EDICULA

Educational Digital Innovative Cultural heritage related Learning Activities

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INTELECTUAL OUTPUT:	**O1 EDICULA EDUCATIONAL TOOLKIT**
DELIVERABLE:	**D1.3 Architecture of the EDICULA+ educational toolkit**
LEAD ORGANIZATION:	NTUA
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Table of contents:

1. Introduction

The present report regards the Deliverable *D1.3 Architecture of the EDICULA+ educational toolkit*, in the framework of the first Intellectual Output (O1) of the EDICULA project, and presents the second module of the EDICULA educational toolkit, an open-source educational platform that addresses key issues in the rehabilitation, protection and sustainability of Cultural Heritage (CH) assets, and disseminates valuable knowhow and experience both to the wide audience as well as to CH stakeholders, scientists and professionals.

A relevant deliverable *D1.2 Architecture of the EDICULA-4-all educational toolkit* has been developed (26.04.2021), which regards the first module of the educational platform that is addressing the needs of a wider audience.

As described in D1.2, the architecture of both educational toolkits has a very high commonality. This is justified by the fact that the field of CH protection covers a wide range of issues, that are of interest to both the general public, as well as to more specialized users. As a result (i) the methodological approach for the architecture of the EDICULA educational toolkit, and (ii) the development of the thematic nodes of the EDICULA toolkits, are common to both modules of the educational toolkit and have already been described in detail in D1.2

The present report will, thus, focus on identifying, justifying and describing the differences in architectures and expected contents of the two modules EDICULA-4-all and EDICULA+ of the educational toolkit, as well as the relevant technical requirements.

As described in D1.2, the fundamental characteristic of the EDICULA educational platform is that it will promote a holistic approach for transdisciplinary documentation, without, however, becoming too complicated. In the case of the EDICULA+ educational toolkit, 'complexity" is actually a desired attribute, since the target groups to which this module is addressed to are expecting and can support analysis of information of advanced level.

Although the key issues that the EDICULA-4-all and EDICULA+ modules of the educational toolkit will address are common, the EDICULA+ module needs to developed with emphasis on specifically addressing the needs of its target groups:

- the enhancement of the educational aspects of engineering innovation
  - ⇨ *The EDICULA+ target groups are generally more acquainted with the engineering innovation, compared to the wider audience, however, the specific module should focus on the educational aspects of the transdisciplinary engineering innovation as compared to the field-related innovation, as a tool to improve the dialogue between different scientific and engineering communities*
- the emergence and establishment of transdisciplinarity as a new trend in the protection of monuments
  - ⇨ *The EDICULA+ module must clearly demonstrate the virtues of transdisciplinarity in addressing acute challenges in the field of CH protection and rehabilitation focusing on the summative benefits of employing a wide range of disciplines and knowhow, within a joint perspective of analysis, to resolve complex engineering and socioeconomic issues.*
- the capabilities of multi-modelling methodologies for multi-discipline management and analysis of knowledge
  - ⇨ *The EDICULA+ module should be able to exploit the advanced levels of know-how and expertise of the target groups it is addressed to, in order to describe and demonstrate in higher detail how multi-modelling methodologies can enable a co-operative "vehicle" of multi-discipline*

information towards an effective, productive and sustainable management and analysis of knowledge.

- the capabilities of Augmented Reality (AR) and Virtual Reality (VR) to effectively diffuse information for social responsibility and awareness
  - ⇨ *The EDICULA+ module should exploit the capabilities of AR and VR as an additional scientific tool for researchers and stakeholder, that can trigger and enable further analysis, as compared to a simpler "navigation" or "visualisation" tool for general public in the case of the EDICULA-4-all module.*

The focus of the common key issues set the specific basic challenges and differentiation paths for a careful and purposeful design of the EDICULA+ module as compared to the EDICULA-4-all. In addition, although the selection of the thematic subjects (see D1.2) is common to both modules, the way they will be presented to the users of each toolkit, must be governed by the educational needs of the target groups they are addressed to.

1.1 Cooperation framework for the development of the Architecture of the EDICULA+ Educational Toolkit.

The EDICULA+ Educational Toolkit covers a wide range of thematic areas, relevant to the protection and rehabilitation of CH assets. These thematic areas have been defined and described in the previous deliverable, since they are common to both modules. In the case of the EDICULA+ module, the special issues involved in these thematic areas, demands an even closer cooperation between the EDICULA partners, as compared to the EDICULA-4-all module, due to the specific advanced information that needs to be incorporated within the EDICULA+ module to ensure both an effective educational attribute as well as scientific quality and completeness.

NTUA is the leader organization of O1. All partners cooperated in order to provide their own knowhow as well as to identify the differences between the two modules. The close cooperation of all EDICULA partners ensured that each partner can contribute to many more thematic areas compared to their own discrete expertise, in effect, being able to "approach" each thematic area from their point of view. This cooperation framework is more effective, as it provides an opportunity for exchange of ideas and experiences, otherwise not feasible if an alternative compilation-based approach was selected. In the EDICULA+ module, in particular, this is even more crucial, due to the specialization of knowhow among the partners, that needs to be 'distributed" among the various thematic areas. The technical specifications of the EDICULA+ fully addressed its architecture.

The architecture of the EDICULA educational toolkits and the respective deliverables, were approved by all partners at the 2nd Steering Committee on 19 April 2021.

2. Methodological approach for the architecture of the EDICULA+ Educational toolkit

The methodological approach to the development of the educational toolkit has been described in detail in D1.2, and need not be repeated. This report, thus, will describe the differences between the two architectures of the basic and advanced toolkits. From the following issues that have been identified in D1.2 as drive as important for the toolkit development, two categories can be defines:

Common issues

- The toolkit-to-user information presentation approach and educational aspects
- The technical requirements for the creation and operation of this educational toolkit

Module-relevant issues

- The target groups that the toolkit will be addressed to
- The content (thematic areas) of the EDICULA toolkit
- The semantics and ontology of the toolkit content and its management
- The Artificial Intelligence (AI) module for classification of different data and metadata

2.1 Differentiation perspectives between EDICULA-4-all and EDICULA+ educational toolkits

As has been stated earlier (D1.2) a central decision in the EDICULA project is that the EDICULA Educational Toolkit consists of TWO MODULES, regarding the access level to target groups:

- **EDICULA-4-all educational toolkit**, addressed to the **wide audience** (with **open access**), including **basic level of information**.

  It supports only a limited number of scientific data *and is also designed to support general information about the projects' objectives*
  It can be transferred in life-long learning and school education*, demonstrating the effectiveness of transdisciplinarity in fusing science into general knowledge*

- **EDICULA+ educational toolkit**, which is the **advanced module** (with **registered access**), addressed to **scientists and experts** in the field of protection of monuments with a relevant background.

  It provides ***knowledge with more scientific details*** *and will* ***encompass advanced information****, relevant studies, scientific papers, data and metadata of the knowledge gained by the consortium in the emblematic* ***restoration of the Holy Sepulchre.***
  It can be transferred to professional and university courses *addressed to architects, archaeologists, conservators, students in arts and other relevant engineering disciplines, demonstrating the need for a new teaching framework that promotes cooperation and utilizes complementarity between diverse disciplines*

The EDICULA-4-all is more "narrative" in nature, focusing on providing **basic information** more relevant of the values of CH, the need to preserve them and general approaches for the protection, rehabilitation and sustainability of CH.

The EDICULA+ which is addressed to scientists and experts **is more "scientific" in nature**, providing far more **advanced information**, in a format and in quality appropriate for the further elaboration and analysis of the provided data.

2.2 Differentiation strategies for the fundamental prerequisites between the two modules

The architecture of the EDICULA+ toolkit will conform to the following fundamental prerequisites, the same as presented in D1.2:

- Provide **flexibility** through its e-learning platform, enabling **easy navigation and immediate access** to all main categories and activities of the toolkit. Compared to the EDICULA-4-all, the EDICULA+ module will demonstrate a higher degree of flexibility in navigation and access. Instead, the EDICULA-4-all is approached through a framework of narrative presentation and access of information, due to the comparatively limited knowledge background of its target groups
- In the case of the EDICULA-4-all no previous knowledge in cultural heritage or its rehabilitation is required. However, in the case of the **EDICULA+ some basic scientific background and expertise is required**, in order to be able to understand the scientific content of the thematic areas, to be able to analyse and synthesize new knowledge from the data and educational material provided in the EDICULA+ toolkit and to be able to "navigate" through the various thematic areas in an organized and logical methodology in the framework of enhancing the users' knowhow and expertise.
- **EDICULA+ will provide an easy sequential learning progress**, divided into basic and advanced modules, enabling the end-users to experience a learning procedure.

It should be highlighted that the EDICULA-4-all and the EDICULA+ educational toolkits are based and developed on the same thematic content – ontologies, however through utilization and adaptation of different semantics and narration.

- *In the EDICULA-4-all educational toolkit the monument, the values, the aesthetics/architecture and the history are at the foreground.*
- *In the EDICULA+ educational toolkit, the various disciplines involved in CH protection, the relevant techniques and methodologies are at the foreground*

2.3 Differentiation objectives between the two modules regarding the types and size of the content

As in the case of the basic module (D1.2) the architecture of EDICULA+ educational toolkit refers to a wide range of educational material types, including lectures and virtual laboratories, videos, lecture notes, and other types of educational material. Although this range of educational material sets specific technical challenges for their management, the management is similar in both modules, although obviously in the case of the **EDICULA+ it regards a large amount of information, more relevant to the challenges of handling big data**.

2.4 The utilization of the Artificial Intelligence module

As it was briefly described in D1.2, an Artificial Intelligence (AI) module is currently under development in Task 1.3. It will aid and facilitate classification of multimodal data and metadata for data storage and retrieval, in a more reliable and transferable approach, compared to the conventional subjective and expert oriented methodology. The presence of the AI module is closely linked to the EDICULA+ educational toolkit. As mentioned above, the basic EDICULA-4-all toolkit regards a more narrative-type of platform, where the content, although scientifically sound, it has undergone a very cognitive treatment, in order to convey and focus on the values and necessities of the CH protection instead of the advanced details of these processes.

