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Rethinking the Role of ICTs. Digital transformation and Culture enjoyment continuity

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Abstract: This document will analyze recent trends and evolution of the use of ICTs in the field of cultural heritage from a different standpoint, the service provision in the age of digital transition and pandemic. The initial focus is on the usual approach in the field of goods, proper design to elicit a positive feeling by potential customers. Recently a new type of good has been identified, service. Services grown up incredibly in the pandemic, goods delivery, food delivery, and more. So, thinking at services like a good we must design them to better the appreciation by customers as since the early XX century the people did with objects and merchandise. Appling the same approach to digital services a design phase is required together with all the different components that will provide a positive feedback from the user, this means to deal with interaction design, user centered approach, usability guidelines and the overall concept of positive user experience. Recent trends and reborn technologies like the path from edutainment to serious games and gamification, the new approach to immersive interactive technologies in a nonintrusive format. Last but relevant the need to take the momentum to ensure the culture enjoyment continuity in case of crisis.

Keywords: e-Culture, Digital Transformation, Pandemic, Immersive Technology, Virtual Museums, APPs, Gamification

Setting the scene

Cyber technology is pervasive, and its key role is growing up every day, citizens consider cyber technology as a commodity. Mobile position aware devices represent the most recent revolution in both technology and society, they are perceived as something different from computers even if they play, among others, the same role and immediately became part of our daily life, a wearable accessory as our wallet or wristwatch. Extremely user-friendly devices are nowadays used with relevant satisfaction by formerly digital divided citizens [24]. Accordingly with some technology forecast by the year 2030, half of the world population will adopt merely online and internet-based materials, this is part of the so-called "digital transformation" even termed DT or DX. This is not the "full" scene, in 2020 an additional event took the stage: the pandemic. This unexpected event found major part of the countries unprepared even at public health level to do not mention all the other sectors. Extended lockdowns, a variety of national ad even local policies, many times changed very quickly led to the paralysis of major parts of the activities including the traditional ones in the field of culture: concerts, operas, museums, exhibits, travels, etc. Citizens were forced to reinvent their "life".

In such a scenario it becomes vital for cultural institutions and heritage in general to deal with another buzzword after digital transformation: "resilience". This means to ensure cultural assets fruition continuity even in case of exceptional events. This can be considered a new paradigm that requires new solutions and the rethinking of cultural enjoyment. This paper analyses the phenomenon and the potential outcomes of such renovated approach starting from the technological aspects and actual scenario to point out the effects on cultural institutions.

Digital Transition or Transformation in brief

Digital Transformation: We all agree on the meaning of the term "transformation" but "Digital" has different meanings. Jim Swanson, CIO of Johnson & Johnson says, "*Digital is a loaded word that means many things to many people*". "*Say 'digital' to persons and they think of going paperless; another might think of data analytics and artificial intelligence; another might picture agile teams; and yet another might think of open-plan offices*". A comprehensive definition of the term digital transformation should be the integration of digital technology into all areas of activity, from business to public sector, fundamentally changing how we operate and deliver value to citizens or customers. To frame the digital transformation phenomenon, we can consider 1995 and the motto "Where do you want to go today" the "disclosure" of the web technology to families and citizens, next significant step was the rapid market penetration of mobile position aware devices such as smart phones and tablets. Cyber domain become and additional dimension of human and social life. The concepts of "pervasive computing", "disappearing computers" and "ubiquitous computing" become reality[i]. The opportunity to enjoy direct access to information, even if not supported by official sources, become a kind of collective memory pushing kids to say: "Why do I need to memorize names and dates studying history when I can simply "google" them?". These side effects will produce relevant impact on young generations, but this topic deserves a full paper.

Current technological developments bring us closer to living in ubiquitous computing environments where digital services are offered continuously to users [33]. The behaviour of citizens should be subdivided in different groups, on one side young generations (Y generation) they consider "on-line" as an extension of their brain and memory, communities as novel families. Many times, they lack critical thinking following influencers and opinion leaders, on the other side they are naturally trained to act multi-tasking and have direct access to the information they require. Preceding generations faced the digital world step by step as a more or less "alien" but useful environment, so they use to massively take advantage from it e.g., social media. Seniors sometimes joined the "alien creature" other times resigned and rely on relatives and friends when necessary.

Citizens use to buy and sell goods online, book their travels and vacations, as well as enjoy a number of services unthinkable before the Internet from extremely vertical services to crowd services or funding. Platforms are the real "silver bullet" that created major opportunities and real impact on society and economy. A relevant part of digital transformation relies on platforms and standards, these aspects are directly linked with the "owners" of such platforms and standards, this can be considered a kind of monopoly not yet regulated, a kind of grey zone, so in the digital transition there is a potential risk to fall under control of few key players.

The diffusion of platforms if on one side creates new opportunities on the other side "kills" several existent businesses. The access to global service platforms creates a shortcut between offer and demand cutting out major part of the traditional added value chain, as it was long time ago because of malls it is now because of platforms. The big difference is that you don't need to invest relevant capitals to feed your business, the key investment is the creation of the digital platform, the asset you own is the number of users both on the offer and demand side, this to do not consider the fiscal benefits they usually enjoy compared with the traditional retail system. This new model led to positively evaluate and size on the market companies having a relevant number of "customers" paying zero money to the company, this is mainly valid for services not based on a triangular market model service/user/advertisement as in the past was and still is cultural heritage.

Another relevant innovative trend in DT is the use of "crowds" to provide data and services not foreseeable before the Internet [30]; simply think about APPs like TripAdvisor[ii] or the one providing the local gas price daily or real-time traffic bottlenecks. It seems to be a completely new paradigm of software development beyond user groups and open software, the only way to face huge projects and

compete with key software enterprises. The average "size" of "social" products and services is now affordable mainly by crowdsourcing. Several services that do not find a proper economic dimension or even do not have the required appeal to be provided by companies may only rely on crowds, crowds and platforms. This approach enabled innovative solutions like project funding[iii] or collaborative film production[iv]. In the global society crowds are playing the role of "public services" [23].

To conclude, we cannot forget that the computer scientist concept of "Clouds" captured the users, so we moved from local storage and processing to cloud computing in its various declinations (SaaS, PaaS, IaaS, Haas); several hardware devices, such as tablets, smart phones and even security cameras, offer cloud services to their users apparently for free even if apart from user profiling we don't know additional use or misuse of such data. So, clouds are now populated by business data as well as by back-ups, health info, photo albums, video clips and songs. Apart the rest of useful services, the introduction of clouds solved a typical nightmare of e-Citizens, the need to change their personal device, phone, tablet, or computer because it doesn't work anymore, it was stolen, or they bought a new model. The diffuse use of "clouds" contributed to adding another degree of freedom to e-Citizens; many times, this was a seamless transition, so the idea to show their "selfies" or share a document wherever they are and whenever they want from a notebook, a tablet or a smartphone is a consolidated habit and a powerful driver of "innovation".

Impact on the Society

Digital transformation impacts the whole society. It's a cultural change that requires organizations and even citizens to continually challenge the status quo, experiment, and get comfortable with failure. Furthermore, on the citizens' side, even and more significantly, it is required the willingness to "go digital" even if sometimes this choice become a "must" to do not be "cut off". It is evident that digital transformation it is not a process "one size fits all", each specific sector and even activity requires a particular approach and custom solution; this starting from the three main branches: citizens, companies, public administrations.

Because digital transformation will look different for every subject/service, it can be hard to pinpoint a definition that applies to all. Sometimes this means walking away from long-standing business processes that companies were built upon in favour of relatively new practices that are still being defined. In such a situation the "trial and error[v]" finding by continues improvements the optimal solution is the practical approach.

Furthermore, everyone experienced in "ICT based innovation" knows that "It is not only a matter of technology". Human factors are an essential tile of the whole process as well as a re-thinking of the whole organisation and process. We must keep humans in the loop and carefully consider the social and economic impact due to digital transition.

One of the potential benefits considered in the early phase of digital transformation was the unique opportunity to pour in the software procedures some knowledge about methodologies and procedures. Methodologies, or better, know-how accumulated in years and years of diligent activity trying to bridge the generational gap, this in addition to traditional coaching.

A different approach was generally used dealing with procedures, procedures must be reconsidered from scratch making "tabula rasa". This mainly because procedures are, very often, the result of a "stratification" of layers of "reference points" included in the pipeline; this reshaping many times causes some friction due to the loss of some "power-nodes" within the organisation. The design phase must carefully reconsider one by one the "steps" checking the function of each of them within a well-defined rationale framework. The benefits using a platform is to guarantee the optimised workflow and offer to the citizens the opportunity check the progress of the process and related timing.

Cultural heritage and ICTs

After a general overview it is now time to get closer to the focus of this document. Cultural heritage concept is continually evolving through time and referring to diverse elements ranging from archaeological sites, historical buildings, monuments, museums and their collections, libraries, archives, known as tangible CH, to oral traditions, local knowledge, and rituals known as intangible CH nowadays

including contemporary artefacts[vi] and, why not, future heritage. This document will mainly focus on museums and exhibits.

Often the cultural heritage is perceived by most as something obsolete, cryptic, with no appeal to the audience, unable to provide real added value to citizens and ultimately a pure "cost" in terms of conservation, maintenance, custody, etc. On the contrary cultural heritage represents one of the key attractors for tourists; the promotion of heritage addresses two issues: cultural enrichment and economic sustainability of the sites. The exploitation of such assets and related values will not, necessarily, jeopardise our heritage; cultural assets are not rivalling, and a wise exploitation will not "consume" them. "Wise" means not damaging the artefacts or sites, avoiding overcrowding and unappropriated use or behaviours. As one of the direct consequences, a limited number of visitors may be admitted at a specific time, online booking of visits managed by optimisation algorithms will harmonise the flow of visitors.

