AC/E DIGITAL CULTURE
2017
ANNUAL REPORT

Smart culture: Analysis of digital trends

Focus: The use of digital technologies in the conservation, analysis and dissemination of cultural heritage
Acción Cultural Española’s fourth edition of the AC/E Digital Culture Annual Report follows an editorial policy of familiarising professionals of the culture sector with the main digital trends they need to be aware of over the coming years. Since 2015, a committee has been advising us on the choice of subjects and authors for the first part of the report. This year, a group of experts analyse issues such as content curation as a means of tackling digital overload, neuroscience applied to technology, the latest advances in artificial intelligence, the Internet of Things and Big Data applied to culture, and the use of digital technology in music.

Each year’s edition also includes a field study: the Focus, which reports on cases of good practice in digital technology in a specific discipline. The first edition examined the impact of digital in the world of the performing arts; the second focused on museums; and the third on the use of digital devices at fifty Spanish and international culture festivals. This fourth edition surveys in depth the use of digital technology in the conservation, analysis and dissemination of our cultural heritage. This sector is rapidly growing, leading to a radical change in methodologies and formats which the author, David Ruiz Torres, analyses exhaustively.

Since the publication of the first edition of the Annual Report only a few years ago, we have seen how breakthroughs in the digital sector have now become everyday realities that are present in AC/E’s own exhibition activities, where we have turned to digital technologies to produce educational resources. Together with the Real Academia de Bellas Artes, we have taken part in a virtual reality experience for the exhibition Carlos III y la difusión de la antigüedad (Charles III and the dissemination of antiquity): a six-minute immersion in the archaeological excavations of the ancient cities of Herculaneum and Pompeii produced by the Spanish company Future Lighthouse. It was on show for three months at the Madrid, Naples and Mexico venues, where it was a great success with visitors, and is now available free of charge from the virtual games platform Steam.

To present the results of the Annual Report, we rely on the collaboration and support of the Espacio Fundación Telefónica, which assists us enormously with its dissemination. Throughout the year, we will also present it at various international centres and forums for digital culture. Last year these activities took us to the summit of the International Federation of Arts Councils and Culture Agencies in Malta, the European Commission Working Group on the Promotion of Access to Culture via Digital Means, the MUSAC Encuentro sobre Redes en Museos y Centros de Arte in León and the Meteoriti Breaking Culture forum in Siena.

Our Annual Report is the result of an in-house reflection begun four years ago on how to incorporate the digital dimension into AC/E’s goals and work in support of the culture sector. We want it to reflect the impact advances in technology are having on our society, in order to explore the changes in the culture sector and help its organisations and professionals create experiences that live up to the expectations of twenty-first-century users.

Elvira Marco
Director general
Acción Cultural Española (AC
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CONTENT CURATION IN THE DIGITAL AGE. CURATION FOR DIGITAL HERITAGE

Robin Good  @RobinGood

Robin Good is an independent author, publisher and speaker focusing on key trends connecting technologies and communication, marketing, design and learning.

Based in the island of Terceira, Azores (Portugal), Robin has published since 2001 over 3,000 articles on communicating effectively with new technologies and the Internet.

His work has been read by over 30 million individuals and it has been mentioned in over 100 books. He has also been the first EU-based small independent publisher to have invoiced over a million dollars to Google in 2008 in advertising commissions.

His best work on content curation can be found here:

http://curation.masternewmedia.org
https://flipboard.com/@robingood/content-curation-world-9pgk3c6gy
http://contentcuration.zeef.com/robin.good
https://medium.com/content-curation-official-guide
http://pinterest.com/robingood/content-curation-visualized
https://it.pinterest.com/robingood/great-examples-of-content-curation/
https://it.pinterest.com/robingood/what-is-content-curation-best-definitions/
Introduction

When you live in an age where you are surrounded by information, differing viewpoints, hard to vet and verify sources, fake news and propaganda, content curation moves rapidly from being a trendy buzzword for content marketers to become an in-demand necessity for any human interested in actively learning, comprehending and wanting to make sense of today’s reality.

Content curators act as expert “trusted guides” who help us manage this overwhelming glut of information, while supporting us in making sense of the issues, topics, events and people that interest us most.

“When we curate content online, it enhances who we are... – we learn things, and we help to define ourselves by understanding our own interests – and in a more external way, by allowing other people to better understand who we are. It becomes part of our ethos, part of our personal brand.”

(source: http://sco.lt/7cPrPd)

Dr. Gideon Burton of Brigham Young University offers an interesting insight into why curation is such a valuable activity for humankind by pointing out that our efforts to gather, collect and order the information chaos surrounding us are a critical activity to understand ourselves, to learn more about anything and to make sense of the world we live in.

Real-world examples of such content curation are everywhere around us. They range from music compilations, to video playlists, galleries of images, directories of tools and resources, to hand-picked lists of experts, custom maps, timelines, guides and in-depth news stories.

Culturally, these curated resources are not just shortcuts to the “essence” of something, but they also shape and define the character, the perimeter of who we are, of what we are interested in, what we like, give value to and seek.

For these reasons content curation acts both as a cultural portal to discover who we are as well as a multifaceted lighthouse pointing to whatever our culture deems to be relevant and worth of attention and scrutiny.

Content curation shapes and molds our own culture as it promotes the filtering and highlighting of what is identified as being of greater value and interest by experienced scholars, researchers, and passionate information explorers.

In turn, content curation shapes and molds our own culture as it promotes the filtering and highlighting of what is identified as being of greater value and interest by experienced scholars, researchers, and passionate information explorers such as content curators are.

Filtering and the Content Curator

Although one may not realize it, the greatest part of our lives is spent filtering out irrelevant, unimportant or uninteresting signals while paying attention and giving focus to what we feel is important and relevant at any given moment.

Our lives are spent making choices. We are the only animal who can do this: stop and decide what to choose, listen, watch, read, and respond to.

We make choices even when we choose not to make a choice or when we let others do it for us.

And if this is a key trait that makes us different from other living creatures, it would only appear to be logical that we did our best to make valuable, intelligent choices every time we were confronted with one.

In other words, if I took this concept to the extreme I could say that a fully operational human
being curates his life, moment by moment, by deciding constantly what to pay attention to, instead of letting habits, traditions, prejudices, fears or others influence and decide it for him.

But what happens when a human being lives in a digital information economy where there are literally billions of alternative routes, products, strategies and ideas to choose from?

We can filter, select and choose effectively only when there are few alternatives and when their key characterizing traits are clearly and easily identifiable.

But we have much greater difficulty in making choices when:

a) we are not quite competent with the field we are approaching
b) suddenly the alternatives are tens or hundreds,
c) their characterizing and differentiation traits are not so obvious to us.

In such situations the only effective survival strategy is learning to be skeptical, and to develop an inquisitive mind. One that asks lots of questions and honestly attempts to look at reality from different, sometimes opposing, angles.

Critically analyzing different viewpoints and interpretations of a specific issue is the best way to better understand any problem and to evaluate the best available strategies to resolve it.

But while it is easy and natural for us to do this when we are familiar and competent with the matter at hand, things change a great deal when we want to learn something new, or we approach a field of interest we know little or nothing about.

It is in these situations that we look for and appreciate the contribution from a trusted, expert guide who can provide us with "intellectual binoculars”. Virtual eyes that can see further and deeper into the issue than we can.

We look for someone who is not just a subject-matter expert, but who has also a passion for analyzing, investigating, asking questions and verifying things before drawing conclusions or sharing advice.

The 21st-century content curator is a passionate subject-specific scholar, who enjoys finding, collecting and sharing best resources, news, info or tools on a specific theme while transparently sharing his bias, prejudices, preferences and disclosing his ties.

But we don’t look just for “any” expert. We are attracted more by those experts that we can empathize with. Someone who shares, at least in part, some of our goals, values, ethics and ideals.

Here he is: the 21st-century content curator. A passionate subject-specific scholar, who enjoys finding, collecting and showcasing/sharing best resources, news, info or tools on a specific theme / topic / issue / event while transparently sharing his bias, prejudices, preferences and disclosing his ties.

Not a newspaper or magazine editor, nor an art or museum curator. A content curator is related to these professionals, but only inasmuch as a motorcycle rider is to a Formula 1 pilot or to a cycling champion. They all race, but their skills, training focus, and required abilities are quite different.

A content curator is in fact much more than a simple editor, as many people may think.

If you look close enough, there are some clear differences between the two:

a) Curation strives to highlight and distill what is most interesting, representative, rare and unique on a specific theme, subject, issue
b) It does so through the eyes of a subject matter expert, researcher or explorer who puts his name and face on it

c) The curator adds and illustrates his viewpoint and perspective

d) The curator discloses his bias, prejudices as well as his interests and ties (commercial and otherwise).

e) The curator cites and systematically credits his sources

f) The curated collection/stream is openly / publicly shared

Editorial selection, on the other hand, can be easily recognized by:

- less focus
- no official signature / author
- sources are not cited or credited
- authors are often not subject matter experts
- there is no critical analysis
- there is no disclosure of bias, prejudice or commercial ties.

Curation and Culture

Curation and culture are two sides of the same coin. They are deeply connected and rely on each other for survival. One could not exist without the other.

Consider this: if one desires to get a glimpse of a culture, where does one go?

To the top museums preserving and showcasing key records, paintings, writings, and other artefacts defining that culture.

From their utensils, their tools, their cutlery, clothes, ornaments, jewelry, weapons, to their writings, music and paintings, to their food, art and architecture. Physical things, but also the ideas, symbols and beliefs.

"Culture is the characteristics and knowledge of a particular group of people, defined by everything from language, religion, cuisine, social habits, music and arts."

Source: Livescience

But today, if you think of it, museums are not anymore just those we have come to know in the physical world.

The internet is now full of highly valuable repositories, libraries, catalogs and directories that organize and showcase who we are today. Without having been labelled as museums, these online collections, directories and catalogs act as true extensions of the classical museum and as live digital galleries of who we are, what we do and what we are interested in.

The content that we curate, publish and share online today is a reliable mirror of our culture(s) and of who we are, what we like, think and dream of.

By curating, we are now all actively (at one level or another) re-defining constantly who we are, what we like, want and live for, in a multitude of different ways. And we do so by exploring, vetting, by adding our own viewpoint and commentary and by sharing valuable resources with others on our preferred social media channels.

It is our own act of filtering, of aggregation, of adding value and of sharing (curation) that allows others to discover, make sense and consider options and viewpoints that were until then, outside their awareness.

Think of Pinterest, and its infinite visual collections on just about any topic. Think of Dribbble or Behance. Think of Wikipedia. Think of Twitter and its ongoing stream of filtered suggestions.
of what to read, watch, listen to. Think of Flipboard, Medium or Scoop.it.

All of these “curatorial” publishing platforms, are filtering engines and public vetrinas of our interests, fears, dreams and desires as a society.

For all of these reasons, in an age where everyone is a curator, a filter for what to look, see, explore and learn about, content curation may have become both a personal and a social (cultural) necessity.

A personal necessity because an increasing number of people needs to pick, select, collect and organize the resources, tools and the techniques most needed to carry out their work. While in the recent past these were few and physical, now that we are in the information age, these have exploded in number and have mostly become intangible, digital entities.

In an age where everyone is a curator, a filter for what to look, see, explore and learn about, content curation may have become both a personal and a social and cultural necessity.

A social (cultural) necessity because by curating our most precious, interesting and rare ideas, resources, tools and visions, we are not just collecting for our own private interests, but we are also helping others discover, learn, comprehend and make new ideas and perspectives part of their own, while preserving the path and signposts that led us there.

Content Curators as Trusted Guides

According to Smith-Maguire and Matthews, content curators today act as “cultural intermediaries”, helping the layman discover, learn about and appreciate great authors, books, films and ideas he would have never met otherwise.

"[Cultural intermediaries] ... construct value, by framing how others (end consumers, as well as other market actors including other cultural intermediaries) engage with goods, affecting and effecting others’ orientations towards those goods as legitimate – with ‘goods’ understood to include material products as well as services, ideas and behaviours."

In this light, those who take care of selecting, organizing and making sense of resources (information artefacts), become natural “trusted guides” for anyone interested in learning more about a topic.

Just as when confronted by an unfamiliar jungle or the exploration of a new territory, when we are surrounded by an ocean of information of which we know and understand only a very small part, having good sherpas and expert guides become indispensable.

When we explore new grounds, when we are in doubt or we are trying to grasp and understand a new subject we do not know too well, we have learned to seek the help of someone who has more experience than us, but with whom we share some strong affinities (ideals, enemies, life values, ethics, etc.): these people are now known and referred to as trusted guides.

But who are they? How can they be recognized?

Trusted guides may include friends, family, experts in our network of connections, as well as people we follow on social media and with whom we share common interests, as well as life ideals, principles and ethics.

Trusted guides are individuals who possess specific know-how, expertise and ability to evaluate and judge, and who continuously search, verify, vet, collect and organize the most relevant news, stories, resources and tools on a specific topic, while contextualizing and commenting on them publicly.
In the age of exploding “fake news” such trusted experts can save a lot of time, avoid unnecessary risks, while providing access to more ideas and viewpoints outside our typical horizons.

As a matter of fact, content curators as “trusted guides” are gradually replacing appointed officials, big celebrities, TV hosts, brand experts and other influencers who, for decades, have been advising mass media audiences on what to look at, read, watch, wear, eat and pay attention to.

These traditionally beloved and highly trusted sources of influence and advice have rapidly lost their appeal and their trustworthiness.

Why?

Because we have discovered that, often, they are not trustworthy.

They advise, promote, suggest and report news and stories because they have a “personal” (often “economic”) interest in the matter at hand.

Thus, albeit a bit late, we have come to realize that many institutional and commercial communications were and are still driven by specific political or economic interests, by propaganda goals or by hidden agendas.

Content curators as “trusted guides” are gradually replacing appointed officials, big celebrities, TV hosts, brand experts and other influencers who, for decades, have been advising mass media audiences on what to look at, read, watch, wear, eat and pay attention to.

That’s how, as more and more people have realized that “brands”, “celebrities” and “institutions” were not honest and transparent about what they publicly said, these same people have started to turn to friends and to direct personal, trustable contacts for news, advice, and for keeping themselves updated.

Trusted guides are immediately recognizable individuals who have become known because of their ability to publicly and freely share insightful, competent and independent reviews, analysis, recommendations and advice while being upfront about their true interest, partnerships and ties.

Most of them are content curators. Subject-matter experts who can act as competent guides in suggesting relevant resources, readings and authors to further explore the matter at hand.

Content curators analyze, vet and check tons of potentially relevant information, content, resources and tools, looking for those rare pearls of wisdom that can be found only after a dedicated and sustained search effort.

Content curators showcase publicly these resources, often within dedicated channels, blogs, podcasts, news streams or into growing collections while adding additional context, reference information (authors, sources) and related resources (where to find out and where to go to explore for more).

Not just that.

Curators’ key added value is their personal assessment, viewpoint and insight into what they pick, select and showcase.
What is in that information artefact they share that has gotten their attention and interest? What is the value that they see in it? To what else do they see a connection with?

By adding their own viewpoint and disclosing their prejudices, bias and interests, curators provide a much more credible profile for themselves in sharp contrast with the “designed”, detached and highly-polished communication approach used by most companies, professionals, and by the traditional media expert.

**Content curators advice is also recognizable** and clearly distinguishable from the officially appointed expert approach because it is either voluntary and unpaid or compensated directly by those who need to be informed rather than from those who want to sell something.

**Curation Cultural Value**

The **key contribution** that content curation provides to our own culture is its role as a discovery and sense-making engine for any art, interest or science.

Take music for example.

If you consider that today just by themselves Spotify and Apple Music offer more than 30 million songs and that there are many more music distribution services like Rhapsody, SoundCloud or Deezer, you can start to realize how difficult it becomes to find the music you like, if you do not know who makes it.

“Like music supervisors in film and TV, curators are now industry gatekeepers, approached with reverence. These invisible influencers can break an artist through a choice playlist placement.”

(source: The Observer)

With an estimated one fifth of all music streams occurring on curated playlists (source: Forbes) music curators are now very valuable assets at Apple Music, Pandora and Spotify as audiences prefer the value of a human selection over an algorithmic one, while a small army of grassroots music fans does a very similar job on popular platforms like Soundcloud, Blip and 8tracks by curating unique playlists and compilations, without asking for anything in return.

By adding their own viewpoint and disclosing their prejudices, bias and interests, curators provide a much more credible profile for themselves in sharp contrast with the “designed”, detached and highly-polished communication approach.

How would you be able to discover and learn about new songs and bands, in such an exploding ocean of music, if it weren’t for music curators online or club DJs searching and listening to thousands of tracks? How would you learn about the history of many artists if it weren’t for radio DJs who provide you with context, history, anecdotes and event information about your favorite artists?

The music curation trend exploded first in the 70’s and 80’s with user-created cassette mixtapes, and then evolved in the mid-’90s, with innovative DJs and music producers, like Jose Padilla, who started to produce successful commercial curated music compilations that brought together well-known artists with unknown, emergent ones under a common theme or style (think of Cafe del Mar or Buddha Bar CD series and their success over the years).

Many new record labels have then followed, all specializing in well-defined musical genres and driven by the idea to curate and bring together the best of a specific music style.

Lots of private radio stations do the same. They curate the music of our time.

But consider also the specialty, privately-owned bookstore (CityLights in San Francisco) that focuses on your favorite genre and authors, or the online vinyl record store which helps you find
old rare gems that cannot be found anymore (MusicStack). They both collect and curate, making it easier for the layman to discover, appreciate and learn about music he would have never otherwise have come across.

Take Wikipedia. It may not be the most reliable information resource for some topics, but it is hard to deny that this is a great example of collaborative, crowdsourced content curation that many of us have successfully browsed, consulted and referred to.

Consider big international events like TED, LeWeb, SXSW, as well as small, locally organized ones, where event curators, talent scouts and subject-matter experts laboriously find individuals that have great ideas and stories to tell, and bring them together to share and present them publicly.

Look at the work of online curators like Maria Popova (BrainPickings) or Dave Pell (NextDraft) and at how they stimulate our interest and curiosity by uncovering great insights and stories from authors and books of all kinds as well as from the news of the day.

Take independent organizations like TrendHunter or Trendwatching who study and analyze the ocean of data generated by consumers to extrapolate, anticipate and predict what the key changes and innovations around the corner will be.

Consider all e-commerce and online shopping activities. According to a recent Pew Research Center survey of U.S. adults, when it comes to buying online, more than seven-in-ten get advice from people they know (77%), or consider it very important to be able to read reviews posted online by others who have purchased the item (74%).

All of these examples show how the trend-makers, those who suggest and advise where to look and what to pay attention to, have moved away from being top appointed officials, celebrities and spokespersons as occurred in the mass media age.

Now, individual curators are our new trusted guides to discovery, insight and knowledge.

It will surprise us in the years to come to see the impact of content curation on many aspects of our lives such as education, news and journalism, entertainment, marketing, design, ecommerce, art and, last but not least, online searching.

The Future

As a consequence of these changes, what may indeed surprise us in the years to come, is not so much the relevance and critically important role that content curation will play in many of our activities, but the impact it will have on many aspects of our lives such as education, news and journalism, entertainment, marketing, design, ecommerce, art and, last but not least, online searching.

Let's look at some of these in detail.

News and Journalism

Thanks to content curation, in the near future curated news hubs will bring together the top stories for any industry saving you the time that it would take to visit way too many sites and helping you discover new sources, sites and blogs which you did not know.

To get a glimpse of this future, take a look at Techmeme, Memorandum, Mediagazer as well as HackerNews and AllTop. All of these curated news hubs aggregate and bring together in one place the top stories and news on specific topics.

A renaissance of “niche” email newsletters will curate specific industry verticals by collecting, summarizing and publishing all of the most relevant news for specific industry verticals. An early
successful example of this trend is Smartbrief, a company that publishes hundreds of curated newsletters, each one focusing on a specific industry, from aeronautics to pharmaceuticals. Each newsletter picks, selects, and adds commentary and opinion to the most relevant news of the day in his specific market niche.

Similarly, the newest kid on the block, Inside, is also positioned to become a one-stop-shop for niche email newsletter curating the most relevant news and stories in a myriad of other verticals. In general, we may see a growing trend of new journalism moving from news as an entertainment and light-information source, to news as a service, made up of specialized streams of highly organized and vetted information, subjectively curated by dedicated teams of experts.

**Personalized, custom learning paths** will replace traditional standardized curricula as the number of available online courses explodes. Subject-matter experts will curate them by bringing together the best online classes from the most diverse set of universities and colleges. Coursera, Springboard, and smaller companies like CourseBuffet or eLearnHero are already paving this way, while adding profitable complementary services like personal mentoring and certification.

New tools, like Peak, allow smaller schools to aggregate content from multiple sources like the Khan Academy, YouTube Education, Britannica School, and many more and to create custom courses and classes tailored to specific needs.

Content curation starts being used as a better and more effective approach to let students discover and fully immerse themselves in any topic to be learned. By using a curatorial approach in a learning environment students are prompted to do so by actively exploring and critically investigating the matter to be learned, rather than by simply memorizing its related facts.

Curated textbooks will replace their traditional academic counterparts, by bringing together in a highly customizable fashion the best and most relevant information already available in existing articles, research papers, essays and textbooks. (McGraw-Hill Create, Panopen, Boundless)

Teachers, professors and parents will take personal responsibility to find, test and evaluate new tools and resources in a public, collaborative, crowdsourced fashion. (EdShelf)

Subject-matter experts who curate specific topics, issues and themes will become the new educators / facilitators / guides as traditional teachers and professors rapidly evolve into “curators” or risk losing a good chunk of their appeal, credibility and trust.

In the near future it is possible that we will strive less to get absolute objectivity, as curation makes us realize that this is not a 100% tenable position. Reality can be looked at from different viewpoints, and it is now up to us to pick and select through which “glasses” we want to look at it.

**Education and Learning**

The whole educational universe is being completely revolutionized by curational practices.
As a consequence the role of the teacher / professor is gradually being transformed into one of an expert guide, go-to-person, museum guide, who can suggest and advise on where and how to look to find out more about a specific issue, problem, or topic. (Springshare LibGuides)

**The Arts**

As museum and art galleries fully digitize themselves, the opportunities to create additional value by curating, not just what is in the collection, but also what is related to it but outside of it, will literally explode (see The Open-Source Museum).

Art will disenfranchise itself from having to depend on monolithic interpretations and views as it will become possible for multiple experts to contribute their views and interpretation to any art collection (The Met Connections).

Better still, art lovers and connoisseurs will be, for the first time in history, empowered to create and showcase their own art collections without needing to own any of the actual pieces. They will also be able to contribute, comment on, annotate and curate personal collections, thematic showcases and galleries of their own creation and choosing (Google Open Gallery, Pictify, Kapsul).

Art lovers and connoisseurs will be, for the first time in history, empowered to create and showcase their own art collections without needing to own any of the actual pieces.

The curated collections of the near future, which will be accessible in a digital format, will remain available forever (no need to take them down to give space to another exhibition), and will offer the opportunity to be frequently updated and expanded, while preserving a complete and thorough history of all the changes, modifications and additions made to it (see Google Street Art).

Digital art collections (aided by virtual/augmented reality) will make physical-only, static collections a thing of the past.

**Films**

The world of films will also greatly benefit from curation activities and in particular it will see an explosion of discovery tools that will make it much easier to find and re-discover movies, films and documentaries that have never made it to the commercial movie-theater circuit or to television.

Here are a few early examples:

- **Omive** – find instantly any movie by genre, rating, votes, runtime, year, keywords, directors and actors.
- **Tastekid** – recommends similar music (musicians, bands), movies, TV shows, books, authors and games, based on what you like.
- **MovieMap** – visual movies search engine helps you discover similar movies you may like.
- **IsNotTV** – movie discovery platform leveraging user contributions, reviews and “trusted guides”.
- **SuggestMovie** – custom movie search engine helps to filter and find whatever type of film you may be looking for.

Curated resources like the Criterion Collection, a curated film boutique that digitally remasters and sells access to classic authors’ films, while bundling with each movie, unique and rare interviews, clips, unpublished/censored scenes, backstage images and other relevant materials (that would be otherwise next to impossible to find) will also prosper.

There will be plenty of independent curated hubs dedicated to collect and organize the
best films of a particular genre, author, epoch. Specialization and depth, rather than breadth and general info will again be the characterizing traits of these new curated outlets.

Their existence will make it so much easier to discover and appreciate thousands of great films that otherwise had no hope of being ever found. Look at:

FilmsforAction – a curated collection of films about activism and social change.

Also of interest is the fast growing number of free websites that collect and organize all of the great documentaries freely accessible online. Here some great examples:

- TopDocumentaryFilms
- Documentaries
- DocumentaryAddict
- DocumentaryHeaven
- DocumentaryStorm
- JohnLocker

The film curators behind these new catalogs will be our trusted guides in finding and selecting the best movie to watch, rather than having us check tons of trailers or skimpy reviews by film critics we know little or nothing about.

Photography

In the field of photography new tools and services will span a renaissance of visual showcases, catalogs and collections that will bring together the best imagery, ideas and emerging concepts.

Thanks to dedicated image curation platforms like Behance, Dribbble, 500px, Flickr it will be increasingly easy to get infinite visual inspiration and ideas as well as to find great photographers and visual artists for any type of project or endeavour.

New, revolutionary free curated platforms, like Unsplash will allow top-notch visual imagery and totally unknown photographers to be found and appreciated as never possible before.

Pinterest itself will continue to be a reference tool both for discovery as well as for the creation of new valuable image collections.

Even online stock photo agencies will start to deeply curate their own image libraries, as the key differentiator among them will not be just volume anymore, but also image quality and originality, the ever more important ease-of-finding.

e-Commerce

When the inventory becomes near-infinite, as in the case with Amazon, eBay and other large online retailers, then curation becomes a necessity.

Buyers do not like to be overwhelmed with choices and alternatives. Rather, they like and appreciate independent expert advice, commentary, opinions, buying stats, ratings and user-driven top picks, selections and suggested bundles.

Thus, to curate, big retailers will need to work hard to best organize products in well defined categories, to collect and add precise info and data, while adding key value by letting buyers share reviews, comments and opinions in a crowdsourced fashion.

The consequence is that next to algorithmically-based lists and suggestions, we will rely more and more on users’ suggestions, comments and recommendations.

A growing set of dedicated tools and services is already available for anyone wanting to take a lead on this front.
For example, Polyvore makes it easy to find and bring together fashion items into small beautiful showcases curated by individuals.

Other interesting examples of services that leverage curation to help consumers find their ideal products are:

- **Styloko** – Aggregates products from top brands and lets you save and collect your favorite ones. Instantly find similar items to the ones you like.

- **Nuji** – Editors’ collections provide ideas and inspiration for what to wear on different occasions while **hundreds of detailed categories** help buyers easily find what they want.

- **Chicissimo** – Makes it easy for fashion buyers to showcase their favorite outfits and looks.

Overall, it may be quite likely that curated collections, user recommendations and crowd-sourced curation will give a powerful boost to online shopping as product catalogs grow to huge dimensions and even search results do not provide a useful enough filter to identify relevant stuff.

**Entertainment (music, films, TV shows, video, etc.)**

No matter whether you are looking at music, films, TV shows, radio or podcasts, the content offerings are so vast and diversified that the real challenge for the normal person, overwhelmed by the sheer amount of options available, is what content to pay attention to and where/how to find it without losing a ton of time.

Thus just as Apple Music, Pandora and Spotify have started to heavily invest in human curators to create great playlists and compilations that their audiences can identify with, the same has started to take place with entertainment providers like Netflix, which publishes lists, categories and recommendations to facilitate content finding.

No matter whether you are looking at music, films, TV shows, radio or podcasts, the content offerings are so vast and diversified that the real challenge is what content to pay attention to and where to find it without losing a ton of time.

A fast growing number of tools helps anyone interested in finding video content to explore selected themes and topics across the many video outlets available online.

One good example is Pluto.tv, which gathers and curates over 80 TV channels in 11 categories from news to sport, comedy and entertainment. It also offers **50 different thematic channels** that bring together and on-demand the best of what is available.

On Youtube, it has become harder and harder to find the many gems and quality videos available on the platform, but that’s where internal video curators and public playlists are going to make a difference.

As a consequence Youtube playlists will also gain much value, both for those who will be included in them, as well as for those who will curate them.

**Literacy**

The practice of content curation by individuals or by formal publishers forces those curating to pay extra attention to the matter at hand. Specifically, it forces them to double vet it, verify it and compare it with other sources and opinions.

Content curation and its use forces those doing it to be “critical”. That is, it obliges whoever is doing it not to take any information, no matter
what the source, at face value, but to critically analyze it, question it and verify it against different alternative sources.

**Take for example the “fake news” phenomenon** every newspaper, magazine, radio and TV station has been recently talking about. The practice has been there for the longest time, but it is only now that it has gotten so much media attention.

Fake news is everywhere, and major mainstream publishers and brands are frequently the ones guilty of publishing it.

Unfortunately, the best way to counter such a phenomenon may not be by certifying and officially labelling who is trustworthy and who is not (as this may have very more risky consequences on our ability to discern truth from fraud), but rather by learning, at the individual level, how to check, vet and verify any story, news, article or tweet.

**The task at hand is not to** mark unreliable authors and websites, but to learn how to tell that a news story, report or article is not trustworthy. No matter who has published it. Sidestepping it, by taking any mainstream news as reliable by default, simply because it has been published by a “trusted” or “well known” brand, will not cut it anymore.

**Search engines will increasingly be gateways to curators and content collections rather than to individual tracks and pages. This will be particularly true especially when you query a topic, a theme or interest, or better still, a musical genre.**

The task at hand is to preserve, mark, organize, highlight, comment on and share all of the great, valuable content that we find out there. Not to ostracize or censor. History has already taught us that what may appear heretical and impossible today can easily become a shared reality for everyone in very little time.

This is what content curation will bring to us in the near future: a much more responsible approach to finding and reading online information, based on the awareness that ALL content must be checked, vetted and verified.

**Online Search**

Search engines will increasingly be gateways to curators and content collections rather than to individual tracks and pages.

This will be particularly true especially when you query a topic, a theme or interest, or better still, a musical genre.

In all of these situations, where you want to dive in, discover and learn more about a topic, it is much better to be offered a selection of playlists, compilations, collections or hubs, compiled by well-profiled experts, covering that theme rather than a specific song, product or artist.

Search and discoverability of content will rely more and more on intermediaries that will take on the burden of making sense and organizing in the best possible way a specific realm of information (it can be a music genre, or the analysis of a biological topic) rather than – as happens today – provide a linear list of individual web pages matching that request.

Although it may seem impossible today, individual users and organizations will challenge Google's monopoly on search, not with more servers, faster lines or less advertising intrusions, but by providing better, more comprehensive and expert-vetted results in a growing number of very specific interest areas.

The key characterizing traits of these new search alternatives are both their focus and their not-exclusively-algorithmic, human DNA.

By placing all of their resources and attention on a very small and well-defined area, and by
leveraging the know-how and experience of multiple subject-matter experts, these new search engines will be orders of magnitude better than Google at finding relevant information in specific knowledge areas.

Early examples of this are Nomadist, who collects, vets and curates best cities and places to live around the world for digital nomads, Olversion which not only collects and organizes, but also physically preserves all of the released versions of free software tools (making it a snap to find and switch back to any past versions of Skype or iTunes).

Both of these are not just evolved vertical search engines with many custom, dedicated filters, but they also act as full-blown directories where each result brings in or aggregates a plethora of relevant complementary info. Nothing like what Google offers.

What is being done to preserve curated content for the long-term future?
Unfortunately, very little or nothing is being done on this front. Though there are specific initiatives and organizations devoted to this.

The same vertical search approach is also the one used for example by Stylig and Stylight (fashion, clothes, shoes and accessories) which facilitate discovery across brands by curating and bringing together in one place the newest and most interesting fashion products available online.

In the near future, it may also be possible that individuals will be able to tweak and customize search algorithms themselves, choosing and applying their preferred filters, sources and ratings, while collaboratively curating and annotating highly focussed search results instead of relying exclusively on Google proprietary, secret ones. Zakta Research is an early example in this direction.

Cultural Heritage and Preservation

Although there is widespread agreement that the loss of the Library of Alexandria marked a very dark moment for the cultural heritage of this planet, we do not seem much concerned today about the fact (and not simply the probability) that a very significant part of our digital content will be forever lost in a few years from now.

Consider this for example: An estimated 44 percent of Web sites that existed in 1998 vanished without a trace within just one year (WashingtonPost).

Given all the good things that our culture derives from curating content, and the awareness of the flimsiness of digital content and the ease with which it can get lost, what is being done to preserve curated content for the long-term future?

Unfortunately, very little or nothing is being done on this front. Though there are specific initiatives and organizations devoted to this, like national libraries such as the British Library, the U.S. Library of Congress and the Internet Archive, they are yet very distant from having the resources and technology to be able to preserve all that is relevant.

And one key reason why they are not yet capable of preserving all that is of relevance is that there is no one suggesting where the good stuff is.

As a matter of fact, while we take for granted that anything saved or published online is there to stay forever, we have ample proof that this is not the case at all, and that we gradually lose a great chunk of the information artefacts we create, publish and share online.

In a recent study looking at academic references, Zittrain, et al. (2013) discovered that over
70 percent of all web links inside academic publications had gone broken. The same thing had happened to 50 percent of U.S. Supreme Court opinions. After six years, nearly fifty percent of the URLs cited in those publications no longer worked.

In another study conducted in 2014 at the Harvard Law School it was reported that “more than 70% of the URLs within the Harvard Law Review and other journals, and 50% of the URLs within United States Supreme Court opinions, do not link to the originally cited information.”

(source)

**Content disappears for many reasons:** much is moved to different online addresses and becomes difficult to find, some is censored, taken down for copyright or legal reasons, some goes down because the author / publisher does not properly maintain his website. Some is lost to malicious attacks, some of it goes offline because there are no economic resources to maintain it.

Furthermore the evolution and changes to file and hardware formats and standards makes it all the more difficult to access, read files and documents that are only 20 to 30 years old (think for example of 5¼ floppy disks, or about the tons of one inch analog videotape used in television studios until the 80s). How can you read and access all of that stuff unless you digitize it?

