was then established for the EEN games.

The games are played through a first-person perspective in virtual reality. The players use their head to focus on areas of interest in order to perform actions. When they focus their view on a target area or object, one of a number of icons is displayed to the player. Each icon corresponds to a different action. Each individual target area or object can only have one action performed on it. Pressing the x button on the DualShock controller will execute the action.

Actions correspond to specific icons in the game. In the first iteration (The Chantry), only a limited number of possible actions were designed and programmed (fig1):

- Move | *foot icon* | X: This action allows the player to traverse the game environment from node to node;
- Examine | *hand icon* | X: This action allows the player to pick certain objects, bringing them closer for inspection and to eventually listen to connected audio hints;
- Enquire | *question mark icon* | X: This action allows to only enquire an object and listen to audio hints.



Fig. 1. A scene of The Chantry with the icons that the player could select (courtesy Sheffield Hallam University)

During the second iteration (NiF), it emerged the need for more actions to adapt the game to a more complex story and scenario (fig2). Actions available to the player have been therefore extended, activated by buttons of the DualShock controller (controller), as to include also:

- Move | *foot icon* | X
- Examine | *eye icon* | X
- Enquire | *question mark icon* | X
- Collect | *finger* | O: This action allows the player to stash certain objects in an inventory. Such items are displayed as a thumbnail on the player HUD while in the players possession. The player can only hold one object at a time.
- View special objects | R1, R2: Two special types of objects the player can carry are a map of the forum and the task list. R1 and R2 triggers on the controller enable players to open them any time.
- Use | O: This action allows the player to make use of any object in his/her possession. This action will only be available in certain target locations if the player is in possession of the corresponding item.
- Remove | X: This action will allow the player to remove certain items from the game environment .



Fig. 2. Actions available through the controller

A number of problems emerged during the ingestion phase in the game engine (PE), mainly related to the quality of the visual results. The ingestion itself, in fact, was a slow process and Visual FX capability was limited, at least in comparison with the same work done with other engines, such as Unreal or Unity. Unfortunately this has been only partially minimized, by identifying a procedure in the first iteration and then re-used in the second, shared between DH and VG teams.

Another issue in the development of the game has been motion sickness. Since the game was targeting different types of users (not only gamers) and it was planned its use in public spaces (i.e. museums, exhibitions), it was of high priority to find a solution that would have enabled all users to play. The EEN game class is strongly oriented towards possibly prolonged explorative sessions of the virtual environment while wearing an HMD. The locomotion in immersive VR games and interactive experiences is particularly important and actively researched in literature [11], [50], [32]. Most user experiences designed for immersive VR HMD often put limitations or constraints on the ability to walk into the virtual environment (VE): the main reason for such decision is that both developers and researchers did realize that exploring the VE using the wrong interaction model can lead to motion sickness and fatigue. Several solutions have been proposed to solve these problems: the vast majority of these techniques rely on teleport solutions [13], to avoid cybersickness issues and provide a comfortable experience during the game [46].

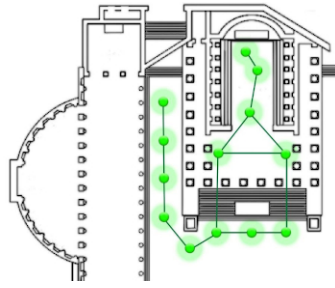


Fig. 3. Example of locomotion graph (courtesy B. Fanini)

In REVEAL, a derived technique based on locomotion-graphs has been adopted. A set of locomotion nodes are placed during level design in key locations where player can move (with proper transition speed) to solve challenges, tightly bound to the EEN gameplay (fig3 ). Some of these nodes in fact, are enabled or disabled depending on specific game events (such as a specific challenge being solved, etc.) allowing to constrain or unlock areas of the Augustus Forum. A complete description of this result is available in [31]. The framework developed during the first iteration, has included this type of locomotion, so that any new game could reuse it, adapting it to new assets and stories workflow.

#### 2.4 Alignment between gameplay and stories (e), stories and content (f)

Another obtained result with the development of the Reveal framework has been the formalization of the alignment between gameplay and story and between story and learning concepts. One of the objectives of the project was in fact the identification and development of features and tools to be used by game designers to produce educational titles, to be used also in cultural tourism, that improved cognition and learning capabilities. The story and the content are therefore key elements. The potential of immersive VR and of environmental storytelling for learning has been extensively studied since the beginning of the 90s [14], [15] and it has been underlined also its contribution to experiential learning, its support to contextualization, spatialization, sense of presence enhancement [18].

Regarding the story, the followed approach was based on the four key properties of environmental storytelling, as described in [30]:176, and on the story grammar theory of Thorndyke [52]. For the structure of the games, we have therefore chosen a graph-based narrative architecture [30]:177. One of the open issues in videogame production, in fact, is the lack of alignment between the gameplay and the story. Usually, in common production, story writers are involved to provide the player with narrative, that is then used to build the digital environments (in-game storytelling). Writers in most cases use specific tools for interactive storytelling [51], such as Twine [1] or Inform [47]. Unfortunately, this activity is carried out separately from game design and programming, thus resulting in a lack of consistency or in parts of the story somehow lost in the final production [26]. In EEN games, stories are developed with educational goals in mind and therefore missing parts would mean gaps in knowledge acquisition. To avoid and overcome this issue the story written for The Chantry was first of all structured hierarchically using a story graph: this structure, in fact, was proved to help memorization and recall [52]. Then a Storyline Scaffolding Tool (SST) was developed by Utrechts university as a multi-platform desktop program that tracks locations in the game where story hints are placed, aligning story elements with game events designed using a gameplay graph (a full description of the tool is available in [26]). SST was also designed to help teachers or educators to check how much content is encountered while playing and to verify accordingly knowledge acquisition. This tool can be potentially used also to check educational potential in already published games.

During the development of NiF, it was used the same approach, but it was necessary to adapt it to new discoveries, emerged during the co-design of the new content. What has emerged, in fact, has been that the story-writing task requires a further internal subdivision into two sub-tasks, also due to the fact that the story grammar structure is too conceptual for the creative work of writers. At the same time, this structure needs to be maintained, being proved to ease memorization [52].