The "power" of Culture, even if sometimes not appropriately considered by politicians and businessmen, is one of the key components of our daily life. "*Culture is not one of life's luxuries, it is life itself. Culture is the soil that provides society's nourishment and the basis on which it defines its value system, traditions, and behaviour. It contains morals and ethics of the community, governs society's conception of its own future and selects the means of getting there.*"[vii]

At the end of the 1990s the need to embrace a cultural agenda by ICT was evident and supported by governments and institutions. "*Information and communication technology (ICT) is an engine of growth and change for the world economy. If this technology is to be harnessed to enhance democratic principles, it must contribute to the creation and enrichment of an educated, informed citizenry; it must incorporate the accumulated knowledge and creativity of the past; and it must anticipate and enhance creativity for the future. In this context, it is essential that ICT embrace a cultural agenda. Development effectiveness depends to a great extent on "solutions" that resonate with a community's sense of identity and culture creates that sense of identity. Culture encompasses human knowledge, values, beliefs, behaviour, customs, language, ideas, codes, institutions, heritage, rituals, and creative expression all of which constitute essential signposts for understanding who we are and what we do. If advances in health, commerce, education, and economic growth are to be implemented and sustained, understanding culture is critical*."[viii]

The use of ICTs in the field of culture, cultural heritage, and museums dates back some decades from early data bases to technologies devoted to researchers, archaeologists, to the use of 3D and multifrequency scanners, computer graphics and virtual and enhanced reality and moreover. Museums and even more libraries took relevant advantages from the use of ICTs. Nowadays digital transition and more recently the pandemic reshuffled the cards and at the same time museums changed their mission from the classic term Mouseion (Greek μουσείον) and its original meaning "Temple of the Muses" or "Institution of the Muses", home of the custodians of arts but even philosophical school and library to the evolving definition of "Museum" as outlined by ICOM:

- "*A museum is a permanent institution (...) in the service of society and of its development...*" the narrative order in which museological developments had occurred historically. Acquisition and conservation still preceded all other functions. Exhibitions, communicating and educating came only later in the conceptual order of things – a reminder of old hierarchies and priorities
- According to the ICOM Statutes, adopted by the 22nd General Assembly in Vienna, Austria on August 24th, 2007: "A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researchers, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment."
- "A museum is a non-profit making, permanent institution in the service of society and of its development, and open to the public, which acquires, conserves, researchers, communicates and exhibits, for purposes of study, education and enjoyment, material evidence of people and their environment." (ICOM Statutes, article 2, para. 1)

These evolving definitions underline the active role of museums in contributing to shape the society, trying to better fit with citizens issues and expectations. In the light of the digital transition and recent citizen's habits let's consider the problem from a different standpoint.

Of course, independently from the weight that each one of us assigns to "culture" DT impacted the cultural sector mainly through the Internet, if we focus on fruition and communication. Albeit relevant contributions to research and preservation have been provided as well. Let's now consider valorisation of cultural heritage from another standpoint the "industrial" one to understand if something better can be done. Let's consider the key aspects in the field of good and services.

Goods and Services

Long time ago an expert in cultural heritage[ix] developed a socio-economic theory on cultural heritage. "Every time cultural heritage contributes to artistic, educational, or social development, it is a source of value: esthetical value, experience value, existence value for which the production implies economic movement, and not to take this into consideration would lead to a lack of fundamental understanding[x]."

When looking to set the value of cultural heritage objects we must make use of socio-economic theory. Cultural heritage must be treated as a (consumable) good. Further, according to socio-economic theory, cultural heritage objects are "Common Goods". Common goods are characterised[xi] by being:

Non-exclusive: A good is non-exclusive when a user cannot technically be stopped from enjoying / consuming that good.

Non-rivalling: The enjoyment / consumption of the good for one user is not reduced by more persons enjoying it simultaneously.

The private (and profit driven) market cannot produce or supply sufficient non-exclusive common goods. The reason is simple: if you cannot force someone to pay to consume a specific good you cannot generate any profit! If profit may not be achieved for a 'good' the mechanisms of the private market, ensure that such goods are not offered on the (same) market. So, if the mechanisms of the private market alone decided, only those (immovable) cultural heritage (ch) objects with a high market value would be protected. The logic is similar for all common goods.

Now if this is the position of cultural heritage in a market, how do we find out what value that these goods have? From the perspective of value creation / definition there is no defined and unified methodology to specify the socio-economic value of cultural heritage objects. But standard economic calculation methods may be used to define the value of a cultural heritage object – or better an aggregated group of cultural heritage objects.

"The value a consumer gets by consuming a market good is equal to the highest sum of money the consumer is willing to pay to secure that good for his own consumption."[xii] Consequentially the value of a cultural heritage good is the highest sum of money a 'consumer' is willing to pay to ensure the possibility to enjoy (consume) the good. This is the "use value" of the good. But, as other common goods, cultural heritage is a 'nonmarketable good' and also a 'non-renewable' good. The final estimation of value must also consider what we can call a "non-use value".

In conclusion, the value of such goods must be defined by analysing to types of values: Use value and Non-use value. In this paragraph we will concentrate on trying to analyse the use value of cultural heritage from a social economic perspective. The non-use value is a value that must be added to the use value to achieve a correct picture of the total value of cultural heritage to society. The outcome of that study was that the overall size of the CH market at European level is comparable with the automotive market[xiii].

Let's proceed with the assumption that CH can be considered as a good. The concept of "design" is usually directly related to physical goods, it become a relevant attribute of product since the end of the nineteen centuries when "artists" started to assign a significant value to the study of the shape and functionality of objects[xiv].

The extension of economy from physical goods to services led to a similar approach, like any good, services require to be designed to better perform and guarantee a positive user experience. This is probably the most recent evolution from services to experience economy. Service design encompasses different phases including interaction design, the in-depth analysis of the concept of service design is tightly related to user experience (UX).

In early stages the interaction with computer was reserved to computer scientists (electronic engineers), data processing and service provision was patrimony of super calculus centres, later a restricted number of citizens were trained to "speak" computer language to interact with computers, it was the time of big paper volumes full of codices associated to physical items. That time getting to the mall to buy something the cashier use to kook for the exact code of the item to set the bill, bar codes come later. In the eighties a new professional profile come on stage: the software engineer and the information scientist. They had specific expertise in software design, to extremise the differences let's consider typing machine designers versus writers.

The early phase of the service industry probably dates to early nineties, object design was very popular as well as fashion design, universities started to multiply the branches of design: furniture, jewellery, car, web … and more; service design was ignited by web services. Software developers and experts in interaction design invested time and resources to identify and define the guidelines for on-line services. Of course, this approach to service provision wasn't limited to online services, for instance, even food delivery service was "designed". To "officialise" this new branch, the International Council of Societies of Industrial Design (ICSID) added services in the description of the design (2005), other organisations and universities included service design as a new branch[xv]. The European Union provides the following definition of service design: "Service design is the activity of organising and planning people, infrastructure, communication and material components of a service in order to improve its quality and the interaction between service providers and customers." And more over "It is a creative, viable, and user-centred design process that is used by organisations to create value for their customers or users and serves as a competitive advantage for the service provider." The European Union observes that "service design has only started to be adopted by the private market in the last few years.[xvi]"

Moreover, to stress the role of service design at social and economic level the European Union observes that "The socio-economic relevance of service design as a means to advance business models is directly related to the role of the service sector in the European Union. This sector has been a key engine of economic and job growth. Over two- thirds of those employed in Europe now work in the service sector and between 60 and 70% of the annual gross value-added figure achieved by the majority of European states can be attributed to services." Several fruitful examples illustrated the impact that service design can have on the way a company conducts its business, as well as to explore the drivers and obstacles related to the use of service design by companies (and particularly SMEs), its scalability potential, and the role of policy makers.

The concept itself of service recalls the idea of a process that can be subdivided in different phases, referring to our specific environment, the cultural heritage, we can subdivide the process into:

1) Pre-visit Service: activities before users/visitors access the service such as advertising, website, promotion. This phase is closely connected with marketing;

2) On-site Service: Each service provided on the occasion of the visit, such as the services provided by the cultural institution (e.g., QR codes, digital guide, merchandise, bookshop, restaurant, bar, etc);

3) Post-visit Service: keeps the visitor in contact with the institution after leaving the facility, such providing customised information, alerting about forthcoming events, after-sales customer service, customer loyalty management. Moreover, service design allows users to experience aesthetics, escape from the substance, enjoy entertainment, or even be trained. Public places such as museums and airports will increasingly be transformed into complexes of services closely related to the visitors' lifestyle.

Human-Computer Interaction (HCI)[xvii]

If our service will take advantage from the use of computers a specific section of service design is devoted to Human-Computer Interaction (HCI), this is usually, more in general, termed as "interaction design" involving all the different aspects that characterise this interaction both physical and not. An interesting aim of interaction design is to develop interactive systems that elicit positive responses from users, such as feeling at ease, being comfortable, and enjoying the experience of using them. More recently, in accordance with the trend towards emotional experiences, designers have become interested in how to design interactive products that elicit specific kinds of emotional responses in users, motivating

them to learn, play, be creative, and be social. This trend is usually directly connected with the so called "user experience" (UX).

