CULTURAL HERITAGE AND RISK:
LET'S *GIVE INTELLIGENCE* TO OUR TECHNOLOGIES

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ABSTRACT:

In the last decades, the evolution in the sector of technologies applied to cultural heritage has taken on extraordinary accelerations in terms of accuracy and reliability of the measurement and restitution, as well as in the management of acquired data. In particular, the complex of these measurement and documentation actions are of fundamental importance if interfaced with other types of heterogeneous data acquired in different ways. Nevertheless, in face of such a complex framework of know- how, increasingly advanced technologies, dedicated programs and funding, meetings and debates, the establishment of specific Institutional Bodies to manage decision-making plans and their implementation, we continue to witness the frantic chasing of emergencies after the occurrence of catastrophic events. The spectrum of risks is more and more manifesting itself in its breadth: to the evidence of the effects due to Climate Change, those deriving from hydrogeological instability, from the lack of care of the territory and coasts, the devastation of an anthropic nature due to the senseless consumption of soil, and the unsustainable pressure of an uncultured, omnivorous tourism, are added with increasing frequency. This contribution deals in a general way with the theme of technologies for the knowledge of Cultural Heritage. It intends to critically question about the dangers inherent in the "indiscriminate, unconscious and uncritical" use of technologies for the knowledge of Cultural Heritage oriented towards its preservation. The aim is to prompt a discussion within the scientific community dealing with the documentation and conservation of cultural heritage in order to promote an indispensable culture of prevention and planned conservation, in which the *intelligent* relationship between Man and technology must be rediscovered.

1. INTRODUCTION

1.1 Background

At the beginning of the 21st century, at a time when 'algorithm' and 'Artificial Intelligence' were not yet part of the lexicon and 'popular' concepts in the public domain, Umberto Galimberti in *Psyche e Techne. L'uomo nell'età della tecnica* (Feltrinelli Ed., Milan 2000) was already writing that:
"*...We continue to think of technology as an 'instrument' at our disposal, while technology has become the 'environment' that surrounds and shapes us according to those rules of rationality that, measured only on the criteria of functionality and efficiency, do not hesitate to subordinate the needs of man to the demands of the technical apparatus. Unaware, we still move with the typical traits of 'pre-technological' man who acted according to goals having a perspective of meaning, with a baggage of ideas and a set of sentiments in which he recognised himself... Indeed, technology may mark that absolutely new point in history, and perhaps an irreversible one, where the question is no longer 'what can we do with technology', but rather 'what can technology do to us'.*" (Galimberti, 2000).
'Only' twenty years later, the pervasiveness of the algorithm and Artificial Intelligence (AI) can today be found in all the multiple sectors making up our globalised societies. Even in every domestic activity of our daily lives.
It accompanies us, indeed often replacing us, in managing our homes (domotics), in the (semi-)automatic driving of our cars and, going up in scale, ever more in complex cognitive and decision-making processes, right up to their outcomes.
If we think solely of medicine and the fundamental activity of diagnostics, the old *imaging* techniques, now being able to be based on AI applied to big data, are intensely implemented and open up previously unthinkable interpretative scenarios. To what extent then, is it still the doctor who determines the diagnosis?
So, much more so than in 2000, the question is indeed what 'technology can do to us'.
This reflection, as we well know, is applicable to any other disciplinary domain, scientific or humanistic, to whichever project and management domain based on knowledge, up to and including political, government and administrative fields.
It is then legitimate to ask to what extent today, at the beginning of the third decade of the 21st century, can we still affirm with certainty that we are still builders (and not victims) of our future. In a word, just how aware are we of what kind of future lies before us? Above all, how much room can we continue to find in it for the same values that have hitherto represented the foundation and substance of our progress towards a perspective of growth in a - hopefully - human sense of our society of human beings?
Moreover, we do not know how differently we will have to adapt our approaches to the various knowledge paths underpinning any decision-making process, nor what the tools and share of human/technological involvement will be.
On the contrary, it now seems that the terms at stake have undergone a fierce and unstoppable trend reversal, difficult to decipher and which appears entirely dichotomous with respect to a very recent past.
Indeed, while both the previous Industrial Revolutions did not substantially lead to any decisive cultural discontinuities within the historical processes, the so-called 'digital revolution', accelerating in recent decades, undoubtedly introduces an out-and-out interruption in the process, clearly drawing a *limes*

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between a 'before' and an 'after'. A revolution tantamount to that produced by Gutenberg's invention at the end of the 1400s.

Today, it is not just a matter of the 'unreachability' of the speed of technological innovation, which, as a form of new power, is also distinguished by the fact that it now possesses apparently 'autonomous' logics and paradigms that elude familiar discourses on traditional production processes.

Technology today defines and imposes new behavioural models and stimulates ephemeral 'needs' and hetero-productive approaches.

It would be no exaggeration to say that a new ethical question is arising and it is worthwhile questioning whether the new technologies risk representing the end of Humanism.