During the first step, DH and CH teams have met and have identified a number of learning concepts characterizing the content. These concepts were transformed into a first version of the story as educational layer (Story A). This was written by DH team using a descriptive communication style [42], [39], and structured using a graph as in The Chantry (fig4).

After this phase, the VG team game writers re-wrote the story (Story B) using a narrative style suitable for both audio or written hints used in EEN. Moreover, in order to verify the knowledge acquisition goal, it was necessary to simplify the gameplay, assigning to each task one or more learning hints. All (Story A and Story B) were stored into a mapping database, where learning concepts of Story A have been associated with story B sentences, and to other elements of the game, such as characters, locations and objects. In this new EEN game structure, it was possible to build relations also between the game and the interpretation process beyond Story A and the 3D reconstructions (places and objects). In fact, since story and models have been built consistently (see chapter 2.2), it was possible to track their connection with sources.

For instance, one of the learning concepts (see in the Appendix the complete list) written by the DH expert regarded the connection between Augustus and Caesar:

*Octavianus Augustus is the first emperor of the Roman Empire, after the Republican period and the murder of Julius Caesar.*

When the player arrives in the center of the square, exploring the facade of the temple of Mars, he reaches a certain locomotion and story-node. He can in fact select a hint and hear the voice of the Roman guard telling to him (text produced by the professional writer):

*I often saw Augustus walking into this part of the Forum. Never sure for what, but it always looked like he was contemplating something. It must have weighed heavily on his shoulders, being the successor to the murdered Caesar. I guess he derived inspiration from being surrounded by icons of his mortal and divine ancestors.*

In some other cases the hint is an object (such as the statue of Romulus in the tribunal, that is mapped on the learning concept of the connection between Augustus and Romulus) or a written text (as a wax tablet that the player can find in the guardpost, another locomotion node, with an invitation to a summon, that represents the mapping with another learning concept)

At last, we wanted to strengthen also the player involvement, by adopting an useful strategy to bridge the gap between the player and the historical content (the historical content in fact can be extremely far and unknown for the user) [7]. Since we learn by comparison ([9]: 68, 94-98), we have adopted an analogy paradigm in the story creation, introducing a multi-temporal analogical spatial approach, that was already successfully tested in a previous serious game [28]. New distant concepts were transformed in the Story B using comparisons with our daily life (i.e. there are many trials for foreigners in Roman times, an emergency as today). In the table at the end of this article are summarised the results.

### 3 NIGHT IN THE FORUM CASE STUDY

The above mentioned structure was used in the design of NiF videogame. We have tried to be compliant with best practices in the digital heritage domain [43]. The game takes place into an archaeological site: the Forum of Augustus in Rome. This scenario is wider than the one in The Chantry (limited mostly to internal rooms) and the actions therefore need to take place into several buildings and in distant open spaces. NiF has used a 3d model of the archaeological site as it is today (introductory scene) and also a 3d model of its reconstruction during the 1st



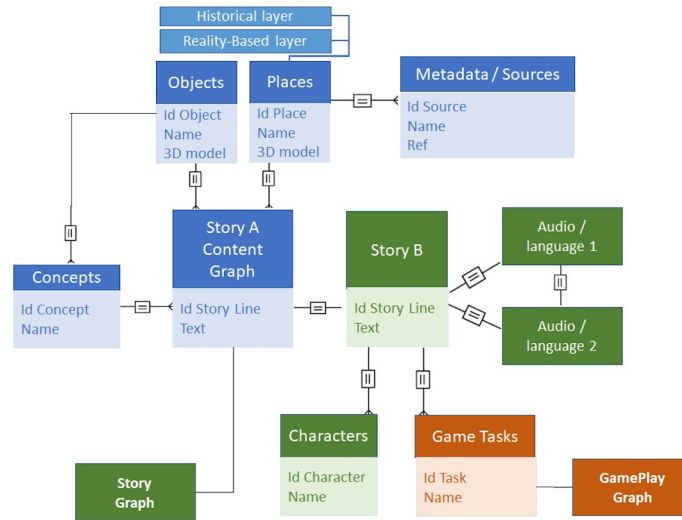


Fig. 4. Graph of the learning layer and its connection with game and story layers

century AD, which includes: the square with its decorated porticoes, the temple of Mars the avenger (Ultor), the sacred room hosting the gigantic statue of a Genius of Augustus (Aula of the Colossus), tribunals, archives and a guard post.

### 3.1 Pre-Production

The pre-production phase included a) the design of the general concept (the plot), b) the definition of the learning concepts and creation of Story A, c) the design of gameplay and game mechanics, d) the identification of the details of the scenarios to be modelled and of all sources needed, e) the creation of Story B and development of the storygraph. All teams were involved (CH, DH, VG).

3.1.1 a) *the plot*. A tourist, while visiting this archaeological site in a guided tour, remains behind and doesn't notice that he is locked inside. It's almost the sunset and while looking around with curiosity, he finds an object on the stairs of a building. It is a shiny helmet and when he picks it up, he is ported back in time, where he has to play the part of the guardian of the forum and carry out all assigned tasks and get the place ready for the new opening at the sun rising, to come back to its time.

3.1.2 b) *learning concepts and Story A*. During three understanding sessions, the teams defined a list of 35 basic learning concepts. The selected concepts are the same that are provided by museum staff to tourists, during guided tours. These moments were also used to verify 3d reconstructions, updating them in consideration of the last studies and discoveries. Main concepts included: the site wasn't an open area, but a place for legal activities and trials of Roman and foreigners (*peregrini*), with tribunals and archives, porticoes and *exedrae*; a lot of information comes from Pompeii and Herculaneum, where have been found invitation letters to trials, written on preserved wax tablets, directed to citizens who were required to show up in a certain area of the Forum and at a certain date/time [53], [54]; the forum included two sacred areas: one dedicated to Mars the avenger (the temple of *Mars Ultor*) and one to the *Genius Augusti*.

The identified learning concepts were grouped into two themes: Rome during Augustus and Augustus the emperor. For each concept, a list was identified of locations, actions/tasks, characters with memory about it,

objects (i.e. the role of Mars | the interior of the temple of Mars | checking if the door of the temple is closed | Augustus | statue of Mars and Venus in the cella) (fig5). The concepts were used to produce a first version of a story, with a more descriptive style (Story A).



