DOCUMENTATION FOR ENVIRONMENTAL RISK ASSESSMENT AND MITIGATION OF BUILT CULTURAL HERITAGE IN CENTRAL ASIA: THE ERAMCA PROJECT

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ABSTRACT:

The ERASMUS+ initiative funded, in 2019, a Capacity Building project named ERAMCA (Environmental Risk Assessment and Mitigation in Central Asia) to build up a study plan at the Master of Science level (120 ECTS in 2 academic years) open to Architects, Civil, Building, and Environmental Engineers to build-up a new generation of professionals able to work in a team with different specialities to document Cultural Heritage assets by considering environmental risks. These new professionals will be able to set up the helpful basic knowledge to plan future actions of preservation and enhancement by following the most recent development in the restoration field at the international level.
The ERAMCA project started with a survey of the basic knowledge of architects and engineers in Uzbekistan and Tajikistan on the documentation of natural and anthropic risks.
By considering the common knowledge, the Partners of the ERAMCA project (3 European Universities from Italy, Germany, and Croatia and 4 Universities from Uzbekistan and Tajikistan) realised a study plan by concentrating the teaching activity on the following disciplines: Geomatics, Restoration, Structure and Seismic Engineering, Hydrogeology and Geotechnics.
ERAMCA project is in its last year of activity, and the final results can be presented and discussed among the Cultural Heritage Documentation community to offer possible suggestions for future actions to diffuse documentation strategies.

1. INTRODUCTION

The ERASMUS+ Capacity Building (Higher Education) initiative of the European Community aims to promote transnational cooperation between European and no European Higher Education Institutions.
The main goals are to offer voluntary convergence with European development in higher education, increase cooperation with European Universities and ease the exchange of students at the international level (European Commission, 2023).
Every year, funding opportunities are offered to allow massive participation from a high number of no European Countries, mainly concentrated in South America, Asia, and Africa.
Proposed projects usually last three years and promote people-to-people contact, intercultural awareness, and understanding.
In this frame, Italy, Germany, Croatia, Uzbekistan, and Tajikistan joined a project today at the end of the development.
The following paragraphs will briefly describe the main aims and the achieved results of the ERAMCA project funded in 2020 and which will end its activities in 2023.

2. THE ERAMCA PROJECT

The ERAMCA project was proposed in 2019 to develop a Master of Sciences on **E**nvironmental **R**isk **A**ssessment and **M**itigation of **C**ultural Heritage Assets in Central **A**sia (ERAMCA).
Hydrogeological, seismic, and climate change hazards in this area are the most dangerous phenomena that can cause conservation problems for Cultural Heritage Assets.
Local (Ministries of Culture) and international (UNESCO Offices, ICOMOS National Committees) bodies pointed out this problem and the need for a new generation of Engineers and Architects to intervene correctly to preserve Cultural Heritage monuments and sites against natural risks.
Some of the European Universities involved in the proposal had, in the past, the possibility to work in Central Asia, establishing mutual collaborations with some local Universities.
Therefore, the idea of the ERAMCA project is to prepare a new generation of Engineers and Architects to work together, joining the different competencies in a modern approach complying with the basic rules of the conservation and restoration strategies adopted at the international level.

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The team is composed of Politecnico di Torino (Italy), Bauhaus University of Weimar (Germany), and Josip Jurai Strossmayer University of Osijek (Croatia) as European partners.

Two universities from Uzbekistan (Turin Polytechnic University of Tashkent, and Samarkand State Architectural and Civil Engineering Institute) and two from Tajikistan (Tajik Technical University of Dushanbe, and Khujand Polytechnic Institute of Tajik Technical University in Khujand) accepted to be involved in the project by considering the similar needs of the Higher Education system in both Countries.

Due to specific knowledge, the Institute of Water Problems, Hydropower and Ecology of the National Academy of Sciences of Tajikistan has been involved in preparing local teachers in Tajikistan.

Due to the importance of the project for Central Asia Universities, the UNESCO office in Tashkent and the Ministry of Culture of the Republic of Uzbekistan accepted to be associate partners of the initiative.

