Corrigendum: The gap of cultural heritage protection with climate change adaptation in the context of spatial planning. The case of Greece (2021 IOP Conf. Ser.: Earth Environ. Sci. 899 012022)

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[1] Fatorić, S., & Biesbroek, R. (2020). Adapting cultural heritage to climate change impacts in the Netherlands: barriers, interdependencies, and strategies for overcoming them. Climatic Change, 162(2), 301-320. doi: 10.1007/s10584-020-02831-1
The gap of cultural heritage protection with climate change adaptation in the context of spatial planning. The case of Greece

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Abstract. The case of cultural resources, and in particular of archaeological sites, is one of the key elements of the anthropogenic environment that is affected by climate change and needs protection. At the same time, it is a field of analysis allowing the understanding of the interactions and interconnections of natural and socio-economic systems in time and in different spatial scales, thus providing useful information on the phenomenon of climate change and on how to respond and adapt to it [1]. However, the related scientific research, policies and actions are still limited, as only in the last decade [2] there has been an (albeit ever-increasing) interest in this field. The main objective of this paper is to codify protection policies and to identify a typology of actions for major archaeological sites with tourist interest in Greece, in order to identify a framework for spatial planning to meet the challenges of reducing the effects of climate change such as: the adoption of an integrated design approach to the protection of cultural heritage rather than a traditional conservation approach; linking the cultural heritage with the natural environment; Bridging existing gaps and redefining cultural heritage in dynamic and spatial terms for both climate change adaptation and also emergency preparedness and disaster risk reduction.

1. Introduction
Climate change is a dynamic process that affects the environmental and the socio-economic systems as well as their components, individually. The case of cultural resources, and in particular of archaeological sites, is one of the key elements of the anthropogenic environment that is affected by climate change and needs protection. Climate change has emerged as a major threat to the sustainability of many cultural resources around the world [3] [4]. By distressing major climatic parameters which are associated with the main climate-related risks that affect monuments and archaeological sites, this dynamic phenomenon threatens cultural resources and the areas within which they are located in many ways. On the one hand, direct consequences, reflected in damages on materials and structures [5], degrade the state and the outstanding universal value of many world heritage sites [6]. On the other hand, from a broader perspective, climate change can potentially cause structural alterations to the areas of tourist and cultural capital, with the disruption of their socio-economic activities due to severe weather events being an important factor [7].
The protection of the archaeological sites from climate change impacts has been set as a central priority for international bodies active in the protection of cultural heritage (UNESCO, ICOMOS, ICOM). Since the scope of socioeconomic changes and landscape characteristics varies from place to place, cultural heritage must be assessed on a territorial base, thus its climate resilience to be addressed through spatial planning policies.

Recently, the European Commission has also addressed this priority, both in terms of protecting its rich and unique cultural capital and in terms of the sustainability of tourist activity that is being developed in zones of archaeological sites and monuments. Spatial Planning has been recognised as an important factor for climate change adaptation [8] [9] [10] [11], especially because of land use and infrastructure arrangements. However, drawing upon experiences of spatial planning in practice, there is no common response for all archaeological sites and monuments regarding the risks they face from the impacts of climate change (including extreme weather events), since exposure, sensitivity, adaptability, and ultimately the vulnerability of each site depend on its environmental, geological, topographical, residential and other characteristics, as well as on the intensity and frequency of observed or estimated climatic change impacts that differentiate spatially over time.

Acknowledging the main challenges of spatial planning involves reducing the effects of climate change and identifying the mentioned gaps, this paper aims at codifying protection policies and identifying the typology of actions which can be implemented in major archaeological sites of tourist interest in Greece. The paper is structured as follows. Following the introduction, section 2 sets out the context of international reflection on the challenges of spatial planning related to the implementation of climate change policy for cultural heritage sites. Then the research methodology used for the codification and evaluation of the policy documents and accordingly for the identification of the action typology is described together with the data sources. The next section provides some conclusions and further discussions based on the results of the categorization and evaluation of the preventive and adaptive actions detected in the policy documents. The last section consists of the main conclusion derived from the analysis.