Fig. 5. A scene of the videogame with the locomotion node (the feet), in front of the temple of Mars the avenger

The tasks assigned to the player have been designed as to better align with the learning content. They have been spatially distributed in the most relevant areas, such as inside the temple, in the archives, in the tribunals, in the area with the statue of the *Genius Augusti*. This distribution has also the goal of letting the user visiting the entire architectonic complex to understand the various activities that took place here (fig3).

3.1.3 c) *gameplay*. In order to be able to get back, the player needs to fulfill all assigned tasks. The tasks are: put in order the wax tablets left around (1), verify that the doors of the temple is closed (2), clean the altar from remains of the sacrifices (3), verify that the fire in front of *Genius Augusti* is lighted (4), order chairs and tables in the tribunal (5), find the left mantel (pallium) of a senator (6), remove left working tools from the scaffolding (7), collect all objects abandoned or left around (8).

Tasks are written on a wax tablet and the fulfillment of a task is a separate episode in Story B (as it can be seen in the graph of fig14 ) (fig6).

During the game session, the player understands what is happening and what are the tasks. To achieve this, he/she has to use all hints, like memories, documents (written and audio hints) and objects, finds a task list written on a wax tablet and a map and use them during the game.

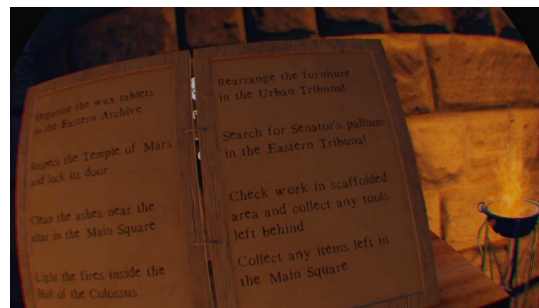


Fig. 6. The wax tablet with the task list

3.1.4 *d) Scenarios and Sources definition.* Scenarios were decided after Story A. It was planned to use a 3d model of the archaeological site as it is today in the introductory scene and a second scenario comprehending all models belonging to the reconstruction of the forum during the 1st century. Within this reconstruction it was decided to focus the game into specific areas, that will then be modelled in detail: the central area with the basement of a statue, the temple of Mars with its internal sacred room (the cella) and an altar on the external stairs, the porticoes with the statue of the *Summi Viri*, the room of the Genius, the guard post, two tribunals and only one archive (the archaeological information about the archives in fact was too limited). In accordance with this choice, it was decided to update an already existing model of the forum, reconstructed for a previous project, Key to Rome [23]. Sources were provided by the CH team to update the model and to model new parts, details and props. An Owncloud infrastructure was prepared to store models and sources in a hierarchical structure, shared with DH and VM teams.

3.1.5 *e) Story B and storygraph.* DH and CH teams organised Story A into a shared document accompanied by a storygraph (fig14) and provide it to the VM team. At this stage, a professional game writer was involved and together with DH team, it was produced a Story B with more narrative style. This Story was then used by the writer to produce the dialogues for the game (audio hints).

In the Appendix it is reported the story and its representation as story-graph (fig14).

The entire pre-production phase lasted only 3 months in case of A Night in the Forum (Table 1)

## 3.2 Production Phase

The production phase of the NiF included a) the production of all digital assets (today scenario, 1st century scenario and props) and their storage in the Owncloud infrastructure, b) the creation of an optimized version of the assets, c) their ingestion in PE, the programming of the game mechanics and d) the production of audio hints.

3.2.1 *a) Digital Asset production.* The 3D scenario of the actual site was modelled using a reality-based technique (Image Based Modelling IBM) [49], while for the 3D scenario of the site in the 1st century we have used a source-based approach. We have defined the reality-based scenario also figurative [12], since it portrays the original architecture in a plausible way.

To fully align NiF design with the planned framework (2.4), the two scenarios have been linked spatially to enable the player to perform a comparison: when the player is teleported in the past, he/she can see the perfect overlap with the site as it is today, thus contributing to align the two representations in his mind, developing a hook and reference during the entire game.

A 3D reconstruction of the Forum of Augustus was already created for a virtual museum [23] in the exhibition Keys to Rome [2], [41], organized by V-Must [3],[42], [29], [40] and held between 2014 and 2015 at the Museo dei Fori Imperiali. This reconstruction represented the Forum during a different historical period (Trajan s 98-117 AD) and its aspects significantly changed by the construction of the neighboring Fora of Nerva and Trajan. Consequently the DH team decided to restart from this baseline and re-model the Forum reusing when possible or improving details and textures, using the new historical, iconographic sources provided during the pre-production phase. This reduced the time of data collection and content creation.

The modelling of the forum for Keys to Rome took 6 months (from pre-production to production), while for the NiF only 2 months were needed.

The new Augustan forum was modelled on the basis of the direct surveys (thus inheriting its correct measures and validating dimensions and proportions [19]) and interpretation activities carried out considering all available sources [53], [54], giving the archaeological remains the architectural and decorative completeness.

During the production phase, it was noted that available historical and archaeological sources were insufficient to reconstruct many of the details. For this reason it was decided to use further sources, such as comparisons,



Fig. 7. *Genius Augusti* reconstruction, belonging to historical layer, and comparison with the remain of a finger kept in the Imperial Forum museum (Marble piece of the colossal statue of Genius Augusti - index finger - Museo dei Fori Imperiali, Roma)