The project follows a strict design procedure:

– need's analysis of Uzbekistan and Tajikistan in Risk analysis and mitigation of Cultural Heritage assets;
– basic knowledge of future students coming from Bachelors activities in the field of Architecture, Civil, Building, and Environmental Engineering;
– study plan of the ERAMCA Master (120 ECTS in two years);
– complete syllabi of the teaching and practice planned activities;
– collection of notes, books and supporting teaching material (e.g. books, notes, slides, videos, etc.) in a free access Digital Library;
– set up the ERAMCA Labs in all four involved Central Asia Universities;
– training activities for the local teachers;
– starting of the ERAMCA Master
– check the results and proposal of the modification to the planned activities.

2.1 The need's analysis

A set of questions have been prepared and submitted to stakeholders of Cultural Heritage preservation both in Uzbekistan and Tajikistan:

– In your humble opinion, what are the main reasons for the deterioration of cultural heritage sites?
– In order to reduce the environmental impact on cultural heritage sites, what focal areas require further development, and in what areas are experts in massive need?
– What new forms of knowledge and skills should young engineers and restorers possess?
– To what extent are this knowledge and skills currently taught?
– How would you evaluate the level of knowledge of the teachers who teach them?
– How many more credit hours should particular courses have, and what additional courses should be included in the curriculum?
– What lab equipment should be procured to conduct practical and lab training at their higher quality?
– What modern devices and software applications should young engineers and restorers be able to work with?
– In addition to those mentioned earlier, what more should be done to improve the skills of students and teachers?
– How would you evaluate the level of knowledge of young professionals concerning the internationally accepted concepts of restoration and conservation of cultural heritage assets?
– What are the main reasons for this lack of knowledge and skills among local professionals and educators?
– Are these knowledge and skills taught at the University, and if so, to what extent?

The experts involved have great experience in the field of conservation of Cultural Heritage in both Countries:

– Rakhmanov Abdusafikhan (Member of ICOMOS, corresponding member of the International Academy of Architecture of the Countries of the East, member of the Union of Architects of Uzbekistan, laureate of the State Prize of the Republic of Uzbekistan);
– Rustam Samatovich Mukimov (Professor at Technical University named after acad. M. Osimi, Tajikistan);
– Mavlyuda Yusupova (Professor, Dr of Science in Architecture, Head of Architecture Department at Fine Arts Institute of Academy of Science of Uzbekistan);
– Jafar Niyazov (Head of Climatology and Glaciology Lab. Institute of Water Problems, Hydropower and Ecology, Academy of Sciences, Republic of Tajikistan);
– Tahir Mamatmusaev (Professor and head of the Department of History and Theory of Architecture of Tashkent Architecture and Construction Institute);
– Karimov F.H (Institute of Geology, Earthquake Engineering and Seismology, National Academy of Sciences of Tajikistan, 2. Tajik National University, 3. Engineering Academy of the Republic of Tajikistan);
– Anvar Yuvmitov (Senior Researcher, PhD, chief specialist at the Institute of Mechanics and Seismic Stability of Structures of the Academy of Sciences of the Republic of Uzbekistan);
– Askar Khasanov (Professor at Department of geotechnical engineering (Roads, floors and Basements), SamSACII);
– Bakhodir Matchanov (Chief architect and specialist at the Principal Department for Preservation and Utilization of Cultural Objects of the Ministry of Culture of the Republic of Uzbekistan).

Figure 1. Participants in the Strategic Forum of the ERAMCA project (Tashkent, September 2020)

During a workshop, the invited experts presented the current situation in respective Countries regarding risk assessment and mitigation. They pointed out the need for a new generation of technicians (engineers and architects) to work in a multidisciplinary context by merging different expertise.

The results of this extensive investigation point out the primary disciplines that the new professionals must manage: hydrogeology, structures and seismic engineering, geomatics, geotechnics and a complete understanding of the restoration principles adopted at the international level and adapted to local situations. To face this last topic, general knowledge of the

History of architecture in Central Asia will also be helpful to understand better the kind of interventions planned on single places and monuments.