Certainly, the virtuous man-nature-technology loop is being interrupted, with the introduction of new paradigms through which XR *extended reality*, a mix of *reality - virtual reality - augmented reality - mixed reality*, is becoming superimposed, to the point of substituting deep perception, on our experience of the real world within a new and unknown eco-system.

And this is happening without the necessary interpretative tools of our new perceptions, of our new and different relationship with reality, without the devising of new value systems and meanings.

2. CONTEXTUALISATION OF THE GENERAL THEME

2.1 Working on prevention or chasing after an emergency?

Moving from the general theme outlined to the specific issue that the CIPA 2023 International Symposium "*Documenting, Understanding, Preserving Cultural Heritage: Humanities and Digital technologies for Shaping the Future*" presents, urgent questions need to be asked on what the future of Cultural Heritage will be and what kind of recognition will still be given to its valuable characteristics.

The aim being to find in these the motivations of knowledge for conserving and safeguarding the Heritage itself.

Specifically, to understand to what extent the coming society will (and will be able to) "inherit the future" left, for better or worse, by the previous century and rebuild on the centrality of Cultural Heritage and culture its own new development model by recognising in them its intrinsic values.

Exactly in order to understand the meaning of the logical nexus of "*Documenting, Understanding, Preserving Cultural Heritage*" and on this, set out the new best practices (really best and no empty rhetorical words).

Lastly, so that it is Humanity, and not technology, that shapes the future.

To guide the reflection proposed here, it is "contextualised" within a specific issue, this too strongly characterised by the profile of reality, the current events of this historical present.

It is a question of developing the reasoning of the documentation (more rightly, of knowledge) of the Cultural Heritage aimed towards its conservation, by circumscribing it from a perspective of 'risk factors' and the ways of counteracting their effects. Emphasising, therefore, the (cultural) alternative between working on prevention or chasing after an emergency. To develop this reflection, reference is made above all to the reality of the Italian model because it is better known. Aware, finally, of how much the analysis can in any case be generalised in a worldwide perspective.

It may be said that to the natural risk factors that are by now, so to speak, 'historical' - earthquakes and hydrogeological instability surely being the most representative - phenomena of varying severity can be added, at times devastating and not yet fully studied and formalised as to their cause/effect kinetics, attributable to Climate Change.

These natural hazards, both old and new, multiply their impact on Cultural Heritage, also due to the summation produced between themselves and with the so-called anthropic ones.

Among the latter, reference is particularly made to the phenomenon defined (with an oxymoron?) as 'cultural tourism'. Perhaps it might be better to classify it for what it really represents, namely 'mass tourism', an undeniable cause of multiple pathologies of degradation at different scales.

The approach often practised, does in fact not recognise tourism as an instrument of cultural development; on the contrary, it is based on an altered concept of substantially commodified valorisation and fruition. For this sort of tourism, 'quantity' is important and not 'quality', thereby bringing about a kind of genetic mutation of historic centres, distorting their uniqueness and levelling them out into a single, standardised image.

Such commodification implies imposing a false and standardised version of what 'past', which 'culture', what 'diversity' we should nourish ourselves with.

Hence the indiscriminate use and abuse of the very same monuments, the same places deprived of their *genius loci*, the same landscapes, the same territories of culture, leaving other monuments, places, landscapes and territories - relegated to second or last place on a scale of values that can merely be monetised - to the most complete abandonment, forgotten and gradually impoverished. Deprived of even a minimum level of attention and maintenance.

Lastly, though certainly brutal and devastating enough, this scenario is exponentially aggravated by the pre-existing and recent crises in the world's widespread theatres of war. In these, moreover, we are well aware of how deliberate destructive practices of Cultural Heritage are deadly weapons for exterminating the social cohesion and consciousness of enemy peoples. The Ukrainian tragedy, with its toll of loss of life, destruction, annihilation of cities and Cultural Heritage, further increases the universal state of crisis. The consequences are irreversible and will significantly hamper the policies and actions needed to mitigate climate change and fight poverty and inequality. But this latter issue - albeit calling it a 'risk factor' nothing short a euphemism due to the immensity of its implications - cannot be dealt with in the context of this contribution's reflections.

2.2 Prevention or Emergency?

The scenarios, which the various risk factors foreshadow or create, require specific approaches of damage mitigation or, following the occurrence of certain events, of 'repair'.

Avoiding, or at least mitigating, potential damage requires complex preventive action; repairing the damage that has occurred instead entails emergency action. By the latter is meant not only emergency management (an array of specific protocols, processes and methods, implemented for example following seismic events), but rather the constant 'wait-and-see' (one might say 'fatalistic') approach we find in the usual management of the public bodies in charge, each with its own authority, responsibilities and operational areas.

Namely, that of 'the day after', when significant parts of material and technical elements and other typically immaterial ones, such as memories and historical-cultural testimonies, have by now inevitably been lost and, after the devastation has occurred, the most destructive restoration work is now necessary. When not even the 'tabula rasa' of the surviving rubble in a futuristic reconstruction (where it was/as it was?) vision. A case in point is Amatrice in the 'crater' of central Italy following the 2016 earthquake.