Although you may never heard about it, this phenomenon is so big and pervasive that an official name has been given to it: **Linkrot.** It signifies the rotting of web links that go bad due to one or more of the reasons listed above.

**Linkrot impact is not marginal** as different studies and research reports indicate that it can account for up to 30% or more of all the documents published online.

In addition to this, nobody has any certainty about the future of the content sharing platforms where we publish and share much of our content. We don’t know whether they will remain alive, independent or whether they will restrict or charge for accessing content, be bought, closed down, or be controlled by larger entities or even by governments.

From this viewpoint, our cultural heritage rests on very shaky pillars, as we let the digital backup strategy and infrastructure put in place by these social media sharing and content curation platforms dictate the future lifetime of much of our cultural heritage.

**Linkrot is the rotting of web links that go bad. Its impact is not marginal as different studies and research reports indicate that it can account for up to 30% or more of all the documents published online.**

While the companies we use to collect, publish and curate information today do have interests in making sure none of their data will ever be lost, they do not seem to be driven by humanistic ideals, but rather by what Wall Street and their stakeholders dictate.

More than anything, these companies are not even aware of holding such great cultural responsibility, and therefore they are obviously not worrying about it.

In such a situation, how much trust can we place in them as reliable gatekeepers of our cultural heritage?

Given the not so remote possibility of a future cataclysmic event, capable of wiping out most of our present-day civilization and technology, there is little hope that whatever survives through it could be accessed and read by future generations or by intelligent beings from other galaxies.

But this is where we should put more of our energies, research and attention.
Here are some alternative routes of action that could be taken to help preserve our cultural heritage:

a) **increase public awareness** of the flimsiness of digital content, and the need to continue to improve technology and tools specifically designed to help us preserve it for the longest time.

b) **increase public appreciation** for the value of preserving our cultural heritage, of its importance, value and of the consequences of when it gets lost forever.

c) **support and incentivize** both government and individual-born activities that strive to collect, organize, and preserve information artefacts of significant value for society. Empower many more organizations and individuals into this art of finding, vetting, organizing and adding value to information artefacts.

d) **create and maintain** multiple, redundant indexes for all of the updated collections available out there. A directory of culturally-relevant curated directories, so to speak. Such a curated collection of collections should be completely distributed, and not secured in one single place, easily replicable from device to device, continuously updated (but with a full record track of all the changes made to it).

Technology solutions that would help in this direction would be those that could enable:

a) **cloning and replication** of vast amounts of data locally,

b) **online access** via our own distributed resources even when there was no Internet (by utilizing our own friends network), and

c) **a way to physically store and preserve** such valuable content for very long periods of time and in harsh or extreme climate conditions. (Crystals and holographic memory may be some of the solutions we may consider soon.)

d) **accessibility** to this archived information by future generations of computers and intelligent machines.

A number of services and tools are already emerging to address some of the basic issues connected to linkrot. Among these are:

- **Archive** – a personal version of the Internet Archive – Wayback Machine, allowing anyone to permanently archive any public web page.
- **Perma.cc and Permamarks.net** are two commercial services specifically devoted to create a permanent copy of any page or document, so that it can be referenced without fear that the original will be moved, deleted, censored or taken down.

The key issue with these services is that most do not seem to be exempt from the key variable that makes them all as vulnerable as any other publishing or social media service online: business permanence (their ability to remain alive as a business in the future, and their ability to find ways to permanently store such data on physical supports that can be accessed and used even without the Internet).

**Conclusion**

**Culture is the cumulative expression** of what we see, do, believe in and of what we express through our daily activities, whether commercial, creative or spiritual.

Content curation collects, organizes and preserves the best and most interesting artefacts of our culture, no matter whether these are news stories, paintings, digital videos, 3D panoramas or stories and interviews of people in the street.
As such curation, is “the” best instrument to hold, preserve and let others discover what our, or any other specific culture, is all about. It allows us to transmit the value of our culture to others across time.

Today, content curators are all around us and help society identify and discover what is relevant, interesting, innovative, rare, by actively separating the wheat from the chaff.

And as traditional brands and institutional spokespersons lose their trustworthiness, content curators replace them by becoming our new trusted guides.

By continuously selecting, archiving and presenting the best resources and information available, content curators define who we are, and the perimeter and depth of our interests.

Curation is the live, updating museum of our culture.

To support it we must find and devise more effective ways to preserve the digital collections we publish and share online.

If the Internet is ever censored, goes down or it is blocked by unforeseeable events that we cannot anticipate now, we should not let our culture disappear in a few milliseconds. We need to be able to find out how to preserve this content safely and for the long haul.

This is our challenge for the future.

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Saving Our Digital Heritage


Content Curation Tools

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Scoop.it – Content marketing and curation platform allows you to search and find niche content and then to edit and curate it for inclusion in thematic journals, websites, blogs, online magazines.

Pinterest – Visual collection, discovery and gathering platform allows you to create boards of info items that can be introduced and commented by the curator.

Microsoft Stream – Video curation platform for organizations for internal use as distribution vehicle for training and HR materials, product information or customer assistance resources.

Diigo – Bookmarking and research support service makes it easy to save and archive any web page “as is”, as well to categorize it, tag it and annotate it.

ZEEF – Listing service allows you to collaboratively curate directories of resources, tools and articles on specific subjects.

AndersPink – Content discovery platform facilitates finding, aggregating and filtering content feeds (RSS) on any topic.

Zakta Research – Research engine leveraging visualization, collaboration and curation to optimize content discovery.

Trusted Guides (content curators) in specific interest areas

(*original tweeters to follow)

Julian Stodd (Social Leadership)

Harold Jarche (Knowledge Management)

Maria Popova (Culture)

Howard Rheingold (Digital Literacy, crap detection)

Kevin Kelly (Future, Tools)

Alfonso Furtado (Publishing)

Sepp Hasslberger (Health, New Energy, Economy, P2P)

David Kelly (Learning)

Joyce Valenza (Education)

Robert Scoble (New Tech)

Michel Bauwens (P2P)

Rohit Barghava (Influence and Trends)
THE MUSIC MARKET GOES DIGITAL. IT’S NOT DIGITAL TRANSFORMATION BUT CULTURAL TRANSFORMATION

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Can we understand today’s music without the model changes of the 20th century?

The first compact disc was created in June 1980. The optical system was developed by Philips, while Sony was responsible for the read mechanism and digital encoding. The creators of CDs, Philips and Sony, aimed to store 60 minutes of audio in an 11.5 cm-diameter disc. But Sony’s chairman, Norio Ohga, wanted to extend the capacity to 74 minutes so that the whole of Beethoven’s Ninth Symphony would fit on a single disc. Its size thus grew to the current 12.7 cm.

This format ensured that quality of sound was not lost over time. It also provided higher audio quality than vinyl. The first compact discs to be recorded were Richard Strauss’s Alpine Symphony and Frédéric Chopin’s waltzes. The first commercially released CD album, however, was Billy Joel’s 52nd Street.

Sony launched its first CD player on 1 October 1982. It was christened CDP-101 as a tribute to the binary system it ran on and sold for 168,000 yen, equivalent to 1,022 euros at current exchange rates.

Three years later, Dire Straits became the first group to sell a million copies of an album in CD format, Brothers in Arms. After four years on the market, CDs became the most widely sold sound system.

Nowadays 75% of consumers access music online. The most revolutionary invention for consuming audio started out in 1988, when the Moving Picture Experts Group was established and a standard for digital audio and video was developed. The Fraunhofer Institute in Germany encoded the MP3 format for the first time. Tom’s Diner by Suzanne Vega was the first track to be compressed into this format. MP3 became the standard for high-quality audio owing to the possibility of adjusting the degree of compression; it could occupy 12 or even 15 times less space than the original uncompressed file.

The lawsuits brought against companies like Napster, which used files of this kind, stemmed from the ease with which files could be shared. Napster was an internet service for the distribution of music files in MP3 format. It was the first major P2P exchange network and was created by Sean Parker and Shawn Fanning. Halfway through 2000, the company’s shareholders and representatives of Universal and Sony held a meeting to negotiate. The record companies demanded 90% of the profits, but no agreement was reached.

Nowadays 75% of consumers access music online. The most revolutionary invention for consuming audio started out in 1988, when the Moving Picture Experts Group was established and a standard for digital audio and video was developed.

Platforms for exchanging files online such as eDonkey, Ares and Kazaa thus emerged, sparking a heated debate about copyright and its boundaries.

The giant Apple dominated the digital market with iTunes and its first iPod, which came on sale in 2001 with the slogan “1,000 tunes in your pocket”. By then P2P networks had multiplied and millions of people were accustomed to downloading music; and mobile phones capable of playing tunes and songs had likewise appeared.

Changes in consumers’ habits, the sharp fall in the value of hard copies and unauthorised transactions in recorded music dealt a harsh blow to record companies.

Investments in the music industry dropped significantly in the twenty-first century. Traditional companies continued to back best-selling artists, but up-and-coming artists were largely left out of the picture. As a result, the self-management phenomenon emerged in a big way.
Meanwhile, experts are claiming that physical copies will only survive as collectors’ items, in a market where vinyl records are expected to enjoy prominence. The first vinyl in history to become a best seller was Vesti la giubba, an opera aria performed by Enrico Caruso in 1902.

In 2005 Kim Schmitz launched Megaupload, a company that was boasting spectacular figures within a few years: 180 million users all over the world and 400 million sites visited per month. The American Society of Cinematographers and the Recording Industry Association of America put pressure on the government, which eventually closed down the platform on 12 January 2012.

That year, 2005, the advent of YouTube changed the music industry in a big way. Today 45% of the content consumed on YouTube consists of music videos. These viewings total some 400 years of music.

But it was Soundcloud that broke all the moulds in 2007. This platform makes it possible to distribute audio content and encourages collaboration between users by enabling them to promote and disseminate their music projects. It is an essential website for understanding the distribution and promotion of music created by amateur artists and the real application of the home studio concept on an internet platform.

That same year Apple took advantage of improvements in the viewing of podcasts, images, video and other iPod functions to bring out its first iPhone, which marked the incorporation of smartphones into the market for selling and exchanging tracks.

One of the biggest transgressors in the music industry, Spotify, emerged between 2008 and 2009. This platform allows audio files to be transferred through the combination of a streaming server and a peer-to-peer (P2P) network in which users take part.

Nowadays, thanks to streaming platforms and dissemination via the social media, the new home industry is attempting to survive vis-à-vis the old-fashioned model of radio format and mass music.

The music industry needs innovation

The evolution of how we experience music is one of the major changes in user habits triggered by the internet and, above all, by technology. Despite the troubling news that is reaching us about the dire situation of the music industry, studies are showing that music is more alive and kicking than ever and that the current reality is very different from what “the industry” would have us believe.

The crisis record labels are experiencing owing to falling sales of physical copies, as well as structural factors relating to the sector, such as the business model, lack of innovation and low commitment to technology, underlines a very sad fact: they are failing to back talented new artists.

Even so, the crisis record labels are experiencing owing to falling sales of physical copies underlines a very sad fact: they are failing to back talented new artists.

This is on top of other circumstantial factors, including the current crisis and the crisis in live concerts, as well as structural factors relating to the sector, such as the business model, lack of innovation and low commitment to technology, among others, which are wreaking havoc on an industry used to living in opulence.

In this connection, I recommend you read “Un artículo sobre la piratería que no va a gustar a nadie” (An article on piracy that nobody will like) (http://www.lavanguardia.com/cultura/20120628/54318080002/un-articulo-sobre-la-pirateria-que-no-va-a-gustar-a-nadie.html), which makes the following important points:

- Physical copies will only survive as collectors’ items, in a market where vinyl records are expected to enjoy prominence.
- The first vinyl in history to become a best seller was Vesti la giubba, performed by Enrico Caruso in 1902.
- Kim Schmitz launched Megaupload in 2005, boasting spectacular figures within a few years: 180 million users and 400 million sites visited per month.
- YouTube changed the music industry in 2005, with 45% of its content consisting of music videos, totaling some 400 years of music.
- Soundcloud broke all the moulds in 2007, enabling collaboration between users to promote and disseminate their music projects.
- Apple took advantage of improvements in iPod functions to bring out the first iPhone in 2007.
- Spotify emerged between 2008 and 2009, allowing audio files to be transferred through a streaming server and a peer-to-peer network.
- Streaming platforms and social media have made it possible for musicians to distribute their music via the internet.
- The music industry is attempting to survive by adapting to the changes brought about by technology.
- Studies show that music is more alive and kicking than ever, even though the industry’s situation is dire.
- Record labels are failing to back talented new artists.
- Other factors contributing to the crisis of the music industry include the current financial crisis and the crisis in live concerts.
- Innovation and a commitment to technology are necessary for the music industry to survive.
- The article recommends reading “Un artículo sobre la piratería que no va a gustar a nadie” for more insights on piracy.
The internet and technology have created an environment that is hostile to the old business models but full of opportunities for new ideas, new actors and, especially, artists – provided that they are willing to adapt to the changes in consumers’ listening habits and are aware of what they need to do to be successful.

Nowadays artists have hundreds of cost-free tools available to them on the internet for creating music; consumers no longer settle for just pressing the play button but want to be involved; and the boundary between both is becoming blurred. Therefore, music must be increasingly focused on fans, on content and, above all, on customising the experience. The importance lies in fans, who decide what they want to consume and how.

After plummeting for a decade, the recorded music industry is on the road to recovery and revitalisation. For the first time in thirteen years, IFPI reported an increase of 0.3% in recorded music revenues in 2012, driven especially by the growth of the digital music sector.

Digital channels are becoming an important source of income in key markets such as those of Norway, Sweden, India and the United States. In the United Kingdom digital revenue overtook physical for the first time in 2012, following in the footsteps of the United States, where digital accounted for 50.3% of income in 2011. The world music industry had been sliding into recession since 2001.

This growth is due mainly to the constant innovation of business models in music marketplaces and the expansion of related digital services.
After more than two decades of instability, it seems that the music market is at last starting to recover. Following the alarm triggered by the advent of the internet, rumours about piracy and falling CD sales, profits have at last been recorded in 2016 thanks to streaming platforms.

Today investment is usually focused on digital, and there is no point resisting this trend. The internet offers millions of people unlimited access to music for an increasingly reasonable monthly fee, as well as free, ad-supported subscriptions. By the end of 2015, paying subscribers to music streaming services all over the world numbered 68 million. According to Bloomberg Technology, revenue from streaming in the United States amounted to $1.6 billion dollars (up 57%) in the first half of 2016.

These figures show that the industry appears to have found its feet. Most record labels, both large and small, have posted profits this year. Even so, according to a report by the RIAA, streaming platforms are still not doing enough to attract more subscribers, who are the real source of these profits.

Ever since Apple began attempting to recover all the money being lost through illegal downloads via iTunes, many alternatives have emerged. The main one is undoubtedly Spotify, whose number of users and paying subscribers, which already stands at 40 million, has not even dropped despite the new impetus being given to Apple Music. The advent of other competitors is bringing new sources of revenue for the online music business. Amazon is working on a music platform of which there has been talk since June. And Pandora, the world’s leading online radio station, is developing a paid service which hopes to have converted 10% of its 18 million free users to premium by 2020.

But are Spotify and Apple Music really the leading streaming services? No doubt they have the highest number of paying subscribers, but in terms of users we cannot omit to mention the
mighty YouTube. According to the *Music Consumer Insight Report 2016* compiled by Ipsos for IFPI, 82% of YouTube users visit this site to listen to music. Bearing in mind the volume of visits the platform receives, this equates to about 820 million listeners.

All these novelties are evidently revitalising an industry that had been cowering in fear for several years. Thanks to subscriptions to online services, average expenditure per person per year is now higher than that generated by physical sales. While these markets are growing, sales of music in both physical and download format are tending to fall, recording a 14% drop in the first half of 2016.

All this is spurring the industry to seek new methods of funding that are more in tune with the present times. More and more work needs to be done behind the platforms to connect with users, generate high-quality, customised content and offer services with a difference... What direction are we heading in? David Kirkpatrick (Techonomy) speaks of a trend towards an emotional and social focus. Perhaps the answer lies in an effective combination of the social media and the world of music, a new functionality in networking.

The subscription system provides the industry with a steady income compared to the seasonality that characterises à la carte sales of tracks or albums. Except for models like Rhapsody and Spotify, the subscription system had never developed any kind of income similar to that of à la carte models.

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Thanks to subscriptions to online services, average expenditure per person per year is now higher than that generated by physical sales. While these markets are growing, sales of music in both physical and download format are tending to fall.

In Sweden – the birthplace of Pirate Bay and Spotify, where legal streaming services are widely used – a positive impact has been detected on total music sales, as well as a notable fall in piracy. This underlines how important it is for the music industry to create business models that are consonant with people's changing music consumption habits instead of focusing its efforts on copyright laws.

Even so, streamed music consumption services continue to bear heavy burdens that can hinder their ability to function as sustainable and profitable businesses. For these freemium businesses, a paradigm shift would involve reducing the taxes they pay on content to the traditional industry, which fluctuate between 50% and 60%; according to Spotify, Pandora is reckoned to pay as much as 70%. This, coupled with other costs, leaves little room for profits.

The main development the record industry has witnessed during the transition from physical to digital distribution and consumption is probably the rising popularity of smartphones, tablets and app stores (Apple's iOS and Google's Android, well behind the former). When consumers buy smartphones and tablets they not only acquire new platforms for consuming music but also new devices capable of performing transactions. For example, it is possible to complete the full experience cycle on a portable device: search, discover and acquire, consume and share. For music companies (or any other company offering content for that matter) as well as developers, these modern consumption devices create new opportunities and new ways of distributing and monetising music.

The value of music in a digital environment: from free to enhanced experiences

One of the main debates in today’s music industry is the value of music in the digital era. The concept of value was traditionally perceived as the measure of profit an economic actor can obtain in exchange for an object or service. From a merely economic perspective, the value of
A product is no longer defined only by its price but rather by all the benefits it offers the client who consumes it. Music, unlike other products or services, is part of our lives and improves their quality; therefore, it is starting to be of strategic importance to bear in mind the habits of the consumers at whom the music is aimed.

In this new environment shaped by technology, in which fans demand closeness to their artists, we need to progress towards building a brand and experience around the artist in a way never previously witnessed. The idea is for clients to perceive the value of the work of the artists they follow. Fostering listener loyalty is of key importance to artists nowadays.

A recent study by Nielsen shows that portals providing access to music free of charge are the most widely used channels for discovering music: 48% of listeners discover music through the radio, whereas 64% of millennials prefer YouTube to all other sources for listening to music.

Viewed from a broader perspective that takes into account factors other than merely economic concerns, digital music consumption is also influenced by time, attention, personal data and social involvement in music-related experiences. Music consumers listen to and interact with it much more than ever.

Taking these factors into consideration, the debate therefore should not necessarily be centred on whether consumers value music in today’s society, because there are many other types of “currency” in consumer transactions when it comes to obtaining value from music products and services. As in all the major industries, perceived value is no longer just a guarantee of revenue. What music industry players need to ask themselves is how to increase readiness to pay for what they have to offer, because when free products and services are perceived to have the same value as those that are paid for, willingness to pay is greatly reduced.
A recent study by Nielsen shows that willingness to pay increases significantly when a number of products and services that complement the music experience are available. Fans want more; they no longer settle for just pressing the play button and this is a need that is not being met. There is an underlying wish to connect at a higher level than is currently available.

New music consumers are calling for a new form of consumption because they value consumption differently. And the facts prove this. A revealing case is that of Sweden, a country where streaming is a larger source of music industry revenue than downloads and CD sales – that is, a country where music has become a service instead of a product. What is more, in Sweden streaming accounts for 91% of digital revenue, whereas in the rest of the world the figure stands at only 13%. Indeed, in 2012, the first year the music industry recorded an upturn since 1999, growth in Sweden amounted to 13.8%, compared to 0.2% in the rest of the world.

Whatever the case, fighting against people’s changing music consumption habits should under no circumstances entail accusing customers of piracy; rather, it should involve strategically building their perceived value of the music they consume. In this respect technology is light years ahead of the music industry, which has a lot to learn from it about working for and on behalf of the people who consume its music and about generating unique experiences that make them a fundamental part of our new way of discovering, accessing, consuming and sharing the music we like.

From music as a product to music as a service

Music is evidently ceasing to be a product and turning into a service. It used to be impossible to buy a song you liked without having to purchase the whole album or to listen to a little-known local musician unless you lived in the same country or belonged to his circle. Thanks to technology, especially the internet, we listen to more music than ever and artists have an easier time getting their content to audiences keen for new experiences, without middlemen.

Enjoying access to music is increasingly taking over from owning it: consumers can access their music anytime, anywhere, and above all from any device. Music that is distributed in physical format only is set to become a handicap or a product aimed more at collectors.

Some time ago I discovered George Yúdice and his book *Nuevas tecnologías, música y experiencia*, unmistakeably one of the best I have read for understanding the impact of technology on people’s music consumption habits:

One of the consequences of technological innovation is the growing ubiquity of music: there are few spaces where it is not present. Today, more than ever, music accompanies us at all times and is part of our experiences. MP3s, iPods, mobile phones... are prosthetic devices that project and shape someone’s personal space, allowing him to take along his own “soundtrack” and making the person who carries them a new type of *flâneur* who not only gazes at wares in the city’s shop windows but carries around his own playlist (services like Spotify). The fact that iPod users inhabit a sort of universe of their own with themselves and their “soundtrack” does not mean to say that they are not part of socialisation networks linked to music.

In Yúdice’s view, the same technologies that make this type of private experience possible also make possible new forms of interactivity, of strengthening bonds of belonging and sociability, resulting in a new type of collective experience.
Phenomena like YouTube are the most visible signs of this social dimension at a time like the present when more music is produced, consumed, commented on and shared than ever.

New technologies have changed how music influences social organisation and the organisation of experience; from blogs to chats to portals and social networking sites, these new “parallel music” spaces are meeting places that connect people and create networks of individuals. The fact that they are furthermore out of bounds to the majors means that we are likely to see a radical shift in the business model.

Today the keys to digital music consumption have changed forever:

- Access v. ownership: “From music as a product to music as a service.”
- Capture v. collect: we don’t want to compile everything but discover and access new songs simply when we listen to them, as proven by the success of applications like Shazam. The key lies in being able to enjoy an infinite jukebox thanks to the growth of subscription models and Cloud Computing services.
- Consolidation of the digital and streaming businesses.
- Sharing: as well as enjoying easy access to music, people want to be able to share it with their friends in order to tap into the sociability afforded by social media services. This is proven by figures such as the fact that more than 60% of the videos viewed on YouTube are discovered through recommendations by contacts on various social networking platforms.
- Changes in how popularity is achieved with the emergence of services like YouTube (have you heard of #youtubers?), which have helped young artists like Pablo Alborán and Justin Bieber, among many others, rise to stardom.

Remix culture and its importance in music

We have left behind the era when creativity was consumed but consumers were not perceived as creators – a top-down culture. Even so, never before in the history of mankind had culture been so professionalised, or so concentrated in the hands of major industries, governments and international monopolies that prosecute people using restrictive legislation and antipiracy laws – users keen to consume and re-create, keen to contribute their creativity.

However, never before in the history of mankind have we witnessed a period in which people have taken part in creating and re-creating culture as much as the present, thanks to the internet and the means technology provides for fostering collaboration between people and access to countless cultural content. As Larry Lessig, a professor at Stanford University and the founder of Creative Commons points out, it is a “culture where people produce for the love of what they are doing and not for the money”. This is spurring the emergence of new phenomena such as remix culture and crowdsourcing, which are having a high impact both on culture, as in the case of music, and on the business world. Lessig stresses the importance of “the culture that your kids are producing all the time… Taking the songs of the day and the old songs and remixing them to make them something different. It’s how they understand access to this culture”.

According to an interview with Vito Campanelli in the magazine Ñ:

Individuals are forced to think in terms of post-production and remixing in order to cope with the overload of digital information they come up against every day. While culture has always evolved through variation, selection and repetition, we inhabit remix culture par excellence, especially bearing in mind the simplicity and
The potential of the internet as a tool for collaboration is ushering in a new era in people’s development, growth and productivity – a new era in which collaboration is changing the game rules for companies, institutions, governments, artists, musicians and people. Initiatives are springing up in this field which are having a huge impact on how music is created and consumed. Indeed, eight of the ten most frequently viewed videos on YouTube are related to music and many of them stem from creations of unknown users who remix, cut and paste, create and co-create new products based on existing materials and those created by artists. Remix culture is playing an increasingly significant role in the music industry; it has always been practised by musicians, but for the first time it is open to the creation and creativity of people and internet users.

As Alejandro Piscitelli points out, “content should not be based solely on originality, but also on transforming that which exists. On the remix idea: I take, mix and upload content which can also have a high degree of innovation and talent”. Recalling Manuel Castells: “much of what surprises us about the internet derives from the four cultures that helped create it: technical-scientific, which gives the internet transparency; hacker, which is based on the value of creativity, the generosity of its members and respect for the pioneers; entrepreneurs; and virtual communities, which are responsible for giving a voice to anyone, whatever their interests. These elements lend the internet a transparency that clashes with the basic structures of society, which need to be adapted to this new reality, such as intellectual property (remix and free culture).”

All over the world thousands of people are creating new things from what already exists. Interesting initiatives are springing up all over the world to foster this remix culture. One of the most successful initiatives is undoubtedly the Creative Commons licenses, which support creators in disseminating their work by transferring some rights to those who consume them and at the same time allow them to defend
a free culture amid the threats of abusive copyright. Therefore, there is growing demand for alternative licenses that lend themselves to remix culture, such as the abovementioned Creative Commons or Colaboratorio Platoniq, an organisation where culture professionals and software developers interact.

Openness is more than just tools and content, it is the culture of digital and the culture of sharing – in other words, the culture of Joi Ito’s free souls. Although it is old, we recommend downloading the book The Power of Open, which commemorates the tenth anniversary of free exchanges through Creative Commons licenses. Some of the music projects dealt with in the book are described below:

**Case of DJ Vadim**

In search of inspiration and new talent, Vadim uses ccMixter, a community remix site, to allow other producers to download his tracks under a Creative Commons license and remake them to their own liking. Three thousand people have downloaded Vadim’s tracks via ccMixter and have created more than five hundred remixes. According to Ben Dawson, who works for DJ Vadim’s record label Organically Grown Sounds (OGS), “People were uploading their remixes and then sharing them with their friends, which brought a lot of attention to the music. This is a great way to let people get involved in the music and put some emotion, heart and soul into it rather than just listening on the radio”.

**Indaba Music**

In February 2007, five musicians launched Indaba Music, a global networking site and collaboration platform. Members can upload their own tracks under Creative Commons licenses or use stems from other members to create remixes or collaborate on projects. An “Opportunities” section lists free and paying requests for artists to contribute tracks to works in progress. Indaba also hosts contests that encourage experimentation with tracks by famous artists like Peter Gabriel, Weezer, Snoop Dogg and Yo-Yo Ma. The remixes from these projects are made available to the public under the Creative Commons Attribution-NonCommercial-NoDerivs (CC BY-NC-ND) license, allowing the collaborations between newcomers and established artists to spread widely.

Indaba’s 540,000 users from 200 countries have proven that, when given the right tools, freedom can expand creativity. In late 2010, alternative rock band Marcy Playground licensed all the components of every track from its latest album, Leaving Wonderland ... In a Fit of Rage, under a Creative Commons license, a manoeuvre that yielded enough content to create a second album – called Indaba Remixes from Wonderland – with tracks remixed by Indaba users. In keeping with the spirit of sharing and collaboration, all of the contributors on the album will be paid royalties.

**Jamendo**

In 2004 the Luxembourg musician Sylvain Zimmer and two partners founded Jamendo, a unique Web platform that allows musicians to make their music available under Creative Commons licenses to anyone who wants to listen to it. The company uses a freemium business model, providing all content for free to the public, then charging for access to rights not permitted by the CC licenses. Jamendo splits its revenue 50/50 with musicians.

**Tiago Serra and RadioHead**

In July 2008, the Grammy Award-winning alternative rock band Radiohead released a music video for the song “House of Cards.” It was produced without cameras. Instead of a traditional video, they asked digital media artist Aaron Koblin to produce a data set of 3D images that looked as if they came from an old TV. The
Providing access to the open source code yielded unexpected results. Tiago Serra, a Portuguese interaction designer, took it and created a set of coordinates using Blender to print a sculpture of Thom Yorke’s head out of ABS plastic with a 3D printer.

Serra – who co-founded a Hackerspace in the town of Coimbra, Portugal, and is a fan of both Radiohead and Koblin – uploaded photos and a video of the manufacturing process onto Flickr and Vimeo. He posted the 3D design onto Thingiverse, a website where users share digital designs for physical objects. Because the code for the original visual data was licensed under CC BY-NC-SA, so was Serra’s derivative work.

The battle for streaming: music is not just listened to, it is also viewed

Subscription models in music, like so many other things we believe the digital revolution has brought, are not new. They are transforming the sector owing to the speed of adaptation and technological disruption, undoubtedly, and above all owing to the speed at which they are changing how people discover, access and consume the content they want and experience it as a service and not as a product. The first known music library dates from the eighteenth century and was created in Paris by the Belgian painter Antoine de Peters and the Italian violinist Jean-Baptiste Miraglio. Their project, called “Bureau d’abonnement musical”, was published in L’Avant-coureur on 22 July 1765 (Music Circulating Libraries in France: An Overview and a Preliminary List, http://digitalcommons.unl.edu/libraryscience/179).

Moving forward from this historical example, today there are some 60 million streaming music subscribers worldwide. 2015 saw the collapse of song downloads via platforms like iTunes and the consolidation of streaming, which recorded growth of 93% and 85% respectively in the United Kingdom and the United States, two of the main music markets which generate 40% of the music industry’s profits.
streaming, as its revenues rose by 40% compared to the same period in 2014 and account for more than 80% of the digital market’s profits.

The disruptive metamorphosis of business systems has led major companies to reconsider their modus operandi with the advent of the new century’s consumers. Buying albums or music on the digital markets no longer works; advertising companies and record labels are adapting to a world where the screen has taken over everything and controls the world around us. Music no longer seeks only to be consumed in digital environments; thanks to technology, it aims to be part of people’s real lives and shape a consumption experience in which the digital and real environments coexist. The unstoppable locomotive of technological development and its increasing adaptation to the young generations is spurring commercialisation and, accordingly, an impressive process of adaptation to the established media.

The music market in digital environments is inarguably one of the leaders and guides of digital transformation and will carry on teaching lessons to many other entertainment sectors and industries, as well as to any other company undergoing transformation. Music is a sector in which people and technology are ahead of the industry, because people’s music consumption goes hand in hand with any technological disruption, as music is part of our lives more than most things. Therefore we will always adapt to whatever allows us to consume, discover and share it efficiently for our own enjoyment and that of our social environment.

2015 was likewise the year that the two technology giants, Apple and Google, launched Apple Music and YouTube Music Key, which not only provide a streaming service but also include a radio offering with new features in Google Play Music or Apple’s Beats 1. And Amazon has launched its own streaming service, Prime Music, in the United Kingdom.

And herein lies the key to the future of streaming: music is increasingly not just listened to but viewed as well.

The major players are no longer only the well-established native platforms that spring to mind, like Spotify, Pandora, Napster, Deezer and Apple Music... Today the main player as far as music is concerned, especially for the millennial generation, is YouTube.

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The technology of the new music industry: virtual reality to bring the digital experience closer to the physical world

An important point of reference in our country is the work of the technology centre Eurecat, which leads a team of researchers all over the world. This group of experts is developing the first professional production tools for creating songs and also live 3D music sessions.

But it is impossible to speak of cutting-edge technology today without taking a look at virtual reality technologies. Björk was the first artist to release a music album in VR. Last week the Icelandic singer presented her latest album, Vulnicura, using this technology as part of the Björk Digital tour.
Like Björk, various groups are offering immersive experiences viewed in HTC Vive. Its room-scale technology allows it to create a virtual space where users can explore a physical environment in order to enjoy a sensory experience.

But there are truly interesting VR music applications. For example, SoundStage transports you to a virtual studio where you can find keyboards, drum machines, modular synthesizers and even a Theremin to start creating your productions virtually. This new app is available for HTC Vive headsets and can be downloaded from the Steam videogame platform.

Groups like Love of Lesbian have used VR technology in “Efímera” to take fans inside the band’s mind, to the origin of their songs and the mechanisms they use to seek inspiration. This unparalleled experience enabled the group’s followers to enjoy an unreleased track whose video clip was recorded in 360 degrees and was directed by Carlos Zorrilla.

The world of technology and music is also very closely linked to that of fashion. Converse Chuck Taylor All Wah launched a wearable for serious rock fans: a special edition of their most famous trainers incorporating an electric system with a built-in guitar pedal.

In his album Hiperasia, El Guincho provides a futuristic augmented reality universe in which to discover his new tracks. His “Internet of Things” motto inspired him to make sweatshirts and wristbands to distribute his work to the public, eschewing the traditional compact disc format.

All these initiatives bring the digital world closer to the physical world as part of the constant, growing need for users to enjoy a complementary physical-world experience of the music they consume in digital format.

Musical novelties in the virtual reality industry

On 4 June at the FACYL Festival we were treated to an innovative session from Carlos Jean based on a virtual reality show in which a well-known artist, Antonyo Marest, interpreted songs with lines, colours, and forms, watched by more than 20,000 people thanks to HTC VIVE and Mountain.

There are prototypes and apps that are adaptable to the immersive experience offered by VR. Lyra explores the concept of synaesthesia and navigates the different perspectives musical creation offers. Users can handle notes as they would with a traditional production programme, with the significant difference that it is a more hypnotic and dynamic action in a 3D environment.

In Intone the adventure begins with a group of blocks in front of you. You can select the blocks and, depending on the noise, they move and change colour. In general, Intone seems to be a virtual reality experiment involving interactive audio-visualisers.

There are prototypes and apps that are adaptable to the immersive experience offered by VR. Lyra explores the concept of synaesthesia and navigates the different perspectives musical creation offers.