Instead, in the case of the EDICULA+ toolkit, the AI module is expected to play a very active and constructive role in the classification of data and metadata, transforming the educational platform in an efficient database instead of a simple data depository. The AI module will, in fact, aid the "navigation" through the various thematic areas identifying joint semantics and knowledge which without the AI module would be "interpreted" strictly within the boundaries of discrete disciplines and thematic issues. The close interrelationship between the EDICULA+ and the AI module is the reason why its development follows the architecture of the EDICULA+, in order to completely utilize the definition of the relevant thematic areas, their interconnection and functionalities.

2.5 General differentiation attributes between the EDICULA+ and the EDICULA-4-all educational toolkits

Based on the architecture of the EDICULA Education Toolkits considers some general issues, critical for the effective development of the platform and its evolution into a valuable educational toolkit.

2.5.1 Degree of commonality between the two toolkits

Since the complexity of the content of the EDICULA+ toolkit is higher compared to that of the EDICULA-4-all, a number of development approaches (Figure 1) were evaluated and considered:

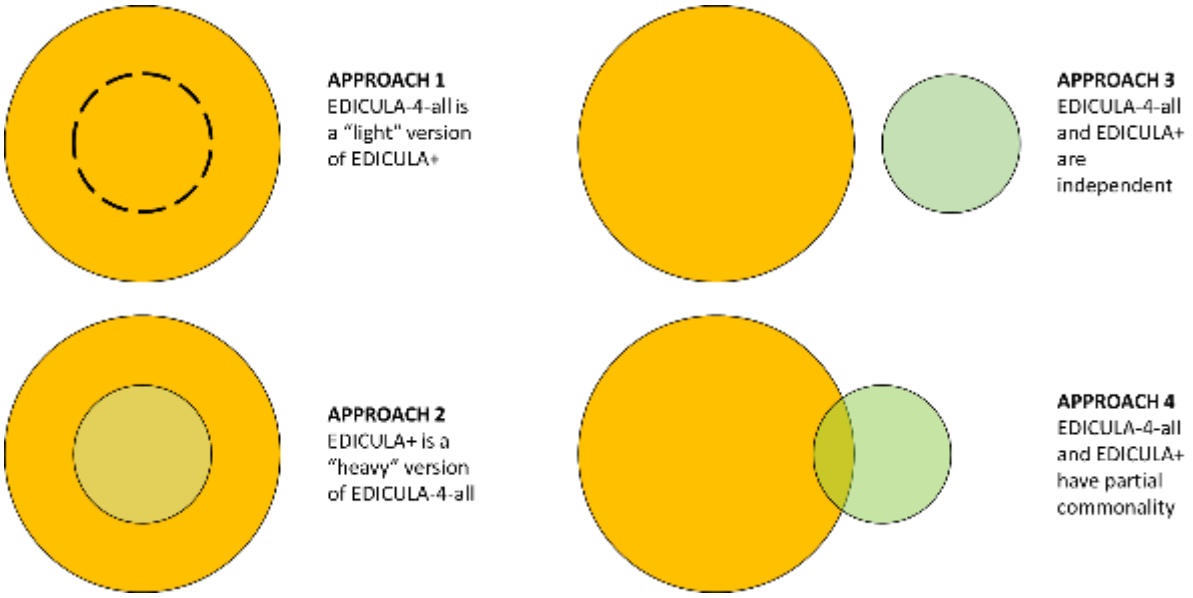

Figure 1. Schematic representation of development approaches for the EDICULA-4-all and EDICULA+ educational toolkits. Note: The large circle represents the EDICULA+ and the smaller circle represents the EDICULA-4-all

Approach 1: EDICULA-4-all is a "light" version of EDICULA+.
This option theorizes that the majority of the development effort is concentrating on the more complex content of the EDICULA+ toolkit. The EDICULA-4-all, then, is created by limiting the access to specific thematic materials or educational material. From a developmental point of view such an approach concentrates resources on the more complex toolkit, minimizing the duplicating efforts of developing a separate one (EDICULA-4-all) completely from zero. However, this option is the least desirable, because the educational material and thematic issues discussed in the EDICULA+ module are far more detailed and of a scientific natura that are very difficult or even impossible for the general public or the basic target groups to grasp. Moreover, due to the open-access of the EDICULA-4-all toolkit, this would result in sensitive information relevant to the use cases to be readily accessible without accessibility limitations. In effect, the

EDICULA-4-all, if this option is adopted, may become a smaller-sized version of EDICULA+ but a "heavy" version in respect to the educational needs of the target groups it is designed for. Therefore, this option may hinder its efficiency for the wide audience.

Approach 2: EDICULA+ is a "heavy" version of the EDICULA-4-all

This option is the exact opposite of the previous one. It has similar effects to the EDICULA+ module. Specifically, assuming that the EDICULA-4-all is developed as required for the target groups it is designed to address, it means that the educational material, aiming mainly to the general public, is basically of "narrative" nature, without high levels of scientific details. Therefore, if the core EDICULA-4-all is "expanded" with additional thematic areas and educational material into the advanced module, it will still incorporate educational material with a different "language" and quality and analysis potential, i.e. the material that corresponds and originates to the basic-level and open access module. This option, at least, partially addresses the accessibility setbacks, since the educational material applicable to the EDICULA-4-all will be completely open-access, however, in the case of the EDICULA+ part of the educational material will be open-access, and the remainder user-defined accessible.

Approach 3: EDICULA+ and EDICULA-4-all are completely independent of each other

Although such an option solves most of the accessibility issues, in effect it regards the development of two discrete educational toolkits. This involves duplication of efforts and permits no commonality among the two modules. This "independence", however, disregards one of the fundamental prerequisite of the toolkits, i.e. flexibility. It is desirable that the users of the EDICULA-4-all can evolve into users of the EDICULA+ module, even without actually attaining the required level of scientific and synthesis capacity, in order to expand the impact of the EDICULA project. The disruption of any commonality between the two modules effectively does not allow an easy upgrade between one level to the other; the basic level user will have to start all over with certain thematic areas, with the risk to quickly lose interest in the whole toolkit. Conversely, the complete independence of the two toolkits is detrimental to the EDICULA+ module. Specifically, certain narrative-type educational material is still useful even to the advanced users of the EDICULA+ module, in order to acquaint them with thematic issues that they are yet not competent. Thus, in cases where the AI module or the synthetic analysis "leads" them to thematic areas where they have limited expertise, it would be more useful to provide them with some introductory, more basic educational material and information.

Approach 4: EDICULA-4-all and EDICULA+ have partial commonality

This approach, which has been the basis of the EDICULA educational toolkit architectures, exploits the benefits of all three above-described approaches, while minimizing the detrimental issues. The two educational toolkits are largely independent of each other, in terms of their content, but engage in some level of commonality (overlapping) in many thematic areas. Although such an approach introduces duplication of educational material (to cover the different needs and accessibility requirements of the two toolkits), such "duplication" is not completely independent but rather evolutional. As an example, a thematic issue that is addressed in the EDICULA-4-all toolkit that provides a basic-level narrative-type educational material can be "expansive" in terms of its content when retrieval of further information is required by users of the advanced module. This additional information can either be linked to the original basic-level educational material (e.g., through the use of keywords or entries) or a completely new educational material can be accessible to registered users of the EDICULA+. This approach has the advantage of a gradual upgrading of the educational material that is available in the EDICULA-4-all, as the complexity level of the end-users of the EDICULA+ toolkit is increased, while sustaining limited accessibility of the additional information to those needing it and registered for. The AI module will be able to facilitate classification of multimodal data and metadata for data storage and retrieval from a joint database, but provide outputs specific to each toolkit. Conversely, those educational materials that are deemed useful for both modules (i.e. the overlapping subjects) need no further development, and can be exploited by all

users regardless of their access level. In addition, there will exist thematic issues that are addressed completely different depending on the module they are accessed from, obviously increasing the workload for their preparation. In these cases the comparative advantage is that the material will be optimized for each toolkit (e.g. lectures, videos), based on the different needs and access level of the different target groups Of course, such duplication may actually end up being even more beneficial for users of the EDICULA+ module since the analysis of the same subject from both a scientific point of view (EDICULA+ accessed information) and from a more "narrative" point of view (EDICULA-4-all accessed information) may reveal interrelationships and semantics that are otherwise not feasible when addressed separately. Finally, one disadvantage of such an approach is the increased number of interlinking between thematic areas and educational material and the difficulties in attaining and promoting a central "narration" or framework of study.

2.5.2 Parallel development capacity

The development of EDICULA+ will benefit from the experience gained from the parallel development of the EDICULA-4-all. Although, to some extent, the educational material will be differentiated, the existence of a common database – providing various levels of access – and common data retrieval mechanisms will permit the resolving of common technical difficulties relevant to these features. The parallel development of the two toolkits enables the incorporation of "fine-tuning" updates to both toolkits, without the need to revisit an already finished toolkit. These updates include additional thematic areas or merging/division of existing ones, if required due to educational or technical reasons. In addition, the parallel development of the two toolkits enables the provision of an overlapping content (see approach 4) and its transformation based on the specified access level.

2.5.3 Update potential of both toolkits

The bilateral correlation and the "open architecture" of both educational toolkits ensures that updates are dynamic and continuous. Specifically, due to a common database, updates of the relevant educational content as well as the learning path from which it is accessible will be directly implemented to both toolkits, without the need for time- and resource-consuming activities. In fact, the exploitation of the AI module, as well as the incorporation of evaluation features in both toolkits, will ensure a high update capability of the toolkits to the expanding needs of their users

2.5.4 Adaptability potential

The EDICULA-4-all toolkit, to a large degree will be functioning with the framework of a central narrative path, addressing all thematic issues of interest to the general public and at a level of knowledge able to be comprehended by the relevant types of users. Instead, the EDICULA+ toolkit will incorporate use-cases as its central means of providing the scientific information and reveal the methodological approach applied in the protection and rehabilitation of CH. The enhanced inclusion of use-cases within the educational content of the EDICULA+ module in turn necessitates different scientific backgrounds, due to the fact that most use cases are typically approached from a limited number of disciplines. Therefore, the advanced educational module is not be bounded by the scientific background of the involved partners but should be adaptable to other use cases with different focus. This is reflected to the selected thematic areas, where they will demonstrate a varying "depth" of information relevant to the capacities of the EDICULA partners, with the provision, however, for addition of supplemental material relevant to other uses cases with different scientific and educational focus.