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This is essentially the same difference that exists between 'ordinary maintenance' and 'extraordinary maintenance' (restoration).

And this happens notwithstanding that at the level of cultural and scientific debate, reflections on the urgency of maintenance as a constant practice have been on-going since the mid-19th century. Evidently generated by the new awareness that had matured within the nascent discipline of restoration of ancient monuments.

Ruskin had argued for the pre-eminence of constant maintenance activities over the more destructive restoration activities. Following Riegl's *Scritti sulla tutela e il restauro*, Boito states "However praiseworthy the restoration of a building may be, it must always be considered a sad necessity. Intelligent maintenance should always pre-empt it".

Cesare Brandi, in the post-war period, introduced the concept of "preventive restoration", namely an action of care aimed at preventing an emergency and extreme urgency interventions.

It was then in 1976 when Giovanni Urbani introduced an avant-garde vision that, taking up the concepts already elaborated by the Franceschini Commission (1964-66), dwelt on the inescapable relationship between artefact and environment.

Thus, an evident change of perspective was introduced, presupposing a more structured vision in which "simple" maintenance is set out in a programmed series of interventions planned and activated, starting from a general survey of all risk factors, exogenous and endogenous to the artefact to be preserved.

Concepts that were widely reiterated in the various Charters and Recommendations following one another in the last century and that have substantially re-proposed the concept of prevention and control of the state of conservation as the only guarantee to safeguard the Cultural Heritage.

To complete this brief summary on the concept of prevention, reference should be made to the Codice dei Beni Culturali e del Paesaggio (L. 42/2004), the fundamental legislative reference overseeing the process of protecting and safeguarding Cultural Heritage in Italy. The definitions contained in Art. 29 are basic[1].

In reality, this is not the case. We continue to witness a ruinous, and always inadequate, race after the emergency has happened.

In operational practice "remedial" paths are followed, which can never - or almost never - be traced back to a vision of planning and prevention.

Notwithstanding, as explained above, the regulations in force that have included in their articulations the concepts that have matured over decades.

Despite the fact that there are regulatory apparatuses, Authorities in charge, infrastructure, projects and programmes, and enabling technological tools to deal with the creation and management of complex databases of heterogeneous data to support prevention activities towards decision-making moments[2].

Regardless of the continuous production of Charters, Recommendations, long-winded and, all too often, uselessly rhetorical Declarations.

In our Country, as noted above, in addition to the patent evidence of the effects due to climate change, with increasing frequency, are those deriving from hydrogeological instability, from the lack of care for the land and coastlines, accentuated by the anthropic devastation due to the senseless consumption of soil and the unsustainable pressure of an uncultivated, omnivorous and never culturally oriented tourism.

Whatever the contingent events, due to sudden structural stresses, predictable if properly monitored (Ponte Morandi in Genova), or rather to natural catastrophes due to landslides, these too predictable in view of decades of land devastation with the misuse and improper land take (Ischia 2022), or to the lack of earthquake-proofing of buildings, especially historic ones (L'Aquila 2009, Central Italy 2016).

Nor does the situation appear to be significantly different at a global level, where to these ills, more or less equally present, we often add, in certain historical-geographical contexts, the horrendous tragedy of wars, the highest and 'fiercest' anthropic risk that devastates human lives, cities and Cultural Heritage.

Thus, with the consequent loss of memory, awareness, sense of belonging.

For Cultural Heritage, the state of perennial emergency is becoming more intense, in the absence of a preventive and planned conservation process, above all taken on from a cultural perspective, and acted upon daily and not merely proclaimed.

So, in brief, prevention and emergency unequivocally represent two different cultural approaches. But despite their diversity, they are mutually osmotic and could benefit from this osmosis, in terms of processes, protocols, knowledge and data sharing.

3. ACQUIRING, PROCESSING, DOCUMENTING

3.1 Technological innovation equals conceptual innovation?

In the case of conservation intervention, the aim of the knowledge process requires characterising - in its morphometric (quantitative and spatial occupation knowledge), material and phenomenological (qualitative knowledge) entirety - the whole asset on which the same conservation intervention is to be designed. Then to implement it and, finally, monitor its *ex-post* behaviour on the same knowledge base.

It is now customary to use terms such as heritage, knowledge, conservation with others such as technology, digitisation, 3D, modelling and to concretise such terms in the actions and operations that support the process of safeguarding and enhancing Cultural Heritage.

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[1] Art. 29. Conservation (Chapter III - Protection and Conservation, Section II - Conservation Measures) states:
1. The conservation of the Cultural Heritage is ensured through coherent, coordinated and planned activities of study, prevention, maintenance and restoration.
2. *Prevention* is understood as the *set of activities* aimed at *limiting risk* situations related to the Cultural Heritage in *its context*.
3. *Maintenance* entails the *set of activities* and *interventions* aimed at *controlling* the condition of the cultural object and *maintaining* the *integrity*, *functional efficiency* and *identity* of the *asset* and its *parts*.
4. *Restoration* means *intervening directly* on the property through a series of operations aimed at the *material integrity* and recovery of the structure, and the *protection* and *transmission* of its *cultural values*. In the case of *real estate* located in areas declared to be at *seismic risk* according to current legislation, restoration includes the intervention of *structural improvement*.