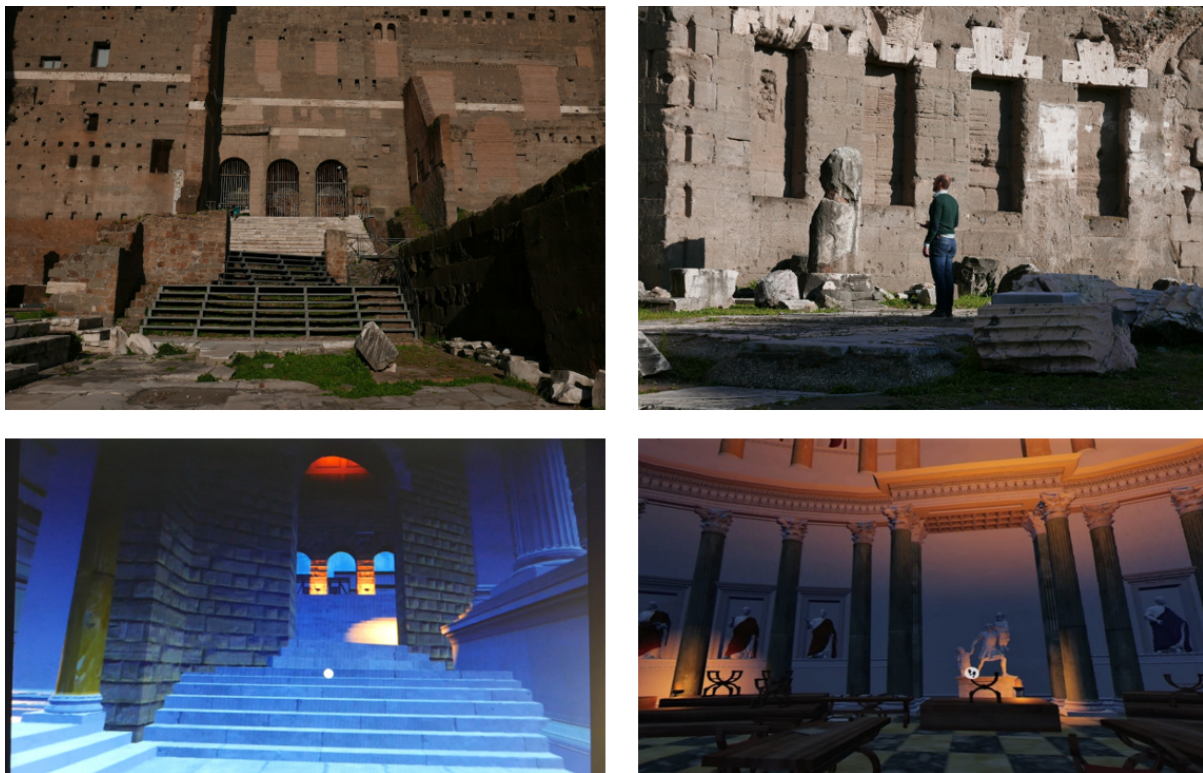


Fig. 8. Comparison between the archaeological site (Forum Augusti, Rome) and the historical layer

reliefs and iconographies (such as the relief of the *Ara Pietatis*, portraying with great details the front facade of the Temple of *Mars Ultor* or the table of G.B Piranesi depicting the state of conservation of the site in the 18th century [45]). The reconstruction process was carried out using the Extended Matrix approach, developed by

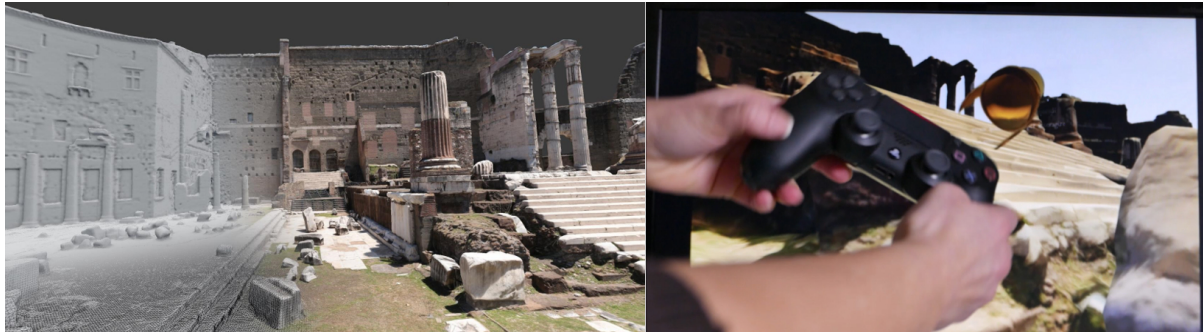


Fig. 9. Left:3D models of the Forum after the digitisation and postprocessing. Right: the Forum in its actual state of preservation in the game

CNR VHlab, a visual node-based formal language based on a stratigraphic approach in use in archaeology, to enable the storage of metadata during the production (for details on this approach [20]). Using this approach it was possible to update the mapping database accounting the sources used and the interpretation processes that have led to the reconstruction of the forum.

The modeling included also hidden parts, such wooden frames and trusses of the roof and ceilings, in order to carry out a plausible simulation. However, the invisible parts were stored but not implemented in the game for graphic performance reasons.

The details about the reconstruction are available in [24].



Fig. 10. 3D reconstruction of the Temple of Mars Ultor juxtaposed with the 3D model of the site digitised with IBM techniques

The most challenging parts to be digitally reconstructed have been the decorative apparatus. The Forum, in fact, was adorned with complex and lavish architectural elements such statues of eminent Romans in the porches, Caryatids and *clipeia* with head of Jupiter in the *Atticus* (fig11) or Capitals decorated with Pegasus protomes in the colonnades of the *Cella*.

3.2.2 *b) Optimisation.* The topology was optimized for RT engines and fundamental characteristics such as the recognizability of the basic geometry and the physical behaviors and chromatic information of the materials that compose the surfaces are baked into textures (for further details see [24]).

Complex elements were reconstructed and needed a particular care in optimizing a version for the game engine. The most challenging parts to be digitally reconstructed have been the decorative apparatus. The Forum, in fact, was adorned with complex and lavish architectural elements such statues of eminent Romans in the porches,

Caryatids and *clipea* with head of Jupiter in the *Atticus* (fig11) or Capitals decorated with Pegasus protomes in the colonnades of the *Cella*. Whenever possible complex elements were produced from IBM techniques and then optimized. As described in 2.2, models have been simplified through re-topology [35] and baking was than applied.

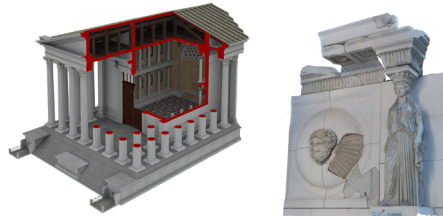


Fig. 11. Left: Section of the Temple of *Mars Ultor* with the hidden wooden infrastructures. Right: 3D model of part of the *Atticus*, digitised with IBM techniques

Finally, several props have been modeled, including a Roman workshop with a crane that would have enable the player to reach the *Atticus* and see at close distance the decorative apparatus. Also in this case, historical and iconographic sources, available from pre-production, were used. For example, wax tablets were reconstructed using the comparison with objects represented in frescos (portrait of Paquio proculo at MANN Museum of Naples) or found during excavations in Pompeii and Herculaneum (*vadimoniale* document: [36]: 193) (fig6): the Roman crane was modelled using a relief of the Tomb of Haterii family (fig12) ([55]: 51).