Imagine you are a child again and you get a xylophone for Christmas. But that’s not all; with Playthings VR you can immerse yourself in a world very similar to Candy Crush, where your instruments are gummy bears, hotdogs or hamburgers... A space full of colour and fantasy where you can learn to handle drumsticks.

The recording artist Squarepusher has composed a VR piece for one of his songs. It is designed to immerse the viewer in a fantastical and psychoactive journey. The story includes an allegorical voyage through realms of colour.
Amplify VR is a virtual platform that allows bands, artists and musicians to generate performances in impressive, spectacular environments where the audience takes part actively.

And we also find 360-degree video clips such as those of The Weeknd or U2, among others, which have embraced this new form of storytelling.

How can music bring the cultural act closer?: the role of brands

It is evident that sponsorship in general, and that of music in particular, is increasingly evolving towards a value model in which sticker sponsorship no longer makes sense and what really matters is for brands to tell stories, support real projects and become actual patrons of real people’s projects. Meaningless mass sponsorship is giving way to customisation, which is increasingly engaging with the people we so want to connect with through brand building strategies.

For many years music has been sponsorship territory. This means that many brands used it to reach a specific artist’s fans or audiences at music festivals and little else. However, the shortcomings of this territory compared to other well-established fields such as sport have been huge from the point of view of brand strategy and value building for the audience, the brand itself or the proprietor (artist, festival…) in question. These considerable limitations stemmed from a variety of factors, of which we will mention only a few:

- Support for artist X or festival Z based purely on the personal tastes of the professionals responsible for the brands.
- For the record company, the brand in question had nothing to offer the artist – a gross mistake – and all it did was pay a few accounts whose figures plummeted owing to the unstoppable fall in album sales.
- They never worked together to build, even though today there is no better means of communication for an artist than a brand, and no better ideas person for a brand than an artist. This is the problem of the business of intermediaries on which the relationship between brands and music has always been based.
- Brand X chooses artist Y because the latter has lots – no, thousands! – of followers on the social media and brand X knows that digital is an increasingly important channel. MISTAKE! Digital is a work ethic, a process of transformation (many people pay lip service to “digital transformation” but few know how to manage it or have professional experience of it, and it certainly doesn’t involve being the best Twitter or Facebook user). It is not so much a case of doing as of understanding and building from an honest position based on fans’ behaviour.

Music is not a territory (nor are other culture and creative industries: they are not sport); rather, it has become an excellent language for telling brand stories. And also a language that is especially effective at engaging with audiences.

Music is not a territory (nor are other culture and creative industries: they are not sport); rather, it has become an excellent language for telling brand stories. And also a language that is especially effective at engaging with audiences.

For there is no better way of reaching people’s hearts than through their ears. And because music is truly transmedia: people listen to it on their smartphones, view it on YouTube, synchronise it on my PC or my Mac, enjoy it live, cry,
Renfe users sent in stories they had experienced while travelling by train through the website www.tuhistoriatucancion.com. The five most moving stories were chosen as inspiration for the singer-songwriters Bebe and Juan Zelada to compose a song.

The song was officially released on 10 November at the Museo del Ferrocarril (railway museum), where Renfe, together with Muwom and the artists Bebe and Juan Zelada, presented a live performance of the result of the innovative “Your story, your song” initiative: the song entitled “A carcajadas”. Naturally the event was attended by the main characters in the story, Eduardo and Rocío, who were very excited to receive an award in recognition and memory of the action.

Bebe and Juan Zelada’s new song, “A carcajadas”, came out on digital platforms on 11 November. All profits will go to Fundación Apascovi.

Projects like Renfe’s show that music is essential for companies and should be just as or even more essential for all the players in the rest of the culture and creative industries. Today we live in a changing environment, which also means an environment of constant opportunities. We should surround ourselves with colleagues who allow us to carry on making our passion our work. Any dream you can fulfil without the help of others is a very small dream. For the opportunity to establish synergies is huge in the new environment where people are increasingly aiming to make that which they enjoy, consume and share every day on the internet a reality.

laugh, share it on the social media... If we speak of digital, connection, experiences or emotions, music is language (UNIVERSAL).

The major brands do not create or produce advertising or content, they generate ADMIRATION. And admiration is a powerful EMOTION, because regardless of how long it lasts (a second, a minute, an hour, a day...) it remains with us forever.

I believe we should try and do things a bit differently every day. The key lies in UNDERSTANDING and EMPATHISING with our target audiences. Major brands and institutions are thus coming up with projects aimed at getting their message across to audiences using music, and many are succeeding.

Renfe’s “Your story, your song”

Music has always been part of people’s lives. Today more than ever before it accompanies us constantly and is part of our experiences. It is present in everyday life, especially when we travel. Train journeys have always been particularly linked to music.

For these reasons Renfe, Spain’s railway company, has decided to use music as a way of reaching its travellers through the initiative “Your story, your song” (Tu historia, tu canción). The result of this project is the first song composed from train passengers’ stories and experiences. The project directly links real-life experiences, turning them into a real song using the digital medium. In 2016 it was the first of a number of initiatives design to foster Renfe’s ongoing commitment to music as a way of getting its travellers to enjoy experiences.
Links

News


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http://www.enter.co/cultura-digital/entretenimiento/el-streaming-quiere-ser-el-salvador-de-la-industria-musical/


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Reports


Websites of interest

Industria Musical: http://industriamusical.es/

Muwom's blog: http://muwom.com


Music Ally: http://musically.com/
Key congresses and conferences

BIME: http://bime.net/

Midem: http://www.midem.com/

SXSW: https://www.sxsw.com/

Encore Awards: https://www.youtube.com/watch?v=qXZ4qGVulXI
STORYTELLING AND CULTURAL DIFFUSION

Eva Snijders  @evasnijders


Eva Snijders is an internationally renowned storytelling expert. She is Master Practitioner and Trainer in NLP and a coach specialized in cultural change and multicultural communication.

+20 years of experience in PR & Communication.
+15 years of experience in Training.
+10 years of experience in Coaching & Change Management.

Of Dutch origin, Eva has been living in Spain for twenty-four years, where she studied Design. She has trained in the areas of coaching, NLP and storytelling in Europe, Brazil and Israel. Works as a publisher of books of architecture, photography and design and as public relations in the sports sector. In 2007 she decided to combine her professional experience with her passion for stories and she founded the first company in the Spanish-speaking world dedicated exclusively to storytelling.

She is currently a communications consultant, international lecturer, and associate lecturer at several European universities.
Premise: How can storytelling aid cultural diffusion?

What is storytelling?

The definition of storytelling for the purposes of this article

A statement from the National Storytelling Network defines storytelling as an ancient art and a valuable form of human expression: “Storytelling is the interactive art of using words and actions to reveal the elements and images of a story while encouraging the listener’s imagination,” it says.

According to this text:

1. Telling stories is interactive

Storytelling involves two-way interaction between a storyteller and one or more listeners. The listeners’ responses influence the way the story is told. In fact, the telling of a story emerges from interaction and cooperation – in other words, the narrator and the audience working together. In particular, storytelling does not create an imaginary barrier between the speaker and the listeners. This is part of what distinguishes storytelling from the forms of theatre that use an imaginary “fourth wall.”

Different cultures and situations create different expectations for the exact roles of the narrator and the listener – for example, who speaks, how often and when – and so create different types of interaction.

The interactive nature of storytelling partially accounts for its immediacy and impact. At its best, storytelling can directly and tightly connect the teller and audience.

2. Storytelling uses words

Storytelling uses language, either spoken or manual, such as American sign language. The use of language is what sets it apart from most kinds of dance and mime.

3. Storytelling uses actions such as vocalization, movement and/or gestures

These actions are the parts of our spoken or sign language that do not consist of words. Their use distinguishes the storytelling from written narrative and text-based interactions. Not all non-verbal language behaviors need to be present in storytelling. Some narrators use a lot of body language while others use little or none.

4. Storytelling presents stories

Storytelling is always about the presentation of a story. There are a lot of other art forms that tell stories but storytelling presents the story with the other four components. Every culture has a different definition of what makes a story. What is considered a story in one situation might not be considered as such in another. Some situations require spontaneity and playful digression, for example, while others expect the exact reproduction of a revered text. Artistic forms such as poetry recitals and stand-up comedy sometimes involve a story and sometimes do not. Given that they usually contain the other four components, they can be considered forms of storytelling whenever they also tell stories.
5. Listening to stories stimulates the active imagination of the listeners

During the telling of the story, the listener is imagining the story while in most traditional theater or dramatic cinema, the listener is under the illusion that he or she is actually witnessing the characters and events described in the story.

The role of the listener is to create images, actions, characters and the events of the story in his mind, based on the narrator’s performance and his own experiences and beliefs and his understanding of what he is being told. The complete story comes together in the mind of the listener – himself a unique human being. And so the listener becomes a co-creator of the story as he understands it.

Storytelling can combine with other art forms. The contemporary movement of oral storytelling includes the development of ways of combining narration with theater, music, dance, comedy, puppet shows and many other forms of expression. However, although it can be mixed imperceptibly with other art forms, the essence of storytelling continues to be recognizable as the intersection of the five aforementioned components.

We tell stories in a variety of contexts which range from conversation at the kitchen table to religious ritual, from telling something while we are busy doing something else to performances in front of large audiences. Some storytelling situations demand informality, others are highly formal. Some call for certain themes, attitudes and artistic focus. As suggested earlier, the expectations of listener interaction and the nature of the story itself vary widely. There are many different cultures in the world and each has its own rich traditions, customs and opportunities for storytelling. All these forms of storytelling are valid. All are equal citizens in the diverse world of narration.

In English, the word storytelling refers as much to the concept of narration as to the act of sharing a story live. This why we often hear that a film has “magnificent storytelling” while such as phrase has little meaning in Spanish as storytelling is always understood to have some interaction between the narrator and the listener.

With technological advances, new and innovative forms of storytelling have emerged. In the National Storytelling Network circles, the validity of each new platform, technique and format is debated. The most conservative believe that storytelling can only be defined as such if the narration is both oral and live. Progressive members are more open to the inclusion of new forms of the storytelling art, although everyone agrees that the five basic principles should be adhered to and used as a guide.

What is culture?

Collins online English dictionary defines culture thus:

noun
1. the total of the inherited ideas, beliefs, values, and knowledge, which constitute the shared bases of social action
2. the total range of activities and ideas of a group of people with shared traditions, which are transmitted and reinforced by members of the group,
3. a particular civilization at a particular period
4. the artistic and social pursuits, expression, and tastes valued by a society or class, as in the arts, manners, dress, etc
5. the enlightenment or refinement resulting from these pursuits
And what is cultural heritage and intangible cultural assets?

Since the Convention for the Safeguarding of the Intangible Cultural Heritage in 2003, intangible cultural assets are to be understood as heritage that needs safeguarding, consisting of “the practices, representations, expressions, knowledge, skills that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. This intangible cultural heritage, transmitted from generation to generation, is constantly recreated by communities and groups in response to their environment, their interaction with nature and their history, and provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity.”

As it is defined in the Convention, the intangible cultural heritage is particularly evident in the following circumstances:

- Oral traditions and expressions, including language as a vehicle for intangible cultural heritage.
- Performance art.
- Social practices, rituals and festival traditions.
- Skills and practices related to nature and the universe.
- Traditional ancestral skills.

Storytelling as part of the intangible cultural heritage

Although the aim of this article is to explain how storytelling can aid cultural diffusion, the author deems it relevant to mention that the discipline is considered an asset in itself; so much so, in fact, that UNESCO includes four examples of this art in its lists of intangible cultural heritage:

6. the attitudes, feelings, values, and behaviour that characterize and inform society as a whole or any social group within it.
7. the cultivation of plants, esp by scientific methods designed to improve stock or to produce new ones.
8. stockbreeding the rearing and breeding of animals, esp with a view to improving the strain.
9. the act or practice of tilling or cultivating the soil.
10. biology
   a. the experimental growth of microorganisms, such as bacteria and fungi, in a nutrient substance (culture medium), usually under controlled conditions. See also culture medium.
   b. a group of microorganisms grown in this way (transitive).
11. to cultivate (plants or animals).
12. to grow (microorganisms) in a culture medium.
The predominant form of cultural expression among the Kyrgyz nomads is the narration of epics. The art of the Akyns, the Kyrgyz epic tellers, combines singing, improvisation and musical composition. The epics are performed at religious and private festivities, seasonal ceremonies and national holidays and have survived over the centuries by oral transmission. The value of the Kyrgyz epics lies largely in their dramatic plots and philosophical substratum. They represent an oral encyclopedia of Kyrgyz social values, cultural knowledge and history. The pre-eminent Kyrgyz epic is the 1,000-year-old Manas trilogy, which is noteworthy not only for its great length (sixteen times longer than Homer’s Iliad and Odyssey), but also for its rich content. Blending fact and legend, the Manas immortalizes important events in Kyrgyz’s history dating back to the ninth century. The Kyrgyzs have also preserved over forty “smaller” epics. While the Manas is a solo narration, these shorter works are generally performed to the accompaniment of the komuz, the three-stringed Kyrgyz lute. Each epic possesses a distinctive theme, melody and narrative style. Akyns were once highly respected figures who toured from region to region and frequently participated in storytelling contests. They were appreciated for their proficiency in narration, expressive gestures, intonation and lively mimicry, so well suited to the epics’ emotionally charged content. During the 1920s, the first part of the Manas trilogy was recorded in written form based on the oral interpretation of the great epic singer, Sagynbay. The epics remain an essential component of Kyrgyz identity and continue to inspire contemporary writers, poets, and composers; even today, the traditional performances are linked to sacred cultural spaces. Although there are fewer practitioners nowadays, master akyns continue to train young apprentices and are helped by recent revitalization initiatives supported by the Kyrgyz government.

Hezhen Yimakan storytelling from China

Yimakan storytelling is essential to the world view and historical memory of the Hezhen ethnic minority of north-east China. Narrated in the Hezhen language, and taking both verse and prose forms, Yimakan storytelling consists of many independent episodes depicting tribal alliances and battles, including the defeat of monsters and invaders by Hezhen heroes. This oral heritage highlights the defense of ethnic identity and territorial integrity, but also preserves traditional knowledge of shamanic rituals, fishing and hunting. Yimakan performers improvise stories without instrumental accompaniment, alternating between singing and speaking, and make use of different melodies to
represent different characters and plots. They usually train in a master-apprentice relationship within their own clans and families, although today outsiders are increasingly accepted for apprenticeship. As the Hezhen have no writing system, Yimakan plays a key role in preserving their mother tongue, religion, beliefs, folklore and customs. However, with the acceleration of modernization and the standardization of school education, the Hezhen mother tongue is now endangered. At present, only the elders can speak their native language. This loss has become a major obstacle to the promotion and sustainability of the Yimakan tradition. Only five master storytellers are currently capable of performing the episodes – a situation aggravated by the deaths of a number of veteran storytellers, and the departure of younger generations to cities in search of employment.

Naqqali, Irania dramatic storytelling from the Islamic Republic of Iran

Naqqāli is the oldest form of dramatic performance in the Islamic Republic of Iran and has long played an important role in society, from the courts to the villages. The performer – the Naqqāl – recounts stories in verse or prose accompanied by gestures and movements, and sometimes instrumental music and painted scrolls. Naqqāls function both as entertainers and as bearers of Persian literature and culture, and need to be acquainted with local cultural expressions, languages and dialects, and traditional music. Naqqāli requires considerable talent, a retentive memory and the ability to improvise with skill to captivate an audience. The Naqqāls wear simple costumes, but may also don ancient helmets or armored jackets during performances to help recreate battle scenes. Female Naqqāls perform before mixed audiences. Until recently, Naqqāls were deemed the most important guardians of folk-tales, ethnic epics and Iranian folk music. Naqqāli was formerly performed in coffeehouses, tents of nomads, houses, and historical venues such as ancient caravanserais. However, a decline in the popularity of coffeehouses, combined with new forms of entertainment, has resulted in diminishing interest in Naqqāli performance. The aging of master performers (morsheds) and the decreasing popularity among younger generations has caused a steep drop in the number of skilled Naqqāls, threatening the survival of this dramatic art.

Arts of the Meddah, public storytellers from Turkey

Meddahlik was a Turkish theatre form performed by a single storyteller called a meddah and practiced throughout Turkey and Turkish-speaking countries. Through the ages, similar narrative genres have flourished due to interaction
among the peoples of Asia, the Caucasus and the Middle East within this wide geographical area. Historically, meddahs were expected to illuminate, educate, and entertain. Performing in caravanserais, markets, coffeehouses, mosques and churches, these storytellers transmitted values and ideas among a predominantly illiterate population. Their social and political criticism regularly provoked lively discussions about contemporary issues. The term meddah, borrowed from Arabic maddah “to praise”, can be translated as “storyteller”. The meddah selects songs and comic tales from a repertory of popular romances, legends and epics and adapts his material according to the specific venue and audience. However, the quality of the performance largely depends on the atmosphere created between the storyteller and spectators, as well as the meddah’s ability to integrate imitations, jokes and improvisation often relating to contemporary events. This art, which places great value on the mastery of rhetoric, is highly regarded in Turkey. Although some meddahs still perform at a number of religious and secular celebrations and appear on television shows, the genre has lost much of its original educational and social function due to the development of the mass media and, in particular, because of the appearance of TV sets in cafés.

Taken together, these four samples are a good example of oral tradition in different cultural contexts. They all feature the five characteristics that the National Storytelling Network has established as vital if an artistic form is to be defined as storytelling: they are interactive, they use words, vocalization, movement and gestures and they relate stories and stir the imagination of the listener. And more importantly, they demonstrate how stories can be vehicles for values, history and a community’s unspoken knowledge.

The historian Shannon Ryan notes that oral tradition plays an important role in the creation and maintenance of the necessary perspective that stops the breakdown of a society’s unity and structure. Ryan argues that in most cultures and particularly among rural ones, its history has been passed down largely orally via the recollection of personal experience. This type of storytelling is often carried out in private.

It is here, in private circumstances, that we can begin to understand storytelling as a concept. From cavemen times to the current era, people have always felt the need to share their past, present and future with their loved ones in the form of stories.

**The five characteristics that the National Storytelling Network has established as vital if an artistic form is to be defined as storytelling:** they are interactive, they use words and gestures, they relate stories and stir the imagination.

Throughout human evolution, we have specialized in different professions and some of us have chosen to become professional minstrels or storytellers. In that way, the art and skill of storytelling evolved and the techniques became increasingly more sophisticated. But we have never stopped coming together around a table to share our experiences and hopes and dreams. In order to understand both the use and the power of shared stories, we need to remember that the telling of them corresponds to a deep human need to understand the world around us, recognize ourselves in others and develop a feeling of belonging.

**The current rise of storytelling that goes beyond culture**

Although there has been a lot of reference to storytelling in the last five years in the Spanish-speaking world, the renaissance of this art began 25 years ago among English speakers. Curiously, the storytelling revival as a way to convey values and knowledge has nothing to do with the art world and everything to do with the technology firm, IBM. In the 1990s, a group
of people that included Dave Snowden and Shawn Callahan started a project that could be defined as organizational anthropology called Cynefin Centre for Organisational Complexity. The people behind the initiative began to gather stories from IBM’s employees who numbered at that time around 300,000. These were then used to understand their culture and hence develop and promote projects.

Other companies, particularly American organizations such as the World Bank, were inspired by IBM’s initiative and this meant that, on leaving the company, each member of the Cynefin Center could set up their own consultancy based on Organizational Storytelling and become the evangelists of the movement.

This trend revived interest in storytelling; the consultants needed to work with professional storytellers for their projects. And so a group of storytellers was nurtured and, in the process, gained exposure for their activities such as story circles, performances, music nights and poetry.

So it was that 25 years ago, there was a wave of recognition that human beings have always told stories because stories are important for their social welfare. As Annette Simmons says of the information era, “We have all the data, now we need to see what it means.”

*When working on storytelling in a cultural context, the first job is to compile existing tales, both oral and written. These should then be labeled and filed away so they are available to whoever needs them.*

**Storytelling and culture**

Stories are essentially vehicles for culture. As such, they form a fundamental part of the cultural fabric of the whole community. All places, moments and objects that are important to a group of people have origin stories and additional stories that give them layers of meaning. These stories exist, even if we don’t listen to them or pass them on. When working on storytelling in a cultural context, the first job is to compile existing tales, both oral and written. These should then be labeled and filed away so they are available to whoever needs them as well as being on hand to enrich educational, touristic and cultural programs in general.

This work is already being carried out by organizations such as the Heritage Foundation of Newfoundland and Labrador in Canada through its Strategy for the Conservation and Maintenance of Intangible Heritage for Future Generations.

Compiling existing stories linked to physical elements of the heritage and sharing them to enhance their meaning is the first step towards working with storytelling in a cultural field.

However, when we approach this work armed with the latest technology and decide, for example, to build a new museum, we should consider what type of community we wish to create before designing the corresponding narrative world. Using this design, we will be able to consider the narrative’s relationship to the public and create experiences worth narrating. As an entity, we will stop being just a messenger and become a host who provides the table and initiates the conversation that our guests will continue.
Examples of storytelling in cultural terms

Storytelling in historical places

Both cultural tourism and tourism based on experiences is a growing market. There are many museums, city squares, parks and arts centers across the world where they tell stories, legends and other tales to illustrate the history of the location.

If the story can be defined as a compendium of dates, names, battles, treaties, appointments, marriages, laws and census information etc., it has all the elements that seem important to share with present and future generations. But the heritage adds value to the facts and as such is less tangible. It is, above all, a living thing.

Our stories, rather than relating the basic history of a place, suggest its value as a heritage. Though we may feel obliged to tell the truth, we don’t have to tell every truth about a place, only what is relevant, which means any truth that might answer the question, “And then?”

In this context, appropriate stories should include the following characteristics:

- They should be set in a specific period of history and deal with one or more real people.
- They should be based on facts or on personal memory.
- Rather than a history lesson, they should be an interpretation of a particular fact.

The Tale of a Town

The tale of a Town is a multimedia project with a strong theatrical component. Its aim is to capture Canada’s collective memory through the personal stories of members of the community.

A group travels across the country in a story-mobile (see image) that is basically a recording studio on wheels. In every town and city where they stop, they organize interviews with the locals. The resulting stories form the basis of plays that are performed in site-specific locations. The project will culminate in a multiplatform celebration in 2017 to commemorate the 150th anniversary of Canada’s independence.

http://www.nlunexplained.ca/2013/10/historical-storytelling-storytelling.html

http://thetaleofatown.com
Globe Theatre

The famous Shakespeare theatre in London offers a guided tour that brings it to life through theatrical stories from its heyday in the 16th century to its reconstruction in the 1990s and contemporary events.

A History of the World in 100 Objects

This is a 100-part series by Neil MacGregor, director of the British Museum, exploring world history from two million years ago to the present. Objects featured in the series can be explored and their stories discovered in the museum galleries or on the website or in the book of the same title or in the BBC TV series. The 100 objects in question take the viewer back in time and across the world to discover how humans have given form to our world and how this, in turn, has formed us. The objects are all pieces from the British Museum collection and include anything from a stone age tool to a credit card.

Backstories of the museum: the Twitter tale of the Thyssen-Bornemisza Museum and its director Guillermo Solana

http://www.shakespearesglobe.com
https://youtu.be/fiWhvUD7jjo

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Troy Library: Book Burning Party

Like many other cities and towns, the global economic crisis forced the city of Troy in Michigan, US, to cut public spending which meant the closing down of its public library. A closing date was set, though residents had the option to vote on August 2, 2011, on whether they were prepared to accept a tax hike of 0.7% to keep it open for another five years.

The only group that seemed happy about the imminent close of the library was an organization called Safeguarding American Families, which declared that it would celebrate with a book burning party. Posters were posted around the city urging residents to “Vote for the close of
the Troy library on August 2. Book Burning Party August 5th. The ones that were torn down, were quickly replaced. An advert for a clown and an ice cream seller to liven up the action were put in the local paper. A Facebook page was established and a Twitter account (“There are 200,000 reasons to close the Troy library. They’re called books”, it said, using the hashtag #BookBurningParty.

There was a furious response and comments were left on social media sites such as “You’re sick” and “This is horrible”, “Idiots” etc. The press and local public figures picked up on the story and ran with it.

However, just before the elections, Safeguarding American Families revealed that it had been a hoax and its real message was “A vote to close the public library is a vote to burn books”. The campaign was waged by the Leo Burnett agency whose aim was to shift the debate on taxes into the realm of the libraries. And it worked. On August 2, there was a 38% turnout and 58% of voters chose to pay more tax to keep the library open.

Streetmuseum (Museum of London)

Streetmuseum is a new augmented reality iPhone app created by the Museum of London in 2010 that allows you to browse historical photographs taken in various parts of the city. The app leads you to various locations around London using either the map or a GPS. Once there, the app will recognize the location and overlay the image on the phone’s camera with the historical photograph, offering a window to the past.

Museum of the Phantom City

The Phantom City Museum is a public art project that uses personal digital devices to transform the city into a living museum. The app shows design proposals that never came to fruition in various locations in New York City such as Buckminster Fuller’s dome that might have covered midtown Manhattan, the 10-storey helicopter landing pad that was designed to be built over Bryant Park or Michael Sorkin’s homeless housing proposal for West Side Railyards, to mention a few.

The art project explores how mobile technology can go further than traditional methods to transform the way we see the city. Inspired by the Situationists who convert ordinary
landscapes into strange settings, this wall-free museum broadens the cultural experience by encompassing the urban environment.

Find the Future: The Game (The New York Public Library)

Find the Future: The Game is a pioneering, interactive experience created especially for New York’s Public Library’s Centennial by famed game designer Jane McGonigal. It originated from an event called Write All Night on May 20, 2011, when players explored 70 kilometers of the library’s bookshelves and, using portable computers and smartphones, followed real and virtual clues about treasures such as the library’s copy of the Declaration of Independence. After finding the ‘treasure’, each of the 500 participants wrote a brief essay inspired by the hunt. These essays were then edited and the collection turned into a book on the future, which is now forms part of the library’s collection.

San Francisco Museum of Modern Art (SFMOMA) App

The SFMOMA has opened its doors again after an important refurbishment. But while it was closed, an interesting experiment was carried out called “museum out of the museum”, that involved organizing events in the city’s public spaces and collaborating with other art programs. The new app for visitors offers access to the museum's audio guides. These suggest a number of walks lasting between 15 to 45 minutes, with voices from Philippe Petit, Avery Trufelman, members of the SD Giants organization and actors from the HBO series, Silicon Valley. The audio guide can be synchronized and heard in a group simultaneously.

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The Pen

Cooper Hewitt launched a design competition to find a technological solution to increase the fun of a museum visit. The Pen invites visitors to learn about design by using a design tool themselves. The Pen, which looks like the stylus commonly used with tablets, is an invitation to interact with the museum pieces. Visitors also interact with the objects through NFC tags that allow you to snag digital information with a smartphone at short range.

The active element is stronger than a traditional museum app, making the experience truly participative for the visitor.

Using high definition tablets, visitors can explore and manipulate the objects that they have gathered with their Pen, discover objects related to the Cooper Hewitt collection, gather contextual information, learn more about the designers, design processes and materials, see and share videos and even draw their own designs.

Secret (and virtual) access to the Ann Frank House

Although this has been available for some years now (evident from the graphics used and the Flash programming), the chance to pay a virtual (and secret) visit to the Anne Frank House is still very appealing. You can explore the house with a 360° view while the audio guide offers anecdotes and fragments of Anne Frank’s diary.

Red Star Line Museum (Antwerp)

This museum is contained in the two harbor sheds that were used for medical examinations and administration for Red Star Line passengers until 1934.
It is designed in such a way that the visitor follows the same route as the two million migrants preparing to make their voyage to the US from Antwerp (the main European Port for the Red Star Line) between 1873 and 1934 – when the shipping company closed down. The itinerary includes the waiting room, the place where luggage was disinfected and the medical examination room.

The museum focuses on the personal stories of the Red Star Line passengers, and the city and port where they came from. But it is also dedicated to the history of human migration as a whole. Hence, visitors are invited to share their own stories and photos related to migration, which are then included in the intangible heritage archive and shared both on and offline: http://www.redstarline.be/en/page/help-write-story-red-star-line-museum

National Leprechaun Museum (Dublin)

This museum is dedicated to the leprechaun, a naughty bearded fairy in Irish mythology and folklore.

The museum’s layout represents 12 chapters of a story that refers to Ireland’s culture identity. Each chapter reflects the mythology of a specific place or recreates experiences typically associated with leprechauns. The result is a series of interactive experiences that relate the leprechaun’s story – from the first ever sighting back in the eighth century, through to modern day representations of the leprechaun in film and popular culture – and plenty of adventures in between.

The Bayview Project. MoAD (Museum of the African Diaspora)

At the start of the 1940s, thousands of African Americans migrated to the historic Bayview-Hunters Points neighborhood in San Francisco. They came from all over the US in a bid to change their lives in the docks surrounding the Bay. During the Second Great Migration of African Americans from the South (1940-1970), more people chose to move to Bayview. The neighborhood offered a sunny climate and appealing work in the shipbuilding industry for people who dreamed of a better life for themselves and their families.

This collection of oral stories (both audio and written) explores a legacy of rare stories for the next generation, offering a unique glimpse of the lives of pioneering African American residents who settled in Bayview-Hunters Point, San Francisco.
**Girl with a Pearl Earring**  
(painting, novel and film)

Fiction can also be useful for injecting culture with layers of meaning. Certainly, this is the case with the historical novel, *Girl with a Pearl Earring*, written in 1999 by Tracy Chevalier and turned into a film by Peter Webber in 2003 and then into a play by David Joss Buckley in 2008.

The novel was inspired by the painting of the same name by Johannes Vermeer and the author explains how she would gaze at a poster of Vermeer’s painting, which she hung in her bedroom, and wonder what had led Vermeer to paint her like that. “There was a story there that was worth telling,” she says.

So one of the most valuable paintings provided Chevalier with her plot. Who is the model and why did Vermeer paint her? What is she thinking as she looks out of the painting? Are her large eyes and enigmatic smile innocent or seductive? And why is she wearing a pearl earring?

The novel is set in Delft in Holland where the painter lived and, through fiction, Chevalier describes the circumstances that gave rise to the painting. But the story goes beyond the dates and details of the Vermeer’s life and the era he lived in, to offer a context that shines a different light on the masterpiece.

**Loving Vincent**


Official site: http://join.lovingvincent.com

Trailer: https://www.youtube.com/watch?v=47h6pQ6StCk

Our painters talk about his work in Loving Vincent: https://youtu.be/1Vie6j_wxgQ

Here you can watch the artists painting each frame in oils on canvas: https://youtu.be/iw9KqtYCsZQ

*Loving Vincent* (2017) is an animated film by Dorota Kobiela and Hugh Welchman. The film is unique in that it consists only of oil paintings – 65,000 frames in total, all painted by hand.

**Työväenasuntomuseo**

The Worker Housing Museum in Alppila, Finland, features small rooms depicting the history of daily life for working-class residents in Helsinki at the start of the 20th century.

The museum operates in one of the oldest wooden houses built by the City of Helsinki for its workers. Nine stove rooms have been decorated to represent homes in various eras. The masonry stoves, washing commodes and
retractable beds, gramophones and electric lights describe the evolution of the lives of working-class families in Finland.

The museum has a strict no-photo policy as the museum authorities believe spoilers detract from the visitor’s experience.

However, this policy was relaxed on December 6, 2014, when cameras were admitted. For only one night, participants of what was dubbed the Snapshot event were allowed to document the museum’s re-created homes and historic German beer saloon.

The no-photo and guided-tours-only policy helps to pump up visitor expectations while events such as Snapshot are designed to create an aura of exclusivity.

**Taüll 1123**

The Romanesque paintings of the Sant Climent de Taüll church in Lleida are among the most important examples of Catalan Romanesque art. The original frescos from 12th century BC are preserved in the National Art Museum of Catalonia in Barcelona (MNAC).

The church used to have a copy of the originals painted on a plaster surface that was in a state of deterioration. After removing the old copy, a meticulous restoration process was carried out to uncover the remains of the original paintings that had been preserved deep within the layers of the walls of the apse recess.

An innovation technique of video mapping now not only virtually restores the paintings to their optimum state, but reproduces the process...
through which they were created. The projected image has been designed in a precise shape that fits perfectly with the original remains still present in the church, and the soundtrack transports us to the era in which they were painted.

**Ullastret 3D**

The Puig de Sant Andreu Iberian settlement in Ullastret (Baix Empordà, Girona) is considered to be Catalonia’s largest Iberian city.

Multiple archeological digs have taken place here in recent years and a series of geophysical surveys to uncover the city’s layout as well as the design of its walls and moat have also been carried out.

The resulting impression is very different from what had previously been imagined and in order to share it, an immersive reality projection was built of the entire city in 3D.

Thanks to a sort of ‘magic box’ room, the visitor can walk through the streets and into the houses of the Iberian city as it was 2,000 years ago.

A six-minute audiovisual offers a dream-like trip through the Iberian city while its history is told by an actor in the role of a member of the city’s elite who recalls the most dramatic moments of his life. To add to the intensity of the experience, the surrounding area has been scattered with materials used in that period and a soundtrack reproduces the noises that would have been common in those days.

**Museum of Broken Relationships**

The Museum of Broken Relationships is both a physical and virtual public space created for the sole purpose of treasuring and sharing heartbreak stories and symbolic possessions. It is a museum about you, about us, about the ways we love and lose. It is brilliantly simple as an ode to personal life.

**Museum of the Bible**

The Museum of the Bible in Washington DC is still in the process of construction, but will open this year.

Its layout is designed to provide visitors with an immersive and personalized experience as they explore the narrative, history and impact of the Bible.
The Narrative Floor promises an immersive experience involving all the senses.

The History Floor will exhibit archeological finds through modern cinematographic narrative to bring the Bible to life.

The Impact Floor will explore the effect the Bible has had on different cultures, civilizations and daily life over the centuries, including its powerful influence on art, science and politics. This floor will be technologically advanced and interactive, inviting guests to share their own stories.