2. Planning challenges and barriers to existing Climate Change policy for cultural heritage

Archaeology allows descriptions and interpretations of past social components that have appeared in the present, such as economic relationships power and governance relationships and knowledge and use of the environment [1]. Until recently, academic discourses preserved archaeological sites, and cultural heritage in general, as social structures of the past. It is only in the last decades that the scientific/academic perspective on archaeology and its present orientation has opened new relations among archaeology and other sectors. It is now comprehended that archaeological sites can also enhance capacity for learning and transferring the knowledge into current social contexts and experiences [12]. Climate change and spatial planning are two interrelated areas that this could be proved very useful, though very complicated and challenging.

Academic literature provides a solid understanding of the role of heritage in spatial planning and how this has changed over the past decades. The political urgency and scale of these concerns have increased drastically over the course of the last decade. This sense of a future crisis makes spatial planning for climate change stand out from many other spatial planning assignments. It is also the case that mitigation and adaptation measures are often informed by different kinds of expertise, different authorities and on different scales. This could foster differences in mindsets regarding the role heritage has in spatial planning. Three main approaches developed in a historical sequence are recognized regarding the integration of heritage into planning, namely, the sector, factor and vector approach [13]. The sector approach is based on the notion that socio-economic and spatial dynamics pose a constant threat to the cultural heritage, the factor approach sees heritage as a component of spatial quality embedded in a new plan or regeneration scheme, while the latter inspires and guides spatial planning in the broader sense, supplying it with a historical narrative.

On the other hand, Risk and Disaster Management is a process that is applied in a wide range of cases and includes two related but distinct phases: (I) Disaster risk reduction refers to both policy
objectives and the strategic and organic measures used to anticipate a future risk, reduce existing exposure, risk or vulnerability, and improve resilience of the element in need of protection. This phase includes all the necessary precautionary measures and interventions that can be implemented for this purpose. (II) Disaster management refers to social processes for the design, implementation and evaluation of strategies, policies and measures that promote and improve disaster preparedness, response and recovery practices, at different organizational and socio-economic levels.

Regarding more specifically the treatment and management of the risks of climate change in terms of archaeological sites and cultural heritage in general, until today, two basic types of strategies are recorded. The first type is related to low-risk actions that focus on improving protection against changing climatic conditions that are already occurring and the approaches applied generally involve either thematic risk analyses or specific material studies. The second type is related to higher risk actions, which require adaptation of practices or even changes in what archaeological management or historical conservation considers acceptable. These are strategies that, for the most part, fall into the second phase described above, that is, after some kind of change or disaster has taken place [12]. The first one is the most common in national policies.

Over the past three decades, climate change adaptation research, policy and practice globally have focused on various vulnerable sectors but research on adaptation of various cultural heritage types is still relatively weak [4] [14]. Regarding cultural heritage and climate change, there are two main narratives. According to the first one, climate change is mainly seen as a threat, potentially destroying heritage by coastal erosion, deterioration of materials etc [15]. The latter underlines the important role of cultural heritage in supporting and ensuring knowledge for climate adaptation and mitigation, with the heritage protection to be developed into ‘management of change’ [16].

The most recent research has focused on developing frameworks, tools, or methods to assess climate risks and vulnerabilities of diverse cultural heritage types [4] but there have been limited efforts to understand the design of feasible adaptation measures, and the governance challenges encountered in implementing actions to increase cultural heritage resilience [12]. Therefore, there is a need to identify the barriers that arise in the adaptation process in order to bridge the gap between climate change science and climate change adaptation planning and implementation for cultural heritage. However, only two studies [17] [18] systematically identified and characterised multiple types of barriers to cultural heritage climate adaptation and strategies to overcome them.

Barriers are the result of complex governance processes, the characteristics of the multi-level actors and nature of the system (e.g. cultural heritage) involved, and a broader governance context within which the multi-level actors and system operate. Barriers are shown to arise at all stages of the policy process, from framing the problem of climate change, considering response options and adaptation planning, to implementation, monitoring, and evaluation [19]. The emerging evidence on barriers to climate adaptation of cultural heritage suggests that there are broadly four types of barriers: institutional, technical, socio-cultural, and financial barriers [17].