2.5.5 Upgrade potential

Both toolkits will not be stagnant regarding their design and content. Instead, as the dissemination activities are bringing both toolkits to the forefront and their use is tested in real-environments, the feed-back collected from experts and the general public will improve the toolkits' efficiency. This upgrade potential is even more crucial in the case of the EDICULA+ toolkit, due to its more advanced nature, where

the feed-back retrieved is expected to be more focused on the use-case educational capacities and the need to expand the applicability of the toolkit, rather than the user-related issues and navigation capabilities relevant to the EDICULA-4-all version.

3. Thematic nodes considerations for the EDICULA+ toolkit

The development and selection of the thematic nodes of the EDICULA toolkits has been covered in detail in the relevant deliverable D1.2 which regards the similar EDICULA-4-all educational toolkit architecture. This report, thus, will highlight the differences in the architecture relevant to the thematic nodes between the two toolkits.

Since the thematic nodes have already been described and defined in the relevant architecture of the EDICULA-4-all toolkit, the critical parameter regards, to what extend each toolkit will address each thematic node.

A critical decision is that both the EDICULA+ as well as the EDICULA-4-all educational toolkits will be structured around the same thematic nodes and areas. This will be reflected also in the user-interface and the presentation layer

The rationale behind covering the same thematic areas is twofold:

1. Although the EDICULA-4-all is mainly addressed to the general public and to a basic knowledge level **it is of utmost importance that the users of this toolkit realize the complexity of the field of CH protection, rehabilitation and management**, even if from an educational point of view they need not engage into a more detailed and scientific-intensive learning process.
2. **The users of the EDICULA-4-all, and in general the material that is open-access, must not convey the feeling of being something like a "poor relative" compared to the EDICULA+** limited-access educational material, at least in terms of "completeness" and "coverage" of the numerous and complex thematic areas in the field of CH protection.

3.1 Clusters of educational material

However, the EDICULA-4-all will not contain educational material in all the defined thematic areas. This is a feature only of the EDICULA+ which is oriented to the advanced-level users. As described above, regarding commonality approach, both toolkits will demonstrate some degree of "overlapping". Specifically, the following **clusters**[1] of content will be available:

Cluster A. Educational material of **basic content** of mainly "narrative-type" character that presents the analyzed and synthesized results from specific use cases aiming to identify, highlight and briefly describe the issues relevant to the thematic area. The scientific background requirements are minimal and mainly correspond to understanding the underlying principles and methodologies of analyses. It can be open-access (AO) or registered-access (AR)

[1] The term "cluster" is used here to avoid confusion with the term "type". The type of educational material refers to it being for example a presentation (pdf), a document (pdf), a video (mp4), an image (jpeg) etc. The term "cluster" refers to the collection of educational material that displays certain attributes relevant to its accessibility, its level of content (from basic to advanced) and its character (from mainly narrative to purely scientific data useful for further analyses by the user)

Cluster B. Educational material of content of **intermediate level** of analysis, that adopts a stepwise explanatory approach that includes the scientific basis on which the presented information was processed and presented. It can be open-access (BO) or registered-access (BR)

Cluster C. Educational material of **advanced content-level** and mainly technology-oriented, aiming to provide multi-sensor and multi-disciplinary data that can support the synthetic analysis from users with advanced know-how and scientific background. It can only be registered-access (CR)

The EDICULA-4-all toolkit will contain mostly Cluster A educational content, with certain thematic areas covered either exclusively by Cluster B or a combination of Cluster A and Cluster B educational material. In all cases, the EDICULA-4-all educational material will be open access. Due to its advanced level, Cluster C is exclusively registered, and thus not accessible through the EDICULA-4-all toolkit

In the case of EDICULA+ toolkit, which effectively covers all thematic areas, the degree of commonality with the EDICULA-4-all and the distinction between open-access and registered-access educational material, as well as the wide extent of clusters, creates various combinations, as described in the following Table.

Table 1. Categories of Thematic Areas

Category of Thematic Area	Containing Clusters			Applicability		Accessibility
	Cluster A	Cluster B	Cluster C	EDICULA-4-all	EDICULA+	
One Cluster						
AO				✓	✓	Open
AR					✓	Registered
BO				✓	✓	Open
BR					✓	Registered
CR					✓	Registered
Two Clusters						
AOAR				*AO only*	*AR only*	Mixed
BOBR				*BO only*	*BR only*	Mixed
AOBO				✓	✓	Open
AOBR				*AO only*	✓	Mixed
ARBO				*BO only*	✓	Mixed
ARBR					✓	Registered
BOCR				*BO only*	✓	Mixed
BRCR					✓	Registered
AOCR				*AO only*	✓	Mixed
ARCR					✓	Registered
Three Clusters						
AOBOCR				*AO & BO only*	✓	Mixed
ARBOCR				*BO only*	✓	Mixed
AOBRCR				*AO only*	✓	Mixed
ARBRCR					✓	Registered
Legend						
						Open
						Registered

As is evident from Table 1, the distinction between open-access and registered-access educational material does not readily indicate its exclusive inclusion either to EDICULA-4-all or EDICULA+ educational toolkits. Indeed, all registered-access clusters are only accessible from the EDICULA+ toolkit, however, the open-access clusters are accessible from both toolkits.

As is described in Table 1, there exist three general groups of thematic areas:

- The first group contains one Cluster only, either A, B or C. Due to the limitation that a cluster C is accessible only from EDICULA+ toolkit, there exist 5 categories of thematic areas in this group (instead of theoretically 6).
- The second group, correspondingly, contains two clusters, either A & B, B & C, or A &C. In addition, there exist two special cases A & A and B & B (it will be explained below). Again, due to the accessibility limitations of Clusters C, there exist 10 categories of thematic areas in this group (instead of theoretically 15). Only one combination of clusters (AOBO) is fully applicable for the EDICULA-4-all toolkit in this group.
- The third group regards three clusters. Some of them can be either open-access or registered access (it will be explained below). However, the full content of a three-cluster thematic area can only be accessed through the EDICULA+ toolkit.

A first analysis of Table 1 may mistakenly indicate that the EDICULA+ regards a very limited number of categories of thematic areas (AO, BO and AOBO). However, this is not the case. Categories that contain clusters of mixed accessibility, e.g. one cluster of the thematic area is open-access, whereas others are registered-access, enable full accessibility through the EDICULA+. However, they also enable selective accessibility through the EDICULA-4-all toolkit. This is the case for an additional 7 categories of thematic areas (AOBR, ARBO, BOCR, AOCR, AOBOCR, ARBOCR, AOBRCR). Only the open-access clusters from a multi-cluster category are accessible from the EDICULA-4-all toolkit, the remaining being off-access. In addition, there exist two special cases. The first regards thematic areas which contain educational material belonging to the cluster A open-access, and different educational material belonging again to cluster A, but registered-access. Similarly, the combination of cluster B open-access and cluster B registered-access. In both cases, part of the thematic content will be accessible from EDICULA-4-all (i.e. AO or BO), whereas the registered-access content will be accessible from the EDICULA+ (i.e. AR or BR).

It could also be argued that four- or five clusters categories of thematic areas could exist. An extreme example might be a thematic area that contains two open-access clusters (AO and BO) and three registered-access clusters (AR, BR, CR). However, this potential case is rather undesirable as it would contain two duplications (AO & AR, BO & BR) of educational material, making such a thematic area rather difficult to handle. In most cases, the EDICULA+ will utilize AO clusters, and only in very rare cases there will emerge the need to also provide an additional AR cluster of educational material. Similarly, the EDICULA-4-all will mostly concentrate on Cluster A content, and only in very rare cases there will emerge the need to provided Cluster B content. As a general guideline, users are encouraged to initially use the EDICULA-4-all toolkit, and if they show further interest or their needs evolve, they can register and start exploiting the capabilities of the EDICULA+ educational toolkit.

Although this seems confusing and complex, in reality this categorization minimizes duplication of educational material. Cluster A or Cluster B educational material that is destined to be open access, can be utilized by both toolkits. Therefore, the EDICULA+ exploits the presence of educational material already uplinked to the open-access EDICULA-4-all. Only in special cases, where certain cluster A or cluster B open-access educational material is not deemed adequate for the users of the EDICULA+ toolkit, additional

cluster A or cluster B registered-access educational material may be uplinked to the same thematic area folder.

3.2 Interlinking matrix

The thematic nodes of the EDICULA educational toolkits and their hierarchy have already been described in deliverable D1.2 "Architecture of the EDICULA-4-all educational toolkit" and needs not be repeated here, as they are common to both toolkits. The complete list is provided, for convenience, in the ANNEX of the current report.

As mentioned above both toolkits will "follow" the same thematic nodes. Actually, the term "follow" regards the presentation layout, in the sense of what the user may be able to see as the complete hierarchy of thematic nodes. It will not correspond to an actual restriction of navigation among the various available thematic nodes.

It should be realized, however, that **the total number of thematic nodes is significant, and hierarchically rather comprehensive** (see Annex). Specifically, it regards **four 1st level Thematic Nodes**, which are divided into **28 total 2nd level Thematic Nodes**, which are then divided into **116 3rd level thematic nodes**. Furthermore, the 3rd level nodes contain in total **195 4th level thematic nodes**.

Although these thematic nodes and their whole hierarchy cover satisfactorily the wide range of issues relevant to the CH protection and rehabilitation, it is still a very significant number of thematic areas to handle. It should also be taken into account that some of these thematic areas may contain up to three clusters of educational material. Therefore the "navigation" through this complex "tree" of educational material emerges as critical educational parameter.

It should also be taken into account that both educational toolkits are not envisioned to function as "stationary" platforms but instead be dynamic and evolving. This means that the content of the toolkits will change not only during their developmental phases, but also as an optimization response to the users feedback and the input from the AI module.