The layout of the museum corresponds almost perfectly to the layers we go through when we listen to – or read – a story; we feel and grasp the plot or structure; we reflect on the message and we link it to our own experience.

Bosch. A story in pictures.
Prado Museum

The Prado Museum offers an interactive resource to accompany its Bosch exhibition. Through so-called ‘scrollytelling’, a time line charts the painter’s life with text boxes and illustrates it with fragments of the paintings in the exhibition. It’s a wonderful play on ‘Did you know?’ that adds an interesting angle to the visit.

Future tendencies

Storytelling trends in a cultural context are obviously related to technological developments, although they are also linked to experiences and the personalization of these experiences. The public will increasingly want more autonomy and power of decision over where, how and when to connect to the different levels of storytelling.

The public will increasingly want more autonomy and power of decision over where, how and when to connect to the different levels of storytelling.

The most important trends:

- The diffusion of experiences through transmedia storytelling (the use of different mediums) linked to the need to transcend physical locations in order to have contact with different cultural realities – such as archeological sites, museums and
historical buildings – and the move to set up franchises.

- The creation of narrative universes that define themes, genre, inherent rules, characters and scenes.18

- Cultural entities as platforms and hubs with an interwoven multiplatform/ multi-channel of content.

- A return to a communication model based on dialogue; a return to ‘we’ and the concept of sharing. Content that requires public participation.

- Personalized and increasingly interactive experiences.

- Experiences immersed in a reality that touches on all the senses.

- A growing use of augmented reality (AR), mobile reality (MR) and virtual reality (VR).

- Gamification

- Personalizing experience.

Finally, it’s possible and even probable that ways of enjoying culture without the use of a screen, audio tools and other extra content will emerge. Something akin to a return to silence.

Conclusion

Stories have been an important cultural, emotional and spiritual vehicle throughout history and will continue to be so for centuries to come.

In the field of culture, as in other fields, technology has supplanted the oral tradition for presenting stories. Like humans, storytelling doesn’t change, it simply evolves.

Reading


https://objectethnography.wordpress.com


http://show-and-tell-project.blogspot.com.es

http://themuseumofthefuture.com/tag/storytelling/

https://www.museumnext.com/conference_history/geneva_museum_conference/


Notes

1. The National Storytelling Network is an American association that represents professionals in the field of narration. It was founded in 1975 and spreads the art of storytelling through promotion, advocacy and education in the US. Although it is neither a professional guild with the legal significance that implies nor a global organization, due to the size of its membership and its influence, it has become a point of reference around the world for storytelling. http://www.storynet.org/resources/whatisstorytelling.html


4. http://www.unesco.org/culture/ich/es/conveni%C3%B3n


10. Shannon Ryan, “The Personal Experience Narrator as Historian: The First Time Andy Short was Shipwrecked”, Newfoundland Quarterly 73.2 (1977), pp. 4-5.


17. http://www.imdb.com/title/tt3262342/fullcredits?ref_=tt拇l_1

BIG DATA IN THE DIGITAL HUMANITIES. NEW CONVERSATIONS IN THE GLOBAL ACADEMIC CONTEXT

Antonio Rojas Castro

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Introduction

Christmas 2016. A perfect time to think back, sum up and publish lists of the main events of the year. Google Trends published the most popular searches grouped into categories such as “News”, “People”, “Technology”, “Films”, “Music”, “Sport” and “Deaths”. A few days earlier the Swedish company Spotify, which provides online access to millions of songs, launched an advertising campaign based on data produced by users. Some of the huge posters plastered all over the streets of London display messages such as: “Dear person who played ‘Sorry’ 42 times on Valentine’s Day, what did you do?”; or “Dear 3,749 people who streamed ‘It’s the End of the World as We Know It’ the day of the Brexit vote, hang in there.”

Spotify’s campaign is both surprising and effective because it plays on the viewer’s engagement. But what has all this got to do with the humanistic disciplines that study documents, texts and images of the past? Or, in other words, how can handling the large amount of data amassed by companies help us gain a better understanding of the limits of our thought, language and historical events – basically all the expressions of our human mind?

If we accept that humanistic disciplines such as philosophy, philology and history are characterised not only by a specific object of study but also by a method that seeks to understand particular, unusual and even unique cases through text commentary, then the answer will no doubt be negative: “nothing, or very little”. However, as Professor Rens Bod (2013) recently argued, since antiquity humanists have also sought general principles, laws and patterns to explain our culture, and have often (for good or for bad) changed how we perceive the world.

We should begin by dismissing certain clichés about the humanities and ask ourselves about their classic objects of study, bearing in mind the methods that are currently available. This requirement is not unrelated to the work of humanists, who have always been in contact with other fringe disciplines such as anthropology, Marxism and gender studies. Indeed, in recent years humanists have established a fruitful dialogue with computer studies and the social sciences – which has been called a “computational turn” (Berry, 2011). In this academic context, the expression “Big Data” has directly found its way into debates on “scale” – how can we study all the eighteenth- and nineteenth-century novels written in England, France, Germany, the United States or Japan?; or, more commonly, in a cross-cutting way through concepts more familiar to humanists, such as “distant reading” (Moretti, 2007) or “macroanalysis” (Jockers, 2013).

Humanistic disciplines such as philosophy, philology and history are characterised not only by a specific object of study but also by a method that seeks to understand particular, unusual and even unique cases through text commentary.

These changes have been made possible by the fact that statistical and computing methods, as well as other methods related to the social sciences, have been modified and have succeeded in adapting their conceptual models to the complexity of texts (English and Underwood, 2016). In other words, we are dealing with a genuine conversation in which the various interlocutors talk and listen to each other.

Concerning the particular in the universal

The expression “Big Data” has been spreading in the experimental sciences and the media since 2011, as if an increased amount of available data were the next scientific breakthrough. The term is used in academia, industry and the media... but what exactly does it mean? Is it an object of study, a method, a group of technologies or a discipline?
One of the few articles to have shed some light on the matter is entitled “Undefined by Data: A Survey of Big Data Definitions”. The authors (Ward and Barker, 2013) collate the various definitions of “Big Data” provided by major technology companies like Oracle, Intel and Microsoft and a few previous reports. In general, the definitions combine two important ideas: storage of a large volume of data (some authors speak of 500 Terabytes per week); and analysing this data quantitatively and visually to find patterns, establish laws and predict conduct.

The classic definition of “Big Data” is a formula that is easy to understand and memorise – the three Vs: Volume (Terabytes, Petabytes, Exabytes), Velocity (data that is constantly generated) and Variety (texts, images, sounds) (Ward and Barker, 2013). Some reports have subsequently added a fourth V, which stands for the term Veracity. Though this volume-based definition of Big Data only makes sense if we consider blogs, the social media and sensors to be main sources of data.

In contrast, the classic object of study of the humanities is usually texts and analogue images which have fortunately been digitised and published in computer-legible format. In other words, if we take the three Vs as a basis, we have to admit that we cannot speak of Big Data in the strict sense in the humanities. For one thing, the classic works of Spanish Golden Age poetry fit into a 4GB pen drive; for another, archives and libraries do not constantly produce new data and at a high speed on our poets, writers or artists (or rather, this data is not accessible to researchers). As for variety, we are dealing with image files in TIFF, JPEG or another similar format, and semi-structured text in XML format or, without markup, in TXT format.

Before the advent of Google Books in 2004, digital humanists worked to digitise corpuses of texts and images in the form of digital editions, libraries and files. The European Association for Digital Humanities (EADH) provides a good example of the type of projects carried out. Since 2015, the association has devoted a space on its website to documenting and promoting access to European Digital Humanities projects conducted in the past five years. The initiative is participatory in nature because any researcher (whether or not they belong to the association) can fill in the form available on the website and submit a description of their project providing details of the name of the project, a descriptive summary, collaborating institutions or the team in charge, among other fields. So far, at the time of writing this article, the association has received 175 submissions. If the titles and summaries are analysed with Voyant, a tool for counting the most frequently used words, it is easy to see that the projects abound in words related to the subject of this article, such as “data”, “information” and “database”, and others that denote the scale or size of the project, including “archive”, “collection”, “platform” and “library”.

The current state of the Digital Humanities in Europe can be gauged by three aspects: projects, tools and research groups. Prominent among the projects for making digital texts available online are Oxford Text Archive, Deutsche TextArchive, Eighteenth-Century Poetry Archive, and DigiLibt. Tools for textual analysis include Alcide, CATMA and Stylo R. Infrastructure and research groups such as CLARIN, CLiGS and Electronic Text Reuse Acquisition Project are also important. These initiatives use algorithms to attribute authorship of texts (Burrows, 2002), discover latent themes underlying a large group of texts (Blei, 2012), or detect cases of intertextuality in several authors’ literary output (Ganascia, Glaudes and Del Lungo, 2015). Suffice it to say...
that many of these procedures are comparable to automatic image processing (Rosado, 2015).

The ultimate aim is usually to find patterns that help understand literary and artistic creations. But text commentary – close reading – continues to play an important role even when statistical methods are used to analyse texts, because researchers shift their attention from the whole to the detail and from the detail to the whole to check that their ideas about the work are correct and accordingly gain a better understanding of the different layers of meaning, the central themes, the events and the style. Put another way, distant reading and close reading are not mutually exclusive because researchers usually combine both strategies: they first gain an overview and then filter and examine the details for a deep comprehension. They usually complete their analysis with visualisations of information in the form of marginal annotations, parallel texts that are connected in some way (colours, density, contrast between form and substance, arrows) or more abstract structures like maps, trees and graphs (Jänicke, Franzini, Cheema and Scheuermann, 2015).

In the humanities we can only speak of Big Data in connection with the technologies associated with this phenomenon, such as data mining, stylometry or natural language processing.

To sum up, although the volume of data is not comparable to that currently generated by the social media, blogs and major companies, in the humanities (and specifically in literary studies) we can only speak of Big Data in connection with the technologies associated with this phenomenon, such as data mining, stylometry or natural language processing.

Data as a human construction

The conversation between the humanities and Big Data does not merely boil down to adopting algorithms for studying large holdings of texts and images quantitatively. Indeed, digital humanists have played an active part in the debates on the nature of data.

In a context in which data is equated with objective, irrefutable evidence, it is constantly stated that data is in fact a human construction; that is, it is conditioned by the time, place, language and ideology of the actors involved in gathering it. For example, the researcher Johanna Drucker (2011) rejects the term “data” – Latin for “that which is given to us” – and uses instead the term “capta” meaning “that which has been taken or collected”; evidently this critical intervention highlights the impartial and incomplete nature of data.

Digital humanists have also stressed the temporality of data – for all data has a date of creation and expiry – and the fallacy of separating data from metadata (that is, data such as title, maker, theme, description, date, format, identifier, source, language, etc.). Actually there is no such thing as second-grade data, as embodied by the root meta; metadata is just as important, selective and impartial as data because it is produced by humans (or rather by algorithms designed by human beings). Equally invalid is the distinction – which dates back to Lévi-Strauss’s culinary triangle – between “raw data” and “cooked data” or between “data”, “raw material” and “information”.

Indeed, for researchers like Tom Boellstorff (2013), data is dense, interpretative and contextual, and it is therefore preferable to speak of “thick data”. Paraphrasing the anthropologist Clifford Geertz, data should be regarded as “our own constructions of other people’s constructions” of objects imagined by a particular community.

For example, the Text Encoding Initiative is a non-profit organisation that publishes Recommendations on how to encode humanistic texts with XML markup language so that they
are interchangeable and, more or less, standard. It is a participatory organisation in which any researcher can suggest changes or improvements based on their experience to the set of labels defined by the consortium. Up until 2012, however, none of its members had questioned the fact that the label <sex> for describing the sex of a person mentioned in a text complied with standard ISO/IEC 5218:2004 and that the attributes (@value) were given as single-digit codes 1 (male), 2 (female), 9 (not applicable) and 0 (not known).

The situation was re-examined when a female researcher pointed out that this typology was sexist, as it put women in second place with respect to men, and codified patriarchal structures with markup language (Terras, 2013). With this I do not wish to detract from the importance of the TEI, especially in giving shape to the Digital Humanities, but rather to stress that technology, data, algorithms and standards are the product of an interpretation of the world and bear cultural marks. In conclusion, data should not be viewed as absolute truths but be questioned critically.

Our cultural heritage is not fully digitised, despite the collective efforts of initiatives like Europeana. Only 23% of European collections have currently been digitised.

In defence of theory

In literature on Big Data it is also common to find that theory is discredited. The argument is basically as follows: if we have large amounts of data and effective statistical methods, we do not need theories, models and hypotheses, which need to be proven or refuted with experiments. Put another way, in the era of the Petabyte, scientific method is obsolete (Anderson, 2008). The dismissal of theories and models has not only been given credit in the business world, but it has also been accepted in a few humanistic writings. Jean-Gabriel Ganascia (2015: 632–33), for example, claims that a theory or previous hypothesis is no longer necessary if we analyse all the existing data as opposed to a sample or small group, as has been done so far.

In contrast to this viewpoint, a considerable number of writings have confirmed the importance of theories, models and hypotheses for research. It should be remembered that our cultural heritage (documents, texts, paintings, images, sounds) is not fully digitised, despite the collective efforts of initiatives like Europeana. According to the latest report issued by the European Commission project ENUMERATE (Nauta and Wietske, 2015), only 23% of European collections have currently been digitised. The survey was answered by some 1,000 European institutions including libraries, museums and archives. These institutions have yet to digitise some 50% of their collections and admit that about 27% of their holdings will not be digitised. These figures highlight the fact that much of our heritage is not accessible on the internet.

Digitisation always involves making a selection based on the resources available to the institution or working group in charge of digitising the documents; but this selection furthermore stems from ideological and identity reasons. It should not be forgotten that museums, libraries and archives are publicly funded institutions and their role is to preserve and disseminate the cultural heritage of a community (for example, a nation). In addition, formats, markup languages and algorithms are also part of a particular culture and ideology and go hand in hand with many assumptions that vary depending on the context.

From a humanistic viewpoint, it is thus hard to believe that analysing large amounts of data could renders scientific method useless, because we never have all the existing data – one of the vectors of Big Data is the Velocity with which new data is generated – because the data is
The connection between the external object (for example, an epigraphic inscription) and the representation (a 3D reconstruction that allows the tombstone to be viewed from various angles and in greater detail) is based on similarity; it is therefore important to place reflection on “modelling” in context of the tradition of semiotics and the science of signs (Ciula and Eder, 2016). Naturally there are different degrees of similarity; the relationship can range from total likeness to metaphor, including a certain similarity between the properties of the object represented and the digital representation.

Digital models are thus icons that help us think and learn more about the original, the analogue object and the process of modelling is influenced by contextual elements.

Indeed, a few authors argue that theories and models are even more important in the era of Big Data because it is necessary to explain and understand the phenomena analysed through abstractions. In the Digital Humanities the concept of “model” is very widespread because it helps explain the core of digitisation work. Models are taken as tools, schemes or designs used in a specific context for particular purposes that are sometimes practical (to make a group of texts available online), but are often, especially in the academic field, speculative (to understand the structure of texts). More than the finished product, what matters in the Digital Humanities is the creative process that takes place when a phenomenon is “modelled”, because the aim is to gain new knowledge, new meanings, by generating an external object that represents it.

Digital models are thus icons that help us think and learn more about the original, the analogue object. This type of thought has been described as “abduction”, because it stands somewhere between induction and deduction and is based on the intuition and experience of the person who “models” (Bryant and Raja, 2014). In other words, the process of modelling is influenced by contextual elements such as starting hypotheses, theoretical assumptions, scientific methods, formats and technologies.
Nevertheless, this type of data is not accessible because municipal libraries have a long tradition of data protection (Starr, 2004). They do, however, publish lists of the most frequently borrowed books which function as indicators of contemporary taste. In order to be studied, this data would have to be published in an open format like XML or CSV and include a series of metadata such as the place and time of the loan, but such practices would encroach on users’ privacy.

For researchers interested in reading habits, enjoying access to so much data would be a breakthrough. For example, it would be possible to ascertain how films, television and advertising influence people’s tastes and reading habits. Manufacturers of electronic books, for example, are already using reading statistics to discover which books can be regarded as good – because readers finish them – despite not being best sellers; or to identify the next Dan Brown based on readers’ degree of satisfaction with books written by unknown authors (Kobo, 2014). Basically, all the data generated by our electronic books is amassed by publishing companies to learn more about the relationship between sales and customer satisfaction; this makes it easier to justify economic decisions about the publishing future of a particular author, literary saga or genre.

By this I do not mean to imply that public libraries and museums should act in the same way as companies. I merely wish to point out that the state of being watched existed before the social media – just as spaces of resistance did. Just as companies like Twitter have been accused of exerting coercive power over research in the social sciences (Reichert, 2015), we should ask ourselves how humanists can study citizens’ cultural habits, in constant dialogue with libraries and museums and using methods to anonymise data. In my view, we should aim to ensure that companies like Spotify and Amazon do not know more about a particular society – about our tastes, interests and moods – than its own members do.

Inside the Panopticon

The constant production of large amounts of data in real time through the social media also has a sinister counterpart. It is not unusual for Big Data to be compared to Big Brother or, better still, to the Panopticon – a type of penitentiary building devised by Jeremy Bentham in the eighteenth century which creates the sensation of being constantly watched – especially in the wake of the Edward Snowden case. Governments monitor citizens to ensure their security; this is by no means new and is part of the history of power structures studied by Michel Foucault, among others. In the modern state people are watched and, at the same time, encouraged to reveal their deepest secrets through confession, psychoanalytical therapy or, nowadays, by posting their “statuses” on Facebook.

As we have seen, the object of study of the humanities tends to be external, autonomous and finished – a historical document, a literary text, a visual representation – and research therefore does not usually pose ethical dilemmas on the privacy of creators and recipients. However, as consumers of culture, our acts are registered every time we search for a book, film or song on the internet, and when we click on a product and buy it; the same is true when we visit a museum – the surveillance camera is there to protect our heritage from crime and theft, but also to keep check of visitors; lastly, when we borrow a book from a public library a record is created in the database.

We should ask ourselves how humanists can study citizens’ cultural habits, in constant dialogue with libraries and museums and using methods to anonymise data.

The case of public libraries is particularly interesting because they are a type of neighbourhood infrastructure accessible to everyone regardless of their economic status. Librarians record all loans, noting the date and borrower, in their databases.
Conclusions

Since 2011 the expression “Big Data” has been widely used in the experimental sciences and the media as if the increased amount of available data were the next scientific breakthrough. Although there is plenty of hype, the humanities have not been unaffected by this phenomenon; very specifically, although the digitisation of our cultural heritage is incomplete, several publications can be found which enter into conversation with Big Data and the social sciences. In European academia, there are many notable projects that process large amounts of data in order to study language, literature or art using techniques such as Natural Language Processing, automatic computer vision, topic modelling and stylometry.

After analysing the meaning of the expression “Big Data”, this article highlights the cultural nature of data and defends the validity of theories, models and hypotheses for carrying out scientific research. Lastly, it discusses the dialectic between privacy and control. In a sense, this issue escapes the traditional field of the humanities, but it also deserves our attention as twenty-first-century citizens interested in the cultural practices of the present. Humanists no doubt have much to contribute to ethical and epistemological debates on the use of the data generated by citizens, recalling the “captured” and cultural nature of data, and bringing their experience to analysing particular cases bearing in mind the general context.

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THE INTERNET OF THINGS: THE DEFINITIVE REVOLUTION IN ART, LEISURE AND CULTURE IN THE 21ST CENTURY

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Introduction

The Internet of Things (IoT) embodies a concept that is intended to reflect the deep transformation and radical shift in paradigm that our way of life is undergoing in our homes, cities and working environments. We are witnessing a technological leap that directly affects how mankind addresses challenges. Basically, the Internet of Things will revolutionise our conception of the world and how we interact with it.

The term “Internet of Things” is not new and could be defined simply as a group of smart devices (cars, fitness trackers, TVs, etc.) fitted with sensors, software and electronics and that enable them to connect to a network and store and exchange data. Although the Internet of Things is already a reality, it is merely the beginning of a social, economic and cultural transformation that is shaking the foundations of mankind. This article will examine in detail the new concepts and trends such as Smart Cities, Mixed Reality, Chatbots, Augmented Human, Internet of Body and Accelerated Learning and how they are changing our understanding of art, leisure and culture.

The Internet of Things (IoT) embodies a concept that is intended to reflect the deep transformation and radical shift in paradigm that our way of life is undergoing in our homes, cities and working environments.

These advances will enable us to develop our capabilities further than we had ever dreamed of. But these changes also pose new challenges to our society and how we relate to each other. Indeed, the metamorphosis is so profound that there is already talk of the new “Technological Revolution” that will also extend to culture, leisure and art. New ways of expressing our creativity and inventiveness are being developed day by day.

We increasingly hear about new technologies and gadgets that have come onto the market – devices and apps that make life, work and daily tasks simpler. The next stage of technological evolution is for us to adapt all the tools already in use (among others, smartphones and tablets) to more intuitive means of communicating with the technological environment.

It is evident that this evolution will transform existing industries, but it will also give rise to new business models. We will not only witness changes in the industrial and health sectors, but also in industries focused on design, fashion and, in particular, art.

Art and the Internet of Things

Since the very origins of mankind, art is what has set us apart from other species. The cave paintings, which date from forty thousand years ago, still amaze us today on account of their expressive force. Since then, artists have sought different ways of expressing both their inner world and their environment, and they have shown particular interest in people who made an impact on others’ lives.

The advent of the internet and new technologies has had a twofold effect. For one thing, they enable artists to reach bigger audiences, cutting promotion costs, and to enjoy easy access to anywhere in the world. For example, local artists who create great works or establish an impactful style can easily gain international recognition if they share their works on the social media and can sell them in all corners of the planet.

The ability to transform any physical object into digital furthermore makes it possible to build emotional links between users. Incorporating digital links into works leads to the exploration of new ways in which they can interact with the people who go up close to view or experience them. This is where the difference lies: we are going to be able to feel, share or contribute to works that are influenced by the IoT.
The start-up of the “Bemoir” project (http://bemoir.com/) was prompted by the revolution of the Internet of Things to come. Its technology enables each artwork to “tell its own story”. Artists can create a unique digital identity or avatar, upload their work, and incorporate a multimedia element into each piece. The ability to associate additional information with objects allows artists to tell the story behind each piece, so that a direct link is established between their work and visitors.

Current situation

The number of internet-connected devices in use is set to triple from the current 10 billion to 34 billion by 2020. Of them, 24 billion will be IoT devices and the rest traditional computer devices (smartphones, tablets, etc.). In terms of economic potential, we are talking about nearly six billion dollars that will be spent on IoT solutions over the next five years.

The number of internet-connected devices in use is set to triple by 2020, in terms of economic potential, we are talking about nearly six billion dollars that will be spent on IoT solutions over the next five years.

It is an evident fact that everything will be connected; indeed, in many cases it already is: people wearing sportables, homes, cars, cities, factories... nothing will escape this hyperconnectivity. Converting an everyday object into one that is smart is seemingly straightforward: take, for example, an umbrella. If we fit it with an Intel Curie chip, it will be able to connect to the internet and to process information from the sensors we can also incorporate. Once it is connected, we can find out the weather forecast in real time. If rain is forecasted, when it detects movement a red light will come on telling us to take it with us to avoid getting wet. We have just turned an ordinary umbrella into a smart umbrella.

So far so easy, but in order for an object to qualify as part of the IoT universe, it must meet a number of requisites:

- The device must be fitted with sensors that gather information about the surroundings: for example, a push-button, a gyroscope, a thermometer, a gas detector or proximity sensor.
- It must be able to connect to the Web: the data that is gathered needs to be sent to a digital platform to be processed and can use any of the existing communication technologies: NFC, 4G, 5G, Wi-Fi, Bluetooth, etc.
- All this information must be used for a purpose: it can be sent to a smartphone app to help the user make a decision or to a Machine Learning system to increase or reduce the production of an industrial plant; or, in the case of a patient monitoring system, it can used to send a warning to a hospital ward.

In short, the device must have sensors and communication and decide on a process. The current systems allow many manufacturers to convert everyday objects into smart ones, ranging from forks that measure the calories we ingest or mirrors that reflect the traffic and recommend an early morning route while analysing our mood, to smart cars that enable us to arrive at our destination without having to pay attention to the road, while we carry on reading our favourite magazine.

But the IoT goes further than objects of this kind and is allowing us to start building wider solutions, broadening the scope of influence and generating synergies between devices and the information they exchange. We already have smart homes, which are beginning to be managed by devices with artificial intelligence (AI) such as Google Home and Amazon Echo.

On a larger scale, there are smart cities capable of managing pollution and water quality or traffic...
by regulating traffic lights or parking spaces in real time. This concept has given rise to curious projects such as “Pigeon Air Patrol”, whereby a group of geniuses (or madmen, depending on how you look at it) strapped sensors that measure air quality in real time onto pigeons in cities like London and Los Angeles. This information is processed and sent to the related app so that users receive a report on air pollution in their neighbourhood every morning. Another example, further away from cities, is crop fields where there are drones that survey the state of the crops, sensors that measure soil dryness and robots that analyse leaves in search of pests.

Our lives are starting to change as a result of all this information and all these devices, though, like any self-respecting revolution, it has started out being almost invisible. Aside from the impact it may have on how we work or communicate with friends and relatives, it will also affect leisure.

Institutions and promoters are exploring new ways of getting artistic content to consumers. Artists themselves, who in their quest for creativity seek new means of expressing their emotions in their works, have at last found a technology that allows them to reach more users and, more importantly, amaze them. For make no mistake, in today’s world hyperconnectivity and information overload are making it harder and harder to surprise us.

What the IoT can contribute to art and culture

Artists constantly come up against obstacles in their attempts to make known their traditional works and gain due recognition. If things continue as they are at present, the art market will shrink. Could the Internet of Things be the solution?

Artists will seek, in their quest for creativity, new means of expressing their emotions in their works, with a technology that allows them to reach more users and, more importantly, amaze them.

We cannot lose sight of the fact that one of the greatest risks posed by the use of new technologies is that they could do away with intellectual property rights and increase the risk of plagiarism. Some artists are lagging behind owing to their inability to adapt to such a changing environment, but the advent of IoT technology, far from being a disadvantage, is an opportunity, as it will allow them to create unique works that interact with the users who visit them and make a worldwide impact.

What the IoT offers artists: opportunities

The Internet of Things can provide artists with new opportunities. For one thing, evolved and hyperconnected artworks can fetch higher prices. For another, each artist can create a unique work by incorporating new ways of interaction, raising the quality of their work and minimising the possibilities of fraudulent practices.

Let us take a look at a few examples of the so-called “Network Art” or interactive art, which makes it possible to share emotions or moods in artworks by accessing information from anywhere in the world:
1) eCLOUD project

Installed in San José International Airport, eCLOUD is a permanent artwork by Aaron Koblin, Nik Hafermaas and Dan Goods. It is built from 3,000 LTI SmartGlass liquid crystal panels, each of which is capable of changing colour in accordance with meteorological data gathered on more than a hundred cities. The information is received from the NOAA (National Oceanic and Atmospheric Administration) and is used to create a simulation of the climate of any city in the world by activating and deactivating the individual panels based on a particular pattern.

http://www.aaronkoblin.com/project/ecloud/

2) Living Light

Designed by Soo-in Yang and David Benjamin, Living Light is a project consisting of a huge map whose panels represent the districts of Seoul. Every fifteen minutes the panels light up in order of best to worst air quality, based on twenty-seven sensors that relay information from the Korean environment ministry in real time. What is more, passers-by can send messages to the “work” to check pollution data for their district.

3) Waves

Artist Matt Roberts has designed a piece called Waves, which responds to changing sea conditions. Every half-hour data is downloaded from an ocean buoy located near where the work is installed and transformed into a low-frequency sound wave. As the size and movement of ocean waves constantly change, so does the frequency of the sound waves they produce. The system sends the waves to a loudspeaker and then projects the received image of the wave on a wall.

To gain an understanding of the new cultural possibilities this technology offers theatres, cinemas and museums, we will begin by examining its impact on the cities that host all these spaces.

Smart cities and their cultural offering

A smart city is a new concept whereby the local or municipal government encourages the use of information systems and technologies to create an infrastructure that helps boost operational efficiency and disseminate information to residents and visitors, at the same time improving the quality of public services. These services include transport, traffic management, energy, health, water and also the management of leisure, tourism and culture.

Managers of major cities are beginning to use more and more technology such as sensors, management systems and advanced data analysis tools to monitor and analyse traffic patterns, energy consumption and the use of public transport, among other aspects.

The concept of smart city invites people, tourists, academics, local authorities, architects and town planners to create new ways of transforming the city. Applications using these technologies modify areas of the city and the related services, establishing artistic and cultural districts with a critical mass of art galleries, cinemas and concert halls, public places for hosting performances, restaurants, cafés and shops.

They are also an attraction for talented artists and innovative companies, who convert the...
Cities will become thriving and highly creative places, promoting interaction and “citizen participation”, as smart city is nothing without its citizens.

In the Arab Emirates a “happiness measure” has been created which records digital input from citizens and tourists on their reactions to and interactions with the various elements of the city. For example, it is being used to evaluate the cleanliness of the streets and the efficiency of public services.

The step prior to arriving in cultural spaces begins in peoples’ homes. How do we plan our consumption of leisure and culture from home?

Smart homes

The science-fiction view of a high-tech, connected home is rapidly becoming a reality: Amazon and Google have already launched smart assistants and Apple is rumoured to be about to bring out its own system based on the Framework HomeKit.

Amazon Echo is a loudspeaker with a personal assistant called Alexa. It acts as a control centre for all the devices installed in a smart home, including light bulbs, thermostat, sensors, alarms, background music and home appliances. Google launched a similar device of its own called Google Home.

Voice command systems allow users to ask questions and control their IoT devices merely by giving voice commands. Behind all these devices are chatbots, software that simulates human conversation (or writing) through artificial intelligence. This service supports people’s needs and is employed chiefly for specific purposes such as customer services centres and health services, or for entertainment.

These systems use the voice or natural language to improve interaction with users. Instead of clicking on buttons on a website or mobile app, you can perform operations simply by chatting and asking questions like “What films are on tonight?”, “Can you book two tickets for the opera this Saturday?”, or “What are the final football league standings?”

A few examples of their use for entertainment purposes are listed below:

Disney created an official bot of Judy Hopps, one of its main digital characters, on Facebook to promote the release of the film *Zootopia*. Users helped Judy Hopps solve cases and could chat to her and ask her about the film.

Domino’s Pizza has launched a service that ensures that users can get a pizza anywhere and at any time. They can order from the Amazon Echo chatbot, Facebook Messenger, Twitter, smartwatches and smart cars.

Now that we have our ticket for the cinema or theatre, which we have bought from home using a smart device, we can enjoy the experience.

Smart cinemas & smart theatres

Although major progress is beginning to be made in the world of entertainment, the fact is
that, with the advent of the Internet of Things, limitations and barriers are beginning to be overcome. Future innovations in the cinema and theatre are becoming increasingly feasible. These innovations include dancing drones, actors who transmit data in the form of emotions, one-to-one interactions, flash mobs and virtual reality shows, among others. Everything will be possible from now on.

One of the future trends is immersion in films – even being able to experience certain parts of them. For example, the Subpac backpack enables you to feel soundwaves in person, and amplifies them so that they envelop you. As you wear it on your back (spine), you feel the music all over your body.

The latest advances are enabling us to experience new kinds of sensations. The concept of 4D movies entails incorporating rain, wind or certain odours.

The latest advances are enabling us to experience new kinds of sensations. The concept of 4D movies entails incorporating rain, wind or certain odours. From our seats, we will even be able to feel the blows received by our favourite actor in a fight. New professions will spring up in the performing arts, such as “theatre maker” or “cinema experience maker”.

One of the major challenges is incorporating 3D into cinemas, as it is not going down as well as expected. Cinemagoers are not overly keen on wearing glasses to watch a film. One of the staunchest advocates of 3D, James Cameron, is experimenting with 3D viewing without the use of glasses for his next films; will we get to see this?

Perhaps we will start exploring the possibilities of using mobile phones in some cinemas, but as part of the “Second Screen” concept. The idea is for us to be able to interact with our mobile

at certain moments in the film, such as when the main character has to make a decision or to decide what planet he should visit. We will also be able to find out about a mysterious character’s past or help address a logical challenge. This alternative offers a host of possibilities – that is, provided that nobody in the theatre objects to the glare of mobile phones in the dark.

New IoT technologies applied to the cinema or theatre

A few examples of interactive shows are the performances of Shakespeare’s *The Tempest*, which has been played in theatres all over the world over the past four hundred years. Ariel, the spirit, has been fully digitised to offer a unique digital experience. During the performance an actor’s movements are digitally captured and the character is rendered, coming to life in real time in the audience’s presence. Intel has taken part in the project by supplying two servers with Xeon and Core i7 processors. After gathering the information, the technicians use twenty-seven projectors to make the character visible to the public. *The Tempest* is just one example of how technology and science are making it possible to add a new dimension to the arts and the theatre.

Artificial intelligence to bring artists’ works to life

Today AI (artificial intelligence) algorithms make it possible to learn from artists’ existing works and create new ones. For example, Microsoft tested a “Deep Learning” system using more than three hundred works by Rembrandt. For eighteen months the works were scanned from various perspectives and views: lighting, style, costume... and the angles and the geometry were captured, among other features. The algorithm used all this information to calculate probabilities, facial characteristics and other aspects, succeeding in creating a new Rembrandt never previously seen.

https://news.microsoft.com/europe/features/the-next-rembrandt-blurring-the-lines-between-art-technology-and-emotion-2/#sm.0000o1f0io8hfmudouzdjwcyxl

Other technologies that will revolutionise the future of the performing arts are drones and 3D printing. Drones are a unique opportunity to create aerial choreographies. Their ability to synchronise and the possibility of fitting them with LED lights or getting them to project images have enabled light and sound shows to be created such as those performed by the Cirque du Soleil on mount Fuji in Japan. But that is not all: we are also starting to see artworks painted by drones equipped with airbrushes.