Institutional barriers are often interlinked with spatial planning while national, and local institutional frameworks and policies for climate or spatial adaptation of various sectors can be implemented for diverse heritage types [20]. Institutional barriers are often attributed to lack of institutional frameworks, policies, laws, and regulations, including unclear mandates [17] [21]. Evidence shows that lack of guidelines and standards for adaptation to assist decision makers and stakeholders in selecting relevant interventions for reducing risk from climate change and lack of prioritisation processes among numerous cultural heritage assets are institutional barriers to adaptation processes [17] [18] [21]. Furthermore, lack of coordinated governance, limited collaboration, low levels of communication among multi-level actors and stakeholders, and the lack of awareness and sense of urgency of the intersection of cultural heritage and climate change were found in the literature as key barriers that constrain adaptation planning and implementation for cultural heritage. Barriers to climate adaptation can also arise from factors such as lack of political commitment caused by climate change denial or lack of trust in government for heritage preservation [20].
3. Methodology and Data analysis

This research concerns archaeological sites with specific characteristics (e.g. Ancient Olympia, Delphi, Epidaurus, Mystras etc): (a) presenting a combination of cultural (e.g. sites of the UNESCO World Heritage List) and tourist capital (location in important tourist areas); (b) being located in areas of natural (non-urbanized) environment.

Regarding the identification of the proposed actions typology, the methodology concerns the identification and evaluation of policy directions, measures and actions, that are included in institutional, management and scientific documents, and are related to specific climate risks. Specifically, the research is focused on four climate risks associated with alterations in key climatic parameters (temperature, precipitation, sea level rise, wind speed, desertification) that can potentially affect the archaeological sites; namely, flooding phenomenon, sea level rise, forest fires, soil erosion.

The research includes two stages:
A. The indexing of the legislative and institutional framework as well as other related policy documents and studies regarding the directions and actions of preventive and repressive character in five (5) thematic sections:
   I. Integration in the planning stages [Planning phase]: 1. Diagnosis-Preparation, 2. Analysis / Empirical Evidence, 3. Strategy Formulation, 4. Application, 5. Monitoring, 6. Feedback
   II. Based on their target [Planning direction]: 1. prevention and adaptation actions, 2. crisis and risk management actions;
   III. Category of actions/directions [Category]: 1. Operational awareness, 2. ICT Infrastructures, 3. Governance – Definition responsibilities – Cooperation of bodies, 4. Management directions/actions, Guidelines, 5. Specific actions – Operational implementation;
   IV. Type of actions/directions [Character]: Study/Plan, Project, Administrative action;
   V. The competent implementing body [Body]: central administration, local government, etc.;
B. The evaluation of the directions and actions identified, based on four (4) criteria:
   I. Regulatory density [Regulatory density]: based on the degree of binding, clarity and interpretation of the direction/action;
   II. Applicability of the preferred directions and actions [Applicability], according to the ease and immediacy of their adoption and implementation;
   III. Degree of relevance with the spatial planning [Relevance to spatial planning];
   IV. Direct or indirect correlation to the protection of cultural heritage, and more specifically of archaeological sites [Reference to arch. sites].

A total of two hundred and thirty-three (233) unique actions, detected in thirty-three (33) institutional documents (26 and 7 at the national and European level respectively), were identified, grouped, and evaluated according to the above-mentioned nine (9) variables of analysis. These actions refer to the prevention and risk management/adaptation to four (4) types of climate-related risks (flooding phenomenon, forest fires, sea level rise and soil erosion).

The examined documents cover different but interrelated topics that are either directly or indirectly related to the phenomena of the four selected risks such as the protection of the environment in general, climate change, spatial planning etc. These are essentially documents of different institutional strength, specialization and goal setting that overall form the framework for decision-making and policy/action implementation in Europe and in Greece.

The workflow includes, first, the creation of a database with (thematic and evaluation) nominal and ordinal variables, then, a descriptive analysis with frequency distribution in predefined categories and grouping by stage and climate risk (crosstabulation), and finally, a correlation analysis using proper statistical indices for categorical (nominal) and ordinal-nominal variables.

4. Results and discussion

A quantification of the main points regarding the prevention and adaptation actions to the specific climate risks is presented in the table 1. Regarding the integration of the foreseen actions of the examined documents in indicative stages of planning [planning phase] it can be noted that most
actions (46.8%) relate to procedures that are part of the implementation phase of planning. A significant share of actions (21.5%) is also observed in the planning stage regarding the formulation of strategy. Actions/measures that refer to the initial stages of planning (Diagnosis-Preparation Analysis & Empirical Evidence) have small participation rates (10.6% and 12.7% respectively) and finally, the smallest shares (2.3% & 6%) are recorded for actions related to monitoring the implementation of planning and feedback.