[2] There are numerous initiatives supported by world States and European Union (Horizon Europe (HEU), European Framework Program for Research and Innovation 2021-2027). We can mention, for example, EUROPEANA, ARIADNE, DARIAH-EU, Arches Project. And infrastructure as E-RIHS, IPERION HS Consortium.
Furthermore, there are international collaborations with the aim of developing geo-spatial platforms, basically open source, which constitute digital archives for web management of material asset. For example, several initiatives and projects, both at national and European level, aimed at combining the monitoring of the state of conservation of Cultural Heritage with Space Policies and Activities (for all, Copernicus in Europe). Indeed, the integration of data from satellites with those acquired at different altitudes - today typically from drones - and with extremely fine-grained and punctual data on ground represent the most cutting edge of operational knowledge in terms of risk prevention and planned preventive conservation.

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A few years ago, during a Conference on the role of Cultural Heritage in the 21st century, during a critical intervention on the pervasive, but too rarely criticised, affirmation of ICT technologies in the phases of documentation of this Heritage, the graphic expedient of a triangle (as a kind of Maslow's pyramid) was used to rank the single phases in order to better verify the role of technologies for each of them.

At the base of the triangle, the phase dedicated to the study of 'geometric consistency and form' (by means of morphometric characterisation) was solidly placed. In the intermediate layers, from the bottom to the top, were in order 'material consistency and state of conservation' (by means of morphological characterisation and instrumental analyses), then 'historical-critical aspects' and 'significance and value'. At the peak was the chief concept, the founding outcome of the knowledge objective for preservation, the 'right to heritage'.

As an initial observation, it appeared quite evident that, in the state of the art of those years (mid-second decade of the new century), in actual working practice, only for the first three basic layers (morphometric, material and state of preservation documentation, historical-critical analysis) was it possible to speak in terms of useful 'enabling technologies', since in these the aim was to bring order and relationships on *quantity* and *quality*, *measurement* and *description*, for the *conservation*, *communication* and *fruition*.
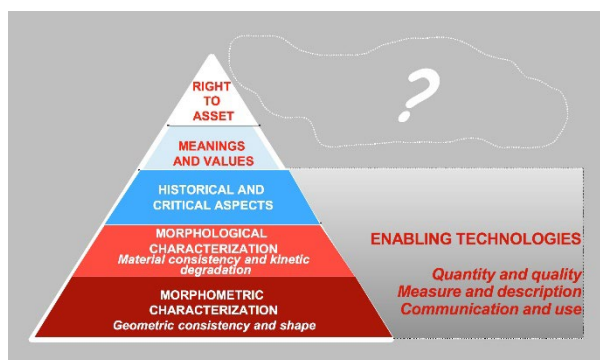
Figure 1. Ideal pyramid of the approach to an asset:
from the knowledge to the perception of meanings and values,
from analysis to the Right to Heritage.
Where is the role of technologies?

In fact, there were, and increasingly today, examples testifying to how the evolution in the field of technologies applied to Cultural Heritage has in recent decades made rapid leaps in terms of accuracy and reliability of measurement, rendering and management of acquired data, though not always accompanied by a simplification of procedures and cost reduction.

We have moved in a very short time from traditional stereoscopic photogrammetry systems to so-called *structure from motion* methods, from 'simple' topographic measurements to the use of *laser scanner*.

By constantly upgrading both the data acquisition hardware (in some cases even in terms of low cost) and the post-processing algorithms, it has become possible to produce advanced image-based and range-based expeditious systems using SLAM (Simultaneous Localization And Mapping) technologies capable of rendering complex three-dimensional geometries in real time. But this same possibility of using technologies that significantly multiply our measurement capacity, in terms of increasing reliability and ever more advanced automatisms - as was commented on in the same text - introduces reflections on the extent to which technological mediation interposes itself between us, the subjects of knowledge, and the artefact to be known, creating objective conditions of less attention towards the object

of study (perceptive and analytical, but also emotional) and, on the contrary, of greater focus on the instrument and the technology in use.

At the conference, the question was instead raised on to what extent enabling technologies can contribute to the definition and understanding of *meanings* and *values* and, therefore, how to ultimately guarantee the *right to heritage* at the apex of the triangle.

The explicit answer at the conference was decisively negative.

3.2 How intelligent are the technologies?

The level of development achieved by research, in progress over the last few decades, gives cause for reflection today. Such research has introduced growing attention on the role of semantics in the ontological interrelationships between objects of study and their individual constituent parts, and between these same individual components at different scales, as well as the historical-geographical-environmental contexts of immediate reference.