Throughout the process of interaction design, designers must be aware of key aspects in their designs that influence emotional responses in target users. The need for products to convey positive emotions and avoid negative ones is critical to product success. These aspects include positive, negative, motivational, learning, creative, social, and persuasive influences to simply name a few. One method that can help convey such aspects is the use of expressive interfaces. In software, for example, the use of dynamic icons, animations and sound can help communicate a state of operation, creating a sense of interactivity and feedback. Interface aspects such as fonts, colour palette, and graphical layouts can also influence an interface's perceived effectiveness. Studies have shown that emotional aspects can affect a user's perception of usability.

Emotional and pleasure theories exist to explain people's responses to the use of interactive products. These include Don Norman's emotional design model[xviii], Patrick Jordan's pleasure model[xix] [2], and McCarthy and Wright's Technology as Experience framework[xx] [3].

In addition, in a similar way to how architecture and design traditionally relate to the business sector[xxi], there is currently much interest in how to design websites that people can trust, that make them feel comfortable about divulging personal information or making a purchase. This area of interaction design is based on the concept of affective aspects. When following such principles, the designer will attempt to ensure not only that the experience of the product will be remembered by the user, but also that the experience is extended as much as possible in time and space, with the ultimate aim being continuous feed.

We will now look at how and why the designs of computer systems (e.g., MacBooks, different Pads) can cause certain kinds of emotional responses in users. We begin by looking in general at expressive interfaces, examining the effect of an interface's appearance on users and how it influences the usability (e.g., for the iPad).

With regards to positive and negative emotional responses, I remember when Caleb Chung[xxii], on the occasion of SIGGRAPH '99, delivered a presentation as a member of a panel on user interfaces. He started his presentation by showing some high-tech devices with dull interfaces, and then asking whether the designers of these dull interfaces considered the actual, everyday use of such devices. Why is it that many designers do not seem to take their target users and the way in which their devices interact with our everyday life into account?

Based on this, we can distinguish between two main approaches to technological innovation. The first is termed tyrannical technology and corresponds to the view that technology imposes its own vision of the world on the target user. This is the approach that forces humans to operate according to the needs of the machine or product: to browse long lists of items in tables, to remember complex and meaningless sequences of codes, to adapt themselves to use complicated interfaces[xxiii]. The second and opposite approach is termed user-centred; in this case the product design is based upon user needs and requirements. As much as we proceed with "smartness", that much as must foresee any possible situation due to both the user and the environment. This to avoid unpredictable behaviour in case of unforeseen situations[xxiv].

User-centred design is a design philosophy that proposes that users should be consulted throughout the development cycle. It is the seed of the process later defined as co-creation; you bring together a company producing goods and a group of customers/users and let them work together to shape a product that provides mutual satisfaction. But who are the users? And even if we know who they are, will they know what they want or need? For an innovative product, users are unlikely to be able to envision what is possible, so where do these ideas come from? At the corporate level, this means that sales and marketing experts must be involved in the decision-making process as well as designers. In addition, the specific case of computer-based product development will require psychologists skilled in human/computer interactions and test laboratories, usually termed living labs, that can check whether the product fulfils the requirements of the end-user when used in the "real world". When we say test, we mean really "test"; very often users interpret the functionality of the product in a very personal way, resulting in unexpected actions. Dealing with cultural heritage and related sectors like tourism we need to

refer to different user requirements: families, people found of heritage looking for in depth information or very specific artefact, people mainly looking for leisure and more.

There are different examples of interaction design; in addition to the public phone accepting credit cards forced to leave part of the card accessible to the user[xxv], time ago when the first generation of automatic tellers started their activity it took some time to establish a trust relation with citizens often concerned about the risk of losing the control of the specific transaction or losing their banknotes or credit cards inside the machine in case of a malfunction. To solve the "human" lack of trust in the machinery designers decided to reshape the design of both hardware and introduce much more interaction, thus providing the feeling of "trust". The same happened more than 30 years ago with the early experiences of unmanned metro trains, the windscreen and windows of the conductor cabin were shielded with dark films to avoid passengers, waiting in the station, can understand that there was no subway conductor.

A co-creation process may aim to replace or update an established system, or it may aim to develop a totally new product with no obvious precedent. There may be an initial set of requirements, or the project may involve producing a set of requirements from scratch. Whatever the initial situation, and whatever the aim of the project, the users' needs, requirements, aspirations, and expectations must be discussed, refined, clarified, and probably reassessed. This requires, among other things, an understanding of the users and their capabilities, their current tasks and goals, the conditions under which the product will be used, and constraints on the product's performance.

The approach described above, although apparently more time- and resource- consuming than the other approach, will yield products that will integrate easily and quickly into the user's everyday life. They will be used appropriately due to their own good design. Such products do not force us to learn additional information; they offer a clear vision of how they work. These may be doors and handles that shows clearly how they operate correctly, taps that mix to give the required water warmth, and panels of switches that clearly indicate which switches activate which appliances (avoiding the need for guesswork). They also include well-designed software applications that execute their own added-value tasks without involving the user in technological problems, allowing him/her to focus their attention on the application itself. This corresponds to the "information at your fingertips" approach to software design proposed in 1990 by Bill Gates: "the opportunity to focus on our own task assisted by a friendly and transparent (to the user) technology."

This paragraph outlined the different approaches and methodologies used to develop services and applications, these notes are valid even in the field of cultural heritage when we plan to develop applications to assist in planning a visit and visiting a museum or an archaeological site.

User Experience (UX)

This term was and still is very popular in the field of interaction design, UX measures the quality of the application or service design. A poor user experience negatively impacts the product or service. While many authors believe that there is no universal agreement on what UX means precisely, many scholars highly recommend the definition proposed by Nielsen, a well-known UX designer and researcher. The definition is: " 'User Experience' encompasses all aspects of the end-user's interaction with the company, its service, and its products." (Donald Norman and Jakob Nielsen[xxvi]). It should be borne in mind that UX definition is a complex concept and should not simply be used equally with usability or user interface (UI). According to Hellweger & Wang (2015) [8], UX takes a more holistic approach, aiming to balance pragmatic aspects and other non-task related aspects (hedonic) of product possession and use, such as beauty, challenge, stimulation, or self-expression. Based on other opinions, UX is a feeling of intense excitement. In a word, feelings beyond expectations can be called user experience. Liu & Idris (2018) state that consumers or visitors should obtain three different levels as follows: Functionality, Usability, and Pleasure [12]. (1) Functionality refers to this concept that without function, there would be no use. In other words, what a product is used for together with the context of use must be realized. (2) Usability, which refers to the ease of using a product, and finally (3) Pleasure. According to the theory 'hierarchy of human needs' or 'Maslow pyramid' [xxvii], higher-level needs always follow the prior satisfaction has been achieved, that is why after the usability is satisfied, the user is inevitable to pursue more, such as emotional experience [12]. This process was initiated when the overall performance of computer systems (hardware and software) was considered satisfactory and the

interaction design was properly developed at that point the driver for choice become beauty, design, appeal, senso of belonging to a “community”.

Usability is described in the ISO standard of the human-centred report as "the extent to which a product, system, or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO 9241-210, 2010). Usability has been identified in the literature as a critical determinant of interactive systems and products. Amongst the usability benefits for the users and vendors, the following have been recognized: enhanced user productivity, diminished user errors, diminished user training effort, diminished service and support, enhanced approval, and enhanced reputation [19]. Over the years, the notion of usability was extended to consolidate the concept of user experience (UX), which indicates the personal feeling and assessment of the individual towards the goods, system, or service in use. User experience concentrates on the inclinations, insights, emotions, and dynamic and psychological replies of the users throughout the use of an interactive good, as well as before-use phase and the after-use phase, and it is typically associated with the satisfaction dimension of usability [19].

Making Cultural Heritage Alive: The Role of Cultural Mediators

One of the main ways of evaluating the effectiveness of a visit to a museum or exhibit is to ask for feedback about it. Do users exiting the museum believe that they know or understand more about the exhibits than they did before the visit? How do they “score” the experience? And what about feelings and emotions? Of course, the whole paragraph does not refer to experts and researchers.

Referring to the classic taxonomy proposed by researchers[xxviii], “objects” may be mainly subdivided between “tools” and “communication objects”. Through the centuries significant “tools” lose their practical utility and may turn into “communication objects” as it happened for Roman masonry tools or Galileo’s telescopes.

Artefacts and archaeological remains are mainly “communication objects”, so they must “communicate” something to visitors. The communication process associated with cultural heritage involves a reasonable degree of complexity. We can present a work of art and propose an interpretation of it or try to offer to the visitors the whole set of elements required to evaluate the work of art autonomously. Each visitor may receive a different “message” from the artefact according to his/her own cultural background, interests, mood, etc.

Some of the main intrinsic difficulties with the cultural heritage communication process arise from the fact that the artefact usually pertains to a different historical and cultural context; from its integrity and conservation; and many times, from its unknown function due to its being out of its context; indeed, many of them are no more located in their original place and their original location may be not accessible anymore. Objects removed from their usual context or function, and artefacts on display without a “code” that can help us to understand their function or meaning, represent a “defeat” for cultural institutions.

Of course, the case of archaeological relics is one of the most significant ones because, very often, glass boxes inside museums are located far from the original archaeological sites host similar relicts. In such a situation we face a cryptic object pertaining to a completely different age and cultural context, deprived of its original function and location; hard enough? Anyway, the situation does not differ too much if we consider frescos, sculptures or any other work of art including mechanical and scientific marvels.