3D printing is making it possible to create highly sophisticated futuristic costumes for plays.

Tomasz Dabert used 3D printing to create armour and costumes for the staging of Wolfgang Rihm’s opera The Conquest of Mexico at the Teatro Real in Madrid.

https://i.materialise.com/blog/3d-printing-for-the-royal-theatre-of-madrid-tomasz-dbertsmodern-armor/

One of the technologies expected to transform cultural spaces in the coming years is beacons. Let us now examine what they are and how they are used.

Beacons: enhancing cultural spaces

What are beacons?

Beacons are small wireless sensors that communicate with smart devices equipped with Bluetooth technology, such as smartphones, tablets, smart glasses, smartwatches, etc. Beacons constantly transmit their location to these devices using a low-energy transmitter. In turn the devices establish their proximity to the beacon so that when the user is in the desired range the content of the related application is activated and is displayed.

Museums are beginning to tap into the potential of beacon technology. Inexpensive and easy to install, beacons enable them to implement
Beacons can be a valuable means of
informing visitors about the locations of
exhibitions, libraries, restaurants and other
services, as well as of sending warnings and
notifying visitors of events that take place
near their current location.

It is difficult to use GPS in enclosed spaces
with thick walls like museums. GPS receivers
rely on the continuous transmission of signals
from various satellites and physical barriers can
therefore significantly interfere with the signal.
Beacons have proven to be a transparent and
robust solution for large indoor spaces.

Meshing entails creating a virtual, wireless mesh
network that makes it possible to capture and
monitor the largest possible area. Therefore
carrying out a previous analysis of intensities,
possible interferences and obstacles is highly
recommendable. How the mesh network is
created is one of the points that need to be
considered because Bluetooth technology is
affected by various factors: architecture, visitor
flow, interferences from metal objects, tempera-
ture changes, battery life, etc.

One of the main advantages of beacons is the
duration of their batteries – as long as two years,
depending on the model and configuration. Nev-
ertheless, temperature changes appear to have
a significant effect on battery life, which may be
considerably shorter for outdoor beacons.

To ensure that the user experience is as effective
as possible, it is very important to understand
how possible interferences such as metal and
visitor flow affect communication between
beacons and devices.

What are their possible applications?

This technology offers huge possibilities for
enhancing and contextualising the traditional
visitor experience. These are just some of the
ideas:

1. Interactive guides

Perhaps the most obvious use of beacons in
museums is as guides. For example, visitors
can download on their mobiles an app that
serves as a virtual guide and shows them how
to get to the work they are searching for or
find the nearest exit.

Another possibility is to offer audio and visual
guides, depending on the language, and even
augmented reality content related to the
work. This function can be extended and
adapted to specific targets or audiences, such
as children or people with visual limitations.

2. Transmitting comments and experiences

Has an exhibition ever had such an impact on
you that you immediately wanted to share it
with someone? Now beacons enable you to comment on your sensations, convey your impressions of an artwork and associate all this with a particular point or area of the museum.

3. Treasure hunts

Treasure hunts have traditionally used QR codes or manual inputs to confirm that clues or tokens have been discovered. Now we have the possibility of incorporating geopositioning experiences and making the search more dynamic thanks to beacons.

4. A digital “like” for a physical object

Have you ever wanted to give a “like” to a painting in a gallery or post a tweet about a specific element in a museum? Just as beacons can establish what particular object we have in front of us, simply by making referencing it on our social media we can give it a “like” or tweet our experience of the museum.

5. Advanced analytics

We can gather significant information on how visitors interact and how they move in the cultural space by creating a heat map of visitor movement and learn about aspects such as interactions inside the building, waiting time and most visited places, in order to help design future exhibitions.

How can beacons take the cinema experience to a new level?

The major film studios have been searching for new ways of advertising grand premieres and new releases with gripping trailers and surprising events.

As part of this strategy, they have come to realise that beacons can offer a new alternative for establishing better communication with film enthusiasts and, accordingly, boost sales. This is an important challenge, as the app for managing the connection with the beacons will run for a limited time – the duration of the film in question. However, this can be solved with general apps associated with particular studios, for example Sony or Warner Bros, or shopping centres. To what uses can they be put? Here are a few examples:

1. To build loyalty programmes

These messages could vary from special offers to customised notifications based on the user’s location in the cinema. For example, if it is a visitor’s first time, we might offer them a discount off tickets for a film that has not yet been released, whereas a frequent visitor might be rewarded for their loyalty with a free soft drink or popcorn.

2. To locate seats

The size of movie theatres has increased and today we find large IMAX screens such as the London one, which is twenty metres high and can seat 498.

Owing to the large size of many modern cinemas, people often get lost when making their way to their viewing room or seat. The difficulty is further exacerbated if they have arrived late and the room is in complete darkness. Although Wi-Fi has sometimes helped solve the problem of location, this indoor positioning technology is not always

http://www.ibeacontrends.com/beacons-for-museums/
pressure sensors (Teslasuit: teslasuit.io) and gloves that enable us to touch virtual objects (Manus: manus-vr.com), and electronic tongues and noses are even being developed to allow us to savour our favourite dishes in the virtual world.

All this sounds a lot like teleportation, not in the sense of transferring matter immediately from one point to another but on a mental plane. Companies like Facebook, Google and Samsung are investing in it. We will soon be able to walk along the Great Wall of China from our sitting rooms, but not only watching a downloaded video using our glasses. If we install in the wall several high-quality 360-degree cameras located at different points, they can broadcast live, and with our VR glasses we can see the people strolling along beside at this moment. If this is still not enough, suits, gloves and sensory devices can allow us to touch the wall and even sense the aroma of wet stone if it is raining.

But what technologies are going to make it possible for the Internet of Things to create unique spaces and experiences? Let us now examine some of them.

We will soon be able to walk along the Great Wall of China from our sitting rooms, but not only watching a downloaded video using our glasses.

The Internet of Reality

Much has been said about augmented reality (AR), which incorporates fragments of virtual information into our field of vision. And many possibilities are offered by virtual reality (VR), which can transport us to other worlds designed by computers or recorded with 360-degree cameras. Now, thanks to our connected devices, we can add to the sensations they allow us to experience. For example, we have VR suits with

To boost ticket sales

According to a recent study, shoppers in malls are five times more likely to go and watch a film than the average person. In addition, when someone sees the trailer for a film they are three times more likely to go and watch the movie. Bearing in mind this data, NBC Universal used beacons and Wi-Fi to target shoppers in shopping centres with a campaign for attracting their attention and sending them offers for forthcoming releases. The campaign enabled shoppers to receive exclusive digital content on the film, trailers before they were released for general viewing, and calendars with exclusive bookings and premium seats.

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Mixed or holographic reality makes possible a perfect interaction between our reality and the virtual objects we project onto it, as it possess depth-sensing cameras that detect the objects around us: tables, chairs, walls, ceilings, etc. It projects virtual objects onto these objects so that they are perfectly integrated and almost indistinguishable from the real ones. Now we can see a rugby player breaking our wall and throwing a ball at us, a yogi seated on our sitting room floor guiding us through a yoga session, or even a pet dragon resting peacefully in our favourite armchair.

In addition, Intel is constantly reducing the size of its processors to adapt its strategy to the IoT, as the company is keen not to miss out on this promising technology. It began a couple of years ago with the postage stamp-sized Edison processor, which was followed by the button-sized Curie processor. Even so, its product roadmap features plans to reduce the Pentium to the size of a pinhead over the next four or five years.

Does this give an idea of the potential of the new materials and processors applied to artworks and cultural spaces?

**The Internet of Body**

The Internet of Things encompass various concepts such as the Internet of Body, wearables and Augmented Human. They entail a revolution not only in the use of wearables but also in new devices such as brainwave headsets or biohacking technology to enhance capabilities. Let us take a look at a few cases and uses:

**Wearables**

Smart watches, smart lenses, smart ID cards and activity wristbands will have a role in society and will help us interact with our environment. Nowadays most categories of wearable technologies (except fitness trackers) feature a large range of products, each with its functions and specific uses. Wearables represent the next logical step in the mobile revolution. If things are done properly, with a varied ecosystem of brands, retailers, healthcare providers and even governments, these devices will create more

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*The latest advances in nanotechnology will allow us to access technology that is increasingly invisible and goes totally unnoticed to users but it will only be possible to attain this degree of miniaturisation with new materials.*

**Nanotechnology and new materials in the art world**

The latest advances in nanotechnology will allow us to access technology that is increasingly invisible and goes totally unnoticed to users. It will only be possible to attain this degree of miniaturisation with new materials. One has been dubbed the “material of God” on account of its extraordinary abilities: graphene, which is two hundred times harder than steel, incredibly flexible, highly conductive, transparent and lightweight. These qualities make it ideal for increasing battery life and designing ultraflat screens, for example.

Another case is Aerogel, 98% of which is air; it therefore hardly weighs anything, yet it is hard and fire resistant, able to withstand temperatures of up to 1,000ºC without alteration. It is a perfect candidate for NASA’s space shuttle, but can also offer artists a new dimension for creating large, lightweight outdoor structures that can withstand the elements.
efficient and transparent experiences for users in the field of leisure and culture. For example, Disney provides guests at its resorts with Magic-Band wearables. These wristbands authenticate visitors, allowing them to go on rides and enter hotels and restaurants, and even act as a means of payment. What is the result for guests? Shorter queues and queuing times, and the advantage of not needing cash when they visit the park.


Wearables in the fashion world

Smart fashion has yet to find its way onto the main catwalks, but we are starting to see the first clothes that are connected or designed with 3D printers among the fashions for the coming months. There are already a few examples, such as clothing that changes colour depending on our mood and rings that vibrate when we get a call. These are some of the initiatives:

- **Ringly**: rings that are connected so that the wearer can receive notifications and also monitor the exercise they are doing.
- **Cuff**: a small sensor that can be embedded in various pieces of jewellery. It notifies you when a call or text is received.
- **Memi bracelet**: vibrates when a call is received.
- **CuteCircuit**: connected and smart fabrics and clothing (EasyJet project).

It looks as though wearables are also going to solve the problem of authentication and payment. We will no longer need to take out our telephone to speak or our keys to start our vehicle, open doors, pay for purchases or check in at the airport...

A more extreme example is the Swedish biohacking group who have implanted chips beneath their skin. They can open doors and use a photocopier with their RFID chip implant.

Wearables for communicating

These devices can be used to create and consume content. Photos are taken and videos are recorded using Spectacles, smart glasses which upload content to Snapchat.

The introduction of new channels for content consumption calls for tools and processes that enable media companies to create content that is easily adaptable to various devices and sizes, be it for smartwatches, Instagram, Facebook, Snapchat, Twitter, mobile widgets, mobiles, tablets, desktop computers or televisions.

Brainwave headsets

We are starting to see commercial and accessible headsets that can “read” our brainwaves. They even enable us to move objects using circuits that detect these waves. For example, when we think about a particular movement, such as “go up”, the helmet and its algorithms are capable of “reading” the thought and conveying the order to a device, which could make a drone take off. There are also experiments in the field of leisure, such as UMood (http://www.brandchannel.com/2015/10/07/uniqlo-umood-100715/) by the Japanese fashion chain Uniqlo, which created a space in its stores for advising customers on
what garments to buy depending on their mood. This information was gathered using a headset that read people’s thoughts in real time.

For the time being, these brainwave headsets are only capable of reading our minds; in the near future they will no doubt be able to delve more deeply and reveal to the world our ideas and fantasies, but... will we be capable of writing new thoughts and ideas in our brains? [https://www.diygenius.com/hacking-your-brain-waves/](https://www.diygenius.com/hacking-your-brain-waves/)

**Biohacking and Augmented Human**

One of the trends in man-machine integration that we will soon see is the concept of "Augmented Human" or Human 2.0. It marks the next step in human evolution driven by technology. It involves not only fitting our brains with biochips but going one step further and incorporating chemistry and genetic modification.

This type of technology will make it possible to enhance human capabilities and skills more than we had ever imagined. It is a combination of what is known as Human Enhancement Technologies (HET). They entail biohacking, whereby physical or chemical components are embedded in the organism, and also Accelerated Learning, techniques for quickly learning new knowledge and skills, based strongly on virtual reality (VR) or transhumanisation; all this will involve implants or visible and high-impact modifications to our organisms. This technology will enable us to use exoskeletons to move large objects or apply CRISPR 2.0, scissors that allow us to easily cut, remove and add DNA sequences...

The so-called “Internet of Senses” is a technology that enables users to experience different sensations with external stimuli or enhance them by means of sensors. For example Victor Mateevitsi of the University of Illinois has created a suit called SpiderSense. It is capable of sending and receiving ultrasounds in a similar way to a high-frequency radar. This allows it to “see” and “feel” objects around it, even in total darkness ([http://www.vmateevitsi.com/wp-content/uploads/2015/03/mateevitsi.spidersense.pdf](http://www.vmateevitsi.com/wp-content/uploads/2015/03/mateevitsi.spidersense.pdf)).

**Will the Internet of Things convert us into superhumans?**

This movement has many detractors, but we also find cases such as the following: not long ago an “adventurous” biohacker injected into his eyes a combination of chemicals containing Chlorin e6, a compound found only in a few deep-sea fish. The result was that he managed to see in the dark for thirty minutes.

Now, imagine that we are headhunters for a security company or airline. Which of the two applicants would we hire if both possess the same skills: someone able to see in the dark or a run-of-the mill candidate? Perhaps we will have no choice but evolve so as not get left behind.

**Ethical barriers**

However, transhumanism and biohacking challenge our ethics and our values. Improving body and mind through technology and science raises a number of questions that touch on the very essence of what it means to be human. It is obvious that helping individuals overcome challenges is a positive aspect of technology and the Internet of Things. But we are entering ambiguous territory when we begin to consider these advances’ potential not in the field of palliative improvements but to create “super-powers” which can make a significant difference between human beings.

What will we be like when we “evolve” through technology? We are about to find out.
Bibliography


**Recommended websites**

(online resources)

WT VOX (Wearables & IoT): [https://wtvox.com/](https://wtvox.com/)

Techcrunch (trends and events in state-of-the-art technology): [www.techcrunch.com](http://www.techcrunch.com)

Venture Beat (news and trends from technological entrepreneurs): [www.venturebeat.com](http://www.venturebeat.com)


Blog Adafruit: [https://blog.adafruit.com/](https://blog.adafruit.com/)


Empowering the People of Business and Technology: [http://www.techrepublic.com](http://www.techrepublic.com)

Bemoir: [http://bemoir.com/](http://bemoir.com/)

**Twitter accounts:**

Tony Fadell (cofounder of Nest): [@tfadell](https://twitter.com/tfadell)

Kevin Ashton (IoT pioneer): [@Kevin_Ashton](https://twitter.com/Kevin_Ashton)

David Isbitski (Chief Evangelist Amazon: Alexa and Echo): [@thedavedev](https://twitter.com/thedavedev)

Stacey Higginbotham (journalist for *Fortune*): [@gigastacey](https://twitter.com/gigastacey)

SimonPorter (Vice President – Commercial Sales, IBM Europe): [@simonlporter](https://twitter.com/simonlporter)

Intel IoT (Intel account specialised in the IoT): [@IntelIoT](https://twitter.com/IntelIoT)

Internet of Things News: [@TheIoT](https://twitter.com/TheIoT)

Mike Gualtieri (chief analyst at Forrester): [@mgualtieri](https://twitter.com/mgualtieri)

IBM Watson IoT: [@IBMIoT](https://twitter.com/IBMIoT)

Notes


8. https://ringly.com/


WHERE ART MEETS NEUROSCIENCE

Ximo Lizana (LinkedIn)

Research Professor, National Prize of Contemporary Art (AECA) in Spain and prize of the Köln Messe (Germany). Former artistic director of ARCO, professor at the European University of Madrid (UEM) and the University of California at Irvine. Director of the Masters Live Entertainment from Live Nation/UEM and Creation and Management of Video Games and Play Station / UEM. Former academic director of McCann / UEM’s Master of New Trends in Advertising Communication. He collaborates with more than twenty high technology corporations and his experience comes from research centers such as MIT, ZKM or Texas Tech. He is a frequent speaker at events such as TEDex, WOBI, Inspirational, etc. Advises the main advertising corporations and media agencies in their innovation committees. Currently he is the artistic director of Aqualium, combining this activity with international exhibition projects and technology advice to companies such as Disney, Thyssen Krupp, Repsol, Banco Santander, etc.

He specializes in the singularization of corporations through technology and is one of the pioneers of the introduction in Spain of VR, AR+, holographic laser technology and interactivity. Among his first milestones he stands out as the first artist to sell a robot as a work of art to a museum in Spain or to make the first holographic sculpture without material. NeuroCulture has also been an international pioneer, since it is the first system capable of quantifying emotion in art.
For the past 15 years, I have been involved in the processes that bring art and technology together. And I would like to give a very personal view based on my own experience, of the connection between art and neuroscience and the journey that has taken it from a mere idea and turned it into a methodology and a concrete system which is capable of quantifying reactions to art.

This involves understanding technology as a device, meaning everything that ‘develops’ the human being, freeing him from his natural constraints and projecting this development towards what we might call a new fluid reality.

In this basically self-sufficient process that was carried out without the aid of references, books or documentation in this field, I have had to rely on intuition to perceive the true dimensions of art and its impact on society.

I have, of course, relied upon certain references, such as the great experimenters, whose work is reflected in the classic psychology of color books, based on studies from authors such as Kandinsky or the Gestalt theory or Bauhaus school of thought that analyzed, for example, the impact of color and abstraction on the observer, with techniques based on observation, experimentation and the trial and error method, which were the only research tools available at that time.

Perceptual groupings, such as figure-ground perception and pregnancy and depth perception, as well as principles of grouping and games using different perspectives or combinations from different theories of color have laid the foundations for research that the subsequent more sophisticated techniques of neuroscience have been able to verify digitally.

Art in itself has always, I believe, been a launch pad for innovation and an unmistakable testament to the different cultures that thrived in different eras, whether in classical epochs, the historical avant-garde or contemporary periods. It might be hard for us to detect its narrative function from the perspective of the new vanguards but this I believe is due to a lack of perspective, since history teaches us that it has always been so and it is, I believe, simply a question of being able to get some distance on it.

As an artist, suspended halfway between art and engineering, I have always been amazed at the contrast between the artist’s passionate attention to detail, search for excellence and sense of vocation and the art world or ‘market’ – a much more quantitative and qualitative environment where the criteria depend on variables such as context, geographical location or media access, not to mention the approval of institutions. Art nowadays has become a business of politics and tangible assets.

**Neuroculture measures and decodes neural impulses in the context of art. It was conceived as a tool to enable cultural institutions to change their strategies when measuring the impact of their exhibitions.**

This contrast was what triggered the concept of neuroculture – the need to return society’s most important vehicle of innovation to the people while laying the foundations of objective artistic creation. And it could never have been turned into a reality without the help of an incredible team and the collaboration of various experts all keen to find out more about one of humanity’s most basic needs. When we accept creative challenge, we are reminded that art is one of the disciplines that set us, as humans, apart from other living beings. Devoid of an apparent specific practical use, art does not appear to directly affect our struggle for survival.

After discovering the potential application of neuroscience, the first phase of our investigation focused on searching for other experiments previously carried out in this field. The search didn’t throw up much more than the odd
experiment involving the vision of neuroscience maestro, Antonio Damasio.

Born in Portugal, Professor Damasio laid the foundations of neuroscience, a science that is still in its embryonic stages. His books, *The Feeling of what Happens, Descartes’ Error* and *Looking for Spinoza*, are referenced by all neuroscientists and used as a cornerstone for their activities. Together with his wife Hanna, a prominent neuroscientist in her own right, Damasio runs the Brain and Creativity Institute, as well as teaching neuroscience, psychology and philosophy at the University of Southern California.

When it came to creating ‘neuroculture’, we took inspiration from some of his conclusions, such as ‘The images we perceive are cerebral constructs triggered by an object and not specular reflections of the object’ or in the chapter Of Appetites and Emotions from *Looking for Spinoza*, ‘emotions precede feelings’.

Others had also been inspired by Damasio, leading to hundreds of experiments linking audiovisual elements and neuroscience, that in turn gave rise to different lines of neuroscientific investigation, such as neuromarketing, cognitive experiences, mental gymnastics for disorders such as obsessive-compulsive disorder or attention deficit disorder.

When it came to creating ‘neuroculture’, we took inspiration from some of Damasio’s conclusions like ‘emotions precede feelings’.

Many of these experiments seemed to be of interest and we started to look for studies that had measured and decoded neural impulses in the context of art. Surprisingly there had been very few. The first one we came across was a groundbreaking project in Switzerland, which aimed to analyze different perceptions of an art object in an environment divided by race.

We were thrilled to discover that the most advanced laboratory in the world, the European Organization for Nuclear Research (CERN) had an Artists in Residence program, that involved musicians, writers, dancers and contemporary artists, some of whom were specialized in mathematical and neuroscientific processes, inspiring engineers to think outside the box and search for creative solutions with a view to establishing a scientific basis for entirely innovative systems.

We were also aware that an article had been published in the journal *Frontiers in Human Neuroscience*, talking about controlled experiments carried out by a team from Houston University for the Menill Foundation that sought to measure cerebral activity in context – a departure from the sterile and controlled environment of the laboratory.

José Luis Contreras-Vidal and his team aimed to establish the contrasting levels of neural activation between the two environments, taking into consideration sex, age etc., believing that in the ‘uncontrolled’ context of an exhibition, the readings would be higher than when the subject was exposed to audiovisual prompts in the laboratory.

These were just some of the elements that inspired us to create ‘neuroculture’, conceived of as a tool to enable cultural institutions to change their strategies when measuring the impact of their exhibitions, rather than as a laboratory study.

**Neuroscience in Spain**

Neuroscience in Spain is at the teething stage with most activity taking place within a university context. The Complutense in Madrid runs a Masters in Neuroscience, the Autonomous University of Barcelona does a Doctorate as does the Spanish Society of Neuroscience while other institutions have different research programs underway, such as Granada University or the Basque Center on Cognition, Brain and Language. There are also a variety of small start-ups...
in the Neuromarketing field and experiments receiving institutional and European funding with a view to generating research mainly linked to health, cognitive learning, disabilities and the study of the nervous system in relation to human behavior.

There have also been a number of neuroscience forums, including the conference organized by the Spanish Society of Neuroscience in Alicante this year, and the seminars run by the Telefónica Foundation called Neuro Whaaaaat?, not to mention the incredible neuromarketing conferences organized by Mónica Deza in the City of Arts and Sciences in Valencia.

Also available is the Authors Map of Neuroscience [http://bac.fundaciorecercat.cat/neuroscience](http://bac.fundaciorecercat.cat/neuroscience) in which a broad spectrum of proposals by institutions have been documented in a research context – the only reference list of its kind in Spain that we know of.

**Distancing ourselves from the controlled environment of the laboratory allows us to experiment using authentic subjects and authentic situations, enabling us to offer far more conclusive results.**

In this sea of mini neuroscience companies, there is incredible variety. There are those focused on attracting funds to research subjects in “an academic context” and there are “international projects” or long-term and extensive European projects whose activity usually culminates in scientific article or ‘a paper’ and then there are analytical-empirical exhibitions which are often not conclusive, coming as they do from a specialized study with a clear research vocation.

The small and medium-sized start-ups are often launched by university researchers who want to apply their systems to ordinary life for much more direct and specific results, generating increasingly more advanced ‘bug fixes’ and beta versions. We identify with this kind of company for two reasons: the obsolescent nature of technology and the viral nature of information in a global context. Distancing ourselves from the controlled environment of the laboratory allows us to experiment using authentic subjects and authentic situations, enabling us to offer far more conclusive results that are easily understood by those who need them, such as museum curators.

The introduction of new techniques with electroencephalogram (EEG) rhythms in analyzing how a work of art is perceived allows human perception to be explored from the perspective of the integration of groups of neural networks and the resulting feedback measured by the sensors. The rhythms of neural discharge that create these groups can connect with each other by forming functional and transitional units in various areas of the brain – interrelation that is captured by the EEG sensors. This data, combined with the vision vectors of the eye-tracking system and the bio-rhythms captured by diverse biosensors, gives us a series of inputs that – once sifted and separated by applying adequate interpretation and eliminating ‘the noise factor’ – establish a series of primary links between the individual, the work of art and the environment. This, in turn, makes it relevant to exhibiting and storytelling, with regard to the commissioning of the exhibition.

**Understanding cognitive mechanisms**

The relationship between primary cognitive and learned cognitive is the true basis of neuroscience, as is the relationship between the structures and the neural zones relating to human knowledge and linguistics.

Neuroscience is everything that refers to understanding and how the brain interprets external inputs and assimilates them inside its own neural fluctuation network, processing the acquired knowledge.
This cerebral activity not only lays the foundation of perception, but defines other associated structures such as those concerning language, idea association and everything related to brain mapping.

The most recent studies have labeled the merging of variable neurons as 'transitional functions', associated with the synchronization of various areas of the brain within the neural structure of the electric activity of the brain. These allow for the exchange of impulses from different areas of the brain, which in turn condition how we see a work of art and the environment it is in. For this reason, if we are trying to measure the brain’s response to art, the neural band or EEG must be placed just above the points or regions of the brain we wish to analyze, as the information derived from the first impulse of contemplating the work of art allows us to extract the data needed to decode emotion. There must be coherence in the use of the registering sensors to make the capturing of data scientifically sound. It is also important to analyze the behavior in both sides of the brain to see the level of synchronization and activities in different areas of the brain.

The technique decodes physiological signals via biosensors, adaptable electroencephalography (EEG) hardware, eyetracking glasses to measure the moment of attention and the focus of the contemplation of the work of art.

The combination of techniques permits greater precision in the analysis of the experiment and the use of wireless technology makes the experiment as natural as possible as opposed to a symmetrical experiment carried out in the laboratory.

The modularity of EEG technology is almost unlimited. Non-invasive technologies are undergoing a real global revolution, leaving the laboratory behind and moving into more natural and user-friendly environments. This has been made possible by wireless technology and other advances such as the dry sensor – previously the sensors had to be stuck to the skin with a conducting gel.

Thanks also to a breakthrough in the automatic cleaning of Big Data, it is now possible to clean, process and convert large volumes of data into comprehensible information, something that was inconceivable several years ago.

This allows us access to new levels of human consciousness from an internal perspective and to the projection of the interior to the exterior as well as enabling us to amplify the subject using biotechnology systems – systems that allow us access to a new level of consciousness and understanding of our environment as well as our interior.

Successful work is being carried out in the area of transmitting messages by means of these systems via Internet. In fact, several words have been transmitted between two EEG headbands using Internet. In the field of medicine, spectacular advances have been made, particularly in relation to recouping attention in problematic neural areas but also in sectors such as marketing, coaching, security and wellness – achieving previously unheard of levels of precision.

The techniques vary depending on the level of precision needed for the study. The most common are the decoding of physiological signals via biosensors, adaptable electroencephalography (EEG) hardware, eyetracking glasses to measure the moment of attention and the focus of the contemplation of the work of art. Known as wearables, these techniques are combined with others depending on the aim of the study. In the current neuroscientific environment, no information with the potential to enrich the study is dismissed, even if it doesn’t come from strictly neural feedback. For example, many studies take into account micro facial gestures.
confirmed a number of theories, the first being that art is useful and produces emotion; the second being that we are capable of introducing objective elements to a totally subjective environment that scientifically endorse art’s contribution to society; the third is the experiment’s potential field of application once the process is semi-automatic as well as the accessible nature of the results for any professional outside medical or neuroscientific areas of expertise.

Experiments that measure the effect of art on the human brain have prompted us to query the science behind all creative processes.

Experiments that measure the effect of art on the human brain have prompted us to query the science behind all creative processes, not as a one-off, but as a part of daily life as well as in spontaneous and unexpected circumstances. These creative processes lead everyone to have a small internal Picasso inside them on a day-to-day basis – a greater challenge to measure than the functional measurement of concrete artistic projects.

Neuroscience offers real hope in the search for better, more efficient and innovative ideas. And we believe it can help us to exploit our true potential by using a type of gymnastics for the brain.

The most recent neuroscientific studies, which fall into the Neuroscience and Creativity category, are undermining the belief that the brain’s left hemisphere is the creative side where the most humane and passionate feelings reside compared to the right side of the brain, which acts as our computer. As we mentioned earlier, the perception of the areas of the brain as separate units does not hold up in view of the latest advances.

The creative impulse is comprised of many different cognitive equations, as much in the conscious mind as the sub-conscious, better
defined as a team that works to control the correct execution of the target function.

These recent studies imply that the creative network is more or less divided into three areas – the first being the dorsal network of visual-spatial focus. This network relies on communication between the interparietal groove, the second area – and the frontal eye fields – the third. It is the network we use to solve the typical visual-spatial test such as the face-glass test. But we would also draw on parts of the brain that are more often associated with language, such as the Wernike or Broca areas.

Identifying these networks is not only useful for choosing the points of contact for the EEG headband that gives us the readings, it also offers the chance of creating activation and de-activation patterns that are extremely useful when it comes to understanding the creative process.

While creativity is still largely unchartered terrain, research carried out by scientists such as Rex E. Jung, Brittany S. Mead, Jessica Carrasco and Ranee A. Flores at Albuquerque University in New Mexico is particularly interesting. [http://journal.frontiersin.org/article/10.3389/fnhum.2013.00330/full](http://journal.frontiersin.org/article/10.3389/fnhum.2013.00330/full) They are laying the foundations for what might provide the first approximation for how creative cognition might map on to the human brain and though the number of variables is almost unlimited it seems the structure of the brain’s function is far more lateral than was imagined during earlier studies.

The study talks about a phenomenon called ‘flow’ that is typical of musicians’ jam sessions or of rap music where creative improvisation comes into its own, linking one concept with another, resulting in ordered and coherent sequences apparent in quasi real time and it is the most rational area of the brain that manages this purely creative flow to make it coherent.

The study presents intersections of functions within the structure of the neural network, with old functions such as memory and experience meeting new stimulants, which leads to creativity of such an innovative nature that creative explosions can be visualized. The new is intrinsically linked to the past and to the logic of the experience.

But the creative flow cannot exist alone. It needs the intervention of the executive attention network to order the ideas efficiently. Which is when a new difficulty presents itself – the difficulty of establishing the number of cerebral areas committed to each process, enabling them to capture and isolate the relevant data and sift out ‘the noise’.

Another possibility is analyzing the three main networks of creative activity that Jung’s team identified. These networks are:

1. **Executive focus**: The pre-frontal cortex and the areas behind the parietal lobes.

   This is the area of the brain that organizes concepts and solves problems related to reasoning. It also locates each piece of data in its network to make the process efficient and the capacity for association perfect. This is the network that helps us to process information.

2. **Default Network**

   This is the network that is involved in the construction of mental simulations. It is totally dynamic and built below the layer of experience, offering alternatives linked to our perception of those experiences. This
network is also present when we evoke the memory of someone we know, which falls into the category of social cognition. This is the network that allows us to imagine.

3. Salience Network

This network has key nodes in the insular cortex and combines all the stimuli to make the connection between the executive network impulses and the creative network impulses fluid.

Now that the main ideas that put art and neuroscience in context are described, we move on to describing our own case study in more detail.

**Introduction to the neuroculture experiment: Neuroscience and emotions**

In a scientific article published in 1884 in a journal called *Mind*, William James came up with the idea that the physiological and behavioral responses of the human body were produced by the subjective experience of the emotions.

These physiological responses – referred to as different bodily expressions – show different patterns for each emotional experience. Ever since, James’s paradigm has inspired numerous scientists to focus their research on understanding the relation between emotions and the activity of the autonomic nervous system. But first, we need to understand what we are trying to measure (model) and how we can measure it – the activity that is measured to arrive at the model.

- **Structural model of emotion:** there are two main alternatives in the structural model representing emotion: the discreet model – joy, satisfaction, anxiety, fear etc., and the continuous valence electron model of activation-control (the valence electron is otherwise known as hedonic tone or pleasure and displeasure while activation is the level of excitability and control is the level of energy). The continuous basic emotion model then becomes obvious (valence activation) along with an approximation to its corresponding discreet model.

- **Activity measured to characterize physiological responses:** the activities that characterize the researchers’ most commonly used physiological responses are the electrodermal activity (EDA), cardiovascular activity (ACV), respiratory activity (RA) and


Translation of words in diagram: Emotional stimulus (brand, product, advert etc). (Diagram 1) Physiological emotional response. UNCONSCIOUS. Reflected by changes in the somatic state. Neuroscience. (between diagrams) Rationalization (conscience) (Diagram 2) Emotional feeling. PARTLY CONSCIOUS. Feeling reflected by conscious thoughts. Other techniques for researching markets (focus groups, interviews etc.)

Translation of diagram: Emotional stimulus (brand, product, advert etc). (Diagram 1) Physiological emotional response. UNCONSCIOUS. Reflected by changes in the somatic state. Neuroscience. (between diagrams) Rationalization (conscience) (Diagram 2) Emotional feeling. PARTLY CONSCIOUS. Feeling reflected by conscious thoughts. Other techniques for researching markets (focus groups, interviews etc.)
On the other hand, given that in any study the participants move around and possibly distort the physiological measurements, a movement sensor has been added to the ring (a three axels accelerometer) that supports the other sensors. The innovative design of the biosensor – a type of ring – allows all the sensors to be in the same place and therefore estimate the movement more accurately. On account of this, it is possible to filter out ‘the noise’ produced by the signal and carry out studies in motion reliably, minimizing the loss of data.

In addition, neuroculture uses a wearable and wireless headband that allows for simple monitoring of cerebral activity (EEG).

The headband is placed around the cranium and reflex arcs in the frontal and parietal zone. Its sensors are placed in such a way to allow for the measurement of cerebral responses in the areas related to the emotions and the cognitive processes and it is not necessary to apply any conductor gel. The headband is designed for maximum reliability (with a sampling frequency of 256 Hz), without sacrificing any of the speed of putting it on (it can be put on in around 120 seconds) or comfort in wearing it. Thanks to the headband, it is possible to monitor:

- Emotional valence: the positive-negative flow of the emotion. It registers the level of attraction and rejection and varies from a feeling of positive/pleasure to one of negative/displeasure.
- Attention: mental involvement. It registers the voluntary application of the mental activity of the senses and varies from a blank mind to complete attention.
- Engagement: personal relevance. It registers the personal relevance of the content and varies from irrelevant to highly relevant.
- Memorization: index of retention. It registers the level of storage, coding and retention in the memory.