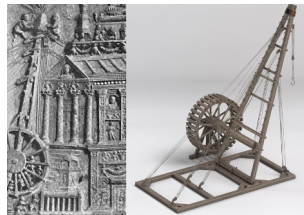


Fig. 12. Left: Historical source used for reconstructing the roman crane, one of the game props - Machinery interpreted as a crane, sculpted on the tomb of the Haterii family [Alinari photograph from [55]: 51, Creative Commons, Public Domain, Mark 1.0); Right: 3D reconstruction of a Roman crane

3.2.3 *c) ingestion in PhyreEngine and programming.* As anticipated, the ingestion of the digital assets in PE took quite a long time, in comparison with a test that was done using another engine (Unreal) it required 50% more. For this reason, the optimisations tasks already carried out in (b) were fundamental to try to limit this effort. The programming in PE was quite straightforward, thanks to the features and template made available by The Chantry production team, including the locomotion interaction model. Only the new behaviors required a longer time to be ready, especially the new actions not foreseen in the previous game (see 2.3).

3.2.4 *d) production of audio hints.* The last, quite short, phase regarded the production of the audio files to be connected with locomotion nodes and with the inspectable objects. The production of the first alpha lasted 4 months in The Chantry, while in the NiF, it took only 2 months, although it was necessary to further work on the programming of the game to include the new behaviours and obtain the first beta version ready for testing.



Fig. 13. Some of the props modeled for the game

Nevertheless it can be considered a time surprisingly short in comparison with the normal effort required by games development.

In case of the digital asset pre-production and production, we can also compare the work done with the same asset in the previous Keys to Rome project, that needed around 9 months to be completed (same number and level of expertise for people involved). In NiF, the same activities required 3 months, due to the re-use of models and sources.

#### 4 CONCLUSIONS

The paper has described the production of an Environmental Narrative Videogame, a Night in the Forum, developed within REVEAL European project, focusing on the identification of solutions to known issues in game production and in the development of templates, procedures and tools to help game designers and developers to create educational titles in PSVR.

The results have been quantitative and qualitative.

Objective 1 (work simplification), was reached. The application of the Reveal framework has demonstrated that it is possible to cut time and costs of development. Moreover, adopting this framework, it was possible to carry out easily the scientific transfer from research institutions (CNR ISPC) to a game company (VRTRON). Its further extendibility, beyond the partner, is facilitated by the free availability of developed tools and features, through the Sony SCEE Net and through the Rage network.

One of the most relevant results has been the overall reduction of pre-production and production times. The teams involved were similar in terms of numbers and skills (with the Chantry team more skilled in the use of PE). The alpha of the first game was produced in around 14 months, the second, while the alpha version of NiF, that required to immediately re-use the Reveal framework, required only 7 months. The time required from pre-production to the development of the release is higher due to the new interaction modalities introduced between the alpha and the beta of NiF; nevertheless the first game required in total 21 months to be published in the PlayStation store, while the second 18 months (Table 1 ).

Objective 2 (cognitive and learning approaches and tools) was also reached. Many of the known issues described in chapter 2 have been faced and solutions have been proposed. The table at the end summarizes the results of the project.

Table 1. Game Creation

| -                                  | Chantry   | NiF       |
|------------------------------------|-----------|-----------|
| =GAME CREATION (alpha):            | 14 Months | 7 Months  |
| =GAME CREATION (release):          | 21 Months | 18 Months |
| Pre-Production:                    | 10 Months | 3 Months  |
| a) the plot                        |           | 0,5 M     |
| b) learning concepts and Story A   |           | 1M        |
| c) gameplay and game mechanics     |           | 0,5M      |
| d) Scenarios and Sources           |           | 0,6M      |
| e) Story B and storygraph          |           | 0,4M      |
| Production (Release):              | 11 Months | 16 Months |
| a) Digital Asset production        |           | 4M        |
| b) Optimisation                    |           | 1M        |
| c) ingestion in PE and programming |           | 10M       |
| d) production of audio hints       |           | 1M        |

| Results                                |  |  |   |   |
|--|--|--|---|---|
| TASK                                   | ISSUE                                      | KEY INDICATORS                                 | SOLUTION                                  | RESULT  |
| Character production                   | long time and high costs                   | Reduction of time and costs                    | EEN (no character)                        | Time and costs: 0   |
| Creation of Digital Assets             | long time and high costs                   | Reduction of time and costs                    | Re-Use of assets                          | Time and costs: reduced by 70%                                  |
| Creation of historical reconstructions | content experts not included in production | Pre-production team including also specialists | Inclusion of Digital Heritage specialists | CH and DH teams included  |
| Ingestion of assets                    | Long ingestion time                        | Faster ingestion                               | Procedure or use of different engine      | Procedure identified and shared                                 |
| Visual effects                         | High effort in PE                          | Advanced VFX effects                           | Use of more suited VFX and engines        | -   |
| Game mechanics                         | Motion Sickness                            | Motion Sickness limited of cases               | locomotion-graphs interaction model       | Locomotion-graphs applied                                       |
| Story design                           | Lack of alignment gameplay -story          | Stronger connection bw game                    | graph-based narrative architecture        | Storygraph applied / Storyline Scaffolding Tool (SST) developed |
| Learning concepts                      | Lack of alignment story -concepts -sources | Better connection                              | Maps of content - DB                      | DB developed and used in Story A                                |
| User engagement in educational games   | Distance bw player -historical content     | distance minimisation                          | Analogy                                   | Analogy adopted by Story B                                      |

Regarding the evaluation on the results, part of them have been already tested during survey sessions. Specifically, the educational impact obtained during classroom sessions, playing The Chantry, have been carried out by



UTC Sheffield, while the Storyline Scaffolding Tool (SST) as a tool to measure story completeness, level of lostness and usability have been tested by Utrecht University. What those studies has started to demonstrate as learning outcome is that spatial memory is reinforced by the immersive game-play provided by the VR immersivity and the EEN structure [25]. In the next months, a further testing experiment will be completed by CNR ISPC on Night in The Forum videogame, to fully verify the assumptions described in this paper with groups of students and tourists.