2.2 The knowledge background of future ERAMCA students

To be able to design a study plan which satisfies the requirements described in the previous paragraph, an analysis of the possible knowledge background of the potential students has been conducted by considering the study plans of the Bachelor and Master in Architecture and Civil, Building, and Environmental Engineering activated in both Uzbekistan and Tajikistan.
This investigation aims to point out the possible common knowledge of the future students of the ERAMCA Master and to drive the Partners in the following steps of the project.
Only the study plans authorised by local authorities were considered, and a deep analysis of the teaching materials (notes, books) already published has been conducted to understand better the starting point of the ERAMCA Master.
All the collected information opened an extensive discussion among the partners.
Architects and Engineers have different backgrounds, and the differences cannot be overpassed in a two years Master.
In all the interventions on Cultural Heritage, deep documentation is needed to allow the specialists to plan possible interventions correctly, and these data must be collected and organised in such a way as to drive future decisions in the correct direction.
Therefore, a possible approach of the ERAMCA Master could be to give the students a basic common knowledge of all the disciplines, the necessary additional knowledge on specific topics by considering their primary expertise, and to train them to work as a team facing complex situations.
Engineers can develop their knowledge and share the main results with Architects and Conservators to take optimal solutions which respect the main principles of restoration and conservation.
Architects and Conservators must be able to understand the technical proposed solution and suggest possible changes and adaptations.

2.3 The ERAMCA master: planning teaching activities

The results achieved in the previous steps of the project allow the Partners to plan a complete study plan for a Master of Science (120 ECTS) and the necessary equipment and teaching materials.
The teaching activity is divided into two years of 60 ECTS each (see Fig. 2).
In the first year, the basic of all the involved disciplines are given in traditional classroom-based learning: the students are informed about theoretical concepts of the primary disciplines and trained on a set of basic instruments (hardware and software) and pushed to study on the teaching materials which will be prepared in the next step.
In the second year, the students are invited to join a joint project which is faced in three different teaching ways: project, work, and research-based learning activities.
Each University will choose one or more (by considering the number of students) Cultural Heritage assets where complete documentation and risk analysis will be performed and possible planning of interventions to be acted to mitigate the environmental risks.
Figure 2 shows the overall planning of the teaching activities. A complete description of contents, expected results, and assessment criteria have been defined for each teaching module.
This information is helpful to future teachers and students better understand the contents and motivations of each teaching module concerning others.

Year	Semester	Pedagogical approach	Status: Compulsory (C) or	Module	Year	1st		2nd	
					Semester	1st	2nd	3rd	4th
					ECTS credits				
1st	1st Semester Total 30 ECTS Credits	Classroom-based learning (CBL)	E	Elective module	30	6			
			C	History of Architecture in Central Asia		6			
			C	Geomatics I		6			
			C	Structural Mechanics		6			
			C	Hydrogeology		6			
	2nd Semester Total 30 ECTS Credits		C	Restoration I: History and Theories	30		6		
			C	Geotechnical Engineering			6		
			C	Earthquake Engineering			6		
			C	Advanced Structural Mechanics			6		
			E	Elective module			6		
2nd	3rd Semester Total 30 ECTS Credits	Project-based learning (PBL)	C	Restoration II	30			6	
			C	Geomatics II				6	
			C	Seismic Protection of Historical Structures				6	
			C	Risk Assessment and Mitigation (Hydrogeology and Geotechnics				12	
	4th Semester Total 30 ECTS Credits	Work-based learning (WBL)	C	Training Period (Professional practice)	30				10
		Research-based learning (RBL)	C	Master Thesis (including laboratory research or field work)					20
				Total:	120 ECTS				

Figure 2. The general structure of ERAMCA Master course activities

The theory and principles of the peripatetic school (Peripatos), founded by Aristotle (384–322 BC), a Greek philosopher and polymath during the classical period in ancient Greece, are implemented into the Master Course structure. The term peripatetic is a transliteration of the ancient Greek word περιπατητικός (peripatētikós), which means “of walking” or “given to walking about”, and in this case, is referring to learning-by-doing in-situ with learner and teacher working together.