In scientific literature, there are numerous articles that endorse the particularity of the central nervous system’s activity to construct both continuous and discreet emotional models using measures from these activities, either individually or in combination.

**Results that can be obtained with neuroculture**

Neuroculture uses wearable and wireless biosensors to allow for the natural monitoring of two of the most commonly used physiological activities by researchers aiming to distinguish emotions, namely:

- Electrodermal activity (EDA): this is characterized by changes in the electric resistance of the skin, which depends on the amount of sweat present. The measurements most commonly used by researchers to distinguish emotions are the skin conductance level (SCL), skin conductance response rate (nSRR) and the skin conductance amplitude (SCR).

- Cardiovascular activity (ACV): this describes the changes in blood flow through our veins and arteries. The most commonly used measurements by researchers to distinguish emotions are the heartbeat (HR), the change of heartbeat (HRV) and systolic and diastolic blood pressure (SBP and DBP).

The biosensor is placed in the phalanx of the fingers – the point on the body that gives the most reliable reading of electrodermal activity due to the high density of sweat glands in the zone – it is the position recommended by the Society for Physiological Research.

the cerebral activity obtained via EEG or through means of functional magnetic resonance imaging (fMRI). Numerous scientific articles endorse measuring the activity of the central nervous system to construct the continuous emotional and discreet models.
Finally, neuroculture uses eye-tracking glasses to obtain information on:

- **Patterns of visual attention:** zones of visual interest. It registers the elements that attract most attention and those to which people’s gaze is drawn.

- **Patterns of exploration:** visual journey of exploration. It captures how people explore the stimuli via their visual patterns.

### Specific process of neuroculture

The latest neuroscientific advances (Source: Antonio Damasio / *Looking for Spinoza*. Neurology of emotion and feeling) demonstrate the importance of the emotional response when taking decisions (for example, Damasio’s *Looking for Spinoza*: Joy, Sorrow and the Feeling Brain).

The emotional response that stems from something physiological is unconscious, uncontrollable and generates changes in the somatic state.

This physiological response is produced before any process of rationalization kicks in, which involves analyzing the situation, environment or context. The feeling of emotion is the rationalization of the physiological emotional response produced when an element of rationalization enters into the situation or context. These emotional concepts may not coincide.

The emotional physiological responses can be measured objectively by using research methods originating from neuroscience. The results are complementary to other qualitative research techniques that allow information to be obtained on the feeling of the emotion.

When we analyzed the possibility of making a system to measure the real impact of culture and art on people for the first time, we looked into the proposals and technology.

To our surprise, we found that nobody had considered that the methods used in neuroscience could be used to throw light on the impact of cultural activities.

**The latest neuroscientific advances demonstrate the importance of the emotional response when taking decisions that are unconscious, uncontrollable and generates changes in the somatic state.**

Neuroculture is the first global system that measures the impact of cultural products on the spectator. In order to do this, it uses the most advanced systems of neuroscience called eye tracking, IPS/ GPS and biosensors.

The technology had been focused mainly on sectors such as audiovisual, medicine or retail.

**How do you quantify the value of culture?**

This is the question neuroculture seeks to answer.

Six years ago, Professor Ximo Lizana and Maria Porto came up with an innovative idea born out of the need for an accurate, believable, quantifiable and analytical method of measuring the impact of art on the spectator, analyzing it from the departure point of data, rather than empirical or subjective perceptions of culture and how it enriches society.

The patent of the original idea was registered by Aqualium and it was then decided that we would use 100% Spanish technology.

In order to turn the concept into a reality, a strategic partnership was established between...
Targeted cultural products

By measuring the impact of an exhibition in a pilot, we can know the level of emotional activation it will produce before it is officially launched, enabling us to channel exhibitions to an objective public.

This focus can help with strategies from the mounting of the exhibition to the accompanying media campaign or associated workshops.

The Narrative

The accuracy of the measurements allows us to include an emotional story-telling element to exhibitions, creating a journey that is experiential as opposed to historicist.

We can find out which pieces of art work better alone and which work better grouped, as well as which kind of information is relevant and which is redundant; which spaces have negative repercussions and which intensify emotion. The system visualizes the experiences and the hotspots, in much the same way as supermarket studies do, with a view to more effective product placement.

Manufacturing capacity

We make our own software and hardware. This allows us to make tailor-made applications to address particular issues and install custom-made software that can be used as a daily work tool.

Neuroculture offers curators the chance to raise their game.

Presented with answers on concrete issues, curators will be in possession of the information needed to create a perfect balance between emotion, knowledge and precision, allowing them to create combinations of elements that mutually reinforce each other as well as taking out elements that don’t work and replacing them with elements that do.

Neuroculture allows attention levels to be measured and formats to be sought that connect at a multigenerational level. It tells us which supports reinforce the content of the exhibition, capture the attention and establish a two-way relationship with the spectator.

The system is a landmark in the measurement of emotion, which facilitates a global vision for cultural activity in an exhibition space.

When it comes to strategy consolidation, neuroculture can base its evaluation of the success of an exhibition on more than mere visitor numbers.

Art is emotion and by measuring the emotion with data that can be evaluated, analyzed and easily understood, we are basing our evaluation of the impact of the art on real criteria. This in turn enables us to defend the social effect of the activity scientifically.

Efficient use of resources

By deducing the success or failure of a cultural product, we are able to take accurate decisions when it comes to the employment of resources, putting the accent on elements that will generate more emotion in the visitor.

“…useless effort leads to melancholy…”

Ortega y Gasset
### Targeted cultural products

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### The case study

We are going to describe an example of a pilot experiment that was carried out using the exhibition Animals and Pharoahs, put on by La Caixa.

It is a study related to the museum sector, in which Egyptian art was evaluated using an uncontrolled task in which the participant has no time restriction as he walks freely around the museum.

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### Manufacturing capacity

We make our own software and hardware

This allows us to make tailor-made applications to address particular issues and install custom-made software that can be used as a daily work tool.
The conclusion is that the experience is much more intense in the exhibition space than in the controlled environment where the works of art are viewed on a screen.

It was also surprising to note that the level of activation produced by an exhibition was somewhat superior to what was produced by a film or multimedia content.

Data analysis

The analysis of the signal registered by the sensors is totally individualized (by means of the self-calibrating statistics and what is deduced from the emotional response of each participant). Computer models are used for this process. Once the parameters of emotion are registered and compared between the participants, the results are added up to obtain an overall result.

The advantages of this style of analysis over traditional statistics are:

• A high level of accuracy and reliability in the decoding of the emotions.
• High specificity of results based on small samples (approximately 10 participants in free tasks).
• The possibility of carrying out segmented analysis according to the profile of the participants.

The following equipment was used in the experiment.

- Biometric ring: a wearable wireless measuring system equipped with biomedical sensors to measure electrodermal activity, the pulse volume and rate. It is also a Wi-Fi device that allows multiple participants to be monitored simultaneously.

- EEG headband: a wearable and wireless measuring system equipped with dry electroencephalography sensors to measure brain activity. It’s also a Wi-Fi device that allows multiple participants to be monitored simultaneously.

- Analysis Software: professional design and execution software that synchronizes the biometric devices – the rings and headbands.

Experiment protocol

The participants know they are going to be evaluated as part of an experiment without being told what the results might demonstrate – they can find out at the end of the study if they wish. The participants are told to act as naturally as possible during the visit.

In a series of charts, we analyze the exhibition space as a whole and the attention and activation hot spots with the aim of gaining a global vision of the level of activation the two target exhibition rooms produce.

Experiment protocol requires there to be two separate studies that can later be compared – the first in a controlled environment and the second in the 'natural' exhibition space.
The conclusion is that the experience is much more intense in the exhibition space than in the controlled environment where the works of art are viewed on a screen.

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**Metrics and charts from the study**

This study focused on the analysis of the following metrics:

**Emotional metrics**

Emotional activation: it measures the emotional level by unit of execution time. It varies from rest to excitability.

Emotional impact: it measures the variation of emotional intensity by units of time.

Execution time: it measures the duration of each task in seconds.

Once the parameters of emotion are registered and compared between the participants, the results are added up to obtain an overall result.

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- The possibility of carrying out segmented analysis according to the profile of the participants.
**Emotional activation comparison chart**

This graph permits the comparison of average, maximum and minimum emotional activation levels and the 75 and 25 percentiles. This measurement has no units but it is useful for comparing the relative emotional intensity between the tasks.

**Emotional impact comparison chart**

This graph allows the average, minimum and maximum and 75 and 25 percentiles of the levels of emotional impact to be compared. This measurement has no units but it is useful for comparing the relative emotional intensity between the tasks.

**Execution time comparison chart**

This graph facilitates the comparison of the distribution of the execution time as well as the execution time relative to the area covered in each task with regard to average, minimum, maximum and 75 and 25 percentiles. The graduation of the chart is in seconds and seconds/m² (normalized) allowing the results between the tasks to be compared.

**Emotional activation dynamic**

This graph allows the evolution of the emotional activation of each participant to be observed and offers information on the zones that have the biggest impact. It also shows the variations in execution time.

**Emotional activation map**

This map shows the spaces that triggered the biggest emotional activation in red. (In this case the chart corresponds to an example that is a retail outlet as opposed to art so that the efficiency of the chosen retail spot could be measured)

**Execution time comparison chart**

This graph facilitates the comparison of the distribution of the execution time as well as
Density of visitors map

This map shows the areas of greatest visitor density in red.

Map of interest hotspots

This map shows the spaces that triggered most interest in red, deduced from the fact that visitors spent more time in them.

Interpretation of the quantitative results

After a global analysis of the spaces, we can refer to another phase of the study in which each piece is analyzed individually and then with respect to its relationship to the other pieces within the global frame. The analysis also helps us to answer questions that might be asked by a specialized curator.

Details such as the layout of the exhibits, the emotional impact felt by particular age groups or sexes leads to an infinite range of possibilities. This sea of possibilities can be channeled by the curator’s ‘useful’ questions that will help create the most effective composition and content possible.

Our conclusions

In the world of neuroscience, it is very complicated to obtain conclusive results that can be used by novices in the field. This is due to the enormous amount of information that needs to be processed and the absence of conclusive data concerning specialized questions.

Neuroculture, however, has focused on bringing together art specialists and experts in neuroscience, paving the way for a series of extremely useful surveys when it comes to undertaking particular projects. At the same time it facilitates a vision for the direction the museum is taking.
Neuroculture can lead to answers for a variety of questions. Here, we present a number of questions and the answers we got:

Is there more activation with guided group tours or individual visits?

Which of the smaller works of art activated the subjects most? The hippopotamus?

The work of art that activated the subjects most, possibly because of the mix of color and level of detail.

Despite being emblematic, this work of art produced an average activation. The possibility of placing it alone in the next exhibition is now being studied given that it is a benchmark piece in several museums around the world. Here, it seemed to be less relevant.

Did any of the art produce negative emotions? Where...? There was no representative percentage of them.

Do the pieces that are exhibited behind glass activate less than those with no barrier distancing it from the spectator?

The average activation for pieces behind glass: 5.41

The average activation for barrier-free pieces: 5.77

Women or men? Which group responded with more intensity?

As can be seen in the following chart, women showed a higher level of activation and so it can be concluded that they experienced the exhibition more intensely.

Translation of diagram: Men, Women

As we can see, neuroculture could be a highly useful tool in decision making when it comes to evaluating the emotional components of an exhibition project. The technology is constantly evolving and we are already working on improvements, both in hardware and software, as well as other aspects such as formulating relevant questions and the automation of the results with a view to generating an analytical tool that the director of culture himself can use to carry out his own studies.
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GAME DESIGN AS A CULTURAL DISSEMINATOR

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Thanks to technology, games have become an activity that is present everywhere, from our sitting room to train carriages. Thanks to video games, nowadays we play alone on our computer or mobile and have also created new ways of playing with others via the digital media – such as massively multiplayer online games, where hundreds of people in different countries engage in play together in virtual worlds. Like any new technology or medium, even today video games still have something of a reputation for being a waste of time, a form of entertainment that rots players’ brains. It is easy to see that these attitudes are not very different from the opinion people had of chivalric novels in Don Quixote’s day. But just as chivalric novels have become a prestigious literary genre over time, so too are video games gradually shedding the prejudices of the old guard and are on the road to becoming a fully legitimate form of communication and artistic expression. This process also calls for traditional games to be viewed as an essential part of culture, as they are a social activity with a shared point of reference. As we shall see in this article, games – both digital and traditional – are clearly already part of the cultural discourse. In particular, we will examine how video games are giving rise to new forms of creation and expression that are also becoming incorporated into other aspects of art and culture.

Games are already part of culture

Back in the thirteenth century, King Alfonso X the Wise gave orders for one of the most important historical documents in the field of game studies to be written, *El Libro de los Juegos* (*The Book of Games*). The fact that the subject of board games should have been included among the writings commissioned by Alfonso X along with poetry, scientific, legal and historical texts is a good indication that compiling the rules of these games was already part of Spain’s cultural heritage. This first encyclopaedia of games was furthermore multicultural, as it featured those of the Muslim kingdoms.

The study of games as part of culture traditionally falls within the realms of anthropology and history. One of the first authors who are usually cited in the field of game studies is Johan Huizinga, whose book *Homo Ludens* (1938) explores the role of games as a ritual activity, arguing that ludic activities precede culture, so that cultural activities such as festivals, sports competitions and poetry derive from the divide between ritual and everyday life.

Video games are giving rise to new forms of creation and expression that are becoming incorporated into other aspects of art and culture.

We can also see how games are part of every region’s folklore, if we note how the rules for different card or board games are handed down from generation to generation along with each society’s nursery rhymes, traditions and myths. Alfonso X’s book describes the games of his own day, but these games have continued to evolve over time, incorporating variations and new rules. Packs of cards and game boards with the Game of the Goose on one side and Ludo on the other have been as common in Spanish homes as spouted wine pitchers, and every family has its own particular rules.

Following in Huizinga’s footsteps, Roger Caillois (1961: 11–36) offers a classification of games,
which can be competitive (agon), chance (alea), involve mimicry, or produce a state of dizziness and disorder (ilinx). Caillois’s classification spans the whole gamut of games, from crosswords and flying kites to chess, the theatre, dancing a waltz, and mountain climbing. It thus shows how games encompass an unusual variety of activities.

Games have also given rise to rich and varied discourses that reflect their richness as a socio-cultural phenomenon. Brian Sutton-Smith (2001: 9–17) defines the different rhetorics that are used to speak of games; each rhetoric expresses a different relationship between games and society. The identity rhetoric (91–110) is a type of discourse that explains the examples dealt with in the previous paragraph; it is a discourse focused on ludic activities as a defining part of collective identity, a shared knowledge deriving from the fact that traditional games normally require a group of players. Sutton-Smith also draws attention to the rhetoric that speaks of games as a type of progress (18–34), which is the discourse used in pedagogic sciences, such as Piaget’s work (1945). According to this rhetoric, games are a test of the challenges of adult life, providing activities that help develop intellectual and motor abilities. Sutton-Smith also points out the existence of a rhetoric that presents play as something frivolous (201–3). The rhetorics of play as progress and as a frivolous activity echo people’s condescending attitudes towards games, even though, as we have seen, play is an essential part of social identity. This condescension is also associated with the rhetoric of the self (173–200), which views games as an individual and escapist activity that isolates the player from the rest of the world – a stereotype associated with people who spend hours glued to video games, like Don Quixotes of the PlayStation.

To counter the rhetorics that undermine the cultural importance of play, we tend to justify its role in other fields that enjoy cultural prestige, such as literature or the fine arts, referring to its educational potential (the rhetoric of progress that Sutton-Smith describes). However, as we have seen, the cultural tradition of games has existed since Alfonso X’s day. Our perception is changing thanks to the digital media, which, as well as expanding the definition of what is considered to be play, are contributing to the emergence of new disciplines associated with the development of video games and in turn help us understand other cultural expressions in a new light.

**Digital media are expanding the definition of what is considered to be play and are contributing to the emergence of new disciplines associated with the development of video games.**

**Game design as a discipline**

With the industrial revolution, games went from being part of folklore to commercial products, as artefacts considered part of the toy industry were created. Games began to be sold in boxes, with specially designed pieces, cards and boards for playing new activities in a social context, and were not aimed solely at children. Throughout most of the twentieth century, game creation thus became a commercial activity and the creators of games came to be considered inventors, because their products were associated with the physical side of the game (boards, pieces, dice, cards) as well as the rules.

These first inventors show that games, as a cultural expression, can also reflect ideologies. Lizzie Phillips’ *The Landlord’s Game* (1904) was designed to criticise the capitalist system through its rules (Pilon 2015). Parker Brothers purchased the patent from Phillips and converted it into the famous *Monopoly* in 1935; a good example of abstraction, the Parker Brothers’ version has become an apology for capitalism all over the world.
The introduction of digital technologies brought a change in the role of game inventors. A video game does not usually require physical pieces to be created, but rather for its rules to be abstracted in the form of a series of instructions establishing how the computer should respond to the player. Computational processes allow extremely complex games to be created, some with systems that would be difficult to emulate in board games. Creating a video game requires not only knowledge of programming but also creative skills like music, the visual arts or inventing fictional worlds. We have gone from noughts and crosses in the first computers to exploring, as in the game The Elder Scrolls: Skyrim (2011). A video game can be created by one or two people, a small group of 10 creators or, in the case of console games, teams of between 100 and 200 people. The bigger the team, the more specialised each discipline is: the designers focus on creating specific levels, optimising combat systems or creating different storylines; the programmers deal with artificial intelligence, systems or graphics; the graphic artists design architectural spaces in the manner of art directors and the props for the fictional world; the animators bring the characters to life; the sound engineers and editors and the composers create the game’s soundtrack; and teams of producers and testers ensure the programme functions properly. The process of creating the game rules is therefore a discipline separate from programming, hence the shift from game inventors to game designers, whose work is to create rules that give rise to a series of interactive experiences. This distinction also applies to the creators of board games, because the discipline of game design is considered to go beyond physically designing a product or writing a computer code.

Video game design is still related to programming at various international educational institutions, but a good programmer is not necessarily capable of designing a game. We are also witnessing an increase in the number of centres that teach game design in their fine arts and design schools, as they regard digital games as an artistic and cultural expression. The divide between science and arts no longer exists, because creating games requires just as much cybernetic thought as psychology or story-writing skills. Game designers must work from a Renaissance-style interdisciplinary approach, being as well versed in digital creation as they are in human nature.

The divide between science and arts no longer exists, because creating games requires just as much cybernetic thought as psychology or story-writing skills.

Games are thus emerging that serve as an artistic expression and can accordingly also convey ideas. Papers, Please: A Dystopian Document Thriller (2013) places the player in the role of an immigration inspector in a fictitious communist state who has to decide whether or not travellers should be allowed into the country based on the papers they show. For every traveller whose application is correctly processed – whether they are allowed in or detained – the player earns money to maintain his family, whereas mistakes lead to loss of money or no
wages. The game poses constant dilemmas, such as whether or not to listen to the pleas for mercy of travellers with forged papers desperate to be reunited with their families, or whether to accept a bribe to let someone in and run the risk of losing everything in exchange for money to maintain your family. The tension lies in whether to obey the impulse to win the game by abiding by the rules and, accordingly, succumbing to the dehumanisation promoted by the system, or whether to rebel and become a subversive agent but risk losing everything. Players espouse their character’s dilemmas by taking part in the game.

Beyond gamification: designing participatory experiences

Video games are the medium with the longest history of creating interactive experiences, either through digital media or in the form of board or card games. Game design as a discipline entails creating interactions, both between individuals and between humans and computers. In a sense, video game design has been a pioneer in defining the professional skills of the future.

Other fields, such as education or advertising, have experimented with incorporating game design as a possible means of advancing as disciplines. This genre was initially called serious games, as games of this kind are not designed to entertain but have a purportedly serious purpose – though this goes against the nature of games according to Huizinga’s definition (5–8). Ian Bogost (2007) calls such games persuasive games, because the intention is for the player to adopt or modify a conduct while playing. There are thus serious games that educate, raise awareness of social problems or sell commercial products. The field of serious games arose in response to games’ connotations of being a frivolous and childish activity; in the case of video games, it also sought to shed the stereotypical view of video games as an incitement to violence. This correction is based on myths about games and their nature. We have already discussed how games are part of cultural heritage and are related to rituals and other sociocultural activities. We are witnessing a rise in the number of adult players, especially women (AEVI 2015: 34), thanks to the popularisation of mobile platforms (smartphones and digital tablets) which facilitate access to a host of digital games.

Games, particularly the digital variety, are usually required to prove their positive aspects scientifically in order to redeem their purported negative influence. Both extremes pose problems, as it is assumed that video games can change players’ conduct, both negatively (by encouraging violent behaviour) and positively (by helping them learn, motivating them), but it is not realised that their potential effects depend not only on the type of game but also on the context and on who is playing (see for example Manero Iglesias et al. 2016). Any cultural expression has the potential to cause an effect; however, processes are not one-way but part of the sociocultural environment in which a game is created and played.

There are still misgivings about games, but they are increasingly becoming part of everyday life, and the principles of game design are being applied to other areas such as marketing, the workplace and education. We are thus witnessing the gamification phenomenon, which refers to the use of game design elements outside the context of games (Deterding et al. 2011). Gamification was initially limited to associating
certain activities with trophies or best player rankings using a competitive model to motivate participants. The Foursquare application, founded in 2009, had participants notify when they were arriving at a specific place; the user with the most notifications would become the “mayor” of the place until 2014. Gamifying each user’s everyday route turned into a relatively simple game, while users revealed their daily coordinates and provided data on the places they frequented. This information could be used in turn to create profiles of spending habits, as well as posing privacy problems, which is why the gamified part was split off and developed into the application Swarm (2014).

Video games have developed sophisticated strategies for understanding and prompting participatory and interactive conduct, as well as learning over the decades to make the most of digital technology to create new experiences.

The use of a trophy system is precisely what led many of us who design games to feel uncomfortable with the term, primarily because it assumes that games can exert long-term influence on their players, and also because this strategy views games as competitive activities, even though, as Caillois described, there is a broad variety of activities that can be considered ludic. Putting emphasis on competition between participants can also have negative effects, as not everyone is motivated by competing. The use of trophies can be counterproductive because it provides incentives based on extrinsic motivations – which are superficial and difficult to continue for a long period of time – instead of creating systems and activities that motivate and challenge the participant intrinsically, stimulating players personally (Deci 1999).

As Hamari et al. argue (2014), the various studies conducted on gamification usually report positive effects on their participants, but they are partial and their methods often lack thoroughness; indeed, no study to date has managed to prove the effects beyond the context of the experiment. Although Hamari et al. make it clear that gamification is a promising discipline, they also draw attention to the need for better methods for designing and assessing the activities that use game design and its possible effects.

The benefits of applying elements of game design to other areas, according to this author, go beyond its supposed effects. Video games have developed sophisticated strategies for understanding and prompting participatory and interactive conduct, as well as learning over the decades to make the most of digital technology to create new experiences.

An example of how video games have developed certain areas of knowledge which the digital media are now attempting to make use of is the need to create joint activities for large groups, for the purpose of education or advertising, or in the workplace. Video games have played a pioneering role in creating activities in which hundreds or thousands of people take part, such as massively multiplayer online games, which originate from university computer networks of the late 1970s and have been gaining popularity since the early 2000s, with titles such as Everquest (1999-present) or World of Warcraft (2004-present) (Bartle 2010). The designers of games of this kind are much more experienced at creating large-scale participatory activities, as they understand the different types of players (Bartle 2006) and their motivations (Yee 2006), and at providing a variety of activities depending on who the player is. There is no need to have worked on massively multiplayer online games to understand these factors, as game design focuses on creating human activities within certain limits. The result of the game design process is intangible but observable; it is called performance, a term that refers to the actions themselves and participation as the intended aim. Game design goes further than creating entertainment: what we do is orchestrate and facilitate human conduct.
Games and their relationship with other areas of culture

The advent of game design as a discipline is a symptom of how the digital media are changing media ecology. Although other artistic fields and expressions such as literature or music still tend to be used as a means of establishing game design as a legitimate cultural activity, the fact is that the tables are being turned and game design is helping us incorporate other cultural expressions into the digital media. It is not that we make video games because the new generations like them more, which is rather condescending, but rather, as pointed out, that the discipline of game design has long been exploring how to design interactive experiences; its interdisciplinary nature helps integrate other cultural areas and expressions into the digital medium. The language of the digital media is increasingly accessible and is now part of the cultural landscape, though admittedly we run the risk of creating a digital gap between those who have access to technologies and those who do not; indeed, the latter risk finding themselves excluded from the spaces of cultural expression created by video games and new technologies.

The new generations expect the traditional media, from novels to plays, to be participatory as well. Readers have probably seen the video of the infant girl swiping the pages of a paper magazine as if it were an iPad because she doesn’t realise they have to be turned (https://www.youtube.com/watch?v=aXV-yaFmQNk). The image of the girl bewildered by the unresponsiveness of the magazine’s inert pages is a symptom of how the digital media are changing how we relate to the media today.

The digital media are changing the traditional media models. Today a computer or smartphone screen enable us to switch from the day’s news to our music playlist, watch the day’s viral video and end up playing Candy Crush Saga (2012). This is a process of unstoppable convergence (Thorburn and Jenkins 2004), which has been taking place over the past two decades and is fully accepted today. We have gradually been shedding technologies that are only valid for one type of content, such as radios and record players, which have become museum pieces or cult objects. Traditional models of communication like that of Shannon and Weaver (1963) are no longer of any use; instead we have digital interactive media in which not only does the message have to be decoded but the recipient must manipulate it and can change it through his involvement; Espen Aarseth uses the term cybertext to explain how digital technology has changed how we read texts, as it requires certain actions in order to be read. Digital technology is customising us to being able to interact with content, going further than interpreting it, so that we can explore and modify it and even contribute to it with our own creations. Games have been encouraging players not only to take part in fictional worlds but also to create content for them. An example of this is a study by Pearce (2006) on the online game Myst Online: URU Live (2003-4), which examines the case of a community of players who reproduced the virtual world in other virtual worlds such as Second Life (2003–present) and There (2001-10) after Urú was shut down early. Pearce points out that several players among this virtual world diaspora learned to use digital production tools to create 3D objects with their relevant textures in order to recreate a space with sentimental value.

**The discipline of game design has long been exploring how to design interactive experiences; its interdisciplinary nature helps integrate other cultural areas and expressions into the digital medium.**

Games have also been used as a means of reflecting Spain’s cultural heritage, though some of the games in question have not been widely distributed. One of the earliest examples is Don Quijote (1987), a video game produced by the Spanish company Dinamic, which converted...
Cervantes’s novel into an interactive story. In the field of non-digital games we have *Aquelarre, Juego de Rol demoniáco-medieval* (Ibáñez Ortí, 1990), whose world is inspired by medieval Spain; instead of resorting to the hackneyed stereotypes that usually borrow from Tolkien’s worlds, it draws on the legends of the Iberian peninsula such as the Castilian goblins and Galician water nymphs. A more recent video game, *Maldita Castilla* (2012), takes place in Old Castile and combines arcade games with medieval paintings, illustrations of codices and the chivalric novel *Amadís de Gaula* (1508). These three examples show how it is possible to create successful commercial games without necessarily falling back on the commonplace so often found in mainstream games, as we have a rich history and mythology that can be explored interactively.

Let us now take a look at how games are helping bring about this change of attitude with respect to other already established cultural expressions such as theatre and cinema, and museum visits.

**Transmedia storytelling**

The concept of transmedia storytelling has spread thanks to the work of Henry Jenkins. According to the definition, transmedia storytelling is a story that unfolds across multiple media platforms, with each new text making a distinctive contribution to the whole. Transmedia storytelling can start with a novel and be extended through films, television shows, comics, video games and even toys and theme parks (Jenkins 2006: 95–96). The nature of transmedia stories is in keeping with the trend for participating in and exploring the media, cybertexts which require a certain effort to be read – an effort which in this case means having to piece together the different parts of the story.

**Video games make it possible to participate, manipulate and experiment within the fictional world of a transmedia story.**

In the production of commercial media this phenomenon is usually referred to as media franchises whereby the main story becomes a brand that is licensed to producers in different media to develop their own stories. The difference between franchises and transmedia storytelling lies in the fact that transmedia stories aim at keeping a coordinated narrative coherence so that each media incarnation provides a different viewpoint or plot line, but always within the same narrative world and contributing to the whole. Jenkins analysed *The Matrix* saga (1999) as an example of transmedia, in which the original film has given rise not only to sequels but to a series of animated shorts, *The Animatrix* (2003), and three video games (*Enter The Matrix* (2003), *The Matrix: Path of Neo* (2005) and *The Matrix Online* (2005)). In each medium, the viewer / reader / player can follow a different part of the story, from the antecedents to the events of the original film to playing the main character’s collaborators.

Video games make it possible to participate, manipulate and experiment within the fictional world of a transmedia story, and are sometimes its origin, such as the *Assassin’s Creed* (2007) franchise, which enables players to visit detailed versions of various cities through the world. *Valiant Hearts: The Great War* (2014), another game by Ubisoft, takes place during the First World War and sets the fictitious story of various soldiers in various real theatres of the war.
always inside a historically documented world. Video games thus make it possible to travel to places in time and learn more about each of them through virtual visits.

**Immersive theatre**

Interaction with the media is becoming so common that it is also spreading to areas such as the theatre. Although this sounds like something new, the so-called fourth wall that supposedly separates the audience from the actors has not always been there; for example, the choruses in Greek tragedies appealed directly to the people sitting in the auditorium. Nor do we need to travel back in time to find other examples of theatre in which the audience takes part in the action: in children’s theatre, both puppet and stage shows, a dialogue is commonly established with the young audience, who often tell the characters what to do or warn them of danger. Once again, we find that activities for children have set the standard for adult entertainment.

There are various degrees of participation in immersive theatre ranging from an audience exploring the space to others where the audience decides on the actions or shows in which the participants play a role.

There are various degrees of participation in immersive theatre ranging from examples in which the audience can explore the space where the action takes place to others where the audience decides on the actions, and finally to shows in which the participants play a role. The first type of immersive theatre is characterised by stage spaces where the audience explores and follows various simultaneous actions. This is not something new, as María Irene Fornés wrote a play of this kind, *Fefu and Her Friends*, back in 1977. And the British company Punch Drunk has pioneered a type of immersive theatre with plays such as *Sleep No More*, which combines dance with Shakespeare’s *Macbeth* and Hitchcock’s suspense. In these productions the audience are silent witnesses of the action, which takes place simultaneously in different parts of a building with several floors.

We also have theatre that is directly inspired by video games, where the audience has to solve a series of puzzles for the action to continue, in other words cybertexts that involve playacting. Escape rooms – activities where the participants start off being locked inside a room and have to solve puzzles to escape – are becoming popular in cities all over the world. Activities of this type are inspired by *escape the room* video games, which were fairly popular in the mid-2000s and could be played from the browser; one of the earliest examples is *Mystery of Time and Space* (MOTAS) (2001). Whereas the popularity of the digital version of these games is waning, escape rooms have become a fairly popular group activity.

Another example of plays that bring game mechanics to the theatre is the Berlin company machina eX, which stages productions inspired by the so-called graphic adventures that were so popular in computer games of the 1990s. In Spain we have the group YOCTOBIT, which has staged interactive plays such as *Mata la Reina* (2012). These plays take place in small spaces and when the characters come up against a problem, the audience has to handle the props to solve the puzzle so that the action can continue.

Finally, we have live-action role-playing (LARP), where there is no longer an audience as such; instead everyone takes part in a story that is developed over a longer period of time, sometimes several days. This type of role-playing is a very sophisticated tradition in Scandinavia, where players not only dress up for the part but actually live as their characters during the event. A few examples are *Inside Hamlet* (2015), a role-playing game that takes place in the real castle of Elsinore in Denmark, and *College of Wizardry* (2015), inspired by the Harry Potter stories, which is held in a Polish castle in the
middle of a forest. This type of theatre not only requires a certain amount of skill at improvising actions, but also dedication and concentration. Therefore activities of this kind are not suitable for everyone.

Other games take stage plays as a basis and allow people to play inside the world of the game. Two games developed by Madrid’s Universidad Complutense, *La Dama Boba* (2013) and *La Cortesía de España* (2016), are based on classical plays, the aim being to get players interested in the original works. *Elsinore*, currently being developed, is inspired by Shakespeare’s *Hamlet*. In it the player takes on the role of Ophelia, whose visions show the tragedy that is going to occur in the castle; the mission consists in trying to change the story through decisions.

**Museums and exhibitions**

Another area where game design enjoys significant influence is museums and exhibitions. Here we find that games are still generally aimed at younger visitors, and they are used as a means not only of attracting them but also of helping them understand exhibitions and encouraging them to explore and take an interest in the museum’s various shows. Games of this type sometimes involve a gymkhana or treasure hunt inside the museum so that the participants explore the space, but they do not always help them understand the contents. This is not very different from the problems derived from superficial gamification, where the player is rewarded for finding an object instead of understanding what it means – instead of using gamification as a means of learning from exhibitions within a context.

An example of the use of a gymkhana-type video game is “Enigma Galdioano”, an augmented reality game for the Museo Lázaro Galdiano aimed at families with children over 8. Inspired by the success of *Pokémon Go* (2016), the game uses a pirate theme to invite visitors to search for specific pieces from the museum’s collection, which they must capture with a telephone or iPad camera in order to access a datasheet and a series of digital mini-games.

Games are still generally aimed at younger visitors, and they are used to attract them, to help them understand exhibitions and take an interest in the museum’s shows.