A proper, let’s say sometimes ad hoc, reconstruction of the context on the different sides, technical, technological, political, scientific, religious, and more will provide the “tools” to better enjoy the artefact. Long time ago in the field of visual arts the clou was to “learn to see” providing the basics to visually analyse a painting or a fresco. Looking to the structure of a painting and posing the focus on the details and the way they are arranged on the scene, the use of light and shadows …. Sometimes the opportunity to compare the same or a similar subject due to another artist may help in bettering our experience and comprehension. The “experience” in visiting the Sistine Chapel may be enriched if we consider that there was a conflict between Florence and the Vatican State at the time of the Last Judgment fresco or the statue named Pietà Bandini was shaped in order to appear in right proportions once placed on a marble basement, or, more simply, make evident the dynamic effect frozen in a “futuristic” drawing.

It may seem an outrageous reference but even in theme parks where we face minimum complexity in "experience" provision, there is significant care taken in briefing the spectator at different levels, the overall context, the specific action, and the best way to experience the performance. Forty years of experience in this sector have certified customer satisfaction. The typical approach well-tuned in theme parks is based on three different phases: an introduction about the general background, a briefing about the specific topic, practical information about the way to behave, finally the key experience. This pipeline is addressed to maximise the added value of the experience, ensuring a positive feedback, we can consider it a positive UX, from any typology of users, both informed and newcomers.

In recent times some pilot projects tested a similar approach, merging the need to control the flux of visitors, mainly for preservation issues, and the attempt to improve the experience of citizens thanks to one or more "stops" in briefing rooms before the "live" experience[xxix]. This approach of course requires some more equipment and, more difficult, more square meters devoted to the exhibit.

Since a long time, we have felt the need to improve the approach to cultural heritage, to find an up-to-date promotion of our rich and precious heritage. The role of "memory institutions" is to research, to preserve for future generations and even, last but not the least as we have already seen, to disseminate and promote knowledge and "culture". Some potential questions are: How can we make our heritage alive? How do we engage citizens in heritage? How do we actualize our patrimony? How do we involve young generations, millennials, and generation Y?

Let's consider for instance a page of an ancient codex like Leonardo da Vinci's Atlantic codex. An exhibit showing this wonderful artefact may attract visitors for the historical and general cultural value of the object but many times it does not "communicate" to the visitor the original role and value of the document, explain the meaning of and the innovation due to that work. It is a paramount objective to provide the opportunity to fully understand and appreciate similar artefacts, not only the myth of the fetish.

If dissemination and promotion of knowledge and culture is one of the tasks in charge to memory institutions, in comparison with the market this is the "service" to be delivered to citizens. Consequently, it would be reasonable to meter this performance and try to improve as much as possible the level of customer satisfaction. If it makes sense to rank the "value" of an artefact or relic, the success of a memory institution does not depend too much on the "value" of its assets; of course, it helps; more frequently it depends on the ability to "communicate" and promote. The task to activate and improve communication between artefacts and citizens is in charge to a specific professional profile, the "communication manager", a person or a group of persons sharing this specific skill; the group may be composed by curators, art historians, experts, psychologists, designers, etc.

One of the main roles of the "communications manager" must be to rebuild the original context of the work of art in such a way that it is possible to "communicate[xxx]" it together with all the elements required to make an objective evaluation. We can better term this role "cultural mediator", including in this definition both communication and mediation aspects. So, at the end we must provide a code to interpret the object and its historic context. Very often the ability to associate a "story" to an artefact generates an appealing entry point for visitors. To accomplish this task, we can take advantage from the use of some technologies[xxxi].

Of course, the implementation of these services will necessitate a different workflow, additional competencies and skills, and more exhibition space to host hi-tech installations. In addition, one of the possible catalysts for the application of technology to cultural heritage is education. Technology-based cultural heritage services should be used at home, at school and on-site. Indeed, there are many digital cultural data repositories, usually websites, which could potentially be linked to set up an educational service[xxxii]. Anyway, we must adequately consider the significant evolution of user behaviours and preferences, especially if we refer to young generations and students.

Recent Trends

Among the number of new or renovated approaches to cultural heritage I would like to focus on two recent approaches the use of gamification and immersive exhibits.

From Edutainment to Gamification

In the nineties, the age of multimedia, we assisted to the attempt to merge education with entertainment creating a hybrid termed edutainment, it relies on multimedia software including visual materials, descriptions, gaming materials and more in informal less didactic styles. Several applications were developed such as: Versailles 1685: A Game of Intrigue at the Court of Louis XIV, by Cryo, Réunion des Musées Nationaux and Canal+ Multimedia, later on they developed Egypte 1156 A.C.: L'Énigme de la Tombe Royale and China: Crimes in the Forbidden City. Due to the interest generated by edutainment applications, additional players then joined the group, such as Montparnasse Multimedia, and an application named Rome: Caesar's Will was introduced to the public at MILIA 2000. Another interesting cultural heritage application addressed at the SOHO (small office/home office) market was "Roma: Duemila Anni Fa" by Fratelli Carraro, Editalia Multimedia and Sacis. Unfortunately, the edutainment approach didn't reach the objective to be applied widely even because of the required competences and efforts if compared with traditional ex-cathedra lectures.

Through time museums have been evolving, proposing a more comprehensive range of alternatives for the audience. Admittedly, the sector has always been moderately diverse, embracing many different themes such as history, art, science, and technology, but these thematic areas always have present in the museums. In the past the "conservation" role of memory institutions uses to prevail on "research" and much more on "education, exhibit and enjoyment". Nowadays, it is more in their mediation means and their missions and purposes that museums are diverse. It appears that museums are converting into more hybrid models mainly because of the increasing cross-fertilization relations particularly among museums[xxxiii] [14].

Nowadays, more and more museums adopt edutainment practices when designing their programs. Based on the document "Creating the new museum definition: over 250 proposals to check out!" collected by the International Council of Museums (ICOM) in 2021[xxxiv], in the 21st century, a museum should contain both education and entertainment paradigms in its core agenda to absorb the visitors and keep them satisfied. As suggested by Tunisia: "*ensure learning by all techniques and sciences of education and communication, ensuring entertainment, games and recreation for all age groups of visitors*".

Moreover, museums must deal with a great amount of competition in leisure, entertainment, and education. Thus, traditional museums are continuously transferring toward the realization of intelligent entertainment, and consequently, they need to look for tools to make visits more of an "experience" rather than a sheer visit. (Mencarelli & Pulh, 2015), this is more or less easy to achieve in consideration to the specific typology of museum (e.g., Science & Technology v/s Art History).

From a social perspective, ICOM states that "The definition of a museum has evolved, in line with developments in society. Since its creation in 1946, ICOM has regularly updated this definition in accordance with the realities of the global museum community."[xxxv] The recent definition of "museum" according to the ICOM Statutes, was adopted during the 21st General Conference in Vienna, Austria, in 2007.

"A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment."

It verifies that the museums' role in society has drastically emerged, and this shift opens the door, as some authors suggest[xxxvi], toward the term "New Museology"; a new philosophy encompassing how museums perform and an evolved relationship between museums and their containers or the societies [9].

Following this approach New Museology's scope suggests museums to re-examine how they function in all stages by redefining their relationship with individuals and communities. As a result, one of the areas required to be re-examined is knowledge and the way it is conveyed within the museum context. Education is becoming explored by museum professionals in new forms, for instance, by concentrating more on the learning process instead of the sheer outcome, a representative that allows a more in-depth examination of experience. This remark involves one of the typical aspects concerning "masterpieces" or "high relevance" exhibits sometimes considered by visitors as a "social must" much more than an opportunity to enjoy art and beauty in depth. Entertainment is very often used in museums

as a means of learning, in the full knowledge that learning is obtained more appropriately in conditions of enjoyment. These concepts find different meanings and application in the wide range of cultural institutions and specifically in memory institutions. Science and Technology museums use to take great vantage from the "hands-on" approach and gamification of concepts, natural history museums invest on augmented reality as well as archaeological museums and site engage visitors thanks to virtual and augmented reality.

Traditional education was limited to schooling and solely based on the outcomes (marks and grades) rather than the learning process. However, this form of focus tends to keep the educational possibilities narrowed. It is a common understanding that recent generations represent a discontinuity if compared with the past ones. Such discontinuity or, if preferred, singularity is recognised both by adults complaining because their children do not pay attention or are getting bored by learning and, by adults, that discovered new skills and capabilities in young generations. An educational and communication divide was already on stage between millennials (generation Y) and the educational system before the pandemic.

Consequently, there is a shift to more interactive, engaging, experiential learning techniques. Contemporary educational research suggests that learning is a natural and lifelong process, learning happens continuously, derives from many sources, and occurs in many ways. Human minds build new understandings through a continuous process of perceiving new patterns, images, and ideas, having debates, and accommodating them within existing structures.

Gamification

Playing games has always been an inseparable component of human life. The history of playing games goes back as old as the origin of humanity. According to Ronchi (2009), the remains of toys such as dolls and other game sets have been excavated by archaeologists worldwide [21]. The energy released and surprise factors that games offer to the players are known as the main characteristics of getting involved with games. Apart from the recreation side, there are games designed and manufactured to educate a particular subject, expand the concepts, and make the players understand specific knowledge during the play [10].

The first International Conference on Computer Games and Digital Cultures (CGDG) was held in Tampere, Finland in June 2002. The event was organised by the Hypermedia Laboratory of Tampere University along with the University of Turku, the IT University of Copenhagen, UIAH Medialab of Helsinki, and some partners from the digital content industry[xxxvii]. This event was a follow-up to a series of international meetings and work- shops devoted to computer games inaugurated in Copenhagen in 2001 by Computer Games and Digital Textualities. Another relevant event devoted to new technologies, education and edutainment applications is usually held in the US—the ASTC (Association of Science and Technology Centres) Annual Conference[xxxviii]—where, together with the traditional "hands on" approach, we can find thematic educational games. These events and others associated with the entertainment and games sector provide clear evidence of the relevance of this sector.