2.4 ERAMCA Digital Library and Laboratory

In this project step, the Partners worked divided into six disciplinary groups: Structures, Seismic Engineering, History of Architecture and Restoration, Geotechnics, Hydrogeology, and Geomatics.
Each group collected or produced already books and teaching materials (e.g. notes, slides, videos).
All the produced materials have been written in English and translated into Russian by local teachers to ease the teaching activities in local languages.
This expensive choice was adopted since the beginning of the project and accepted by Erasmus+ authorities by considering the low diffusion of the English language in Central Asia Universities.
The accessibility to the material in both English and Russian will also help improve English knowledge and diffusion among the students as a common language to access international experiences and publications on interesting arguments.

The complete written material is accessible to the teachers and students through the ERAMCA website (https://eramca.com/).

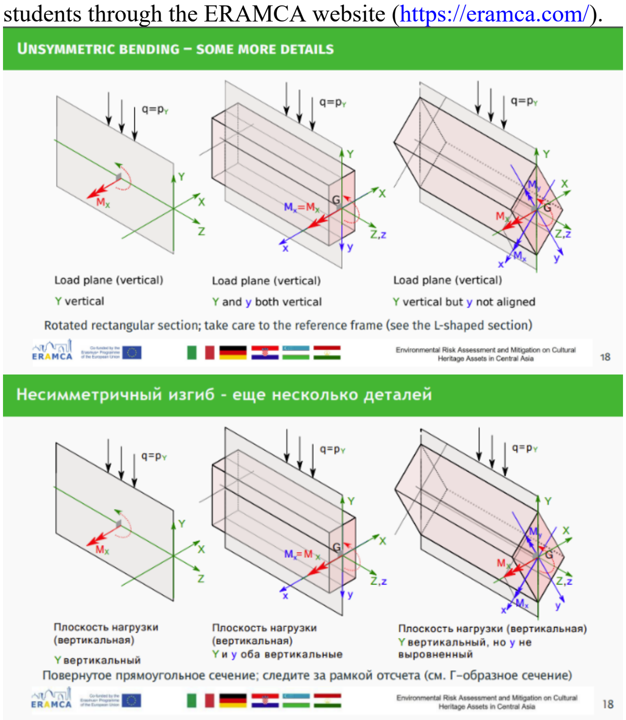

Figure 3. English and Russian versions of teaching material

Considering the planned teaching activities, a list of instruments (hardware and software) has been adopted to allow the students a practical approach to theoretical concepts.
Each of the 4 Central Asia universities is funded to build a Laboratory for 20 students, which instruments are listed in Table 1.

Area	Items
GENERAL	
Indoors/Classroom Activities	**10 Desktop Computer - Tower**
	10 Desktop Computer - PC Monitor
	1 Laptop Computer
	1 All in one Laser Printer
Outdoors/Field Activities	**1 Laptop Computer**
SEISMIC AND STRUCTURAL ENGINEERING	
Indoors/Classroom Activities	**10 MATLAB with toolboxes**
	10 SAP 2000 v22
Outdoors/Field Activities	**1 Seismograph**
GEOMATICS	
Indoors/Classroom Activities	**10 Autodesk full licences**
	10 MicroSurvey STAR*NET 10.0 (v10.0.15.974)
	10 QGIS
Outdoors/Field Activities	**1 Terrestrial laser scanning system**
HYDROGEOLOGY/GEOTECHNICAL ENGINEERING	
Indoors/Classroom Activities	**10 Rockscience licence**
	10 Visual MODFLOW Flex
Outdoors/Field Activities	**1 Mechanical profilometer**
	1 Schmidt Hammer
	1 Soil Penetrometer, pocket type
	1 Pocket Shear Vane (Torvane)
CONSERVATION AND RESTORATION	
Outdoors/Field Activities Measuring instruments	**1 Thermal imaging camera (low to medium cost) including software for thermographic processing data**
	1 Diagnostic Scope