Today, increasingly high-performance and reliable algorithms make data acquisition and, above all, post-processing phases 'lighter'. Thus, freeing up operational time and enabling more attention and analysis to be focused on the 'qualitative-descriptive' data to be associated with the 3D model of the whole and its constituent parts.

Particular attention must be paid to the interrelations between heterogeneous data. It is therefore essential to further studies on ontologies aimed at overseeing such integrations. Just as studies on the environments and platforms, in order to best ensure managing this complexity and the dissemination and sharing of this complex information system, must be implemented.

3.2.1 BIM e HBIM: Regarding the actions on the first three basic levels of the abovementioned triangle (morphometric and morphological characterisation, diagnostic framework, historical-critical analysis), after the first theorisations and experiments at the end of the last century (Salonia and Negri, 1995) and the first years of the new millennium, based on the use of GIS technologies (Geographic Information System) in strictly 2D environments, available at the time (Salonia and Negri, 2003), recently, by mediating technologies created for the design of the new in construction (BIM *Building Information Modelling*), a new tool, HBIM (*Heritage Building Information Modelling)*, is becoming widely used, although definable at least as 'hybrid'.

First of all, it is worth stressing that, from the point of view of 2D and 3D geometry rendering, the results are entirely questionable. Indeed, geometry, the same geometry that automated systems are able to render, has its own rules (as Descriptive Geometry teaches us, a fundamental subject in University Architecture courses).

On the other hand, the morphology of monuments, as well as historical buildings - the outcome of historical-technical-constructive phases and methods, constituent materials, the ravages of time and the kinetics of degradation processes - manifest other geometries in space.

In terms of representation/rendering of reality, there is no 'compatibility' between the two. This means that any system, be it CAD, BIM or other, may necessarily be limited to rendering an abstract and simplified model of the reality represented by any historical artefact in space. A product that may even be sufficient for certain study purposes (think, for example, of numerical finite element modelling to analyse the structural behaviour of a building in a seismic risk zone). But not so much so for a preparatory study for a conservation and/or restoration intervention, for which the exact identification of the

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morphologies of the whole, its parts and the relationships between them, is, as is well known, fundamental.

So, a provocation as it were, the term HBIM is in some ways nothing but an oxymoron. Indeed, it is not by adding an 'H' for Heritage - for some, Historic - that the primary purpose of BIM, devised to manage the planning of the new, is transformed. Nor even its specific functionality.

At the very least, it can be argued that it represents a conceptual forcing which, if not properly regulated, could become dangerous in an honest process of knowledge for conservation. Yet our Conferences, Proceedings and articles, are now teeming with discourses and case studies in which we always and only encounter the one and only HBIM.

What has changed compared to what was pioneered at the turn of the century? Where does the added value lie? In the technological tool or in the conceptual approach?

Technology has certainly made great strides (though it is worth recalling that the field of Cultural Heritage continues to be indebted to technologies borrowed from other disciplines for which they were produced).

On the contrary, the primary foundation of the conceptual approach has remained essentially the same as it was in those earlier decades: analysing Cultural Heritage for its preservation, both material and of value, means knowing, collecting, analysing typically heterogeneous data and information, from matter to history, from geometry to form, from surface degradation to the surrounding environment, and so on, and making them interact.

That is, to create inter- and multi-disciplinary sharing environments as the specificity of the domain requires.

3.2.2 Digital Twin: The theme and objectives are therefore the same, the technological tools to be adopted, however, have evolved.

Today, within the complex ecosystem "knowledge and conservation of Cultural Heritage", we speak of the Digital Twin (DT), a current frontier also borrowed from the world of mechanics and industrial production. This system is presented as a valid conceptual basis on which to set the knowledge representation model - also operational - which must necessarily have the requirements of dynamism and to be iterative, just like the knowledge process itself (Jouan and Hallot, 2020).

The possibility of guaranteeing continuous feed-back for any type of data (quantitative and qualitative), being part of an "ecosystem" network that can ensure continuous flows of updated information whatever the source, the feature of not being bound to certain data acquisition technologies (we know how easily they are destined to rapidly become obsolete), in theory recognises the Digital Twin as the tool capable of appropriately managing that "reactive monitoring" which UNESCO recommends for the shared and prudent management of Cultural Heritage (De Luca, 2020).

It can thus be said that DTs represent the (current) answer to the need to create suitable environments for the management of the vast heterogeneity of Cultural Heritage data.

But before the 'physical' realisation of the environments, it is necessary to establish the 'rules'.

To define these, recognising the complexity of the problems posed and the urgency of innovative solutions, then the sharing and cooperation of different interdisciplinary perspectives need to be mandatory.

Hence, the wide range of ontologies available and still at the centre of lively debate and production.

It should explicitly be said that any ontology for Cultural Heritage cannot but derive from a common effort and continuous comparison between different subjects - from computer scientists to architects, from mathematicians to archaeologists, from art historians to chemists, from topographers to physicists, and so on. With the awareness that, in any case, as Umberto Eco once said "it is impossible to draw the whole map of the entire Empire", the shared ability to break down one's own disciplinary fields and submit them to common discussion is necessary.