Therefore **two main challenges emerge**, regarding both two toolkits, although due to its wider and larger scopus they are more intense in the case of the EDICULA+ toolkit:

- **Navigation challenge**. How to effectively navigate and follow through a rather extensive and complex matrix of thematic nodes.
- **Content management challenge**. How to avoid duplication while in parallel ensuring extensive cover of all issues discussed.

*The key element in addressing both challenges is the realization that **most of the thematic nodes are closely interlinked**. Within this interlinking framework, the same subject, the same use case, can be approached from different perspectives.*

Therefore**, the need to provide distinct educational material and data for every thematic node (down to fourth level thematic nodes) is reduced as the interlinking is increased**. This effectively means that an educational material of a cluster within a thematic node x_i, can be relevant and should be accessible through other thematic nodes x_j.

This is addressed through an **INTERLINKING MATRIX**. Such an interlinking matrix should not be a pre-set 2D table interlinking all clusters or educational materials, since this contradicts the basic functionalities of the EDICULA, i.e. flexibility and adaptability. In fact, the interlinking matrix will be **user-adaptable.** In order to achieve this, the interlinking matrix must conform to the following requirements:

1. The **interlinking matrix should conform to the user's access level**. Therefore, an EDICULA+ user should be able to view open-access educational material, but an EDICULA-4-all user should be limited only to open-access educational material, regardless of their interlinking with other registered-access files.
2. The **interlinking matrix should conform to the user's interests profile**. For example, a user not interested at a 2nd level thematic node x_1 should not be granted access to any third or fourth level thematic nodes of the same thematic node x_1. Obviously, this can be reinstated depending on the preferences of the user. In addition, this requires the presence of a user profile (registration), therefore it is more relevant to the EDICULA+ toolkit.
3. The **interlinking matrix should be adaptable to the user's scientific and knowledge background**. For example, a user with an anthropological scientific background may not be able to exploit interlinking leading to mainly engineering educational material. The technical implementation of such adaptability is not trivial, and thus, it will be approached as a pilot application in the EDICULA project, exploiting features from the AI module.

5. EDICULA+ user categories

The effect of users' requirements on the architecture of the toolkits was described in described in deliverable D1.2 "Architecture of the EDICULA-4-all educational toolkit" and needs not be repeated here, as the user groups are common to both toolkits.

Briefly, these are the following:

- General public.
  - Active citizens with basic interest in CH protection
  - Citizens with economic interest in CH protection
- Students
- Experts and professionals in CH-related stakeholders.
- Academic personnel and teachers
- Researchers

It should be clarified that these user groups do not necessarily indicate the access level or a specific educational toolkit. For example, a user that can be described "citizen with economic interest in CH protection" should not by default be limited only to the EDICULA-4-all toolkit. If he/she register in the EDICULA+ educational toolkit, they can study educational material from the advanced toolkit. The access level (i.e. what files become accessible) is granted by the administrator of the toolkit upon verification and evaluation. The access level is not analogous of the scientific background or level of expertise, but is personalized on a case-by-case approach. Thus, as an example, a secondary school teacher who is interested in utilizing the full content of the EDICULA+ toolkit to improve a course curriculum, can in principle be granted full access, regardless his/her scientific background and education level.

It is understandable that the majority of the users belonging to the user group "general public" are expected to mainly utilize the EDICULA-4-all toolkit, whereas as their educational/scientific/research needs increase they will tend to utilize the EDICULA+ toolkit.

The existence of specific user group aims to support statistics analysis of the toolkits. In this framework, EDICULA will **explore the possibility of including a user-questionnaire** that will provide to the toolkit administrators valuable information for the optimization and adaptation of the toolkits to address feedback from users.

For example, the inclusion in the user-questionnaire of questions regarding their educational level, their interests, their scientific background and their research focus can be correlated with the thematic nodes they visit (-> analytics), which in turn can optimize the interrelation matrix.

An additional user-category specific evaluation-questionnaire can be also added at the toolkits, to support analytics regarding the effectiveness of the toolkit per user category.

6. EDICULA+ technical requirements

6.1 Platform Goals

The main objective of the learning platform is to provide an easy-to-use set of tools to course creators in order to enable them to design their courses as they originally intended and not have to make any major alterations in order to upload it into the platform. Along with this, a set of different activity types had to be available for them to perform the different activities found within their courses, such as regular courses content, forums for discussion, quizzes and multiple choice and content submission for assignments and other tasks.

The courses needed to be able to allow different user groups. This meant that courses can either be taken by individual learners or groups of multiple users depending on the course creators' preferences, the type of activity being taken, and the learning outcomes as defined by the course.

The configuration and design of the EDICULA-4-all learning platform was implemented keeping in mind that the courses being made available for this project include asynchronous and synchronous methodology. The web-based educational material hosted on the public website of the EDICULA project allows sharing the results with the general public, interested users and with the EDICULA partners and beneficiaries. The dissemination of project results and scheduled events will be highly served by web-based means and mechanisms

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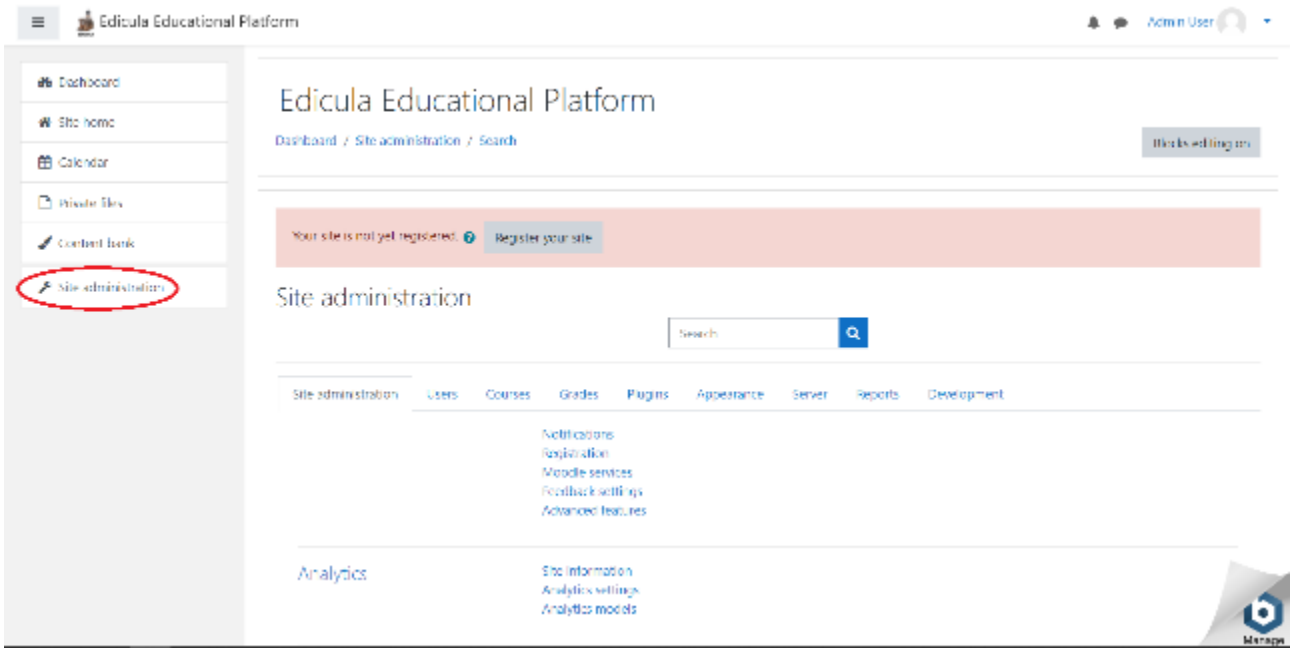

Figure 4 & Figure 9).

6.2 Functional & non- functional requirements

EDICULA beneficiaries take into consideration the functional and non-functional requirements of the EDICULA educational toolkit (see Table 2). These requirements describe the main functionalities that should be addressed during the lifecycle of the project.

Table 2. Functional and non-functional requirements

Functional requirements	Non-fuctional requirements
1) Login screen	1) Multidisciplinary content
2) User registration form	3) Multimodal data
3) Search bar	4) Content management (store and retrieval)
4) Multiple choice interface	5) Suggest difficulty level
5) Account activation	6) Suggest educational program
6) Role allocation	7) Store and display statistic records
7) Follow tutor	8) Delete Account
8) Visualization of 3D data	9) Return to resubmit quizzes and courses

6.3 Hardware Requirements

The portal that will be developed for EDICULA is proposed to operate under the following hardware requirements to ensure compatibility with the proposed software, good performance, capacity, availability and latency, good security features, as well as maintainability and portability. Our educational platform is on-line available: http://edicula.education.eu.ngrok.io/moodle/

Virtual hosting environment featuring is summarized below:

- RAM: 4Gb
- Hard drive initial capacity: 17Gb
- CPU: Intel Xeon x86 64
- Operating system: CentOS 7

6.4 EDICULA e-learning requirements

The e-learning environment is a web-based environment which contains the corresponding educational material for adults' education on Internet use. With this, the participating users educate, train and assess their knowledge on ICH topics, or contribute with training material on these topics. The requirements based on the main objectives of the e-learning environment fall into the thematic nodes described in the previous section.

6.5 Software Proposal

The EDICULA consortium is oriented to adopt a free, open-source software learning management system (i.e., Moodle, LearnPress, LearnDash) powering learning environments worldwide. It is designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalized learning environments.

In this work we are going to represent the tool of Moodle, which is in the scope of this deliverable. The adaptation of the educational management system will be used for blended learning, distance education, flipped classroom and other e-learning projects for the scientific and more professional community. The multidisciplinary objectives of the EDICULA project will be addressed taking into consideration that the adopted educational toolkit will encompasses customizable management features. The EDICULA toolkit will allow for extending and tailoring learning environments using community sourced plugins.