The actions related to spatial planning in their majority is more than expected - especially for Sea level rise and Soil Erosion risks - and the ones that are about archaeological sites are low in general. Thus, it is clear that cultural heritage protection and adaptation consists an area that has not be covered sufficient.

Most of the detected actions concern the phase of prevention and adaptation, while risk management is mostly observed in General Emergency Confrontation Plans (“Dardanos” concerning floods & “Iolaos” concerning forest fires). This is the case for all of the four risks examined. It is, thus, clear that both phases are not fully covered, with crisis and risk management lagging behind prevention and adaptation, although the latter does not adequately and in detail cover all cases in need of protection, such as that of archaeological sites.

Regulatory density is generally low to medium and a smaller percentage is characterized as “high”. This, in conjunction with the indirect applicability of the regulations, significantly reduces the policy-implementing potentialities. The guidelines, regulations and actions identified are mainly operational/administrative while those referring to studies or projects are met less frequently. The applicability of the actions varies according to climate risk. Specifically, most direct actions concern forest fires and floods, fact to which the existence of General Emergency Confrontation Plans also contributes.

Table 1. Percentage breakdown of directions and actions by category for each analysis variable.

| Variable          | Categories                  | Climate Risk | Floods | DARDANOS | Forest Fires | IOLAOS | Sea level rise | Soil Erosion | Total |
|-------------------|-----------------------------|--------------|--------|----------|-------------|--------|----------------|--------------|-------|
| Total             | Share % of risks            |              | 15.6% | 4.2%     | 56.4%       | 2.1%   | 7.3%           | 20.8%        | 100.0%|
| Diagnosis-Preparation |                   |              | 16.70%| 6.3%     | 10.60%      | 37.5%  | 21.40%         | 2.50%        | 10.60%|
| Analysis / Empirical Evidence |         |              | 3.30% | 16.10%   |             |        | 17.90%         | 8.80%        | 12.70%|
| Stages of Planning | Strategy Formulation        |              | 21.70%| 50.0%    | 20.30%      | 25.0%  | 10.70%         | 28.80%       | 21.60%|
| Implementation     |                             |              | 51.70%| 18.8%    | 43.30%      | 12.5%  | 46.40%         | 52.50%       | 46.80%|
| Monitoring         |                             |              | 3.30% | 25.0%    | 7.40%       | 25.0%  | 0.00%          | 6.30%        | 6.00% |
| Feedback           |                             |              | 3.30% | 2.30%    |             |        | 3.60%          | 1.30%        | 2.30% |
| Category of actions| Operational awareness       |              | 5.0%  | 6.3%     | 15.2%       | 37.5%  | 3.6%           | 3.8%         | 10.4% |
| ICT Infrastructures|                             |              | 3.3%  | 11.1%    |             |        | 3.6%           | 1.3%         | 7.3%  |
| Governance         |                             |              | 36.7% | 50.0%    | 32.3%       | 25.0%  | 35.7%          | 52.5%        | 37.4% |
| Management         |                             |              | 30.0% | 18.8%    | 24.0%       | 12.5%  | 53.6%          | 31.3%        | 28.6% |
| Operational        |                             |              | 25.0% | 25.0%    | 17.5%       | 25.0%  | 3.6%           | 11.3%        | 16.4% |
| Planning direction | Risk management             |              | 31.7% | 62.5%    | 17.5%       | 25.0%  | 15.0%          | 17.9%        | 17.9% |
|                     | Prevention/Adaptation       |              | 68.3% | 37.5%    | 82.5%       | 75.0%  | 100.0%         | 85.0%        | 82.1% |
| Regulatory Density | Moderate                    |              | 46.7% | 100.0%   | 28.1%       | 100.0% | 60.7%          | 56.3%        | 39.2% |
|                     | High                        |              | 1.7%  | 21.7%    |             |        | 17.9%          | 17.5%        | 17.4% |
| Applicability      | Indirect                    |              | 88.3% | 62.5%    | 78.8%       | 100.0% | 96.4%          | 86.3%        | 83.1% |
|                     | None                        |              | 33.3% | 81.3%    | 30.0%       | 87.5%  | 17.5%          | 25.7%        |      |
| Relevance to spatial planning | Moderate    |              | 15.0% | 18.8%    | 24.4%       | 12.5%  | 7.1%           | 10.0%        | 18.7% |
|                     | High                        |              | 18.3% | 26.7%    |             |        | 42.9%          | 22.5%        | 25.7% |
| Reference to archaeol. sites | Moderate  |              | 33.3% | 18.9%    |             |        | 50.0%          | 50.0%        | 29.9% |
|                     | High                        |              | 80.0% | 93.8%    | 88.0%       | 87.5%  | 78.6%          | 97.5%        | 88.1% |
|                     | Low                         |              | 2.8%  | 12.5%    |             |        | 14.3%          | 2.5%         | 1.0%  |
|                     | Moderate                    |              | 0.9%  | 6.3%     | 8.3%        | 7.1%   | 2.5%           | 8.3%         |      |
|                     | High                        |              | 20.0% | 6.3%     | 8.3%        | 7.1%   | 2.5%           | 8.3%         |      |
Regarding the correlation table of the analysis variables (Table 2), the main remarks suggest that, there is a clear correlation of Regulatory density with both the Planning stages and the Applicability, which partially confirms on the one hand the validity of a standardization process of measures/directions, and on the other hand highlights the gap between planning and implementation. There is no systematic differentiation of the correlations per climate risk, with the exception of: (a) the differentiation of the correlation of applicability and regulatory density for the Soil Erosion risk, which is probably related to the direction of actions (indirect character), (b) the intensity of the relationship between the category of actions with planning stages and the applicability for forest fires, which suggests a rather clear hierarchy of actions, (c) the proportionally large relation of reference to archeological sites with the regulatory density for the Sea level rise risk, possibly also due to the substantial existence of directions related to the spatial planning and coastal management.