PCs, consoles, digital wristwatches, pads, smart phones, and even car onboard entertainment are just some of the devices that now support video games—one of the engines of IT, and recently, thanks to massively multiplayer online game[xxxix] (MMOG) even of ICT[xl]. One of the emerging gaming sectors is termed serious games. The core markets for serious games are the military, government, healthcare, corporate training, and education, although the traditional gaming sector still plays a major role. The Serious Games Initiative[xli] focuses on the use of games to explore management and leadership challenges facing the public sector. Part of its overall charter is to help forge productive links between the electronic game industry and projects involving the use of games in education, training, health, and public policy. Ignoring the defence sector[xlii] (which includes war games) and the "adult" market, entertainment is one of the main engines for the digital market.

The explosion of opportunities to communicate afforded by the popularities of the Internet and mobile telephony has enabled the development of multiplayer games on smart phones (e.g., multiplayer role-playing games), and massively multiplayer games are now on the horizon of mobile telephony.

Finally, we should also mention peer-to-peer communication. Although this is sometimes associated with the illegal exchange of copyrighted files, it has opened the door to innovative services and

approaches to interpersonal communication. The “game” has always represented a vital component of human life since it allows us to unleash energy and creativity beyond the boundaries of current conventions. Obviously, each game has its own rules, which are usually well-defined and consistent. These rules represent, as we will see, essential reference points for creative people[xliii].

As Ronchi [21] suggests, the “gaming universe” can be analysed according to many different taxonomies: games played alone, in small groups and in teams; educational or neutral games; games requiring the use of specific devices, high-tech games and games based on simple objects or symbols; games based on rules and behaviours; games that depend on physical fitness and games that do not; games that require the physical presence of the other players or not; games that require specific knowledge or ability; simulations or purely abstract games; games based on chance or skill; games that have a winner those that do not[xliv]; as well as others. There is a key aspect in gaming: the ability to interact, to be an “actor” in the action. Just how physical these interactions are they depend on the game, but they are (almost) always present to some degree[50].

Serious games and Gamification, which is known as the application of game mechanics to a non-game environment, was first coined back in 2008 even if in the middle of the 2000s was already known the concept [3, 5], and more.

Gamification has already been successfully used in marketing, business, health industry, education, and tourism sector [32]. A widespread use of gamification in education is through applications such as Duolingo, which helps the learners follow the language course differently compared to the traditional system of learning. Another use of gamification is enterprise gamification, a well-known practical trend in the business world, which refers to applying game elements to the workplace and within the employees, a typical example from 2005 is “Endurance Enterprise”[xlv]. To better understand the gaming approach let’s describe how this application works. The product is aimed at managers, entrepreneurs and team leaders who intend to deal with modern leadership issues within an individual and group path. The product is designed as a tool for trainers, consultants, and coaches, who want to organize engaging and stimulating individual or group training sessions and who wish to propose case studies and analyses capable of capturing the attention of a demanding user. Endurance Enterprise is a multimedia and interactive simulation, which supports experiential training sessions dedicated to managers and entrepreneurs who wish to develop their group leadership skills. Through the detailed story of the heroic Royal Transantarctic Expedition, taken from the diary of expedition commander Ernest Shackleton, the “game” offers new managers the opportunity to confront the Irish explorer's particularly effective leadership style. Endurance Enterprise is structured in episodes, referring to specific events that occurred during the expedition, chosen for their similarity with modern organizational dynamics and problems and therefore particularly suitable for dealing with specific leadership issues. A 3D simulation illustrates the episode and proposes a critical situation, faced during the epic enterprise. The interactive component and the clarification of a mission to be carried out project the learner into the Antarctic expedition, of which s/he her/himself becomes an active part that analyses, decides and evaluates, testing her/his own ability to command and lead groups. At the end, through an accurate processing of the choices made, the user receives personalized feedback on their leadership style and a balance of their skills. Training within organizations is moving towards the acquisition of skills in the context of complex projects, aimed at developing an aptitude for problem solving, leadership, negotiation, conflict resolution and collaborative work. It is important for organizations to have advanced training tools suitable to support this need.

From a study carried out by experts it emerges that the market for interactive training tools is growing strongly in the US and could come to represent 20% of the entire market for distance learning products. Also in the States, according to a survey carried out by the American Society for Training and Development (ASTD), 70% of respondents state that their company uses or plans to use simulation-based tools for the training of its internal staff. ASTD also reveals that the most important aspect for this type of tools by more than 82% of the interviewees is the ability to involve from an emotional point of view. Due to the originality of the format, the ease of use and the wealth of emotional stimuli.

Although the definition of gamification seems to be intelligible, further clarification can make it more tangible. To do so, first of all, the term "game" needs to be defined: In everyday language, the terms play, and game are used interchangeably; in reality, however, their meaning differs. A play is a more accessible form with improvisational aspects, whereas a game "is structured by rules and competitive strife towards a goal". Secondly, the expression "non-game environment" needs a further explanation.

Gamification uses game elements where they are usually not expected. This expectation comes from social, historical, and cultural backgrounds. Consequently, players depending on the context they are dealing with, expect game elements or not [4]. Ever since this concept has been introduced, revolutionary changes have occurred in business and other areas. Nevertheless, the idea that "gaming" is a powerful mean to improve knowledge suggested to try again using a different approach, turn educational or training processes into gaming: gamification[xlvi].

Gamification was even used in 3D solid modelling software training courses. To seamlessly learn how to use a 3D modelling software developers created a computer game that required to create some digital objects to complete the game and win[xlvii], so participants learned the basics about the modeller very quickly with limited efforts. Furthermore, one of my colleagues uses to start a lecture on object-oriented programming asking students to play "Space Invaders" physically playing the different roles: invader, weapon, bullet …. they assimilate immediately the concept of "object" and related properties. A typical branch of gamification are serious games, as we already experienced, aimed to train people thanks to specific roles working in groups.

An interesting application in the field of serious games is CELL[xlviii] and the mobile version Explorer, this application supports "experiential learning" in medical teams thank to high level virtual interaction with patients and the opportunity to compress time axis to see the outcomes of the applied medical protocols.

Challenges of gamification

The application of gamification in different contexts is not easily accomplished and is accompanied by obstacles and challenges. "Gamification can unfold its potential only under such circumstances where obstacles and challenges are addressed adequately" (Sanmugam, 2017).

Notwithstanding the deductive nature assumed for gamification applications, it is discussed that supplying learning materials for individuals in such a method and in an engaging way is more relevant for young people, and most of the research and concentration has been on this group and possibly less on the adults. This attention on the former group is reflected in the prevalence of online and other gaming resources around education, while the former group might not exploit the most of it.

According to Negruşa et al. (2015), too much competition and a too solid game-style approach could bring about an overall loss in employees' productivity and other adverse outcomes. Therefore, it is crucial to keep the balance of using game elements in the non-game environment.

In general, consider four sources of challenges for the application of the gamification:

- Misuse of gamification by developers and decision-makers;
- Gaming the system by the participants through giving too much importance to the rewards;
- Not all game-based actives appeal to all the users. Therefore, a customizable system is needed where the users can create their own activities;
- The over-justification effect might cause the external incentives to harm intrinsic motivation [17].

Nicholson (2013) delves into the second challenge more in detail. He asserts that focusing too much on the reward system ought to reduce the internal motivation that the user has for the activity, as it substitutes internal motivation with external motivation. Nonetheless, suppose the game design elements become more meaningful to the user through means of instilling helpful information. In that case, internal motivation can be developed as the need to emphasize the external rewards is lessened. The concept of meaningful gamification was well defined by Nicholson (2013) to deliver long-term effects, emphasizing intrinsic or internalized urges for people's engagement in activities [18]. The author pointed out: "*removing the scoring elements from a gamification context encourages a focus on the integration of play.*" Accordingly, meaningful gamification urges an intense synthesis of game mechanisms into non-game contexts [12].

Meaningful gamification methods concentrate on the underlying activity to know where the integration of game elements is essential. Going beyond games into the integration of fundamental play elements is more interesting. According to Nicholson (2013), a game without a scoring system is known as a play; thus, removing the scoring mechanism from a gamification context promotes attention to play

integration. An example of this point is a subway station in Sweden. A piano keyboard on the stairs in the subway entrance provoked many people to go for the stairs alternately of the escalator.

Psychology of Game

Chou [2], through many years of experiments and adjustments, obtains that the motivation for doing all the actions in life is based on one or more of 8 Core Drives. He believes that if there are none of these Core Drives behind the Desired Action, there is no motivation, and no action takes place. These Core Drives are:

- Epic Meaning & Calling;
- Development & Accomplishment;
- Empowerment of Creativity & Feedback;
- Ownership & Possession;
- Social Influence & Relatedness;
- Scarcity & Impatience;
- Unpredictability & Curiosity;
- Loss & Avoidance/

Each of these 8 Core Drives has different natures within them. Some make the user feel powerful but do not create urgency, while others create urgency, obsession, and even addiction but make the user feel bad. Some are more short-term extrinsically focused, while some are more long-term intrinsically focused. Chou believes that each gamified system utilizes one or more of these drives. With the help of some examples and radar charts, it becomes clear that how these Core Drives affects different platform.