6.6 EDICULA+ Administration Management

The EDICULA+ is developed using Moodle. The editing of the EDICULA+ website can be achieved from the link http://edicula.education.eu.ngrok.io/moodle/. The environment of the login page is displayed in (Figure 2). After log in the Moodle development page offers a wide variety of possible actions (Figure 3). In this deliverable case, the needed action is to create a new course, which can be achieved by selecting "Site administration -> Courses" (Figure 4), which loads the courses content organization in the platform (Figure Step 9).

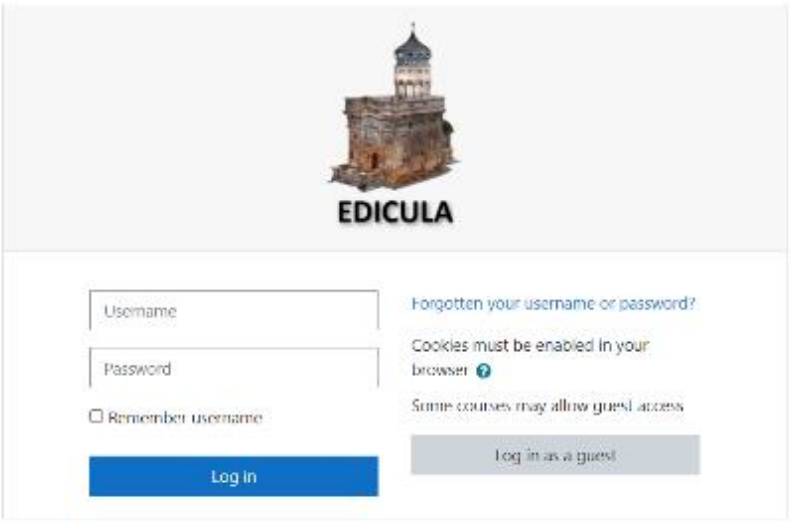

Figure 2. EDICULA Educational Platform's log in page.

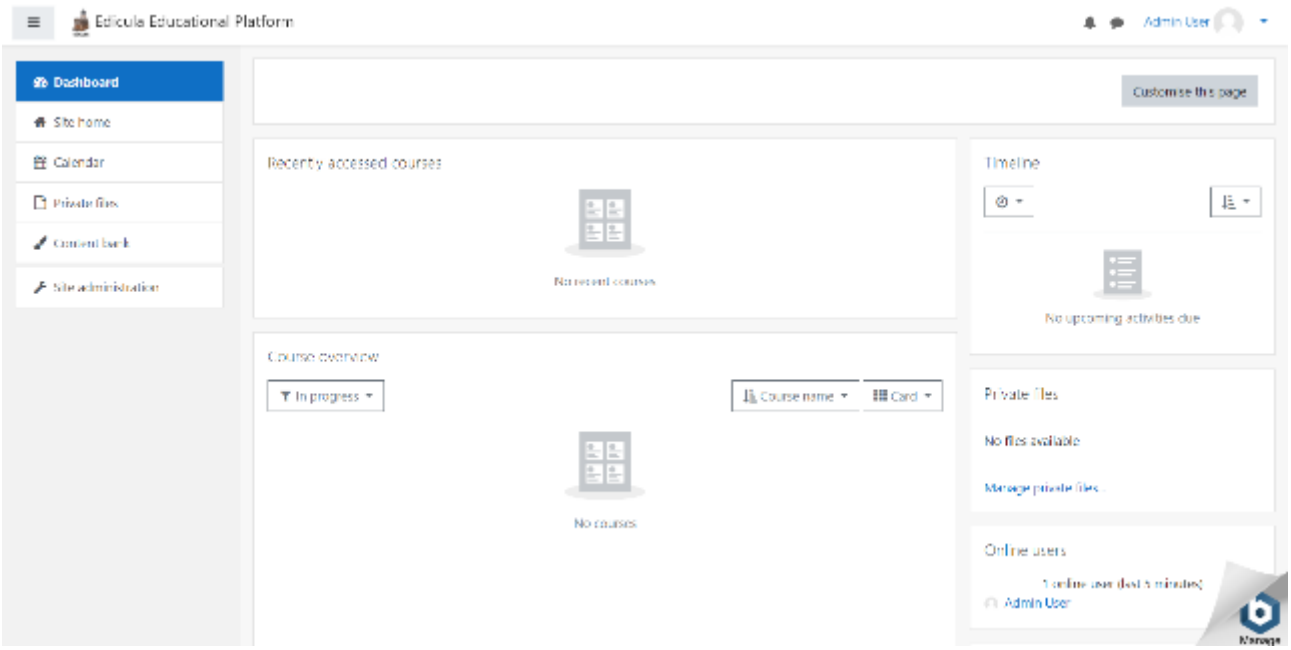

Figure 3. Moodle after log in page.

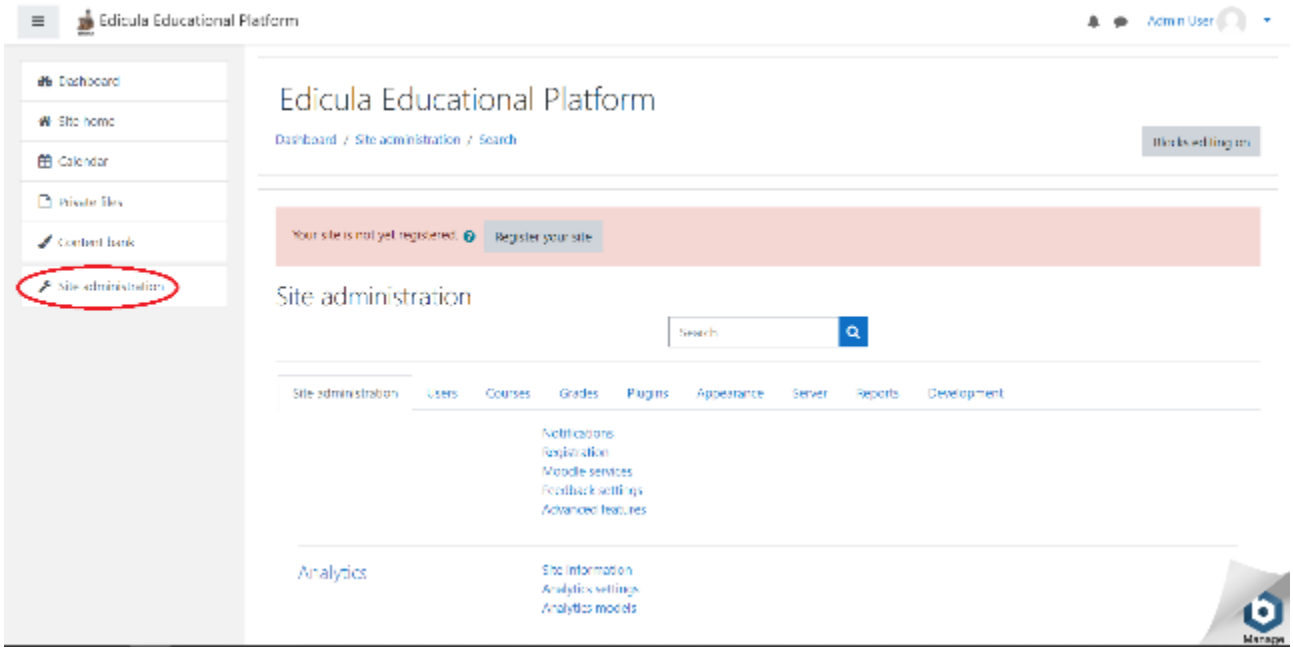

Figure 4. EDICULA Educational Platform's site administration.

By selecting the "Manage courses and categories" option, as shown in (Figure 5), Moodle load the management page of courses and categories (Figure 6). A new course can be created by clicking on "Create new category" (circle 1 –Figure 6) or can be edit by clicking the gear in circle 2 (Figure 6) and select "Edit" (Figure 7). From this menu a category or course can, also, be deleted by selecting "Delete". (Figure 8) depicts the page for adding a new category. "Category name" is a mandatory filled field, while "Category ID number" recommended. The "Parent category" represents the Category in which the new category will be created (e.g., Top for a new course, or the course name for a lesson). By clicking in "Create category" the new category will be created and be available on "Site administration/Course categories" page (Figure 9).

As an example, in (Figure 8) a new course named "Architectural Analysis" will be created. This course added in "Site administration/Course categories" page (Figure 9). Also, using the same method with "Architectural Analysis" as "Parent category", the subcategories "Historic Cities", "Architecture of historic buildings and monuments" and "Digital technologies: Documentation and modelling" were created. (Figure 10) depicts the "Historic Cities" in the editing page (by clicking the "Save changes" we save the changes).

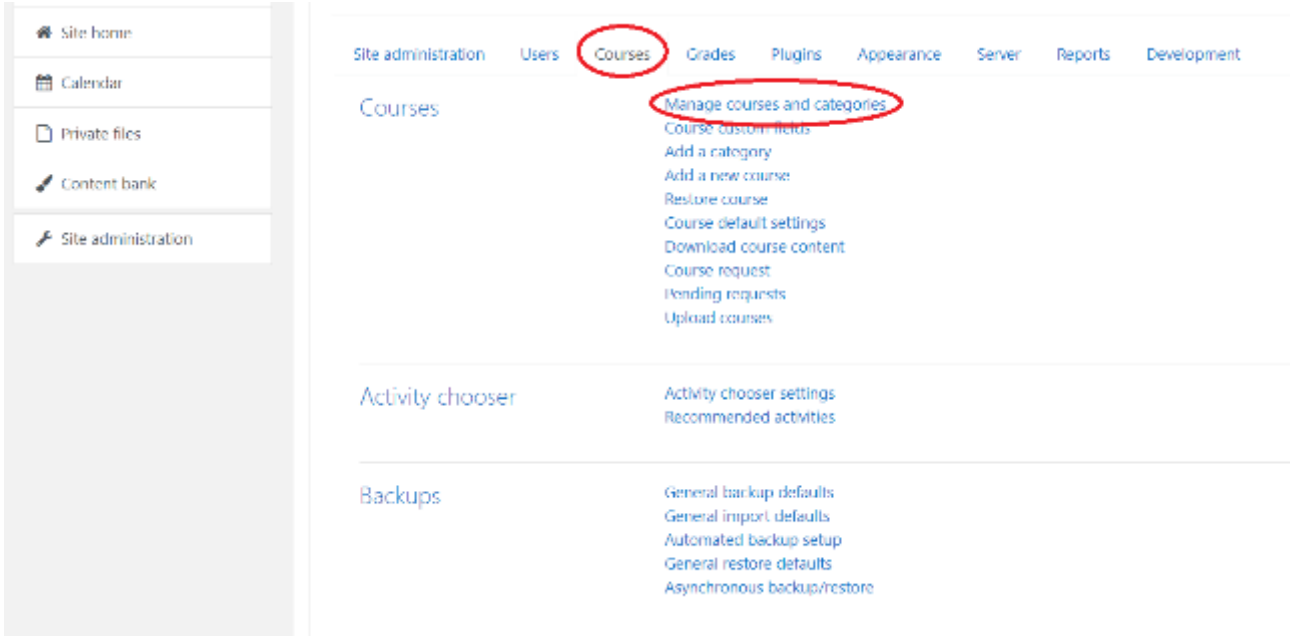

Figure 5. Courses management is accessible by selecting "Courses" and "Manage courses and categories" in the site administration