Table 2. Measures of Association for Categorical Variables (lower diagonal-Cramer’s V*) and Ordinal Variables (upper diagonal-Kendall Tau B**)

| Risk           | Variable                | Planning phase | Planning direction | Regulatory Density | Applicability | Rel. to spatial planning | Ref. to arch. sites |
|----------------|-------------------------|----------------|-------------------|--------------------|---------------|-------------------------|-------------------|
| Total          | Risk                    | 0.101          | -0.036            | 0.334              | -0.194        | -0.144                  | -0.076            |
| Planning phase | Planning direction      | 0.172          | 0.214             | -0.048             | 0.211         | -0.038                  | -0.148            |
| Planning phase | Regulatory Density      | 0.209          | 0.331             | 0.000              | -0.486        | -0.048                  | -0.077            |
| Planning phase | Applicability           | 0.116          | 0.262             | 0.205              | 0.050         | 0.089                   | 0.100             |
| Planning phase | Rel. to spatial planning| 0.190          | 0.221             | 0.000              | 0.029         | 0.074                   | 0.084             |
| Planning phase | Ref. to arch. sites     | 0.162          | 0.071             | 0.124              | 0.181         | 0.077                   | 0.060             |
| Category of actions | Planning direction | 0.164          | 0.240             | 0.000              | 0.027         | 0.221                   | 0.160             |
| Floods         | Planning phase          | 0.271          | -0.015            | 0.385              | -0.122        | -0.204                  | -0.059            |
| Floods         | Planning direction      | 0.145          | 0.145             | 0.015              | -0.408        | -0.161                  | -0.275            |
| Floods         | Regulatory Density      | 0.494          | -0.212            | 0.455              | 0.000         | 0.429                   | 0.053             |
| Floods         | Ref. to spatial planning| 0.257          | 0.387             | 0.154              | 0.164         | 0.168                   | 0.166             |
| Floods         | Ref. to arch. sites     | 0.000          | 0.216             | 0.403              | 0.000         | 0.429                   | 0.053             |
| Forest Fires   | Planning phase          | 0.248          | 0.060             | 0.380              | -0.244        | -0.252                  | -0.072            |
| Forest Fires   | Planning direction      | 0.410          | 0.000             | -0.052             | 0.239         | 0.019                   | -0.167            |
| Forest Fires   | Regulatory Density      | 0.346          | 0.230             | 0.577              | 0.050         | 0.153                   | 0.000             |
| Forest Fires   | Rel. to spatial planning| 0.268          | 0.000             | 0.078              | 0.023         | 0.100                   | 0.000             |
| Forest Fires   | Ref. to arch. sites     | 0.079          | 0.123             | 0.213              | 0.106         | 0.104                   | 0.000             |
| Forest Fires   | Category of actions     | 0.291          | 0.000             | 0.180              | 0.379         | 0.196                   | 0.000             |
| Sea level rise | Planning phase          | 0.305          | -0.152            | 0.061              | -0.082        | 0.000                   | 0.000             |
| Soil           | Planning phase          | 0.292          | -0.300            | -0.137             | 0.333         | 0.098                   | 0.000             |
| Soil           | Applicability           | 0.000          | 0.316             | -0.182             | 0.098         | 0.000                   | 0.000             |
| Soil           | Rel. to spatial planning| 0.339          | 0.394             | 0.047              | 0.137         | 0.000                   | 0.000             |
| Soil           | Ref. to arch. sites     | 0.320          | 0.398             | 0.021              | 0.231         | 0.000                   | 0.000             |
| Soil           | Category of actions     | 0.000          | 0.206             | 0.061              | 0.391         | 0.000                   | 0.000             |
| Erosion-       | Planning phase          | 0.267          | -0.162            | 0.185              | -0.078        | 0.109                   | -0.025            |
| Erosion-       | Applicability           | 0.313          | 0.130             | -0.360             | -0.209        | 0.013                   | 0.000             |
| Erosion-       | Rel. to spatial planning| 0.203          | 0.125             | 0.760              | 0.052         | -0.169                  | 0.000             |
| Erosion-       | Ref. to arch. sites     | 0.214          | 0.114             | 0.235              | 0.000         | 0.140                   | 0.000             |
| Erosion-       | Category of actions     | 0.205          | 0.154             | 0.267              | 0.000         | 0.301                   | 0.000             |