One of the museums that are attempting to incorporate games into the museum visit is the American Museum of Natural History in New York, whose education department invests substantial sums in developing sophisticated games to get younger visitors involved. The game *MicroRangers* (2016) uses mobile platforms as a guide inside the museum combined with augmented reality. Players use the camera on their mobile devices to identify various museum exhibits which they must then connect to solve a biological crisis. The card game *Gutsy* (2016) needs no technology to show the different type of microbes inside our digestive system and how they interact to maintain the balance of our intestinal flora. These are two good examples of how games can help visitors understand a museum’s complex contents.

Games can also serve as a guide and motivation for fine arts museums. The Museo Thyssen-Bornemisza already has an adventure game, *Nubla* (2016), inspired by the paintings housed in the museum. It functions in parallel with exhibitions, by exploring themes and evoking works rather than serving as an educational brochure, and by attracting new visitors or inviting those already familiar with it to see it in a new light. The game is not presented as something exclusively for children but as a world parallel to the museum’s work.
Conclusion

The purpose of this article is to debunk some of the preconceived ideas people tend to have about games in general and video games in particular. Rather than justify games and their design by relating them to other cultural expressions, the intention is to show that games have been a legitimate part of culture for centuries – something that anthropologists and folklorists have been pointing out repeatedly for more than 80 years.

The gradual appearance of game design as a discipline, owing first to commercial board games and subsequently to the emergence of video games, is what is really exerting significant influence both on culture and on how we relate to media content. Video games are contributing to digital literacy, and this in turn is changing our understanding of cultural and canonical forms, which are no longer immovable and monolithic but part of participatory and creative activities, providing new perspectives on traditional artworks and cultural activities, while new technologies encourage the creation of new interactive works.

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THE USE OF DIGITAL TECHNOLOGIES IN THE CONSERVATION, ANALYSIS AND DISSEMINATION OF CULTURAL HERITAGE
The use of digital technologies in the conservation, analysis and dissemination of cultural heritage

INTRODUCTION

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Holds a PhD in Art History from the University of Granada (2013). His lines of research are focused on the applications of new technologies in the fields of museum design, historic heritage and contemporary artistic creation, and have given rise to various academic contributions to publications and participation in national and international events (Brazil, Mexico, Argentina). His latest studies to be published include La realidad aumentada y su aplicación en el patrimonio cultural (Trea, Gijón). He is currently a postdoctoral fellow and associate professor for the postgraduate programme of the Universidade Federal do Espírito Santo (Brazil), where he has developed various projects on the use of new technologies in Brazilian exhibition spaces.
Introduction

The Focus 2017 takes a look at case studies of good practice in the use of digital technologies for the conservation, analysis and dissemination of cultural heritage.

The concept of heritage has progressively broadened over the past decades and is currently very wide-ranging. According to the definitions derived from the UNESCO World Heritage conventions, cultural heritage refers to monuments, complexes and sites; natural heritage consists of geological formations and natural landscapes; and intangible heritage refers to all cultural manifestations of peoples, including customs, representations, expressions, knowledge and techniques that are part of their cultural heritage.

This fact was taken into account when putting together the Focus 2017, which studies cultural heritage – chiefly archaeological heritage and immovable artistic and monumental heritage, though it also reports a few cases of experiences involving movable assets or intangible heritage that are particularly significant and/or closely linked to cultural heritage.

Although cultural heritage encompasses art-historical objects in the care of museums, these were analysed in the Focus 2015, which dealt exclusively with museums and digital technologies.

The relationship between digital technologies and cultural heritage goes back a long way and has been strengthened in recent decades by the exponential growth in technologies and their applicability in the culture sector. The possibilities offered by digital technologies in this area – some yet to be discovered – are many and have great potential, just as the field has many needs which can be codified through technology and presented in a coherent manner for our society and for the future generations.

For an example of this satisfactory relationship, it is sufficient to point out that many of the projects involving digital technologies and cultural heritage are being funded by the European Union’s research and innovation programmes. The fact that the 7th Framework Programme (2004 to 2013) was followed by another programme called Horizon 2020, whose main objectives include the innovative use of cultural heritage as an opportunity for investment, economic growth, development of new markets, job creation and social cohesion, attests to the growing interest in cultural heritage as an instrument of development through new technologies.

There are further signs of this importance our society attaches to cultural heritage. An example is the many international and national events focused specifically on research combining heritage and new technologies, such as the International Conference on Digital Heritage - EUROMED, the DCH International Conference, the Conference on Cultural Heritage and New Technologies - CHNT, the Digital Heritage International Congress (including the Digital Heritage Awards), which was last held in Granada and brings together the experiences of other international congresses, the Science and Engineering in Arts, Heritage & Archaeology (SEAHA) Conference, the Congreso Internacional Patrimonio Cultural y las Nuevas Tecnologías started up by the Instituto Nacional de Antropología e Historia (Mexico), and the Bienal de Restauración y Gestión del Patrimonio - AR&PA (Spain), to mention only a few. They all bring together researchers and sector professionals, who share and make known the most innovative experiences in the field of heritage.

Given the underlying importance of the theme of this year’s AC/E Annual Report, the Focus 2017 gives an overview of the application of digital technologies in heritage, concentrating on three
basic aspects which are intended to cover the current situation, namely:

- documentation, diagnosis and conservation/preservation;
- dissemination, enhancement and education, and
- research.

It should be explained to readers that experiences related to restoration have not been included. As this is a very specific discipline in which digital technologies are of great importance, it would require an extensive survey well beyond the scope of the present study.

The selected case studies show how advances in computing and electronics have given rise to the application of artificial intelligence, the Internet of Things, information and communication technologies, 3D digitisation techniques and virtual, mixed and augmented reality technologies in the cultural heritage sector.

What is more, these technologies have become extremely widespread in the twenty-first century thanks to a variety of devices whose ubiquity and wireless connections are heralding the advent of the smart cities of the future, where cultural heritage will enjoy a predominant presence judging by the pioneering cases we are witnessing today.

In addition to the mobile devices that are already well known, a number of new gadgets are spearheading the expansion of digital heritage, such as virtual reality and augmented reality smartglasses and drones or UAVs (unmanned aerial vehicles), whose rapid spread in recent years has given rise to experiences of great interest to sector professionals.

Smartglasses are noteworthy because they immerse users in virtual environments and allow them to enjoy a more “live” experience of cultural objects; indeed, this has led them to become one of the most cutting-edge resources in heritage dissemination. Drones, for their part, already have a fairly long track record in this field; in particular, their use has become established in documentation work in combination with data acquisition techniques (digital photography or photogrammetry), which boost their potential in this field.

But without a doubt the most revolutionary breakthrough has been 3D printers, which can produce physical models of digital heritage – a new and important dimension full of possibilities hitherto regarded as utopian. Although we will examine a variety of applications, in this introduction we wish to stress a use related to acts of destruction of cultural heritage associated with war. In such cases 3D digital modelling and reconstruction is a palliative means of preserving the world’s cultural memory.

All these developments are giving rise to a situation where three actors – sector professionals, the public and heritage itself – are becoming interrelated as never before thanks to digital technologies.

The survey is not limited to the areas commented on above. The range of possibilities spans a broad variety of examples and cases of good practice which duly illustrate the intrinsic and sound relationship that has been established between digital technologies and cultural heritage.
1. DOCUMENTATION, DIAGNOSIS AND CONSERVATION

In Principles for the recording of monuments, groups of buildings and sites \(^1\) (1996), the International Council on Monuments and Sites (ICOMOS) underlined the importance of recording heritage, stressing the acquisition, dissemination and analysis of the data needed to maintain and manage it. As a result, ICOMOS founded a committee devoted specifically to documenting cultural heritage: CIPA Heritage Documentation \(^2\) whose mission was to facilitate the transfer of advances in the digital recording and conservation of heritage to the various institutions and professionals in the sector.

Continuing along this path, growing importance has been attached to protecting and preserving cultural heritage in recent decades, leading to the design of preventive conservation plans for heritage assets. Digital technology offers a broad spectrum of possibilities in these plans owing to its non-invasive techniques, which allow many of the challenges of this arduous task to be addressed.

It is therefore not surprising that the European Commission has paid special attention to this issue, as ratified in the Lisbon Treaty \(^3\) (2007) and the Treaty on the Functioning of the European Union \(^4\) (2012). It has accordingly promoted and funded many actions for protecting and safeguarding heritage in order to make cultural heritage more accessible.

Preventive conservation tasks have focused on assessing and understanding the mechanisms whereby cultural heritage is damaged, and digital technologies have been of great use in the graphic recording tasks that support other traditional techniques for diagnosis and subsequent intervention. In Spain specific documents have been compiled on this subject, such as the Documentación gráfica del patrimonio \(^5\) published in 2010 by the Ministry of Culture, which brings together a large number of experts and experiences in the sector.

The past few years have seen a growing number of research projects and campaigns which have
come up with a broad variety of techniques and results ranging from monitoring heritage and creating databases to the use of digital acquisition techniques for existing property and the dissemination of highly accurate 3D digital models, especially through 3D printers.

An important technique is the digital monitoring of heritage using wireless sensors – a growing trend in recent years owing to the increasing presence of the Internet of Things (IoT). It allows any monument to be constantly monitored in situ and has solved problems stemming from shortage of resources and personnel.

The search for the best possible techniques and means of ensuring the protection of cultural heritage has also led to the digitisation of heritage using digital data acquisition techniques in order to create 3D models of the heritage assets. As we will see, this is a complex task that often requires a combination of several techniques and procedures to obtain results that are faithful to the original. The main ones are high-definition digital photography, photogrammetric techniques and 3D laser scanning (in combination with UAVs or drones), which are characterised by high visual definition and metric accuracy.

The large amount of information that can be gleaned from heritage has enabled very accurate representations and diagnoses to be made using a variety of means, especially metadata, applications for mobile devices and the recent incorporation of 3D printers, which have been the chief consideration in the latest heritage recording efforts.

### 1.1 Wireless Sensor Networks (WSNs)

Planning the maintenance of heritage buildings for their preservation requires a careful assessment of their structural integrity coupled with a precise and quantitative understanding of the factors that can affect them.

This information has traditionally been gathered through data recording sensors and instruments that measure elements such as vibrations, temperature and humidity. However, there were a few disadvantages to using them in heritage environments, as they require a nearby power socket or extensive wiring in order to be correctly installed. Furthermore, as we are dealing with heritage buildings, many of which contain artworks, the visual impact caused by the recording equipment has limited their use in such spaces.

In the age of the Internet of Things (IoT), wireless sensor networks (WSNs) allow radically different solutions to be adopted to address the abovementioned issues. Small autonomous sensors that communicate by means of wireless systems are less invasive and enable more devices to be installed more extensively to obtain a variety of information.

When designing a wireless sensor network for the monitoring and conservation of heritage sites, it is necessary to bear in mind the setting where it is to be implemented. Specific requirements need to be studied such as environment, resources, cost, hardware and limitations of the system, so that the network is tailored as closely as possible to the property’s geographical, climatological, structural and other needs.

In addition, although the main purpose of installing these networks is monitoring to ensure appropriate preventive conservation with respect to environmental conditions, the fact is that these systems can also perform other functions such as surveillance and warning against other types of risks, such as fire, flooding and physical attacks.

There is no doubt that wireless sensor networks are attracting keen interest on account of their advantages for supervising and keeping check on physical phenomena, as using these heritage monitoring systems as part of preventive conservation programmes enables the cultural institu-
tions that manage and conserve our heritage to save costs.

It is therefore not surprising that in recent years research and innovation programmes have included several international cooperation projects for the smart monitoring of cultural heritage.

**Cuspis (Cultural Heritage Space Identification System)**

One such project is Cuspis\(^1\) (Cultural Heritage Space Identification System), developed as part of the FP6 (Sixth Framework Programme). It involved designing a system for monitoring archaeological artefacts from the moment they are identified in their original site until they are deposited in a museum. This system was put into practice at the Villa Adriana site (Tivoli, Italy) and in the city of Athens. Terminals identified and monitored each object using GNSS signals (through the Galileo global navigation satellite system), RFID and mapping techniques for Egnos (Satellite-Based Augmentation System) positioning/tracking and were managed by wireless communication terminals (Wi-Fi and mobile).

**Smart Monitoring of Historic Structures**

The Smart Monitoring of Historic Structures\(^2\) project, funded as part of the FP7 (Seventh Framework Programme 2007–2013), developed a smart monitoring system based on minimally invasive wireless networks and smart sensors installed in historic monuments. The system allows temperature, humidity, air speed, deterioration or cracks, acoustic level, vibration, and environmental or ultraviolet light levels and even chemical attacks to be monitored. A smart data processing system was also implemented to interpret the information gathered by the sensors by developing open-code software that is easy for sector professionals to configure and use.

**Monitoring Heritage System (MHS)**

The MHS (Monitoring Heritage System)\(^3\) is a smart management system ideally suited to historic buildings and other heritage assets. The system, developed in collaboration with Telefónica since 2005, has been implemented and tested as part of the Románico Norte Atlántico project run by the Fundación Santa María la Real del Patrimonio Histórico\(^4\) (Spain).

It consists of barely visible wireless sensors (hygrometers, xylographs, luxmeters, etc.) connected in a network. They are placed at strategic points in buildings to monitor various environmental parameters related to temperature, humidity, atmospheric pressure and intensity of light, as well as other data on vibrations or fissures in the structures. The recorded data is sent to a central server in accordance with the M2M (machine to machine) concept in order to check and evaluate the state of the property.

Basically the system, which illustrates the potential of the Internet of Things (IoT), allows sector professionals to analyse in detail the conservation parameters for heritage property and carry out preventive intervention to remedy possible alterations or pathologies. Other functions which could be very useful in aspects such as security or protection against fire and floods attest to the versatility of the system. Indeed, it is not limited to conservation operations but also incorporates functions based on boosting and promoting tourism (a system of codes and magnetic access cards, 3D projection, downloading audio guides using QR codes and a lighting system to create different scenes or environments).

**SHbuildings**

The transnational cooperation project SHbuildings (Smart Heritage Buildings)\(^5\) is part of the Interreg IV SUDOE territorial cooperation programme for Southwest Europe. It is an alternative heritage management system aimed
chreily at creating more economical sustainability models through the use of smart technologies. Spanish, French and Portuguese companies, technology centres, institutions and bodies, coordinated by the Fundación Santa María la Real de Aguilar de Campoo, are involved in developing this system, which is based on sensors, the Internet of Things and cloud computing.

Monitoring heritage through the SHBuildings system makes it possible to analyse various parameters and detect possible abnormalities, establishing a specific preventive conservation plan for each heritage building. Minimising the efforts devoted to restoration work, maintenance and management of monumental buildings amounts to an improvement in the overall management of historic buildings.

### 1.2 BIM (Building Information Modelling)

BIM (Building Information Modelling) techniques refer to the process of generating and managing the data on a building throughout its lifecycle.

The use of BIM techniques has grown significantly over the past decade in the field of cultural heritage recording and it is considered an important stage prior to the construction of virtual environments. Architects, archaeologists, conservators, engineers and other heritage professionals have found BIM techniques to be a major ally, as they are changing the traditional way of performing the tasks of documenting and administering historic properties.

This new approach is due to the recognition of BIM techniques as a technology that meets the growing demand for the creation of a multidisciplinary database, which is essential to the management of a building’s lifecycle and includes information on intervention tasks that are part of the record and inventory of heritage assets.

BIM is basically a 3D digital representation of a site, structure or building with its intrinsic characteristics. It features smart construction components or characteristics of its surroundings, including data attributes and parametric rules for each object. BIM technology holds a number of advantages over CAD techniques (computer-aided design) as it is capable of managing information and not just graphics.

BIM thus makes it possible to create a digital representation with the physical and functional characteristics of a heritage asset. It is a resource for knowledge sharing that provides information of primary importance to making future decisions during the asset’s lifecycle.

**Sandstone, Heritage Documentation Software**

Sandstone, Heritage Documentation Software is the name of a heritage recording application that has been developed in various phases by Integrated Conservation Resources (ICR) and the World Monuments Fund. Several Spanish institutions have collaborated on the project, such as the Fundación Catedral Santa María (FCSM), the Fundación Catedral de Santiago (FCS), the Instituto de Patrimonio Cultural Español (IPCE) and the Fundación Barrie.

This software, specialised in heritage conservation and recording processes, has been put into practice as part of the Programa Catedral, which includes case studies and diagnoses for restoring the Portal of Glory of Santiago de Compostela cathedral and interventions on Vitoria-Gasteiz cathedral.

Sandstone’s [YouTube channel](https://www.youtube.com) provides tutorials explaining how to install and configure the software using various modules such as PostgreSQL, a structured consultation tool, the geographic information system called Sandstone GIS, and Sandstone Library, libraries that enable all the information contained in this database to be managed.
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1.3 Metadata management systems

Metadata has traditionally been used in book cataloguing systems as a means of managing and retrieving stored information. However, as information is increasingly digital, metadata has become one of the tools with the greatest potential in the field of the so-called digital humanities.

It has been of great importance in facilitating one of the oldest and most arduous historic heritage tasks: inventorying and cataloguing cultural property. Sector professionals have found that databases have hugely facilitated the task of gathering and cataloguing information as, unlike other elements such as publications, artistic objects are very heterogeneous and require the type of detailed analysis that a computerised database can provide.

Incorporating metadata into the system makes it possible not only to catalogue but also to establish a fast and easy data retrieval language that helps access and disseminate all these heritage records. Though this also calls for unifying the required systems and fields to allow data to be exported between the various institutions.

It is therefore necessary to build a suitable organisational infrastructure for managing metadata, which establishes resources for acquiring and selecting data, the use of metadata standards and recording. Metadata standard refers to the minimum level of information needed to document heritage property and encompasses the procedures involved in understanding, protecting and managing these assets. The Council of Europe has established standard international rules for cultural heritage, which are laid down in Documenting the Cultural Heritage. This document describes the three basic core data

PetroBIM

The purpose of this software is to help users create a new project on a heritage property by importing and organising all the multimedia information gathered by techniques such as photogrammetry, digital photography and others. All this documentation is processed by several of the programme's tools to obtain an exhaustive database that allows pathologies and diagnoses for future interventions to be made.

Figure 01 - Interface of Sandstone, Heritage Documentation Software. Photo: video screenshot. Source: YouTube

The use of specific software is also proving to be especially important to sector professionals in the recording and preventive conservation of heritage property. For example, the online tool PetroBIM has been developed to create a database focused on producing three-dimensional models that can be used to analyse all the pathologies and alterations in a particular property by means of information layers. It provides an intuitive and predominantly visual interface that not only records all the art-historical information on the property but also makes it possible to create virtual cross-sections, generate filters for consulting graphs and perform instant information searches, among other functions. One of its advantages is that it is an online collaborative database that involves a large number of sector professionals in multidisciplinary teams. The information obtained will make it possible to undertake intervention and restoration projects on historic buildings, as well as draw up preventive conservation plans.
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The bank based on XMP (Extensible Metadata Platform) markup language allows them to manage and monitor each item by means of a detailed search and consultation system. The idea is for the metadata to be exportable to other databases held by cultural institutions, thereby promoting collaborative and multidisciplinary work.

Basically, having a suitable structural framework based on metadata not only facilitates access to and management of cultural heritage information resources. It also provides guidelines on how to support the effective exchange of knowledge and the retrieval and long-term storage of data.

The examples chosen for this study report cases of collections of movable property which, although not the main object of study, illustrate the possibilities of metadata in cataloguing immovable property. Although catalogues and databases of the latter have been drawn up, they have yet to be widely disseminated in comparison to those of movable assets.

Panel for Metadata Management

As previously mentioned, the needs of cultural assets – which display very heterogeneous characteristics and are very diverse in nature – have spurred the development of specific tools for cataloguing them. It was this need that drove IPTC’s Photo Metadata Working Group, which belongs to a London-based company focused on providing technological support for improving the handling and exchange of information, to develop a plugin for Adobe Bridge software, a programme for organising and editing digital image files. The free plugin, which they called Cultural Heritage Panel, offers a variety of specific fields for cataloguing digital images of cultural assets such as artworks, historic monuments, books and manuscripts. The tool provides an intuitive, user-friendly interface that facilitates the work of curators, archaeologists, architects, restorers and art historians, as well as that of professional photographers, as its image standards for recording historic buildings and monuments, archaeological sites and objects from a general and neutral perspective for each country. There is a similar document establishing guidelines for the integration of cultural information: Information and documentation ISO 21127:2014, developed by the International Council of Museums (ICOM–CIDOC).

This database administrator is a powerful and effective tool for acquiring, managing and searching for data. The software made it possible...
to design individual templates in accordance with the specific needs of the various collections and cultural objects. All the information about the cultural objects was gathered with the support of metadata, so that the information could be used for cross-institutional research, thereby optimising the search options. For metadata management controlled vocabularies, authority files and thesauruses were used (Geonames, GND...) and a generic data model was developed which included core categories (object and media type, date, place...) for different types of objects. This basic data is compulsory and will be mapped to the EDM (Europeana Data Model Documentation) in order to guarantee a consistent global database including all the collections involved.

The creation of this digital repository will make Styria’s cultural heritage available to teachers, researchers, students and professionals of the sector and will document and give visibility to the collections, as well as providing a point of departure for new scientific research and cultural activities.

**Metadata and cultural heritage of Kinmen (Taiwan)**

The small archipelago of Kinmen (Taiwan) was the focus of a project which used a geographic information system to design a digital management resource for cultural heritage involving the integration, collaboration and exchange of resources by sector professionals (Yang et al., 2014).

The research was carried out jointly by the National Taipei University of Technology and the China University of Technology, both in Taipei (Taiwan), as part of the Research Programme 2010–2014 of the Ministry of Science and Technology.

The project considered that the system could improve the tasks carried out during the various phases of recording, restoring and maintaining each asset, according to the parameters established by Taiwan’s cultural heritage laws and the concepts of World Heritage.

The prototype for this metadata planning and GIS management platform included more than two hundred elements such as historic monuments, relics and historic buildings. It also incorporated existing information, such as research reports, conservation plans and management strategies, which were completed with graphic and multimedia information that will be of great importance to users who consult the system database.

Basically, the system was intended to comply with the international standard for managing cultural heritage metadata and was ultimately linked to Kinmen’s aspirations of applying to be on the World Heritage List.

### 1.4 Digital photogrammetry/3D laser scanning

The importance of recording and documenting cultural heritage using digital photogrammetry and 3D laser scanning techniques is internationally recognised, and new instruments, data-gathering methodologies and high-resolution 3D representations are constantly being developed. These techniques make a significant contribution to digital documentation, mapmaking and the conservation and dissemination of heritage.

Visualisation/virtualisation and preventive planning are innovative and powerful documentation tools in the field of conservation. Photogrammetry and laser scanning are among the metric techniques used to document heritage as opposed to other traditional techniques like photography or surveying. Recent experience in digitally documenting heritage using photogrammetry and laser scanning, both separately and in combination, shows that more detailed results can be obtained, as they are truly accurate at recovering lost elements and obtaining data that
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Progress in digitally recording heritage, proving to be a tool with major potential. Laser scanners are devices that acquire the spatial coordinates of a particular structure or object systematically and in real time, obtaining sufficient data to create a point cloud as the basis for producing a digital three-dimensional model. A particular feature of laser scanners is that they provide truly precise information about the relief and texture of a surface, and this makes them especially well-suited to examining and documenting cultural objects.

Roughly speaking, depending on the element it is wished to scan, one type of device or another is used. The long- and medium-distance system LiDAR (light detection and ranging) is used to record the measurement of large surfaces or objects, whereas short-range scanners are ideal for recording the details of an object’s surface from a distance of less than one metre. The combination of both types of scanner allows a more detailed and accurate digital model to be obtained. Work carried out on heritage using laser scanners is therefore giving rise to more detailed analyses of heritage elements, resulting in new ideas and greater knowledge of their history.

Until a relatively short time ago, the application of photogrammetric and 3D laser scanning technologies was limited to institutions and companies with sufficient capital and resources to fund the learning methods and the devices required for applying these techniques to heritage. However, in recent years the situation has started to change as costs have gradually decreased and devices, methodologies and software have proliferated. As a result these technologies are among the resources most widely used by enthusiasts and sector professionals interested in documenting and digitising heritage.

Colonial church of Ekab (Mexico)

Collaboration between the University of California (San Diego, California) and the Instituto
Nacional de Antropología e Historia - INAH (Mexico) gave rise to a project designed to carry out a structural diagnosis and preserve the site at Ekab (Mexico) using digital data acquisition techniques (Hess et al., 2014).35

Ekab was an ancient Mayan settlement located in the Yucatan peninsula (Mexico). It preserves archaeological remains of the indigenous population and other ruins from the colonial era, such as a church dating from the sixteenth century, on which the work performed was focused.

The aim was to use non-destructive digital methodologies to document in detail the ruins of this church – which is located in a place difficult to access – in order to obtain sufficient data to perform visual and structural diagnoses that cannot be made in situ.

The techniques used to document the ruins of the site were chiefly 3D laser scanning and others such as high-resolution photography, panoramic 360-degree imaging, aerial photography and thermal imaging to diagnose the current state of preservation.

The information gleaned is of great importance, as it can be used to draw up future plans for protecting and preserving the site. This diagnostic study has other potential uses, as the information could also be employed in other types of studies related to historical, archaeological and anthropological analyses.

**Fresco mural *Pan American Unity* by Diego Rivera (San Francisco, California)**

The moving of a fresco by Diego Rivera (1886–1957), commonly known as *Pan American Unity*, was an opportunity to put into practice the versatility of photogrammetric techniques as means of diagnosing and preserving cultural property.

This fresco, painted by the artist in 1940, has significant historic and social value, as it is held to be an emblem of the expression of a unified culture of the Americas, presented through an inspiring view of the unity of the art, religion, history, politics and technology of all the peoples.

After initially being shown in an exhibition, the mural was intended for the new library of the City College of San Francisco. However, the library was never built, and it was therefore installed in the Diego Rivera theatre on the college campus.

After several years, the Friends of the Diego Rivera Murals association and the City College of San Francisco started up the Diego Rivera Mural Project, which aimed to move the mural to a new building on the campus for enhanced public viewing.

The task of moving such a large, complex and admirable work to a new location needed to be carried out with utmost care to prevent any damage. It was therefore essential to gather sufficient information in order to draw up an assessment and prevention plan before moving it.

For this purpose Cultural Heritage Imaging (CHI), specialists in the culture sector, were contacted and entrusted with producing a set of 3D images using photogrammetric techniques. The complete 3D representation of the mural, together with 2D images, was the basis for an in-depth analysis and accurate record of the current condition of the mural. What is more, the information gleaned could be used to establish a database that will be important in the long term for managing the conservation of the mural vis-à-vis possible changes in its conditions and structural characteristics [online resource - video].38

**Main chapel of Valencia cathedral**

In Spain photogrammetric and laser scanning techniques have been used in important interventions on cultural property, especially those
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CultLab 3D

A broad variety of instruments are available for digital documentation, and sometimes a combination of several is necessary, making the process complex and wide-ranging. CultLab3D is a laboratory that contains a digitisation system for three-dimensional objects. It was created by the Competence Center for Cultural Heritage Digitization belonging to the Fraunhofer Institute for Computer Graphics Research IGD (Darmstadt, Germany). It is the first mass digitisation system of its kind thanks to an automated conveyor belt 3D scanning system. This would make it possible to scan whole collections of movable assets, unifying all these processes and optimising the work and the time required to acquire digitised data. So far the CultLab3D prototype has focused mainly on a photogrammetric exploration procedure capable of capturing the geometry, texture and optical properties of the objects’ materials – the latter being a characteristic of considerable importance with a view to future 3D printing processes. Automating the digitisation process seeks to provide an effective solution for museums, which are increasingly demanding quality 3D models, and, basically, the ability to document their entire collections.

International Conservation Center – Città di Roma

In other cases, the experiments carried out in research labs have attempted to provide low-cost alternatives in the use of photogrammetric techniques to document and digitise cultural heritage. An example is the work performed at the International Conservation Center – Città di Roma, an Israeli institution devoted to historic conservation and preservation, whose results were presented at the International Conference on Cultural Heritage and New Technologies of 2013 in Vienna (Waas and Zell, 2013).

The three chosen case studies aimed to illustrate several scenarios for assessing photogrammetric techniques. They focused on the wall of a church dating from the age of the Crusades in Tel Yokneam (valley of Jezreel, near Haifa); the paintings and decorative plasterwork on the ceiling of a nineteenth-century house in the coastal city of Acre; and the remains of some Roman latrines near the amphitheatre in the city of Beit She’an.
The studies show that, using Meshlab open-code software, free 123D Catch software and Agisoft PhotoScan Pro licensed software, photogrammetric techniques can be employed in any project for digitally documenting heritage owing to the lower investment required, and that the results are acceptable in comparison to those of costlier techniques such as 3D laser scanning. The idea is for the methodology employed in this study to be effectively implemented for the use of sector professionals.

### 1.5 RTI (Reflectance Transformation Imaging)

RTI (Reflectance Transformation Imaging) is a computational photography method. By capturing several digital photographs which are then synthesised, it allows three-dimensional images to be obtained to enhance the object's surface shape and colour attributes and re-light it interactively from several directions in order to capture details and nuances that result in a digital model as close as possible to the real object.

This technique has had major repercussions in the heritage field, especially with respect to elements with more complex surfaces owing to their composition or particular and/or deteriorated morphology. Unlike the information obtained from a digital photograph, for an RTI image multiple (2D) photographs need to be shot from a stationary camera position, and for each one light is projected from a different direction controlled by the team. Lighting information from all the photographs of the subject is synthesised to generate an interactive (3D) image of the same subject with varying highlights and shadows.

It is therefore only logical that RTI techniques, combined with photogrammetry, have gained prominence in the field of digital documentation, where models need to represent the originals as realistically as possible, reproducing the same conditions as if we were observing it in situ. The use of RTI techniques has made it possible to reveal details of the cultural object that would be very difficult to perceive with the naked eye, but which these 3D digital photographs disclose because they survey and analyse the surface in depth.

Some companies like Cultural Heritage Imaging are at the forefront of the methodology, data acquisition and visualisation of RTI images, as shown by the corporation's [website](#), which explains some of the technical specifications and examples of the use of RTI for anyone interested in employing it to document heritage.

**El Morro National Monument (New Mexico)**

CHI (Cultural Heritage Imaging) is a corporation based in San Francisco (United States) which develops useful imaging tools for digitally documenting heritage treasures before they disappear. This philosophy underpinned the project focused on the inscriptions and petroglyphs on the rocks of El Morro National Monument, a park in New Mexico whose origins date back to the 1st century AD, when it was occupied by the ancient Zuni Indians. It was subsequently occupied by Spanish settlers in the late sixteenth and early seventeenth centuries. The important historical and documentary value of the inscriptions found on the rocks is part of the historical memory of these settlers. These inscriptions have remained for centuries and are one of the attractions for visitors to the park.

In 2015, in collaboration with the US National Park Service and Center of Preservation Research of the University of Colorado (Denver), CHI was entrusted with carrying out work on these inscriptions carved in sandstone, which were at risk of disappearing due to erosion. The techniques used were small-scale 3D photogrammetry to document the inscriptions in fine detail and **RTI (Reflectance Transformation Imaging)**. The combination of these two processes is an ideal means of salvaging inscriptions that are...
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1.6 Robotics and Drones/UAVs

One of the difficulties often encountered in digitally documenting immovable property is the structural limitations that hinder the access of people and the use of the best-known techniques mentioned above, such as 3D laser scanning or photogrammetry. Nevertheless, advances in robotics and artificial intelligence are increasingly coming up with alternative ways of surveying such places.

ROVINA project

An example of the foregoing is the ROVINA project. Funded by the European Union’s 7th Framework Programme, it is aimed at developing autonomous mobile robots to make monitoring archaeological sites faster, cheaper and safer.

The test-case scenario for ROVINA was the catacombs of Priscilla (Rome) and San Gennaro (Naples), two sites with certain risks owing to the presence of a maze of underground tunnels and areas possibly contaminated by gases. For this project a robotic system called DigiRo was developed to digitise the archaeological sites. It was fitted with motion sensors and a laser telemeter to establish the distances of particular objects. Three RGB-D cameras capable of capturing surface colour and depth were used to obtain three-dimensional digital images of the various objects or surfaces. Finally, the data gathered by the robot was stored in the cloud, where an archaeological information system (ARIS) analysed and processed all the data through the collaborative platform. These archaeological sites can thus be effectively monitored and conserved, as digital documentation can be used to prevent damage or restore cultural heritage.

Medieval mosaics of the church of San Michele In Africisco (Ravenna, Italy)

As previously mentioned, RTI (Reflectance Transformation Imaging) technology has proven to be of great interest in surfaces where the visual perception may vary depending on where we view them from. An example is the tests carried out as part of the Digital Materiality research project at the Digital Humanities Lab in Basel, which was focused on a medieval mosaic from the former church of San Michele in Africisco (Ravenna, Italy). Dated to AD 545 and now housed in one of the rooms of the Bode-Museum in Berlin, it belongs to the type of Byzantine mosaics made of coloured tesserae, which created an impressive shimmering effect when light fell on their surface. This was an important factor in deciding to use RTI, as this technology would allow a digital model of the mosaic to be obtained, preserving the reflective properties of the surface, with their changing colours and golds. For this process several dozen photographs were taken while artificial light was shined onto the mosaic’s surface from different directions under the supervision of the team. The digital models obtained using this technology, examined through an interactive RTI viewer, are therefore a much more accurate replica of the original than any other type of two-dimensional digital image could be.

With respect to conservation, the aim of capturing these RTI images was to use them to identify areas whose structure and reflective properties differed from others owing to the presence of tesserae of a different size or shape or differently set, suggesting that they are the product of some type of repair or restoration carried out during the turbulent history of this mosaic from San Michele in Africisco. One of the team’s goals is to conduct the same experiment on mosaics in situ.

Currently illegible, making them easier to discern through an interactive viewer, and results in important documentation and conservation work. This documentation also makes it possible to assess future erosion processes and devise preventive conservation measures.

Medieval mosaics of the church of San Michele In Africisco (Ravenna, Italy)

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Although this project has not been completed, it is also intended to create virtual reality applications to allow users to experience visiting these digitised sites [online resource - video].