Once again, then, are technologies, specifically digital technologies, the key to solving all the problems affecting Cultural Heritage? Despite this evolution, how much 'simplification' of complex issues is still required? Are we sure this is the decisive reality? Is this truth established or merely accepted on faith?

In the 'snapshot' of reality that the graphs of the various ontologies render, what is the level of 'compromise' that they accept in the inevitable simplification for the drafting of cognitive maps?

Put simply, how much does the critical control entrusted to human intelligence alone still play a (fundamental) role in the entire cognitive process that is increasingly 'organised' in formalisms preparatory to its automation? Nor should we forget how much further loss of 'money' the transfer of the ontological graph will entail in the realisation of the 'environment', the information technology system, and how much more again in the populating of the latter[3].

In some ways, this is still the same problem already addressed on the subject of digital technologies for the acquisition of geometric data, for the dissemination of knowledge on Cultural Heritage, for its equivocal valorisation, for its current fruition aka commodification.

The intention here is not on questioning the potential of technologies in handling large amounts of data, the so-called big data, in an 'intelligent' and interactive way.

Rather, we emphasise Richard Saul Wurman's statement when he warns that ours is also capable of becoming the age of 'big understanding' (Wurman, 2011).

To understand, we need not only data, but also new tools to interpret it.

We know how many and what new opportunities are emerging for the systematisation of vast amounts of information, for the digitisation of heritage and the use of new, virtual, augmented, extended systems, networks and environments to support the control, planning, organisation, management, interpretation and monitoring of conservation actions, but also for the identification of new forms of valorisation and fruition.

But just where, at the level of research or heritage management communities, are there the problematic positions that restore to the heart of the debate the critical rethinking of what the role of emerging technologies should be? How can they really help ensure respect for diversity, the diffusion of awareness about the meaning of heritage?

Certainly, technology stands between the world and what the subject experiences of the world (Bisol et al., 2014).

In this relationship, technology is no longer perceived by the subject, but is absorbed, so to speak, into the experiential process. It becomes one with the subject's perceptiveness, which is modified and broadened by virtue of this same technological implementation.

For example, imaging techniques, widely used for diagnostics, or laser scanning for subsequent 3D modelling, enable opening up

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[3] The discourse keeps to the general aspects. It deliberately does not address the issue of the *unicum* represented by each artifact of a historical cultural nature, which each individual case constitutes. This issue introduces reflections on the exportability of obviously "generalist"

systems. Conversely, on the desirability of creating specific *ad hoc* environments (hence related ontologies) for the different contexts analysed.

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and enriching the experiential world of the subject, modifying the horizon of meaning to which the experience belongs.

Technological mediation, by helping define the judgement we make of reality, inevitably also acts beyond hermeneutics and ways of producing knowledge (think of the digitisation of heritage or virtual reality for the construction of immersive environments for a different enjoyment of heritage).

But knowing, studying, analysing and monitoring Cultural Heritage for its preservation and transmission to future generations presupposes judgement skills and responsible decision-making.

"...Judging, besides being a cognitive act, is also the faculty we use to make decisions, to move and act in the world.

Technological mediation, in its hermeneutic being, reveals to the subject of the experience a world already mediated by others and which therefore requires us to take a stance and make decisions..." (Bisol et Al., 2014).

We return to Richard Saul Wurman's recommendation on the 'big understanding' of the vast amounts of data that machines can handle quickly, but on which Man must be the one to interpret and decide.

The problem is purely ethical.

3.2.3 Artificial Intelligence – AI:
All the more so if we consider how the current scenario is seeing accelerations (uncontrolled or controlled only by a few?) that make the near future of knowledge management as has been understood to date even more uncertain.

We are witnessing, also in other scientific fields but in an invasive manner even in everyday domestic actions[4], the rapid introduction of AI.

Artificial Intelligence is increasingly filling up our world and, especially in the scientific circles in charge of its implementation and evolution, the warnings issued and the distances taken by many scientists are ever more pronounced.

Briefly, it can be said that algorithms are able to find correlations by extracting rules that are objectively complex, but insufficiently transparent and, therefore, ultimately dangerously irresponsible.

This is certainly not the place to delve into a discourse on AI.

What is of interest here though, is to emphasise the extreme delicacy due to the aspects and risky factors arising from its a-critical application in a sector such as Cultural Heritage, where the evaluation and decision-making aspects are of prime importance. The issue is all the more topical if we consider how the use of DT is increasingly applied in interpretation and decision-making scenarios entrusted to AI.

Undoubtedly, the central issue - as stated above - involves ethical aspects.