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Night in the Forum videogame is available for PS VR players in the Playstation store and in 3 languages (Italian, English and Dutch) and can be used by museums, schools, families and tourists interested in Roman history and archaeology. In February 2020 VRTRON has published the new release of the game for PS4.

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Appendix: Story and Story-graph

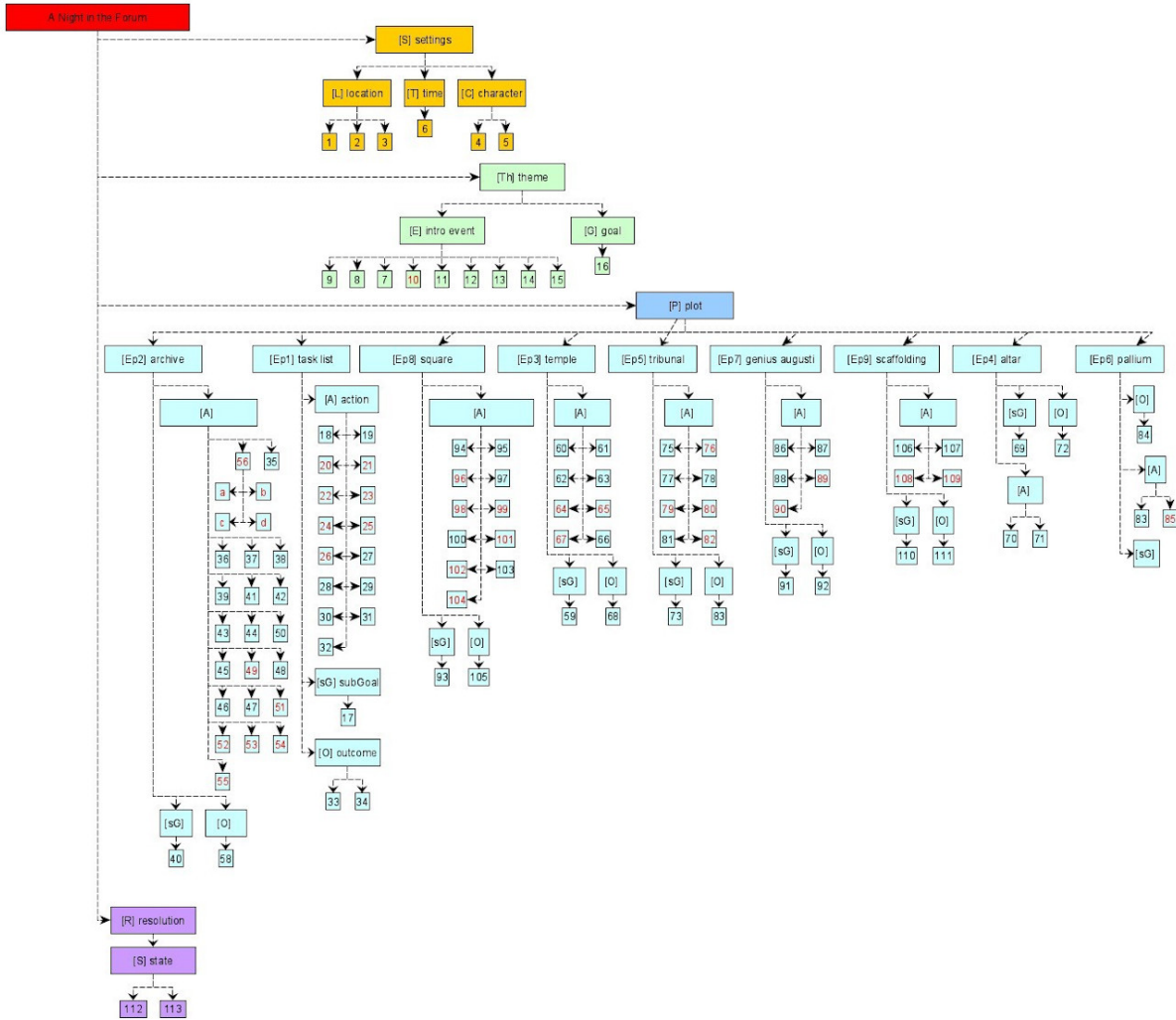


Fig. 14. The storygraph of A Night in the Forum

.1 The learning concepts

- Octavianus Augustus is the first emperor of the Roman Empire;
- Adopted by Caesar he fought and defeated, together with Mark Antony, his father killers (Brutus and Cassius) during the battle of Filippi in 42 BC;
- He thought that his success was possible thanks to the support of the god Mars;
- After Filippi, Augustus had to face and defeat Mark Antony in the battle of Azio in 31-27 BC;
- Thanks to successes and with the support of the Senate, it was named Emperor ruling alone the Roman empire unified;