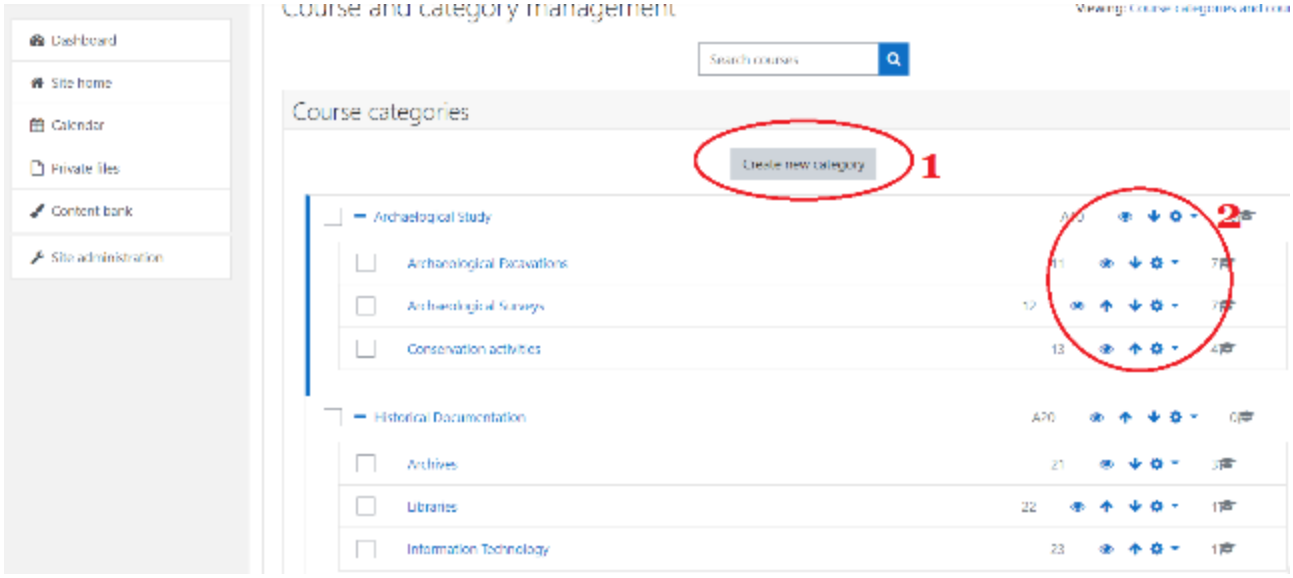

Figure 6. Courses and categories management page

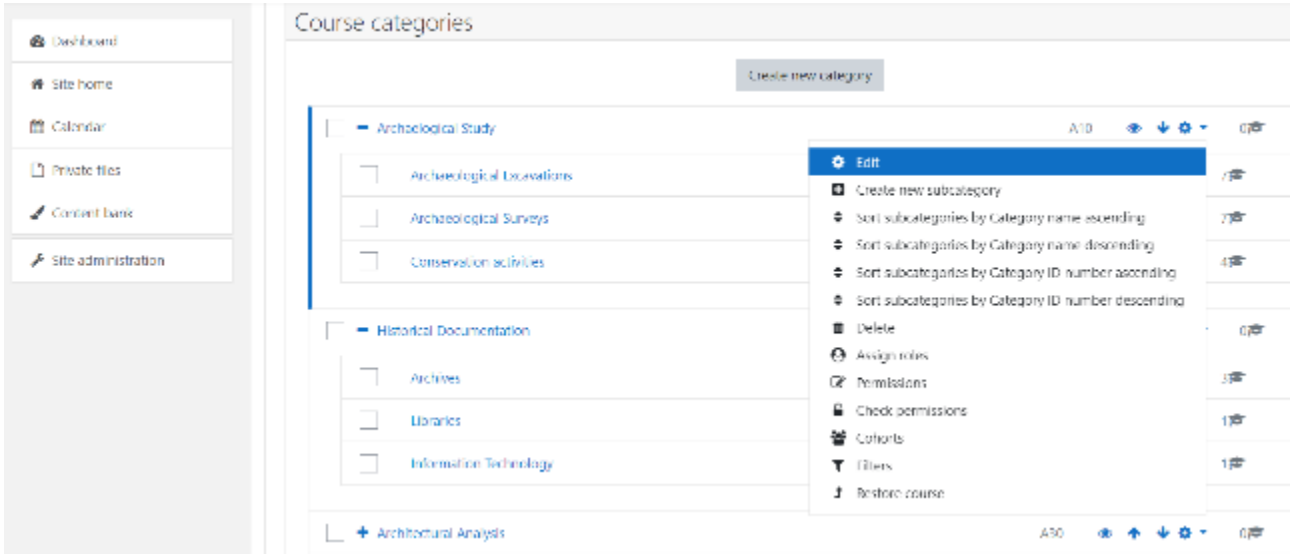

Figure 7: Edit toolbar

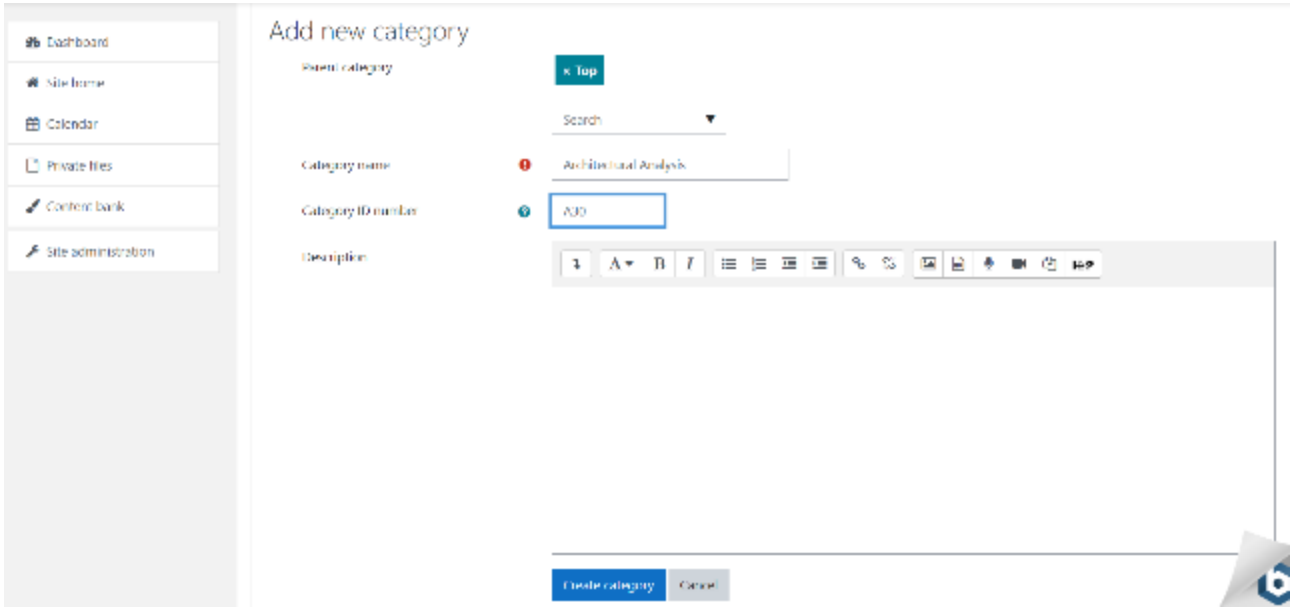

Figure 8: Create a new or edit an existing course page.