Xu et al. [32] assign two types of motivations for playing a game: intrinsic motivation and extrinsic. Extrinsic gaming elements are things such as points, badges, and other rewards or so. On the other hand, intrinsic motivation refers to playing games for the pure enjoyment of gameplay and gameplay's hedonistic value. While intrinsic motivation contributes to long-term engagement and enjoyment, extrinsic motivation such as reward does not affect increased playing activity. Xu et al. mention that both intrinsic and extrinsic motivation need to be considered to create a meaningful gamification experience. In other words, successful gamification should address this intrinsic motivation by using game mechanics (extrinsic elements) to respond to the players' inner call, attracting them to the pure enjoyment of the activities and the hedonic function rather than the utilitarian function of gaming.

According to Xu et al., game systems can be divided into three different components, Mechanics, Dynamics, and Aesthetics (MDA Model), which work together to create a functional and hedonistic value of the gameplay and influence player's experience. The game mechanism is described as game tools known as the specific components, which usually include achievements, collections, badges etc. while game dynamics is the tool responsible for connecting the player with the system, through the means such as freedom of making choices, progression to the next level, teamwork, or competition with other players [32]. The third component, namely Aesthetic, describes emotional responses from the player, such as feelings, emotions, and fun.

The design of the game elements should be meaningful to the user and result in positive change in the user's mind [4]. The designers have "*accumulated a number of patterns, rules, and feedback loops, that are motivational, and create user engagement and loyalty*" [31]. For example, scoring systems, avatars, group chat functionality are some of the game design elements [4].

Generally speaking, to make people behave in a particular way, one needs to create an appropriate system of incentives (rewards) for the desirable behaviours [31]. Incentive mechanism design or just "mechanism design" is an area for research in mathematical economics and game theory studies. The main objective is to design rules that, when followed by the participants, ensure that the overall system satisfies a particular goal or matches a set of criteria, e.g., ensuring a fair chance for participants to maximize their utility, optimization of the common welfare for all participants, or just maximizing the utility of the owner of the system [31].

Different personalities for the individuals make them motivated by different things. On the other hand, the way the rewards are presented to the individual would increase the incentives' effect on their motivation. It implies that personalizing the incentives and the way the rewards are presented to the individual would be beneficial [31]. Although, it needs a great deal of study on different groups of people.

In some systems, one way to personalize is through means of input-based mechanism. It means that the mechanism is part of a dynamic system, and it often requires user input to fit the reward systems to the user and its character [31]. The developers of gamification applications, together with the companies' managers adopting gamification applications for their business, are considered the designers in game design. Managers should customize the companies' goals into game mechanics, develop the gamified experience structure, and create reinforcements that will motivate players' actions or trigger behaviour changes.

Gamification in tourism

Given that by 2030 half of the world population will apply online and mobile technologies, it is essential for the tourism and hospitality sector to integrate Information and Communication Technologies (ICT) in their services [17]. The application of gamification in the tourism sector is not new; nevertheless, it has not been widely adopted. According to UNWTO and as mentioned by Negruşa et al., (2015), game mechanisms can create positive experiences in tourism: fun, excitement, arousal, pleasure, sense of achievement, and to provide tourists with both entertainment and information. Every loyalty card or frequently flying program is a gamification approach as points are collected to be redeemed for a bonus [32]. Gamification is a future trend that can be applied in tourism in many ways and lead to increased motivation for the tourists and behaviour change [32]. The application of gamification tricks to influence consumer engagement, customer loyalty, brand awareness, and user experience in the tourism sector is becoming more widespread. Tourism and hospitality enterprises can integrate game elements and use them to provoke certain types of behaviour in their own favour or even benefit society as a whole [17]. that is how the role of sustainability becomes bold again. In the following section, this matter will be discussed more in-depth. According to Negruşa et al. (2015), by using a gamified platform, the tourist has the opportunity to conceive the game progressing, share the outcome and experiences with friends and get to know new people, and become a part of that gaming community. By combing these incentives, tourism and hospitality companies contribute to enhancing the tourists' experience [17].

Negruşa et al. (2015) suggest that at the beginning, the game mechanics should provide extrinsic rewards for tourists, like accommodation discounts, free drinks, etc.; as the game progresses and the desired behaviour becomes more and more frequent, the rewards should be intrinsic and focus on notable titles, social recognition, etc.

As an example, regarding the application of gamification on the tourism experience, Bulencea (2013) shows the impact of a gamified experience on the visitors of a beer museum [1]. In this experience, three hundred visitors were supposed to fill out surveys by which their expertise in museum visiting was measured. The results showed that the implementation of a gamified concept, even in a rough form (developed in one month by one person and with no budget), had a significant impact on visitor experience compared to the conventional visiting experience: visitors remembered the experience better, felt more engaged, and were more satisfied [1]. One of the potential gamification applications in the field of cultural tourism is based on the value analysis of each of the visited locations and the annotated definition of a score for each of the values in a kind of TripAdvisor scheme, profiled users will have the chance to query the system or be updated by push messages about locations and assets that can better match with their profiles and feedbacks.

Application of Gamification in museums visiting experience

Liu & Idris (2018) regard gamification not as sheer means for fun but a scientific solution by means of which the knowledge of the artwork will be transferred, and potential visitors can be motivated to visit the museum continuously. Incorporating the gamification concept into the process of enhancing UX (User Experience) in museums is not a simple use of game elements, given that most gamification that offers rewards is only suitable for short-term purposes rather than a long-term change. Thus, the correct integration of gamified practices into the museums needs effort and knowledge.

Many museums have employed gamification strategies to entertain visitors during visits; for instance, the National Museum of Scotland, Rijksmuseum (Amsterdam), or The British Museum. The first application is based on capturing the flag games where two groups compete against each other by scanning and capturing locations inside the museum to achieve victory. The second is a family-oriented quest application challenging the visitor to solve several puzzles about some displaying exhibits. The third application enables visitors to play a scavenger hunt game, searching for and scanning the required artifacts to learn fun facts about them through questions. [13]. The last two approaches mentioned above are question-based.

Among not so many published writings attempting to apply gamification for enhancing museum visit experience, López-Martínez, Carrera, & Iglesias (2020) proposes a solution that consists of a gamification platform to enrich museums' visitors' experience with more knowledge about the collection of exhibits through an enjoyable learning mechanism. They introduced a smart object gamification platform for museums. The system exploits a combination of semantic Web and Internet of Things technologies to craft appealing and memorable museum experiences. They have detailed the process by which questions are automatically generated based on a set of templates. Then, we described visitors' interaction with the museum environment utilizing QR codes and a smartphone application that provides advanced visualization and information about the exhibits of interest. The app also offers visitors the opportunity to play the questions that have been generated, thus gamifying their experience. Finally, the prototype of the designed platform was implemented and evaluated in Joaquín Serna telecommunications Museum.

To achieve this goal, the platform is based on multiple-choice questions that are automatically produced by extracting linked data from DBpedia[xlix] and mining text descriptions about the exhibits through entity linking tools. The proposed platform has been implemented in the Telecommunications Museum Professor Joaquín Serna located at Escuela Técnica Superior de Ingenieros de Telecomunicación, Universidad Politécnica de Madrid, Spain [13].

Theme Parks

Theme parks are one of the key players in the so-called “spare-time economy”. Among the most well-known (and oldest) are the Disney Parks, inspired (according to Walt Disney, their founder) by Tivoli Park in Copenhagen (Denmark). Today there are several similar or derived experiences that can be subdivided into theme parks, media centres and technology and science centres.

Media centres are a newer concept than theme parks. They enable visitors to try out new media and related technologies. This concept developed from the idea of facility sharing, particularly of expensive or group/mass-oriented applications.

Technology and science centres were conceived by Frank Oppenheimer, who wanted a place where people that were not directly involved in working with science and technology could experiment with the principles of physics and other sciences in a “hands on” manner. In 1998 Oppenheimer inaugurated the Exploratorium in San Francisco (CA, USA), which was the first science centre to use this approach. Even if something in some way similar was already done in Munich at the Deutsches Museum[l] in the 1930s.

Today’s key phrase is the “live experience”. Operators want the experiences delivered by parks to be remembered and extended as much as possible in time and space, with the ultimate aim being “continuous feeding” of the user, resulting in a virtuous circle. In other words, the user might want to extend the experience and is thus motivated to undergo the experience again to gather more information or is encouraged to try other similar experiences.

Light/laser and music shows represent another interesting sector. Such shows should be performed in both closed and open environments. The ancestors of these include the Son et Lumiére shows, such as the traditional one in Luxor (Egypt) or the magnificent one performed in the Grand Place in Brussels.

As an extension of the concept, each summer there is an international festival that celebrates the best show of pyrotechnical art—Art Pyrotechnique[li] in Cannes (France). These shows are a mixture of fireworks, lasers, and music.

Nonlinear formats like drawings, graphs and combinations of text and images are some of the reference formats. Video games and interactive installations such as theme parks and technology museums should be considered reference models for enhanced nonlinear communication.

This newly emerging area of interaction design is based on the concept of affective aspects. When following such principles, the designer will attempt to ensure not only that the experience of the product will be remembered by the user, but also that the experience is extended as much as possible in time and space, with the ultimate aim being continuous feed.

Culture Value Chain[lii]

Having already introduced the wide range of values associated to cultural heritage and the concept of service like a good, it is time to introduce the concept of value chain. We already discussed about the very usual asymmetry of the cultural market; the main investors are not directly getting revenues from their investments. The concept of value chains has been studied in a wide range of academic domains, from industrial economics to development economics.