The philosopher Luciano Floridi, Professor of Philosophy and Ethics of Information at the Internet Institute of Oxford University, discussing the recent progress of AI and the development of large linguistic models (LLM) specific to deep learning, such as ChatGPT, emphasises the extreme danger if we entrust entirely to algorithms that 'live a life of their own', the so-called 'black box', the logical inferences that underlie complex reasoning preparatory to decision-making (Floridi, 2003). The text, cited in footnote 12, concludes with a worrying argument:
"...*We have gone from being in constant contact with animal agents and what we believed to be spiritual agents (gods and forces of nature, angels and demons, souls or ghosts, good and*

evil spirits) to having to understand, and learn to interact with, artificial agents created by us, as new demiurges of such a form of agency. We have decoupled the ability to act successfully from the need to be intelligent, understand, reflect, consider, or grasp anything. We have liberated agency from intelligence. So, I am not sure we may be "shepherds of Being" (Heidegger), but it looks like the new "green collars" (Floridi 2017) will be "shepherds of AI systems", in charge of this new form of artificial agency. The agenda of a demiurgic humanity of this intelligence-free (as in fat-free) AI – understood as Agere sine Intelligere, with a bit of high school Latin – is yet to be written. It may be alarming or exciting for many, but it is undoubtedly good news for philosophers looking for work...".

Again, in order to be able to distinguish who should be the subject of decisions in the future - whether a human agent or an artificial one - Massimo Chiriatti (Chiriatti, 2021) has also intervened:
"...*It makes no sense to address the issue of technological innovation without relating it to the human being, to the impacts that such innovation can produce on people, companies, economies, societies... even when we talk of Artificial Intelligence. AI is inevitable, and if all its implications leave us numbed in uncertainty we will become ever more passive, just waiting to see what happens to - then - decide. Of course, we cannot know all the answers, but any technology that drives us to passiveness is harmful. The past is immutable, but the future is not ineluctable, it just depends on the choices we make...".*

In the asymmetrical relationship between Man and technology (machine), the differences between the concepts of prediction and decision become central.

Prediction (scenarios of), based on data, can be concretely realised automatically the higher the speed of calculation and, therefore, is an activity that can be delegated (entrusted) to the machine.

But, considering (underlining) that a prediction need not result in a choice that seems to be subject to it, then conversely, the acceptance or otherwise of the prediction itself must depend on Man.

The theme of decision-making involves that of responsibility, a properly human characteristic that creates a kind of shelter from the temptation to get lost in the apparent simplicity and efficiency of quick solutions offered by technology.

Today, however, this Man/technology (machine) balance seems very precarious with regard to prediction/decision-making concepts. The progress of AI systems opens up the delicate scenario of the transformation of the object (technology) into the subject (decision-making), with a particular focus on potential future scenarios.

Again, it is vital to stress the ethical nature of the issue.

Its political, economic and social consequences, dependent on the evolution of Artificial Intelligence and the expedited (and to some extent autonomous) progress of algorithms, in the conflict between the centralisation of powers and the decentralisation guaranteeing individual autonomy, introduce more critical issues due to the potential instrumental and a-critical use of new technologies.

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[4] If we think of Alexa, the multitasking smart assistant to which people entirely rely for the management of their days, from the alarm clock in the morning with diffusion of classical music to the turning on of the lights in rooms. While adults have already lived part of their life in contexts with no technology, something that makes them able to partly

limit the damages, the youngest have no type of protection. Every life experience for them has begun in a world already at the highest technological density, and this represents a serious problem.

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4. CONCLUSIONS

4.1 Let's *give intelligence* to our technologies

In order to try and converge towards a synthesis of what has elaborated so far, it is necessary to put the fundamental terms of the issues discussed in order.

The primary purpose of our action for Cultural Heritage lies in the ethical duty to preserve, maintain, enhance and transfer its material, meaning and value to future generations.

To honour this purpose it is, therefore, necessary to firmly adhere to a road-map that leads from knowledge and understanding to the design of the needed interventions, from undertaking to maintenance, making use of a continuous feed-back based on diversified monitoring actions.

Along this path, there are various phases, numerous ways, tools and skills involved.

Fundamental is the knowledge and documentation stage, also because of the iterative nature this needs to have.

Cultural Heritage constitutes an ecosystem inside and outside other ecosystems (e.g. the environment) with which it interacts through specific relationships that must be maintained in a systemic balance.

It needs holistic approaches, namely capable of grasping it in its primary and endogenous characteristics (both material and of meaning and value) and, at the same time, in the external dynamics intercurrent with the other ecosystems with which it is in close relationships of mutual input-output.

The entire 'life cycle' of Cultural Heritage is constantly subjected to risk situations, of various and different types. It can even be said that risks, extensively understood, both endogenous and exogenous, represent the constitutive factor of Cultural Heritage.

Actions of knowledge and understanding must fundamentally produce a constant update needed to support the construction of predictive scenarios that can effectively anticipate possible outcomes due to foreseeable manifestations of various risk factors. They must also be able to direct emergency interventions, when these arise due to the unpredictability of the onset of sudden, natural or man-made occurrences.

Prediction scenarios are useful and effective in the management of unpredictable emergency situations. In the same way, the know-how that can be gained in emergency management is useful input data for configuring predictive scenarios, in a reciprocal and advantageous osmosis between the two different approaches.