Table 1. List of the instruments provided in each of the 4 Laboratories

Concerning the nature and purpose of the proposed Master Course, where students bring different backgrounds from their undergraduate education, i.e. architectural or civil engineering, the category of the Master Course becomes genuinely multidisciplinary. The Master Course also provide an opportunity to integrate the technical and non-technical skills of engineering and to develop a commitment to professional and social responsibility and ethical codes. Graduates from an accredited Master Course must comprehend the learning outcomes described below, including acquiring knowledge concerning, i.e. building on their entry (relevant) engineering discipline (architecture or civil engineering). The learning outcomes stated are at enhanced and extended levels, the balance of which will vary according to the content and aims of each module. Crucially, Master students will have the ability to integrate their prior knowledge and understanding of the discipline and engineering practice with the development of advanced level knowledge and understanding to continue their education at the postgraduate level or to solve a substantial range of environmental engineering problems, that may be complex or novel. They will have acquired much of this ability through individual and group projects. Ideally, some of these projects would have industrial involvement or be practice-based.

Figure 4. ERAMCA Laboratories in Tajikistan and Uzbekistan

2.5 Training of local teachers

In July 2022, a training week for local teachers was organised to share not the disciplinary contents of all the involved disciplines but to understand in which way those theoretical and practical contents can be reached in the way usually adopted in European Universities.
Some practical sessions on the actual use of instruments and software took place to share the way the students face the use of automatic tools, justifying, step by step, the helpful theoretical background to understand the parametrisation of the tools.
All the sessions were organised on disciplinary topics, and European and Central Asia teachers shared teaching experiences and tried to find the best way to transmit theoretical and practical knowledge to the students correctly.
The involvement of Central Asia teachers with authentic experiences in teaching in their own Countries, was of great importance to planning correct teaching approaches for each discipline.

Figure 5. Practical (above) and theoretical (below) sessions of the training week.

As usual for ERASMUS+ initiatives, having a joint meeting between European and no European teachers is a great possibility to have a fruitful cultural exchange of experiences and a possibility to understand how European approaches can be articulated and adapted in the context of different cultures and traditions.

2.6 ERAMCA Master activation

In 2022, all four Central Asia Universities submitted the study plan of the ERAMCA Master to local authorities to obtain the "licence" to activate the course and to deliver, in the end, the official degree recognised in the respective Countries.
Once the licenses had been obtained, the four involved Central Asia Universities started recruiting potential students and a strong selection among the candidates.

Figure 6. Teachers and students of the Eramca Master in Turin Polytechnic University of Tashkent

In October 2022, the first two ERAMCA Masters started the activities: Uzbekistan (Turin Polytechnic University of Tashkent) and Tajikistan (Tajik Technical University in Dushanbe).
During the lessons, local teachers adapted the contents of the different modules and suggested to the Partners possible improvements and adaptations of the planned activities.
The contributions and discussions among local teachers and students also allowed a fruitful adaptation of the project to real situations that cannot be considered during the planning activities of the projects.

3. CONCLUSIONS

In the next academic year, the other two Masters (one in Kujinad and one in Samarkand) will hopefully be activated. The already achieved experiences in the first two activated master's will allow a better implementation and a continuous adaptation of the contents of the first-year lectures.
In the meantime, the second-year activities in Tashkent and Dushanbe will offer the possibility to close the trail of the planned ERAMCA Master and a fruitful project conclusion.
In December 2023, a final workshop will be organised involving students, teachers, and stakeholders (the ones already involved in the strategic workshop at the beginning of the project – see Par. 2) to summarise the results and analyse the achieved results.
The expected results are a new generation of professionals able to document Cultural Heritage sites by mainly considering environmental risks and proposing possible interventions to mitigate their effects in a team-working approach involving specialists in different disciplines focused on solving a common problem.

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