In the general framework, we consider the value chain concept as "*a sequence of activities during which value is added to a new product or service as it makes its way from invention to final distribution*[liii]".

Kaplinsky and Morris provide a similar description of the concept of value chain: "*the full range of activities which are required to bring a product or service from conception, production, delivery to final consumers, and final disposal*"[liv]. Value chains, as synthetically described above, differ from "clusters"; a short list of main dissimilarities is provided by the European Commission Report and outlines the following key points:

- inclusion of both forward and backward relations necessary for producing the products or services;
- inclusion of the intermediate and final customers in the analysis;
- value chains are mapped at the level of activities and services, not companies;
- value chains analyse the interrelations between cooperating companies only (excluding competitors);
- value chains exclude framework conditions (however, these framework conditions are surrounding the value chain);
- value chains are global in nature; indeed, value chains remain in place also after relocation of existing activities to other regions or countries [6].

Any value chain entails upstream and downstream linkages connecting different activities; a typical graphical representation consists of a stack of activities required to create, produce, and disseminate a certain product or service, connected by functional relationships. A well-known example of this chain in the movie market was originally composed by: novel, movie, thematic park, video game, merchandise, etc. Later on, the stack was sometimes shuffled becoming: movie, video game, novel, theme park, merchandise, etc., or even theme park, merchandise, movie, novel, video game, etc. A concrete example of a movie derived from a videogame is the series "Lara Croft" or "Resident Evil" while a movie derived by a theme park is "Pirates of the Caribbean".

These value chains enable the synergy among the different "outcomes" of the same "seed", and it is interesting to consider the opportunity to shuffle the stack accordingly with the most convenient "entry point".

In the age of traditional movies, the entry point was many times a successful novel later turned into a movie; think about Umberto Eco's "The Name of the Rose[lv]" and the related movie[lvi] directed by Jean-Jacques Annaud. More recently we had the exploit due to Dan Brown with his first three books: Da Vinci Code[lvii], Angels and Demons[lviii] and Inferno[lix]. These examples due to Eco and Brown didn't create an extended value chain in the usual way as did the first two examples: so, no theme park, video game or merchandise, but they ignited a kind of scattered value chain built on the interest generated by the stories about cultural assets or a specific location. Therefore, readers before and movie watchers later started to visit movie locations or key artefacts mentioned in the book or shown in the movie. This was the case

with the Abbey of Melk[lx] in Austria or Castel del Monte[lxi] in Italy, and Da Vinci's Last Supper fresco or the Chigi Chapel with Gianlorenzo Bernini's sculptures "Habakkuk and the Angel" and "Daniel in the Lions' Den" in Santa Maria del Popolo church[lxii]. To conclude let's consider another historical location The Royal Palace of Caserta (Italian: Reggia di Caserta - Italy) ideal location for some movies like Mission Impossible III and Star Wars episode II: the attack of the clones[lxiii].

This is a different typology, a value chain connecting novels, movies, on-site visits. The last link of the chain includes transportation, hotels, restaurants, merchandise and maybe shopping. This is the typical asymmetric market that characterizes a major part of the cultural heritage landscape. The analysis of the effects on cultural tourism due to specific movies outlines how the "entry point" movie influences travellers.

Through the in-depth analysis of interrelations between "actors" that must cooperate to create value, value chains are an interesting concept for both analysis and policy development. Value chains allow for an analysis that goes beyond traditional sector analysis and better reveals the links and economic interrelations existing between the different actors. This approach enables a deeper insight into the actual workings and dynamics of economic actors. Additional benefits are a more comprehensive identification of potential stakeholders and a better understanding of the role those different activities play in creating economic value and employment and last but even more relevant increasing interest for culture.

Immersive interactive experiences

Technology today is moving towards a new era where users will experience and interact with the world in innovative new efficient ways. The latest innovations include Machine Learning AI and its various flavours, Virtual and Augmented Reality, Blockchain, Internet of Things and many more. The COVID19 pandemic turned out to be a huge opportunity for recent technologies to be adopted and scaled up amongst the population that had been in lockdown with harsh limitations to their freedom of movement. Lockdowns also included the closure of many cultural sites and events, which left the cultural and creative sector in dismay and economic crisis. The only opportunities left to this sector, as to many others, was to reinvent itself using promising digital technologies.

This new approach revolves around a subset of virtual reality, called immersive virtual reality or immersive technologies in a format that is recalling the approach defined by Myron W. Krueger[lxiv] "Artificial Reality" in contraposition to Jaron Lanier[lxv] "Virtual Reality", and includes the technologies that give users the impression of being immersed in a synthetic physical and computer-generated world without the need to wear or use devices like spectacles or displays like Oculus. Similar installations are designed to optimize the user centricity as well as the quality, efficiency and the communication impact offering a high level of user experience.

For a few years now, and with a sharp increase during the COVID19 pandemic, immersive technologies in their various forms have in fact penetrated Cultural Heritage and are increasingly popular amongst cultural and creative industries actors. Known projects are Virtual Uffizi Experience (2016)[lxvi], Van Gogh (2020-2021)[lxvii], Claude Monet (2019), The Smurf Experience (2018-2019), Gustaf Klimt (2021)[lxviii], The World of Bansky (2019 Baden-Baden and 2021), The Arc de Triomphe (2020), Napoleon, Beyond the Myth (2021). Similar technologies have been used in the field of operas as in the case of The Last Judgment[lxix] or The Magic Flute[lxx] to get to didactic digital performances[lxxi].

These projects aim to explore the potential of immersive technologies and user-centric experiences for multichannel and multinational digital impact as a future driver for innovation and economic growth in the cultural and creative industries and beyond.

That said, the objective of digital cultural heritage is not to replace the physical one: it is to offer another type of joint encounter with it, another experience for the users/visitors to interact and discover the culture, as embodied in the physical heritage. It allows for completing, specifying, and adding layers of information and meaning to physical objects. It also provides the user/visitor with the opportunity to recontextualize, efficiently and effectively interact with or approach cultural heritage, either from a cognitive, a sensuous, or an emotional point of view. Digital cultural heritage thereby enables the sector to rejuvenate and open to new audiences, such as families and young European people, by offering a sustainable novel and unique cultural, creative, and artistic experience. Access to experiences with

cultural heritage contributes to social cohesion and inclusion, by strengthening resilience and the sense of belonging, bringing people, real visitors, and online users together to improve their cultural education and well-being.

This creative industries and cultural heritage project's challenge will be to better understand how to realise the full potential of immersive technologies and experiences as a driver for innovation, create stronger links even with other sectors (e.g., tourism) and how to contribute to strengthening the European economy, society, and culture in the most sustainable way.

These projects aim to focus on emerging immersive experiences that have successfully penetrated the Cultural and Creative industries, while paving the way to further provide a new cognitive, sensuous, and emotional approach to culture, and explore other industries' potentials, where immersive experience could be, as it is for the cultural and creative sector, a driver for innovation and economic growth. Currently, immersive technologies and experiences require additional hardware (VR goggles, AR smartphones) for users to fully benefit from their immersive experience where costs are still high, preventing small-size cultural organisations or events to fully deploy their immersive experience.

Closing remarks (Fade to black)

The present document considered the role of cyber technologies and specifically ICTs from a different standpoint, "goods and services" as the entry point to define the potential contribution offered by ICTs to the cultural sector and more specifically the cultural heritage sector. This taking adequately into account the wide range of potential values associated to cultural assets: cultural, economic, social, moral, religious, aesthetic, technological, diplomatic, and more. A specific consideration deserves the presence of the ongoing digital transformation that must be carefully considered by the cultural sector as well as the impact due to the pandemic that provided the evidence of the need to be prepared to face similar situations in the future ensuring citizens the opportunity to enjoy culture. In case of disasters or exceptional events culture enjoyment continuity is a must as in other sectors is business continuity.

The emerging trends and experiences due to digital transition together with the pandemic effect are boosting the research and pilot implementations in the cultural field. Online guided tours enriched by some details concerning specific stories or events, usually not known by visitors, together with thematic lectures, usually due to the scientific director or expert in the sector, both on demand and live with the opportunity to pose questions are revitalising the scene.

Of course, we must consider the wide range of cultural institutions and collections, some of them are much more suitable to receive a relevant contribution from cyber technologies other, due to their nature, have limited opportunities. The evolution from edutainment to serious games and gamification has a different "story" in the different typologies of cultural assets. Immersive interactive experiences are flourishing in different cultural sites from the Imax exploration of the "Thousand Buddha Caves" or Mogao Caves[lxxii] to the "Immersion[lxxiii]" interactive experience to take the dive in the Great Barrier Reef of Australia. Once again, the aim is not to surrogate the direct fruition of heritage but to contribute to its better understanding and fruition.

In the past some experiences didn't succeed due to different reasons, now technologies are mature, quality of experiences is appropriate, it is time to rethink the role of cyber technologies for a better fruition of cultural heritage and to ensure the enjoyment of culture in case of crisis.