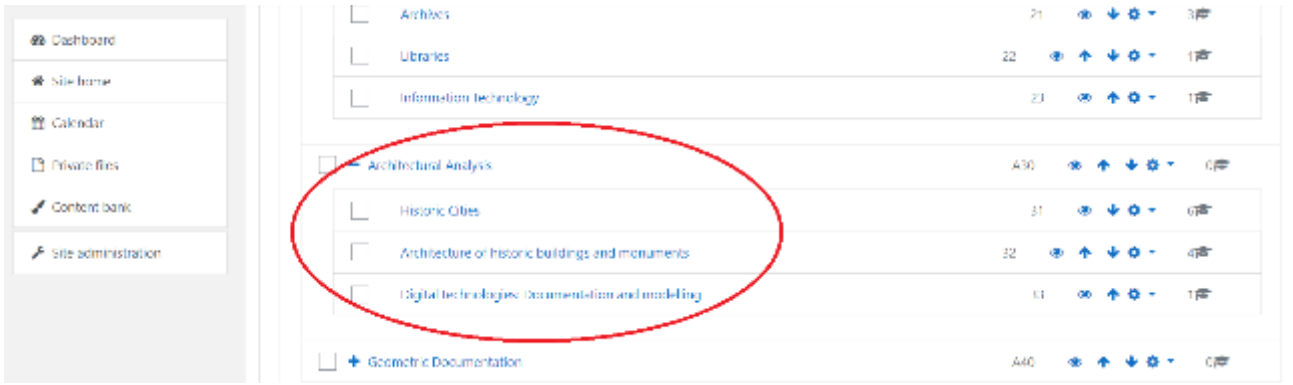

Figure 9: Site administration/Course categories page

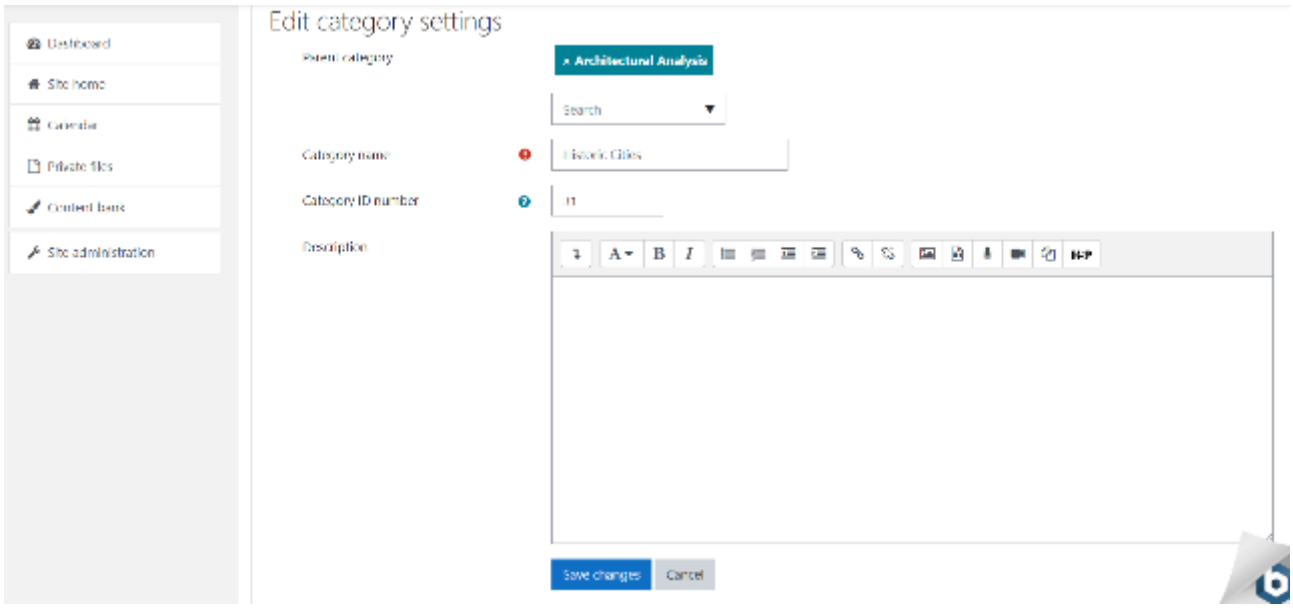

Figure 10: Historic Cities edit page.

Moodle includes, also, the option for viewing the published site. This option is accessible by log in as guest from the log in page (Figure 2). (Figure 11) depicts all the categories created (in circles are depicted the newly created categories in the example above).

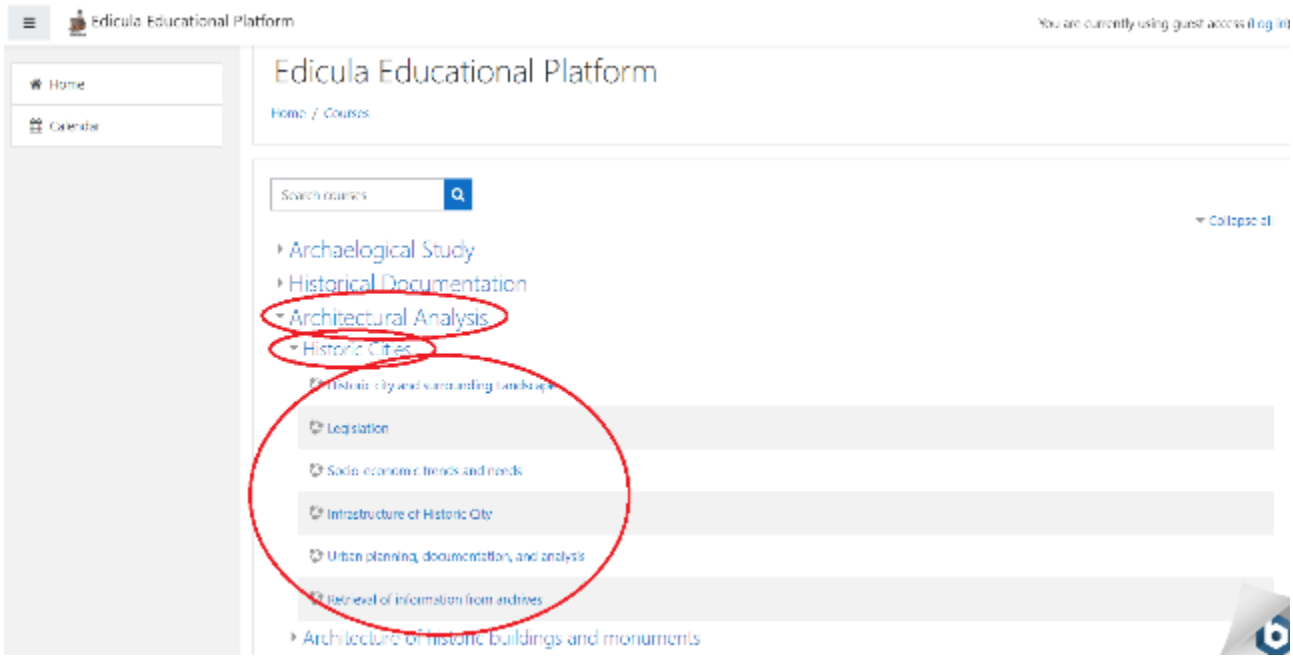

Figure 11: EDICULA Educational Platform's courses section.

Conclusions

In this deliverable we described the EDICULA+ platform. The aim of EDICULA project and why it is important for the scientific and professional community to have access on this platform. The deliverable, also, described the EDICULA+ management policy and all the technical approaches for the creation of Moodle webpage. A brief description of the administrative privileges is, also, included in the deliverable, in addition to the hardware requirements and other technical information about the server hosting and user accessibility.

ANNEX

1. Thematic nodes of the EDICULA Toolkits

[A] ANALYSIS OF CH ASSET

[A10] ARCHAEOLOGICAL STUDY

11 Archaeological excavations

- 11A Research excavations
- 11B Rescue excavations
- 11C Archaeometry
- 11D Archaeogene
- 11E Archaeobotany
- 11F Archaeozoology
- 11G Paleopathology

12 Archaeological Surveys

- 12A Field surveys
- 12B Aerial archaeology
- 12C Geophysical surveys
- 12D Landscape archaeology
- 12E Settlement archaeology
- 12F Maritime archaeology
- 12G Cognitive archaeology

13 Conservation activities

- 13A Conservation ethics
- 13B General techniques of conservation
- 13C Field conservation
- 13D Laboratory conservation

[A20] HISTORICAL DOCUMENTATION

21 Archives

- 21A Ancient texts
- 21B Ancient inscriptions
- 22C Numismatics

22 Libraries

- 22A Digital libraries – Scientific publications

23 Information Technology

- 23A IoT

[A30] ARCHITECTURAL ANALYSIS

31 Historic Cities

- 31A Retrieval of information from archives
- 31B Urban planning, documentation, and analysis
- 31C Infrastructure of Historic City
- 31D Socio-economic trends and needs
- 31E Legislation
- 31F Historic city and surrounding Landscape

32 Architecture of historic buildings and monuments

- 32A Architecture and construction of historic buildings and monuments
- 32B Retrieval of information from archives
- 32C Architectural documentation and analysis of architectural drawings
- 32D Constructional analysis and documentation
- 32E Damages, cracks, humidity and other problems

33 Digital technologies: Documentation and modelling
- 33A Virtual models and augmented reality

[A40] GEOMETRIC DOCUMENTATION

41 Introduction to the necessity of Geometric Documentation (GD)

42 Definitions – Possible products of GD
- 42A Complexity
- 42B Quality
- 42C HBIM

43 Methods of data acquisition for the GD
- 43A Passive methods
  - *43A1 Surveying (topographic measurements, GNSS)*
  - *43A2 Photogrammetry (satellite, aerial, UAV, terrestrial, underwater)*
  - *43A3 Remote Sensing (hyperspectral imaging, thermal cameras)*
- 43B Active methods
  - *43B1 Laser scanning (LiDAR, TLS)*
  - *43B2 Other forms of scanning*
  - *43B3 Range based methods*

44 Processing of acquired data
- 44A Point clouds
- 44B Automation
- 44C GIS

45 Geometric Documentation products
- 45A Vector drawings (2D)
- 45B Raster drawings (2D)
- 45C 3D models
- 45D Mixed realities
- 45E Serious Games

[A50] MATERIALS

51 Building materials
- 51A Historic building materials
  - *51A1 Natural stones*
  - *51A2 Mortars and binders*
  - *51A3 Bricks and ceramics*
  - *51A4 Plasters*
- 51B Characterization of materials properties
  - *51B1 In-situ non-destructive characterization and mapping*
  - *51B2 Laboratory testing (instrumental and physical methods)*
- 51C Production technology and provenance

52 Decorative materials
- 52A Wall paintings
- 52B Mosaics

53 Decay products from the impact of environment
- 53A Crusts and depositions
- 53B Salt Efflorescences
- 53C Cracks
- 53D Delamination and detachment of materials
- 53E Biological decay products

54 Restoration materials
- 54A Replacement stones and artificial stones
- 54B Restoration mortars
- 54C Restoration bricks and ceramics
- 54D Metal and strengthening elements
- 54E Restoration plasters

55 Consolidation and strengthening materials and techniques
- 55A Pre-consolidation and consolidation materials and techniques
- 55B Grouts
- 55C Strengthening materials and techniques

56 Conservation and protection materials and techniques
- 56A Cleaning of surfaces
- 56B Conservation of wall paintings and mosaics
- 56C Conservation of decorative elements
- 56B Protection materials and techniques