- Augustus became the head of the army, religion and public administration;
- he didn't want to be considered a tyrant but a wise man who obtained his power by faith and by his lineage;
- Augustus wanted to be reconnected to Venus, who was Caesar mother, through Aeneas;
- Augustus wanted to be directly connected to the Summi Viri, historical characters, such as Romulus, first founder of Rome;
- Augustus wanted to be connected to divinity and built a sacred room for worshipping its figure represented in a gigantic statue of the Genus Augusti;
- Augustus restructured the law and administration of the empire;
- Roman law ( Ius Romanum ) is the basic framework of contemporary Civil Law, the most used legal system today;
- Augustus built the forum between the 27th BC and 2nd BC (official opening);
- The forum was the place for the administration of justice, with tribunals and archives;
- Different materials used to build the forum were coming from the different countries of the Empire;
- Augustus wanted to be remembered as one who did actions in favour of the Roman people: he found a Rome of bricks and left a Rome of marble;
- The forum was not open to all citizens, but restricted to people who had business to do inside;
- The forum was reserved to people working for Administration or management of Justice: lawyers, praetors, priests also citizens called for an hearing or trial;
- The function of the forum has been for long time unknown;
- The forum was built with porticoes hosting statues of the Summi Viri and Gods connected to Augustus propaganda and to Rome history;
- A temple was placed in the center, dedicated to Mars the Avenger and to the goddess Venus;
- In the temple, priests were in duty of making sacrifices and taking care of the sacred Cella, that could not be entered by anybody;
- Inside there were the Emblems of the Parthians
- Roman law was applied differently when dealing with a dispute between Roman citizens or between foreigners;
- Usually the disputes had a preliminary phase, with invited parties who had to be present in a specific area of the forum;
- In the central square in front of an hanged decree, an authority, specialised in Roman law, would listen impartially to the parties and decide whether or not the case was worthy of a trial;
- Preliminaries used to end with the signature of the documents by the parties, using the SIGILLUM-ring on the wax;
- In case the dispute would need to be further discussed in front of the praetor, the authority would indicate the appropriate tribunal where they would need to go (Urbanus or Peregrinus);
- In the tribunal the case could be presented to the praetor, sat on a podium;
- in important cases a jury of up to 75 Roman citizens were called to judge;
- interesting or scandalous cases drew large audiences of up to 100 people who often participated by shouting and jeering;
- Many women were involved in the trials (being accused or accusing) and there were also women-lawyers (from the 1st BC to the 3rd AD);
- the trial results depended on the status of the accused, with the poorer receiving worst results, such as worst fines or compensations;
- Disputes could deal with different matters: in most cases regarded money, the concession of Roman citizenship, a dispute around the status of Roman citizens for sons of Liberti, or disagreements regarding trade of slaves;

- All documents related to those trials were conserved in archives where in shelves and closets contained a number of wax tablets and Papyrus;
- Tablets were invitation to trials, with indications on day and time and location to show up;
- Spatial indications were not given providing an address but indicating a specific place, such as a statue or a column.

## .2 The story of A Night in the Forum

The forum of Augustus, the first emperor of Rome [1], is an archaeological site in the center of Rome [L][1]. It is part of the Imperial Forum area [L][2]. The forum was built by Augustus between 27th BC and 2nd BC [L][3][13]. A tourist, while visiting this archaeological site in a guided tour, remains behind [C][4]. He doesn't notice that he is left alone and he is locked inside the site [C][5]. It is almost the sunset [T][6]. While looking around with curiosity, the tourist finds an object on the stairs of a building with few still standing columns [E][7]. The object is a shiny helmet [E][8]. While the tourist moves closer to it, a solemn and deep voice starts talking [E][9], telling him that when he (the voice) was 19 years old, he raised an army to set the state free from the domination of a faction (s)[E][10][2][11]. The tourist is invited by another voice, that talks with a familiar tone, to pick up the helmet[E][11]. When he takes it, everything fade to black [12].

When he opens up his eyes, the tourist sees himself in another time [13]. Instead of the ruins, there is a massive temple in front of him [14]. It is dark, stars above his head, nobody around, only the sound of the night [15]. The voice heard before, tells him that if he wants to return to his future, he has to spend the night in the forum in the shoes of a Vigile [G][16].

While searching to understand how he could wear these shoes, he starts exploring around [Ep1][sG][17]. The two voices, the deep one and the familiar one, accompany him, helping and providing precious information, although not always simple to understand [18]. They tell about the temple [A][19]. It is the Temple of Mars Ultor, the avenger, built in the forum of Augustus from spoils of war (s)[20][13]. Mars was a symbol of the strength of the Roman Empire under Augustus, having this god helped him to avenge his father murderers (s)[21][22]. Augustus was, in fact, the successor of the murdered Caesar (s)[22][1][3][8]. In the temple pediment are represented 4 important figures represented here - Fortune, Rome, Palatine and Tiber (s)[23][22]. Two statues of Victory are placed on top of the roof (s)[24]. They represent the victory of Augustus who defeated in two battles the men who slaughtered his father (s)[25][22][3][4]. He was first helped by Mark Antony but later he decided to align with Cleopatra and therefore he had to face him in the battle of Azio (s)[26][2][3]. Following the side of the temple, the tourist finds some high steps that lead to a room through an arch [A][27]. Here, on a table, he discovers two scrolls of papyrus [A][28]. He opens them and finds out that the first is a drawing of a map [29]. He thinks that it should be the map of the place where he is: the forum [30]. The map shows a building in the center of a square, with porticoes at the two sides, giving access to various rooms [31]. The second scroll contains a list of eight tasks [32]. The tourist now understand what he has to do [O][33]: he has to complete all the duties to go back [O][34].

He then sees on another table some objects and approaches them [Ep2][A][35]. They are tablets with a wooden frame and the internal part of wax engraved [36]. Many of them have been found by archaeologists, who were able to understand the function of this area, being these tablets used to invite people to trials (s)[37]. In the forum, in fact, civil or family cases were tried, with judges chosen at random (s)[38][14][19][12]. Not everybody could enter here, only those who had legal matters to attend to or those who held a position in offices (s)[39][18]. As written in the task list, the visitor must bring those tablets back to the archives [Ep2][sG][40]. He therefore picks up one wax tablet and sees that it is an invitation letter for a trial slated for today [A][42]. The parties are invited to meet outside the tribunal of the Praetor Urbanus [43]. The praetor was a magistrate well-versed in Roman Law, overseeing the hearings (s)[44][19]. Roman Law was called *Ius Romanum* and it is still the base of our legal system (s)[45] [12]. The visitor picks the second tablet on that table [Ep2][A][46]. He sees that this is another

invitation for someone to attend the hearings in front of the statue of Diana Lucifer, at the 10th column [47]. The visitor, after having collected all tablets, directs himself toward the eastern archive, following indication of the map on the papyrus [A][48]. The porticoes at the two sides of the temple, gave access to mirror rooms where archives and tribunals were located (s)[49]. He enters in the eastern archive, after having crossed diagonally the forum square [50]. The archive was used probably to store legal documents written on wax tablets and papyrus, conserved in wooden closets, while tables were probably used for examination (s)[51]. From wax tablets archaeologists have understood the function of the forum, but also the common types of trials (s)[52]. Trials were carried out differently in cases involving Roman citizens or Romans and foreigners (s)[53]. They were overseen by the Praetor Urbanus and Praetor Peregrinus (s)[54][24]. There were four categories of disputes (s)[55]: *Fiducia Cum Creditore* on financial case (siblings clashing over inheritance, unpaid debts between business partners) (s)[56a][34][34a]; *Emptio Venditio* on slaves matters (s)[56d][34][34d]; *Judicium Ingentitatis* dealt with problems of status (s)[56c][34][34c]; and cases on immigration (s)[56b][34][34b]. Foreigners were known as *Peregrini* and they aimed at reaching the Roman status (s)[57]. The visitor places back in the closets all tablets that were left around on the tables [O][Ep2][58].