It should, in any case, be mandatory to constantly favour the culture of working on prevention rather than chasing after an emergency.

From what has been expressed so far stems the importance of data, of its processing into information to finally produce knowledge based on logical networks of information.

Knowledge underpins the interpretation of any reality, supports the critical choice between different hypotheses, corroborates the responsibility of decision-making.

In such framework, as expounded in the previous paragraphs, the role of 'tools' - suitable for acquiring heterogeneous data, for identifying algorithms for their processing and systemic organisation of information, for the creation of appropriate platforms that generate the environments for the configuration of multiple predictive scenarios - is central.

UNESCO very clearly defines the activity of documentation as "... activities of searching, acquiring, evaluating, indexing, sorting, storing, analysing, synthesising, publishing, presenting, communicating, disseminating documents...".

The methodological resources of this process are: conceptual analysis, indexing and classification, construction of taxonomic structures and domain thesauri, terminologies, compiling specialised vocabularies. The concept of 'measurement' should be used in a broad sense as an instrument of knowledge valid for different orders of measurement - both quantitative (physical quantities) and qualitative (semantic categories).

A fundamental consideration follows from the above assertion. The semantic description of the object under investigation should be conceived, defined and realised prior to the measurement operations. On the contrary, the latter must be planned, in terms of the methods and instruments to be used, only 'after' the precise definition of the semantics. Only in this way will the data relating to the quantities and qualities measured - and subsequently represented - be endowed with the meaning and reliability of the information conveyed.

It can therefore be grasped just what the logical direction of a hypothetical flow-chart should be. One that directs, first, the 'human' understanding of reality and its context, then the formation of the graph of the ontology, the architecture of the constituting system, and then the operations that follow in the actual construction of the system and its 'populating'.

Much has been written on the pervasive and unstoppable development of technologies, but these must be 'contained' in the actual role they can, and must, play in supporting Cultural Heritage protection activities. In the handling of large quantities of heterogeneous data to be processed to derive information, thanks to the unquestionable calculation capabilities, and, for the same capabilities, to systematise predictive scenarios.

Hence, in support of the management of big data and the preparation of environments to be interpreted, possibly with innovative 'big understanding' approaches controlled entirely by Man. This, and only this, will ultimately be responsible for choice and decision-making.

Today we confuse what is user-friendly with what is not easy to learn: we have direct access to an endless amount of information, apparently for free, but we have not yet developed a logic, a culture to better use this mountain of notions and extract from them the right conclusions.

Michael Merzenich, Professor Emeritus at the University of California in San Francisco, one of the most well-known neuroscientists in the world, warns us: *"...we think that to remove efforts and assign them to a devise is always an advantage, we forget though that every time we assign to a machine a human function we are removing something from our life and our brain. Technology is changing us and it is changing us in the brain. It is amazing to have access to a multiplicity of information but if do not exercise the logic and the reason we are in trouble..."* (Merzenich, 2018).

It is precisely in such words, that the meaning of the phrase 'let's give intelligence to our technologies' in the title can be found. In a nutshell, it is a matter of redefining the Man/Technology (machine) balance within a complete re-design of the entire Cultural Heritage protection process.

On the one hand, restoring value and meaning to the now fading concept of 'critical survey' in which operational practices leading to any measurement operation, such as 'visual analysis', regain value, recovering the teaching of Guglielmo De Angelis D'Ossat who indicated "...the monument as the first document of itself...". In this way, by guaranteeing prudent choices of data acquisition methods and systems, we avoid the current futile 'bloodshed' (resources that could otherwise be readily devoted to the concrete preservation of Cultural Heritage) for the binge-like production of data that are only producing an exasperated growth of entropy which, as we know, is equivalent to the desertification and sterility of information. Documenting for preserving does not only mean acquiring data.

On the other hand, governing decision-making moments within the organisations, structures, and places in charge of this, taking due responsibility and making use of data, information and scenarios made possible thanks to the calculation capacity of

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technology (machines) to derive conscious knowledge.

Lastly (but contextual to the previous points), by relocating the enabling technologies in their specific role as 'means', thus repositioning them in a space that finally makes their precious presence in the complete cycle 'intelligent'.

For a system to be intelligent and for each component to express its own, each must maintain and defend its own role. To Man what is Man's, to technologies the recognition as an 'irresponsible' and a-conscious tool.

In the twentieth century, regarding the innovative rousing aspects of that historic period, Richard Buckminster Fuller reminded everyone of us that "we are called to be architects of our future, not its victims"

Here, an important moral imperative arises and which was absent in the deterministic perspectives: if we are in charge of shaping our future, we can only do it in the light of the personal responsibility, and therefore from an ethical point of view.

To this end, Piero Dominici's words offer help when he affirms that the future *"...is of whom will be able to recompose the fracture between human and technological, of whom will be able to define and rethink the complex relation between natural and artificial, of whom will combine (not separate) knowledge and skills, of whom will combine two cultures (humanistic and scientific) both in terms of education/training and of definition of profiles and professional skills..."* (Dominici, 2017).

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