57 Smart and advanced materials and techniques

58 Non-destructive testing for assessment & evaluation of materials and interventions
- 58A Non-destructive assessment of mechanical properties
  - *58A1 Pulse-echo ultrasonic testing for assessment of mechanical properties*
  - *58A2 Rebound testing – Schmidt Hammer*
- 58B Microstructure analysis
  - *58B1 Portable video microscopy – Fibre Optics Microscopy*
  - *58B2 X-Ray Fluorescence*
  - *58B3 Laser-induced breakdown spectroscopy*
- 58C Surface or near surface analysis
  - *58C1 Infra-red thermography*
  - *58C2 Portable video microscopy – Fibre Optics Microscopy*
  - *58C3 Pulse-echo ultrasonic tomography and testing for assessment of damage layers*
- 58D Geophysical methods
  - *58D1 Ground penetrating radar*
  - *58D2 Electric resistance tomography*
- 58E Prospection technologies
  - *58E1 Remote-control probing robots*
  - *58E2 Endoscopy*
- 58F Mapping of materials on surfaces and structures
  - *58F1 Digital image processing*
  - *58F2 Materials data management and GIS*

[A60] ENVIRONMENT

61 Atmospheric pollution
- 61A CH assets in urban environment
  - *61A1 Primary and secondary pollutants*
  - *61A2 Aerosols*
- 61B Historic Cities
  - *61B1 Migration of air pollution*

62 Water interaction
- 62A Atmospheric precipitation
  - *62A1 Acid rain*
  - *62A2 Aerosols*
- 62B Rising damp
- 62C CH assets in marine environment
- 62D Salt crystallization
- 62E Freeze-Thaw damage to building materials
- 62F Bio-damage of Cultural Heritage

63 Earthquakes
- 63A Earthquake risk
- 63B Geotechnical issues
- 63C Earthquakes at Historic Cities

64 Climate Change
- 64A Floods
- 64B Impact of extreme weather phenomena on CH

65 Anthropogenic impact
- 65A Historic Cities
  - *65A1 Economic and social activities in Historic Cities*
  - *65A2 Impact of CH from Historic City development*
- 65B Archaeological sites
  - *65B1 Impact from visitors*
  - *65B2 Archaeological sites in urban environment*
- 65C Historic buildings and monuments
  - *65C1 Historic buildings in use*
  - *65C2 Historic buildings as museums*
- 65D Tourism

66 Risk assessment and management
- 66A Identification and assessment of risks
- 66B Risk prioritization
- 66C Risk reduction measures
- 66D Resilience of CH

67 Environmental Impact Assessment
- 67A Field visits
- 67B Environmental impact assessment reports

[A70] DIAGNOSIS

71 Methodology of Diagnosis

72 Decay
- 72A Decay patterns
- 72B Decay mapping by NDT
- 72C Decay mechanisms
- 72D Modeling of decay
- 72E Susceptibility of materials to decay

73 Damage
- 73A Damage patterns
- 73B Damage mapping by NDT
- 73C Causes & mechanisms

74 Preservation State
- 74A Synthesis of decay and damage to the pathology analysis for the characterization of the preservation state
- 74B Classification of the preservation state

75 Environmental Impact Assessment
- 75A Mapping of environmental stresses
- 75B Mapping of environmental impact
- 75C GIS management of environmental impact assessment data
- 75D Stochastic analysis correlating environmental stresses to environmental impact

[A80] STRUCTURAL ANALYSIS – ASSESSMENT

81 Analytical structural and assessment methods
- 81A Laboratory testing
- 81B Structural assessment

82 Structural Health Monitoring
- 82A Field testing
- 82B Vibrations measurements in situ

83 Numerical approximation methods for structural integrity
- 83A Finite Element Modelling

84 Earthquake Engineering
- 84A Assessment of seismic performance
- 84B Experimental assessment / Shake-Table testing

[A90] VALORIZATION-VALUES

91 Importance of the CH asset
- 91A Values of the CH asset
- 91B Interaction with the Society

92 Authenticity
- 92A Modifications & past intervention of the CH asset
- 92B Authenticity of the CH asset's elements

93 Compatibility of past interventions with the original CH asset

[A100] Knowledge-based Digital Infrastructure

101 Fusion of multidisciplinary data
- 101A Correlation of multi-spectral / multi-modal data
- 101B Semantic data integration

102 Multilayer management of big data
- 102A Holistic Ontology-based assets records

103 Information platforms
- 103A Time-dynamic 3D reconstruction of CH assets
- 103B Heritage – Building Information Models (HBIM)
- 103C Geographical Information Systems (GIS)

104 Virtual Reality / Augmented Reality

105 Artificial Intelligence and Machine Learning

[B] DECISION MAKING

[B10] STUDIES

11 Architectural Study
12 Structural Study
13 Materials and Interventions Study
14 Other studies

[B20] LEGISLATION FRAMEWORK

21 Adherence to international and national legislation
22 Legal responsibility of CH managers / CH works

[B30] STAKEHOLDERS

31 CH Governance at national level
32 Regional and local stakeholders
33 Society – Wide public
34 Religion
35 Private stakeholder & NGOs
36 Scientific Communities
37 Technical Communities
38 Cross-responsibility issues among stakeholders

[B40] SOCIO-ECONOMIC & TECHNICAL FRAMEWORK

41 Perception of CH by Society
42 Interaction and interrelation of Tourism and CH
43 Impact of CH on the development of Historic Cities
44 Financing CH Protection
- 44A Governmental funding
- 44B European and International Research Funding
- 44C Private funding
- 44D Self-financing of CH

45 Research at the level of Universities
- 45A Innovation
- 45B Centers of Excellence – Research infrastructure
- 45C Cooperation of Universities with Industry and SMEs

46 Research at the level of Ministries and relevant authorities
47 The role of Construction industry
48 Limitations of implementing CH-related works within confined environments
- 48A Archaeological sites in urban environment
- 48B Disruption of socio-economic life

[B50] Conflicts and Challenges

51 Protection of CH in areas of conflicts
52 Cooperation challenges with relevant authorities and stakeholders

[C] INTERVENTIONS

[C10] DESIGN OF INTERVENTIONS

11 Organization of worksite
12 Organization of in-situ laboratories and workshops
13 Logistics of materials and equipment
- 12A Calculation of quantities of materials and equipment
- 12B Ordering and delivering materials and equipment
- 12C Design and construction of special equipment
- 12D Storage and handling of materials and equipment
- 12E Cooperation with suppliers and relevant authorities

14 Human resources issues
- 14A Selection and employment of personnel
- 14B Travel, Food, Accommodation and Health Insurance

15 Design of the iterative process of the main stages
- 15A Gannt-charts and pre-planning of stages
- 15B Definition of targets and objectives per stage

16 Description of interventions
- 16A Detailed specifications for materials, procedures and techniques
- 16B Creation of detail drawings

[C20] INTEGRATED GOVERNANCE

21 Integrated governance of the project
22 Monitoring, quality control, assessment and evaluation
22 Scientific support to decision making

[C30] RISK MANAGEMENT & CONTINGENCY PLAN

31 Identification of potential risks
32 Procedures for risk management
33 Safety issues

[C40] PILOT-SCALE WORKS

41 Design of pilot-scale works
42 Selection of characteristic areas
43 Implementation of pilot-scale works
44 Assessment of data from pilot-scale works
45 Comparative evaluations between alternative approaches
46 Optimization of interventions

[C50] IMPLEMENTATION OF INTERVENTIONS

51 Implementation of interventions
- 51A Interventions aiming to assure structural integrity
- 61B Interventions aiming to reveal and preserve the values
- 51C Interventions aiming to enhance the sustainability of the CH asset

52 Documentation of works
- 52A Digital depositories

[C60] ASSESSMENT & EVALUATION OF INTERVENTIONS

61 Criteria for assessment and evaluation
- 61A Compatibility

61B Performance
61C Architectural authenticity
61D Structural integrity

62 In-situ validation by advanced NDTs and conventional testing
63 Validation of the response of the retrofitted structure by modelling

[C70] REVEALING AND PRESERVATION OF VALUES

71 Revealing of new findings
71A Revealing of new findings during the implementation of works
71B Revealing of new findings through analysis of new data
71B1 Archaeological approach
71B2 Archaeometric approach
71B3 Archaeogene approach
71B4 Evolution of construction phases
71B5 Architectural approach

72 Optimization of interventions to ensure preservation of values
72A Risk analysis for the preservation of values
72B Design, implementation and documentation of relevant mitigation & protection measures

73 Communication strategies
73A Dissemination to the media and to the Society
73B Exhibitions

[D] SUSTAINABILITY

[D10] MONITORING OF CH ASSET

11 Definition of critical monitoring parameters and monitoring protocols
12 Monitoring of CH assets through permanent sensors and instrumentation
13 Monitoring of CH assets through regular scientific surveys

[D20] MONITORING OF THE ENVIRONMENT

21 Definition of critical monitoring parameters and monitoring protocols
22 Monitoring of environmental parameters through permanent sensors and instrumentation at the CH asset
23 Monitoring of environmental parameters through regular scientific surveys
24 Monitoring of data from environmental databases

[D30] STRATEGIC PLANNING

31 Preventive and regular maintenance schemes
32 Prioritization of risks and needs
33 Interaction with Society

[D40] ENVIRONMENTAL MANAGEMENT

41 Historic cities
41A Interventions to the surroundings of the historic city at local or regional level
41B Interventions to infrastructure of the historic city

42 Archaeological sites
42A Interventions to the urban environment around archaeological sites
42B Cultural routes

43 Historic buildings and monuments
43A Interventions to the urban environment

[D50] DISSEMINATION, COMMUNICATION AND INTERACTION WITH THE SOCIETY

51 Dissemination

52 Communication

53 Dialogue between Science, Authorities and the Society

54 Integration of the CH asset into the socio-economic development

55 Tourism

[D60] EDUCATION

61 Cultural Heritage Related Educational Programs at Universities

- 61A Post-graduate programs
- 61B Undergraduate programs
- 61C Employability by authorities and stakeholders

62 Training of the technical community

63 Educating the general public