The visitor wants to fulfill another of the tasks and goes to the temple to see if the door is closed [Ep3][sG][59]. He climbs the stairs, reach the front colonnade and sees that the door is open [sG][60]. He enters to check if everything is ok [Ep3][A][61]. Inside the temple there are torches illuminating several statues around [62]. Two bigger statues are standing opposite the entrance, the god Mars and the goddess Venus [63]. Mars and Venus were important for Augustus (s)[64]. Augustus wanted to highlight his connection with Venus through her son, Aeneas (hero and descendant of Romulus and Remus) and through him with Caesar, his adoptive father (s)[65][22]. Close to the statues there are three stands with symbols [66]. Military standards, recovered back by Augustus after having defeated enemies in Spain, Gaul and Dalmatia, were conserved in the temple (s)[67] [23] [23b]. Everything in the temple seems in order, therefore the visitor leaves the temple and closes the door [O][68].

While descending the stairs of the temple, he noticed some ashes on top of what seemed a marble table [Ep4][sG][69]. The altar was placed outside the temple for priests and emperor to perform sacrifices (s)[70]. He cleaned the area [A][71] and completed also this task [O][72].

The tourist then decides to further explore the porticoes and search for the tribunal to re-order it [Ep5][sG][73]. Looking at the map, he finds the entrance of another semicircular shape room with niches, statues, a podium, chairs and tables all around [A][74]. In the tribunal, chairs were used for the jury, in some cases more than 75 people, and for the audience [75][30]. Here trials were discussed (s)[76]. Looking around at the various statues, the visitor notices a bigger statue at the center of the hemicycle representing Romulus, mythological founders of Rome [77][9]. While the visitor is moving and re-ordering the chairs, he finds a sort of mantel, a *Palla*, used by women draped on top of their tunics [78][32]. He finds also a collar or silver necklace, of the type used by slaves (s)[79]. Disputes over trade of slaves were called *Emptio Venditio* and they regarded foreigners, who could be sent to exile or enslaved, while Romans were not sent to prison, but they paid fines (s)[80][34][34d]. The tourist moves a table and finds a wooden object: a doll! [81]. In the trials, before the magistrate, the Roman praetor, pronounced his decision, defendants used any strategies to gain pity, such as bringing wives and children to influence the jury (s)[82][31]. The tribunal, after having picked up all left object and re-positioned the chairs, is now in order for the next morning [O][83].

While the visitor is leaving the room he sees behind a table another fabric: the senator's *Pallium* [Ep6][A][83]. He now can take it to the guard post for safekeeping [O][84]. Senators, such as riches usually received a better treatment in the eyes of the law, while the poorer had the harsher the fines and lower the compensations (s)[85][33].

While descending the stairs of the guard post, where the visitor had left the *pallium*, he sees on his right, under the portico, a pale light illuminating a room [86][Ep7][A]. Inside this room, he sees a gigantic statue, more than 10 meter tall, partially colored, dressed and with two objects in the hands [87][A]. The statue standing inside this

sacred area was consecrated by Augustus to a Genius, the protector of the senate and the state, resembling the emperor himself dressed as a priest [88][7][10]. Augustus was high priest, Augur, and also the head of the state, of the army and of the government (s)[89][6]. He was assigned the imperium by the Senate and, after, it also agreed to grant him total dictatorship, although Augustus refused this last one (s)[90][5][7]. The visitor notices that two tripods placed at the bottom of the statue are not lighted [sG][91]. He finds a lighted torch hanged on a wall and use it to light up the tripods [O][92]

The night is passing, and the tourist-guardian decides to verify that nothing left remains in the main square [Ep8][sG][93]. Looking around, he sees at the very end of it, a big wheel and a scaffolding placed at the external side of the end of the portico [A][94]. While going there, he stops by a marble basement, placed in the middle of the square, in front of the temple, to check if something was left around [A][95]. Augustus placed in the middle of his forum a bronze statuary group with a chariot led by four horses, guided by himself (s)[96][39]. After having noticed that nothing was around, he moved towards the statues standing in front of the portico [97]. More than 100 marble colored statues were brought by the emperor in the forum, representing gods and the summi viri (s)[98]. Augustus, refusing the title of tyrant, wanted to reconnect himself with the Summi Viri, the founders, and those who played a role in the building of Rome (s)[99][21][7][9]. The visitor finds on the ground, in front of one of them, a piece of papyrus, and a ring [100]. The center area of the forum was used as meeting point of the preliminary phase of a trial, where the parties used to give their testimonies in front of a magistrate expert in the Roman Law, often under an hanging decree (s)[101][26][25]. After this phase, when the case was too difficult, such as in case of a business fraud, the parties were sent either to the Urbanus (if both Romans) or to the Peregrinus Tribunal (if one was a foreigner) to get a final decision from the praetor and the jury (s)[102][27][28]. While going back to the big wheel and scaffolding, the visitor finds another object abandoned on the ground, in front of the statue of a goddess: a wax tablet [103]. Wax tablets were used to write invitations sent both to accuser and accused, to meet in the forum front of statues, such as that of Diana Lucifer, bringer of light (s)[104][25]. The square is now ready for tomorrow morning activities [O][105].

The visitor returns to the scaffolding and climbs them, using wooden ladder [Ep9][A][106]. From the top of it, he can admire the architecture and decoration above the porticoes, representing faces and statues [107]. Augustus used different materials to decorate his forum, coming from different parts of the empire (s)[108][15]. The forum and many quarters of Rome made of bricks and wood, liable to inundation and fires, have been renewed and rebuilt by the emperor in marble (s)[109][16]. The tourist verifies that also here nothing was left around [sG][110]. He picked up one last working tool on the scaffolding [111][O]. All tasks are now completed [R][112]. The sky is getting lighter and the visitor can now return home, walking through the door appeared at the back of the square [S][113].