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Переосмысление роли ИКТ. Цифровая трансформация и непрерывность культурного наслаждения

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Аннотация: В этой статье будут проанализированы последние тенденции и эволюция использования ИКТ в области культурного наследия с точки зрения предоставления услуг в эпоху цифрового перехода и пандемии. Первоначальный акцент делается на обычном подходе в области товаров, правильном дизайне, чтобы вызвать положительные эмоции у потенциальных покупателей. Недавно был выявлен новый вид товара — услуга. Предложения услуг невероятно выросли во время пандемии — доставка товаров, доставка продуктов питания и многое другое. Итак, думая об услугах как о товаре, мы должны проектировать их так, чтобы они лучше оценивались покупателями, как это делали люди с начала XX века с предметами и товарами. С применением одного и того же подхода к цифровым услугам требуется этап проектирования вместе со всеми различными компонентами, которые обеспечат положительную обратную связь от пользователя, это означает, что необходимо иметь дело с дизайном взаимодействия, подходом, ориентированным на пользователя, рекомендациями по удобству использования и общей концепцией положительного пользовательского опыта. Последние тенденции и возрожденные технологии — как переход от образовательных развлечений к серьезным играм и геймификации, новый подход к захватывающим интерактивным технологиям в ненавязчивом формате. И последнее, но актуальное — необходимость набирать обороты, чтобы обеспечить непрерывность пользования культурой в случае кризиса.

Ключевые слова: электронная культура, цифровая трансформация, пандемия, технология погружения, виртуальные музеи, приложения, геймификация

Сноски:

[i] Mark Weiser chief researcher at Xerox PARC was the “prophet” of this important trend — pls refer to https://www.ics.uci.edu/~corps/phaseii/Weiser-Computer21stCentury-SciAm.pdf

[ii] Tripadvisor was one of the first on-line services enabling users to rete hotels and restaurants, http://www.tripadvisor.com, last accessed January 2021.

[iii] https://www.crowdfundport.eu/for-supporters/crowdfunding-abc/

[iv] https://wsa-global.org/winner/wreck-a-movie/

[v] “A way of achieving an aim or solving a problem by trying a number of different methods and learning from the mistakes that you make” – Cambridge Dictionary

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[xii] Ibid.

[xiii] “the cultural heritage sector creates app 26,7 jobs for every direct one, compared to the auto industry where the factor is only 6,3.” Terje M. Nypan, Oslo 25.10.2005

[xiv] E.g. Jugendstil-Ensembles activities carried out in the Künstlerkolonie hosted by the Museum Künstlerkolonie (Ernst-Ludwig-Haus) https://museen-in-hessen.de/de/museen/museum_kuenstlerkolonie

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[xx] https://mitpress.mit.edu/books/technology-experience, last accessed January 2020.

[xxi] Simply consider the architecture associated with banks and insurance companies, or the shapes of their headed paper and publications—so rigorous and so consistent.

[xxii] Caleb Chung has been an actor, writer, comedian, street mime, producer, special effects designer and toy inventor. Invertor of Furby, Shellby https://www.egconf.com/presenters/caleb-chung

[xxiii] Do you remember the setup options on the first generations of mobile phones (“it is really easy, simply press CODE 1,7,3,2 Send in sequence”) or some copy machine with a labyrinthine set of options? Indeed, and only very recently, as an example on our car “on-board computers”, that we have been able to read exactly how far the fuel left in the fuel tank can take us (usr centred design), rather than having to guess based on the level of the fuel tank (3/4, 1/2, 1/4).

[xxiv] A sudden hail storm on the highway can fool the anti-slip system (ASR) by stopping the car even in the overtaking lane.

[xxv] The first generation of public phones accepting credit cards use to keep the customer’s credit card inside the phone, this disincentivate the use of that public phone.

[xxvi] Nielsen and Norman Group https://www.nngroup.com/articles/definition-user-experience/

[xxvii] Maslow's hierarchy of needs is a motivational theory in psychology comprising a human needs model, often represented as hierarchical levels in a pyramid. There are needs lower down in the hierarchy that must be satisfied before individuals can serve needs higher up. The order of these needs from bottom to top are food and safety, need for love and belonging, esteem, and self-actualization. (https://www.simplypsychology.org/)

[xxviii] E.g. Psycologists and experts in Cognitive Sciences

[xxix] E.g. Multimedia Room introducing the set of Giotto’s frescos at the Scrovegni Chapel in Padua, briefing room introducing Leonardo’s Last Supper in Milan.

[xxx] Artefacts usually come from a different historical period to our own, and so we must re-enable communication between the artefact and the public.

[xxxi] E.g. if we need to recreate the original context of the work of art, an important aspect that is specifically linked to computer graphics and 3D models is space contextualisation, which means the ability to place the digital 3D object in the right location while preserving the full set of spatial relations between the model and all of the other objects in the scene.

[xxxii] See, for example, http://www.louvre.edu or EduMedia http://www.edumedia-sciences.com/fr/, last accessed February 2019.

[xxxiii] Please refer to the different evolving ICOM definition of Museum

[xxxiv] https://icom.museum/en/news/the-museum-definition-the-backbone-of-icom/

[xxxv] https://uk.icom.museum/about-us/icom-definition-of-a-museum/

[xxxvi] E.g. Koutoura, 2014

[xxxvii] In 2003 the First Digital Games Research Association (DiGRA) International Con- ference was held at Utrecht University (The Netherlands). More recently (24–28 September 2007), the Third Digital Games Research Association International Conference was held at the University of Tokyo's Hongo campus in Tokyo, Japan.

[xxxviii] ASTC Annual Conference: http://www.astc.org/conference/index.htm.

[xxxix] MMOG is an online game sharing the same server with large numbers of players, often hundreds or thousands.

[xl] Online gaming represents a significant proportion of this market. Several smart-phone-based role-playing games are also emerging, even location-based versions.

[xli] Serious Games Initiative: http://www.seriousgames.org/index2.html; Serious

Games Summit: http://www.seriousgamessummit.com/.

[xlii] At the end of the "Star Wars" project a number of researchers moved from the

defence sector to the entertainment sector, bringing with them knowledge of a number of advanced technologies, such as virtual reality, computer vision, ar ti- ficial intelligence and artificial life (creatures), which they then used the field of entertainment.

[xliii] Consider, for example, the rules and character creation associated with role-playing games such as Dungeons & Dragons.

[xliv] The reader may remember the games of tic-tac-toe (each of which ended with no winner) played between the protagonist David Lightman and the computer Joshua in the movie WarGames (1983, directed by John Badham).

[xlv] http://www.endurance-enterprise.e-mentor.it (last accessed on July 2021)

[xlvi] A typical "authoring system" is genial.ly , this site offers the opportunity to create customised games to train and assess knowledge.

[xlvii] Aliens reached the pla net earth in the past and destroyed some components of key inventions to keep the menkind under control, so the mission is to recreate the missing parts in 3D to ensure the proper evolution of the mankind.

[xlviii] http://www.qbgroup.it/works/cell/

[xlix] DBpedia is a crowd-sourced association effort to obtain structured content from the information created in various Wikimedia projects. This structured information resembles an open knowledge graph (OKG) which is available for everyone on the Web. A knowledge graph is a special kind of database that saves knowledge in a machine-readable format and offers a means for information to be stored, organised, shared, searched and deployed. Google utilizes a similar approach to create those knowledge cards during search (https://wiki.dbpedia.org/about).

[l]Deutsches Museum von Meisterwerken der Naturwissenschaft und Technik // English: German Museum of Masterpieces of Science and Technology

[li] The Festival de l'Art Pyrotechnique takes place in July and August in Cannes (France).

[lii] Ronchi A.M., e-Services: Toward a New Model of (Inter)active Community, ISBN 978-3-030-01841-2, Springer

[liii] Botkin and Matthews 1992, p. 26.

[liv] R. Kaplinsky and M. Morris (2000) "A Handbook for Value Chain Research". IRDC.

[lv] Umberto Eco, Il nome della Rosa (The Name of the Rose), ISBN 978-88-58-70615-2, Bompiani.

[lvi] The Name of the Rose (1986) film directed by Jean-Jacques Annaud, based on the book of the same name by Umberto Eco.

[lvii] Novel 2003, film based on the novel 2006.

[lviii] Novel 2000, film based on the novel 2009.

[lix] Novel 2013, film based on the novel 2016.

[lx] Melk Abbey (Stift Melk) a Benedictine abbey above the town of Melk on the river Danube west of Vienna http://www.stiftmelk.at/englisch/, last accessed February 2021.

[lxi] Castel del Monte UNESCO World Heritage list http://whc.unesco.org/en/list/398, last accessed February 2021.

[lxii] https://www.britannica.com/place/Chigi-Chapel and https://www.youtube.com/watch?v= CZJDf_UiMqA, last accessed February 2019.

[lxiii] https://www.reggiadicasertaunofficial.it/videos/palace-movies/

[lxiv] Myron Krueger is an American computer artist who developed early interactive works. https://aboutmyronkrueger.weebly.com/videoplace.html

[lxv] Computer scientist, composer, visual artist, author http://www.jaronlanier.com

[lxvi] https://www.youtube.com/watch?v=8pG4FLIEFBc

[lxvii] https://www.youtube.com/watch?v=WyyXYo7sdyU or https://www.youtube.com/watch?v=BbgrHnbgoDU

[lxviii] https://www.youtube.com/watch?v=oaDc-blTdCw

[lxix] https://www.youtube.com/watch?v=3uz9DztRf8g

[lxx] https://www.youtube.com/watch?v=NvbZwIEbO1I

[lxxi]https://photos.google.com/share/AF1QipPmGPlL-u4-cIMmpEQ5aC1Ag7cpwdRA-BkjP9waWq-Bl8VJT0ZBVuIee2CkwjlbDg?key=azU5OTVYcEN5U0s5RE9mX1JvdmY0ZzZZWmpab2pR

[lxxii] Mogao Caves, Dunhuang County, Gansu Province, China - https://whc.unesco.org/en/list/440/

[lxxiii] The cutting edge of interactive immersive technologies. Delivered summer 2020. - https://vimeo.com/530289560