*Cramer’s V* is interpreted as a measure of the relative (strength) of an association between two nominal variables. Useful for comparing multiple χ² test statistics (more than two categories) and is generalizable across contingency tables of varying sizes. The coefficient ranges from 0 to 1 (perfect association).

**Kendall Tau B** is a nonparametric measure of the strength and direction between two variables measured on at least an ordinal scale. The coefficient ranges between -1 and 1 [22].
5. Conclusions
This research aims to fill part of the scientific gap concerning the institutional barriers to cultural heritage climate adaptation and related strategies to overcome them in the context of spatial planning. Institutional barriers are often attributed to lack of institutional frameworks, policies, laws, and regulations, including unclear mandates. Coordinated governance, guidelines and standards for adaptation to assist decision makers and stakeholders, effective communication among multi-level actors and awareness of the urgency of the intersection of cultural heritage and climate change are also of significant importance in a process of adaptation planning for cultural heritage.

The analysis concerns the prevention and adaptation of archaeological sites in areas of natural environment combining cultural and tourist capital to four types of climate-related risks, floods, forest fires, sea level rise and soil erosion. The related actions, identified in a series of institutional documents are related to operational awareness, ICT Infrastructures, governance schemes, management framework and implementation process. To summarize the main results derived from the research so far, the examined European and Greek institutional documents as well as strategic and management plans, include both general but also specialized provisions regarding the four selected climate risks. Greek institutional documents include provisions that are specified and even exceed the general provisions of the European framework, being adapted to the country’s particularities (institutional mechanisms, economic capacity, natural environment, cultural capital etc.). The type and purpose of each document in which the proposed actions are identified determine, to a significant degree, their regulatory density and, secondarily, their applicability.

Crisis management is lagging behind prevention and adaptation, although the latter does not adequately cover archaeological sites. Central government constitutes the principle implementing body of the policies and the actions they embody. Local governments are the second most significant actor in implementing climate change adaptation actions, while other actors play an important role. However, the ambiguity and overlapping of responsibilities, combined with the relatively low applicability and specialization of the envisaged directions, is a significant risk for non-implementation while the provision for monitoring and feedback is weak.

Acknowledgments
This research was carried out in the framework of the “CLIMASCAPE” project (http://climascape.prd.uth.gr) funded by the Operational Programme “Competitiveness, Entrepreneurship and Innovation 2014-2020” (EPAnEK).

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