1.6.1 DRONES/UAVs (unmanned aerial vehicles)

The term drone is generally agreed to refer to unmanned aerial vehicles or UAVs, the technical name for them. Both terms emerged in the military field and have been used since the mid-twentieth century, though their presence has grown considerably among the civilian population in the past decade. This has led to the coining of another specific term, RPA (remotely piloted aircraft).

When we speak of drones in connection with heritage, we are generally referring to them as the latest revelation in data acquisition for generating digital information on cultural heritage. Indeed, they are an important means of broadening the possibilities of photogrammetric and laser scanning techniques owing to their adaptation to a particular context (archaeological, monumental, etc...) or because the data gathered is of great importance to correctly modelling the heritage object in combination with the abovementioned acquisition techniques.

Drones have thus proven to be powerful new tools for sector professionals – particularly archaeologists, who have so far made good use of them to document excavations, map landscapes and identify buried structures. It is therefore not surprising that their huge possibilities have led many culture enterprises to specialise in this means of documenting archaeological heritage, such as the Spanish companies Virtua Nostrum\(^{55}\) and Drone By Drone\(^{56}\).

Nevertheless, the use of drones has not been limited to archaeology, as we also find examples related to documenting historic heritage. According to an article by José Antonio Domínguez (2015), the possible uses of drones in the field of heritage can be classified by listing the functions these devices can perform, namely: 1) high-resolution images or videos to be used as visual documents in inventories; 2) flights with different sensors (visual or thermal) to locate problems and pathologies; and 3) photogrammetric flights to obtain metric (measurable) documents in two or three dimensions.

**Tradr project (Long Term Human Robot Teaming for Robot Assisted Disaster Response)**

The recent earthquake that ravaged central Italy in August 2016 had devastating consequences for the heritage of towns like Accumoli, Arquata del Tronto and Amatrice, many of whose historic buildings collapsed and were left partly in ruins. In this unfortunate situation, new technologies proved to be an excellent ally in restoring damaged buildings. The Tradr project (Long Term Human Robot Teaming for Robot Assisted Disaster Response)\(^{57}\) funded by the European Union’s 7th Framework Programme in collaboration with the Italian Vigili del Fuoco, involved surveying the ravaged region of Amatrice, known as the “town of the 100 churches”. The churches of San Francesco and Sant’Agostino were inspected by several drones and robots, which captured the first images of the state of the buildings [video 1]\(^{58}\) [video 2]\(^{59}\). This documentation work was particularly important for the subsequent tasks of clearing the rubble and restoring the buildings, as it made it possible to establish a salvage plan for all the movable objects still inside the churches and organise their recovery.

**Virtua Nostrum**

Virtua Nostrum\(^{60}\) is a Madrid-based company specialised in work involving new technologies in the fields of archaeology, palaeontology, architecture and geology. Digitisation of cultural heritage is an important part of the projects and training courses this company runs, and it uses drones for aerial work as part of the Cerro...
The use of digital technologies in the conservation, analysis and dissemination of cultural heritage

1. DOCUMENTATION, DIAGNOSIS AND CONSERVATION

1.7 3D Digital Models

As we have seen, 3D data acquisition techniques are one of the most widely used resources for documenting and digitising cultural heritage, as the possibility of recreating a detailed virtual model of an area or object helps study and analyse it.

Following the data acquisition process, the end result is the 3D digital model, an ideal replica for the study phase prior to possible restoration/ intervention. 3D digital models allow various alternatives or hypotheses to be considered and studied without having to make any physical changes to the original elements. Therefore, the various pathologies of the heritage property can be studied in this phase and the appropriate procedures for a future intervention can be subsequently outlined.

Another reason for creating 3D digital models is to gather the data needed to carry out an analysis and diagnosis with a view to designing a plan for the preventive conservation of the heritage property.

But these are not the only conservation possibilities of 3D digital models, as the severe deterioration of some heritage assets is due to various specific and environmental causes, such as adverse climate conditions, prolonged functional use of the building (usually for tourist purposes) or fortuitous exposure to war – a factor that has recently gained prominence. In such cases the experiments were also focused on digitising heritage.

Bilanero archaeological project\textsuperscript{61} (Alhambra, Ciudad Real) and at the Roman site of Santa María\textsuperscript{62} de Villarejo de Salvanés (Madrid), where filming, photography and photogrammetry were performed using drones to obtain 3D models generated from photogrammetric techniques that are available online on the company’s website. In other cases the results consisted in creating high-resolution orthophotos to document the site of the Roman villa at La Majona (Don Benito, Badajoz) and the medieval castle of San Juan in Peñalver (Guadalajara). Virtua Nostrum has also carried out a photogrammetric survey of the upper section of the nave and lantern tower of the tenth-century Mozarabic church of San Cipriano (San Cebrían de Mazote, Valladolid). This survey illustrates the possibilities of using drones in interior spaces where it is difficult to capture photogrammetric data using other techniques such as 3D laser scanning.

Drone by Drone

Drone By Drone\textsuperscript{63} is a Basque company specialised in capturing high-quality images and video footage, as well as in performing technical work and holding courses related to drones, some of which involve heritage.

One of these projects was carried out in collaboration with Arqueocean, a comprehensive archaeological management company that salvages maritime and naval heritage. Part of the work consisted in making a video recording\textsuperscript{64} with drones in the area of the breakwater that connects the island of Garraitz or San Nicolás with Isuntza beach (Lekeitio) to use as documentation for cataloguing wreckage in the Lea inlet.

Also in collaboration with the Universidad del País Vasco and the Grupo de Investigación en Patrimonio y Paisajes Culturales, the site of the ninth-century castle of Santa Marta de Pancorbo, also known as the castle of Pancorbo (Burgos), was architecturally documented. The castle’s special location – it is perched on rocks at the entrance to the Pancorbo pass – made it difficult to reach to document the site. The use of drones facilitated this task and the oblique and overhead shots taken allowed information to be gleaned about the surviving remains and establish possible alterations. Other kinds of drones generated orthophotos and a digital 3D model\textsuperscript{65} of the surviving remains to analyse the inaccessible areas of the site in the laboratory.
Pórtico de la Gloria Virtual

Pórtico de la Gloria Virtual is a long-term project run by the University of Santiago de Compostela. It was begun in 2010 as part of the Programa Catedral. Developed in collaboration with the Fundación Barrié, this project arose with the aim of gleaning the data needed to analyse and diagnose the work required with a view to drawing up a preventive conservation plan for the Portal of Glory in Santiago cathedral and a comprehensive intervention proposal.

During the preliminary stage documentation work was carried out to ascertain the condition of the portal using a high-resolution 3D scanner and thorough high-resolution photographs, which provided extensive complementary information.

This documentation was used by a team from the USC’s Department of Electronics and Computing to create a three-dimensional virtual model of the portal in the greatest possible detail in order to pinpoint the various pathologies and assess its condition with a view to future intervention. The audiovisual production entitled Pórtico de la Gloria Virtual featured a virtual stroll through the Portal of Glory through this 3D model, providing unusual perspectives and details not previously seen, as well as raising awareness of its state of conservation and the need for intervention. The team’s ultimate goal is to develop a tool for exploring and helping study and conserve this monument.

Tomb of Seti I

The tomb of this pharaoh of the 19th dynasty is located in the Valley of the Kings and is one of the largest and most beautiful on the complex. Visits have been regulated and stopped in recent years to help conserve it.

This fact spurred the initiative to create a full-size reproduction of the tomb using digital technology in a project on which the Fundación Factum (Madrid) and the University of Basel (Switzerland) are collaborating for the Egyptian Ministry of Antiquities. The project is part of the initiative for the conservation of the Theban necropolis started up by the foundation.

It is fitting to stress the considerable scope of this project, which was begun in May 2016 and is still underway, as it uses various technologies to achieve a reproduction of the tomb that is as lifelike as possible: short- and long-range 3D laser scanning, short- and medium-range photogrammetry, and high-definition colour photography. For the data acquisition process, two 3D scanners were first used to obtain 70% of the high-resolution images of the walls of the tomb. A few technical limitations of the scanners led this technology to be combined with 3D photogrammetry in areas more difficult to reach with the scanner, such as corners and the upper and lower sections of the walls and rooms.

Finally, high-definition photography was used to document the wall decoration of the tombs in greater detail and capture the colours properly, though in some cases it was also employed for sections of wall without reliefs or any other type of decoration.

Post-processing of the digital documentation began at the end of 2016 with the rendering of digital images and construction of a few panels of the Egyptian tomb in polyurethane resin blocks using 3D printing.

Arc/k Project

Aimed at saving monuments “in danger of extinction” and handing them down to future generations, the Arc/k Project collects photogrammetric documentation on some of the constructions in the city of Palmyra (Syria) that were partially destroyed by Islamic State.

The Arc/k project was started up as a non-profit organisation that sets out to use digital techniques for the digital conservation and protection of heritage, particularly that which is
under imminent threat of terrorist activity, global warming, degradation of the environment and other factors.

September 2016 saw the launch of the organisation’s portal featuring some of the results of the three-dimensional virtual reconstructions of the Temple of Bel, the Arch of Triumph and the interior of the Roman Theatre. The project also involves creating an archive of thousands of digital models of heritage buildings to be used by sector professionals, scientists, researchers and the general public.

One of the novelties is a basic tutorial published on the project’s website, which invites anyone wishing to do so to document their heritage in order to make this a collaborative safeguarding practice that is open to society.

As it mixes the virtual and the real, this technology is applicable to many cases in the field of heritage conservation. It makes it possible to visualise pathologies or proposed interventions using virtual graphics that are superimposed onto the real object.

These practices have been carried out in combination with mobile devices, for which a number of applications have been designed based on augmented reality, which guide users in diagnosing the conservation of a building by means of first-hand observation.

This technology is therefore a valuable tool for professionals in the field of heritage conservation, as it can diagnose possibilities of intervening.

Rasm apk - Realidad Aumentada Móvil para la Conservación del Patrimonio

In Spain a few innovative proposals for the use of augmented reality have emerged, such as that developed by José Luis Izkara in his thesis “Realidad aumentada móvil para la conservación del patrimonio” (Mobile augmented reality for heritage conservation), which involves using this technology to visualise intervention proposals and their results in situ before actually implementing them (Izkara, 2010). It consists of a personal mobile assistant for mobile devices and offers a system based on a platform called Rasm, which guides the user through the conservation diagnosis of a building through first-hand observation. One of the experiments, carried out in the historic part of Labraza (Álava), consisted of a PDA that provided information on particular constructional elements and options for accessing public spaces, among other features. Several markers were distributed around the area and when the PDA’s camera was pointed at them they provided several resources for visualising the intervention possibilities by means of virtual graphics overlaid on the real image of the building.

1.8 Augmented reality apps

Augmented reality technology consists in inserting virtual graphics into our real physical space so that the real and the virtual combine to produce an enhanced or augmented image of reality. Although augmented reality is closely linked to virtual reality, they differ in their configuration, as virtual reality refers to worlds or environments made up entirely of computer-generated graphics, whereas in augmented reality environments the presence of a real image combined with virtual graphics is essential.

Figure 03 - 3D virtual reconstructions of monuments of Palmyra. Photo: screenshot. Source: http://the-arckives.org/
Another experiment was carried out as part of this work in Segovia. Using an Ultra Mobile PC, the visual impact of an intervention on the city’s Cervantes theatre was analysed. The camera on the device and the assistant provided an augmented image of the building’s surroundings with the construction proposals in order to evaluate their impact and possible solutions.

**Ivapta project**

The University of Seville has developed an augmented reality application for the conservation of heritage property which has proven to be valid for studying and diagnosing issues in paintings on canvas. This application is part of a teaching programme, the II Plan Propio de Docencia (2015), and comes under the so-called Ivapta project, which stands for Indicadores Virtuales de Alteración en Pintura sobre Tela (Virtual indicators of alterations in painting on canvas).

The app can be downloaded from digital content platforms and displays a menu featuring various types of issues: colour alteration, warping, previous interventions, flaking, loss of paint and tears. When users held their devices over the work in question – in this case an *Immaculate Conception* attributed to the Sevillian painter Francisco Meneses Osorio – several points appeared indicating abnormalities related to each of the abovementioned issues. They could press the points to activate an audio recording providing precise information, accompanied by a detailed text and images.

Although the application has been tested chiefly as an educational tool for undergraduates studying for a degree in Conservation and Restoration of Cultural Property (González and Prado, 2015), it has significant potential for sector professionals as a useful assistant for diagnosing and evaluating any cultural property.

### 1.9 Projection mapping

Many technologies can be used as part of the diagnostic and intervention process involved in restoring any heritage property, and projection mapping is no exception, as we shall see.

**Church of Santa Maria Inter Vineas (Italy)**

The experiment carried out at the School of Architecture and Design in Ascoli Piceno (Italy) was a specific case of the use of projection mapping to identify the phases of construction of the church of Santa Maria Inter Vineas in that town (Rossi et al., 2014). It focused mainly on the interventions carried out on the building throughout its history in order to gain the fullest possible view and knowledge before designing the plan. Using several types of 3D software, such as Autodesk 3ds Max 2010, a number of three-dimensional digital models of the church were produced with different textures to contrast the various demolitions, additions or restoration work with the current architecture. It was also necessary to create two mock-ups of the church on a scale of 1:50 representing two stages in its construction before and after the year 1950, when major modifications were made. After aligning the digital models with the projector, a sequence of past interventions on the church was mapped onto the physical model. The overall view provided and the immediacy of the information on its architectural history enabled the students to carry out a more precise diagnosis and glean much deeper knowledge of the building, for which a future restoration plan will be drawn up.

### 1.10 3D Printing

3D printing has proven to be one of the most innovative technologies with the greatest potential in the cultural heritage sector and has been rapidly spreading over the past five years.
From data acquisition using photogrammetry or laser scanning techniques to the reproduction of virtual copies of heritage elements, 3D printing can be considered the last link in the digitisation processes, as it involves physically recreating heritage.

Although it is in the area of heritage dissemination where 3D printing has rapidly gained a foothold, the fact is that its conservation possibilities are quickly catching up, as 3D digital models are increasingly high quality and allow extremely accurate replicas to be made.

The most important applications of 3D printing in conservation are linked to the possibility of documenting heritage elements likely to disappear or deteriorate owing to their current circumstances. 3D-printed replicas allow access to heritage for the purpose of conducting studies and analyses, while the original remains safe. One of the possibilities of this technology is to provide replacements in their original context for heritage elements that are now preserved in museums, having been removed from their original settings for conservation reasons. The importance of 3D printing for conservation purposes has also been underlined in relation to the destruction of heritage in wars; in these cases digital 3D models and recreation are a palliative means of conserving the world’s cultural memory.

Arch of Triumph of Palmyra (Syria)

For example, during 2016 landmark sites in the cities of London, New York and Dubai were the chosen settings for displaying a 3D-printed scale replica of the recently destroyed Arch of Triumph of the city of Palmyra (Syria). This project was led by The Institute of Digital Archaeology (IDA), a joint collaboration between the universities of Harvard and Oxford and Dubai Future Foundation, which promotes the development and use of digital imaging and 3D printing techniques in archaeology, epigraphy, art history and conservation.

The initiative is also part of the Million Image Database programme run by the institute in conjunction with UNESCO to compile digital images of cultural or architectural sites at risk in war zones, such as the city of Palmyra, captured by volunteers with 3D cameras.

The Arch of Triumph, destroyed by Islamic State in 2015, has been the focus of several projects which have created different digital 3D models to document and disseminate what was one of the key testimonials to the region’s Roman past. The two-thirds scale replica was based on 3D models generated from a series of 2D photographs of the real arch. The end product was a replica of the arch standing more than seven metres tall and made of Egyptian marble in order to resemble the original. Two robots from Carrara (Italy) were used for the production process. Taking high-definition 3D models as a basis, they sculpted the arch from marble blocks.

This project underlined the possibility of employing digital technologies to recreate images of the past and the cultures they represent. Using 3D printing to create reproductions is a way of bringing back destroyed heritage for our society to appreciate.

Mashrabiya: survival of traditional Islamic architecture

3D printing in the heritage field can be used for other equally interesting purposes such as to foster the continued use of traditional types of architecture in current construction practices. An experiment carried out at Montfort University (Leicester, United Kingdom) and Kansas State University (United States) aimed to recover the wooden lattice screens (mashrabiya) traditionally used in Islamic architecture as a characteristic and identifying element of current architectural designs in the state of Bahrein, on the Arabian Peninsula (Almerbati and Headley, 2016).

The mashrabiya is deeply rooted in the heritage and culture of several Gulf States and other...
Islamic societies. Therefore, the use of emerging technologies such as 3D modelling and printing appeared to be a valid way of preserving and maintaining their historical and social value in a contemporary architectural style.

Furthermore, the visual and thermal comfort performance of the type of mashrabiya featured in the project allowed it to be included in the economic development programme “Bahrein 2030”, which is focused on preserving the influence of heritage property for future modern buildings, while creating sustainable and attractive living conditions. The presence of these new digital artisans and builders is of great importance here, as they can help understand potential construction methods by using 3D printing for the production of mashrabiya.

The modelling of mashrabiya using 3D printers was also aimed at reviving these archetypes of architectural heritage in order to offer a new perspective in view of the shortage of expert craftsmen in the current production market.
2. DISSEMINATION, ENHANCEMENT AND EDUCATION

If there is anything in which the heritage sector of the twenty-first century differs from that of previous periods it is in the increasingly evident presence of digital technologies as tools for disseminating and enhancing the value of heritage sites.

This important and unceasing task has had an ally which, despite entailing both advantages and disadvantages, has been positive overall, as digital technologies enable us to learn about our heritage more closely than ever before.

Indeed, the relationship is so close that we are currently experiencing a new stage in digital heritage. The chief novelty lies in the fact that, following a period in which cultural assets were progressively codified using the new behind-the-screen language, it is now possible for digital 3D models to come to life outside the digital medium, giving rise to new experiences aimed chiefly at providing knowledge of the cultural object.

The initial contact between heritage elements and digital technologies came when acquisition techniques such as photogrammetry or 3D laser scanning were employed to codify it and use it in the digital medium.

The second phase involved the dissemination of this digital heritage through information and communication technologies (ICT); here we are largely talking about the internet as the cornerstone of access to heritage and virtual technologies. During this phase we witnessed a veritable revolution in portable devices, which has led to us being able to enjoy digital content in situ without the traditional separation that existed in the age of desktop. As a result, the digital medium is omnipresent in heritage sites.

The latest step has been driven by the appearance of 3D printers, which have made it possible to recreate digital heritage beyond the screen. This means that these 3D models come to life again, sharing real physical space with the original and giving rise to experiences related to
2.1 Heritage in the digital medium

One of the milestone achievements of information and communication technologies (ICT) was the emergence of the internet as a worldwide network for transferring multimedia data. Its advent benefitted many fields of knowledge, especially cultural heritage, as knowledge and dissemination overcame physical and geographical limitations. UNESCO’s drafting of the Charter on the Preservation of Digital Heritage (2016) and the submittal of the report on El impacto de las tecnologías digitales en la diversidad de las expresiones culturales de España e Hispanoamérica (The impact of digital technologies on the diversity of cultural expressions of Spain and Spanish America, 2016) stress the potentiality of digital and the need to share experiences by joining forces to adopt an interdisciplinary working method aimed chiefly at enhancing the value and knowledge of heritage.

The ultimate purpose is to make all heritage objects available on the internet to be consulted and enjoyed anywhere in the world, facilitating the work of both sector professionals and millions of potential users all over the planet.

2.1.1 Geographic Information Systems

GISs or Geographic Information Systems have been one of the most effective tools for cataloguing historic heritage, as a map location makes it possible to obtain complete and analytical visualizations of a group of heritage sites in a geographical area and globally. Roughly speaking, a GIS system consists of a database which has the particular feature of using geolocation references for inventorying and managing each of the elements incorporated into it. GISs have been of particular significance in fields such as archaeology or cataloguing historic heritage as they allow interactive maps to be created that not only refer to the information in the inventory entries for each item, but also provide multimedia data ranging from links to websites, high-resolution photographs and videos to virtual visits and 3D models that exploit all the possibilities of the digital medium. Many GISs applied to heritage have been published on the internet and there are very interesting examples of their use in disseminating and carrying out research on heritage.

Arches Project

An example worth highlighting is the Arches Project developed jointly by the Getty Conservation Institute and World Monuments Fund.

Arches is a geospatially-enabled software platform for cultural heritage inventory and management which meets a widespread need in the heritage field for low-cost, user-friendly and easily accessible electronic inventories. It is therefore freely available for organisations worldwide without restrictions, based on the open-source philosophy. It is designed to facilitate inventorying and cataloguing for international institutions as well as local bodies with fewer funds. The software accordingly combines several functions, such as identifying and inventorying, investigating and analysing, and monitoring and mapping, taking advantage of the latest digital resources (image, video, 3D models) to allow users to create and manage heritage information in all its richness and diversity. Another of Arches’ potentialities is its use of advanced semantic technologies that make it possible to discover previously unknown
connections and patterns among different kinds of heritage information.

**Virtual Cilicia Project**

The Virtual Cilicia Project uses the Google Earth application to disseminate the rich heritage and archaeological studies of the ancient region of Cilicia (Turkey), which is bounded by the southern coast of the Anatolian peninsula. Various cultures (Persian, Hellenistic, Roman, Byzantine, Armenian and Islamic) had successively left an important historic and monumental legacy in this strategic enclave between Anatolia and the Levant since prehistoric times. An information layer, which can be downloaded from the project’s website, allows the items related to each culture to be located on the map, as well as the type of each heritage element, so that all the available information is grouped together in the same application. The ruins of the Hellenistic fortress of Karasis, discovered in 1994, and the remains of the Byzantine churches and fortresses of Anazarbos are just some of the examples, and are accompanied by texts taken from academic studies and photographs that document each monument in its geographical context.

**Interactive map library at Portal geográfico-INAH**

Similarly, the Google Maps application was used by the Portal Geográfico-INAH (Mexico) as a basis for mapping Mexico’s archaeological, historical and ethnographic heritage through an initiative called Mapas Digitales-INAH, which was developed at the Instituto Nacional de Antropología e Historia and is part of the institute’s Portal Geográfico-INAH. This interactive map features all the heritage sites and a factsheet with the catalogue data of the cultural asset, as well as other multimedia information such as photographs and institutional, legal and protection documentation in PDF format, and links to other websites displaying additional information, such as virtual visits. There are several themed maps, such as Patrimonio Mundial for sites on the World Heritage List; Patrimonio Arqueológico, which focuses on archaeological sites all over Mexico; and Patrimonio Monumental for heritage monuments or ensembles.

**Zamani Project**

Our next case study comes from Africa. This project was developed by the University of Cape Town (South Africa) and documents, conserves and disseminates the heritage of the African continent and a few regions of the Middle East. In the Zamani Project the various sites are mapped using satellite images and aerial photographs, and campaigns are subsequently run to gather data in order to create a database using technologies such as geographic information systems (GISs) and 3D computer modelling. The resulting data is varied, ranging from a 3D model viewer, 360-degree virtual tours, screenshots of
The use of digital technologies in the conservation, analysis and dissemination of cultural heritage

The Rock Art Mapping Project (RAMP)

Ukhahlamba-Drakensberg Park is a nature reserve in South Africa with one of the most important mountain ranges on the continent and important remains of cave art attributed to one of the earliest indigenous ethnic groups to inhabit the area, the San people. The Rock Art Mapping Project (RAMP),

funded by the National Lottery Distribution Trust Fund in collaboration with the University of KwaZulu-Natal (UKZN), was started up to document, disseminate and conserve this important piece of African heritage. It consists in creating an extensive digital database to record each of the nearly six thousand known caves. The team of archaeologists visited these caves, some of which had not been documented since the 1970s, to carry out exhaustive documentation using 3D laser scanning techniques enabling them to create digital models. Finally, the geographic information system (GIS) was used to map the region and locate each of the caves, providing digital photographs, virtual visits and 360-degree videos of them. What is more, not only caves situated in the environs of the nature reserve were documented; the work also was extended to others in privately owned areas which had not previously been studied. The aim of putting together this database was to enhance the value of the known cave paintings, especially those located outside the park, which do not enjoy the same protection and management conditions [resource - video].

Vilas Amuralladas

In Spain we find Vilas Amuralladas, an internet geoportal designed to highlight the important heritage of a few cities in Galicia and northern Portugal which have in common city walls or fortresses that attest to their medieval past and/or frontier history. Lugo, Santiago de Compostela, Melgaço, Monção and Valença are the five chosen cities, which are displayed on a geolocation map with information layers. Users can enjoy a full view of their walls showing the places of interest, leading to a 360-degree tour and additional information about the fortified structures and existing stretches of the walls, which are sometimes only partly preserved. This geo-portal also offers layers of information about each city, classified by historical periods (medieval, modern and contemporary), religious architecture, civil architecture and other nerve centres such as squares or streets with significant cultural heritage of interest to tourists.

2.1.2 Web portals

In the internet world, one of the most coherent ways of presenting specific information on a particular theme is through web portals. Also called websites, they are structured into a series of pages with multimedia elements that are grouped together under the same World Wide Web domain. Although they are one of the longest-standing ways of presenting information on the internet, web portals are still one of
the most widely used means of learning about cultural heritage. The global dissemination offered by web portals and the no less important versatility of the digital world, which enables an endless amount of data to be stored in a broad diversity of formats, meets cultural institutions’ and sector professionals’ need to present heritage resources.

**Argentina Virtual**

A website within the Argentine portal Educar.ar was designed to offer virtual visits of several of the country’s landmark heritage buildings and museums. This project, called Argentina Virtual, consists of a list of heritage sites which are accessed individually through a virtual 360-degree visit accompanied by an audio track that explains each of the elements that the user finds while browsing. In addition, each place presents a total of ten representative objects, digitised in 3D, which can be viewed from home using an augmented reality application with markers. The convent and church of San Francisco in Santa Fe, the Manzana Jesuita (Jesuit Block) in Córdoba, the Museo Casa Histórica de la Independencia and the Congreso de la Nación Argentina are some of the tours that allow visitors to explore virtually some of the country’s most important historic ensembles.

**Portal Virtual del Patrimonio de las Universidades Andaluzas**

A pilot project recently run in Spain was the creation of the Portal Virtual del Patrimonio de las Universidades Andaluzas. This portal, which was started up with the intention of promoting the dissemination of cultural heritage, is part of the Andalusian regional government’s Atalaya Project on which the region’s ten public universities are collaborating.

The idea is to make use of the new digital technologies to disseminate the rich heritage housed in these institutions, which is currently largely unknown.

The portal is designed to provide access to a large number of digital resources including multimedia content, 3D reproductions and interactive virtual tours showing both immovable and movable heritage elements from an interactive, close-up perspective via the screen.

The portal offers other services, such as planning a cultural agenda with the activities, events and projects that take place in the various universities, and it is therefore also used to disseminate studies and research in the context of the heritage of Andalusia’s universities.

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Figure 07 - Panoramic 360-degree view of the convent of San Francisco (Santa Fe). Portal Argentina Virtual. Screenshot. Source: http://www.argentinavirtual.educ.ar/

Figure 08 - Portal Virtual del Patrimonio de las Universidades Andaluzas. Screenshot. Source: http://patrimonio3d.ugr.es/
Red Temática en Tecnologías Digitales para la difusión del Patrimonio Cultural

An initiative started up in Mexico by the Instituto Nacional de Antropología e Historia (INAH) is the network Red Temática en Tecnologías Digitales para la Difusión del Patrimonio Cultural, which aims to combine the efforts of both national and international cultural institutions and sector professionals. One of the main purposes of this network is to devise strategies and develop digital resources for promoting the restoration and conservation of cultural heritage, both tangible and intangible. The website is the project’s nerve centre and gives visibility to the components that are progressively incorporated into the network and the initiatives developed since its creation in 2015. In short, the network is intended as a vehicle for sharing experiences and disseminating projects involving good practice in Mexico.

Cantos Seris de la Creación del Mundo project

A case related to what is known as intangible heritage is the Cantos Seris de la Creación del Mundo project. Developed in 2014 and 2015 by the Centro de Cultura Digital (Mexico), it set out to recover the chants of the Seri ethnic group. For centuries the state of Sonora has been home to this indigenous people, who have preserved their ancient language, Seri, and the chants which reflect the traditional folklore and mythology. The initiative involved documenting several of these ancestral chants using digital sound archives that can be listened to on SoundCloud. The chants were performed by elderly Seri and children and the various genres were studied – chants on earthly nature, women, the sea, war and creation – and translated into Spanish. The project showed that it was possible to perpetuate this tradition using the digital tools available to us today.

Acervo digital de la cultura y la lengua nomatsigenga

We find another example of the dissemination of intangible heritage in Latin America: the oral tradition and language of the Nomatsigenga people (Peru). Through the project entitled Acervo Digital de la Cultura Nomatsigenga, an initiative of the Project for the Documentation of the Nomatsigenga Language (DLN), Organización Kanuja and the Peruvian Ministry of Culture, several collaborative activities were carried out by a multidisciplinary group and the members of this indigenous people to document and disseminate via the internet the knowledge that has been handed down from generation to generation. The project used digital audio and video recordings to document the chants and language of the Nomatsigenga, which were uploaded to a website, as well as multimedia content, transcriptions in the original language and a Spanish translation.

Google Arts & Culture

Since 2016 the platform Google Cultural Institute has included Google Arts & Culture (formerly called Google Art Project), a website devoted to disseminating art and culture through a large amount of digitised content using the cutting-edge technological resources of the giant Google.

Google Arts & Culture features content from more than a thousand prominent museums and archives, which have collaborated with the Google Cultural Institute to make the world’s treasures available online. This content is grouped into three broad sections: Art, History and World Wonders, which span cultural heritage from antiquity to the present day across more than seventy countries. Roughly speaking, Google Arts & Culture is like a huge online catalogue that brings together works of art, photographs, collections, biographies and histories, providing a large amount of multimedia information, especially virtual tours of the main museums and monumental ensembles and an archive of high-resolution images (some in gigapixels) to satisfy users’ concerns.
The homepage is updated daily and is structured in the form of a compilation of content of special significance, such as artists or historical figures born that day, or commemorations of historic events.

Google recently launched a version for mobile devices: an app with the same name that can be downloaded from the digital platforms. The idea is for the digital content of the app to be enjoyed on a variety of devices and shared on various social media.

2.1.3 Web 2.0

Whereas the Web 1.0 enabled cultural heritage to overcome physical limits and boundaries, succeeding in globalising art objects, the emergence of the Web 2.0 has allowed heritage institutions to use new networking tools to reach larger audiences through a less institutional language and a more user-friendly image. In this new age, both sector professionals and users are playing a more participatory role thanks to tools like blogs, wikis, networks and social apps, folksonomy (tagging) and all the platforms for sharing multimedia content.

The essence of this two-way communication role consists not only in offering users content, but in getting them to generate, modify and share it. A contributory factor is undoubtedly the appearance of mobile devices like smartphones and tablets, which have significantly boosted connections and interaction within the Web.

Before going on to mention some of the Web 2.0 tools, we should stress the good use being made of them by heritage institutions and organisations entrusted with safeguarding cultural objects, which have focused a considerable number of studies, talks, training courses and collaborative experiences on them and are excelling in their good practice in this field compared to other knowledge institutions.

Although there are many Web 2.0 platforms on which heritage institutions have been increasingly active in the past decade, it is appropriate to stress those which are having the greatest impact on our society either because they have been around for the longest or because they are particularly topical.

Blogs

One of these platforms is blogs, which sprang up as digital logbooks with different entries on various topics or specialised journals and remain highly significant in the field of heritage, as evidenced by the I Encuentro de Blogueros held during the 2016 edition of the Bienal AR&PA. Examples of such blogs are Domus Pucelae, created by the Asociación Cultural de Valladolid, which mainly provides information on the art of Valladolid; mocadele.blogspot, which is notable for its content devoted to new technologies and Leonese heritage; Iconos Medievales, specialising in medieval artworks all over the world; and Arte Valladolid, whose entries offer art-historical comments specialising in Valladolid’s rich culture and heritage.

Wikis

Wikis are an effective tool for collaborative writing in which users are permitted to create, edit, delete or modify the content of a web page in an interactive, easy and fast manner.

It should be stressed that cultural heritage has benefited considerably from the large amount of content available on the internet through this tool. This content is not only created for readers but can also be written by them.

The best known wiki to date is the encyclopaedia Wikipedia, which has become established as the main reference work consulted on the internet. The endless possibilities of providing links to other information or adding multimedia content, and the fact that many of its entries
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It is therefore hardly surprising that many of these institutions already have an online community manager, the name given to the professional responsible for maintaining the community of users of these social media and developing related strategies.

In addition to newsletters, notices and reminders of special programmes, there are promotions through competitions, advertisements for publications or products sold in the online store, and miscellaneous audio visual content created every day to achieve the maximum number of interactions and, ultimately, reach the largest possible number of users.

There are insufficient in-depth studies on the social media presence of historic-monumental and immovable heritage – whose impact on today’s society has not been properly assessed – compared to the extensive research of this kind carried out in the museum sector.

The number and types of social networks and applications has grown in recent years in pace with the various types of multimedia content that are currently shared on the social media. There is furthermore a tendency to disseminate the same information on several of them in order to reach a larger audience.

The social media and applications are the most widely used tools today – so much so that few heritage institutions are not present on one or several as part of their education and dissemination policy. It is therefore hardly surprising that many of these institutions already have an online community manager, the name given to the professional responsible for maintaining the community of users of these social media and developing related strategies.

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The social media have become an essential tool for reaching the largest possible audience and many institutions have profiles on several of them. Although the best known are Facebook and Twitter, newer ones like Instagram and Snapchat are strong rivals in terms of number of users. They have been enjoying considerable social impact lately and are also being used by heritage institutions, especially to engage with millennials.

A notable case in Spain is the presence of Casa Batlló on well-known social media and applications like Facebook, Twitter, Instagram and even Snapchat. It deserves to be stressed not only for its number of profiles, but also for the many activities and types of multimedia information it
organises and shares almost daily. Its Instagram profile is particularly interesting as it creates content in various multimedia formats, especially photos and footage of the place, which are published both in the image gallery and through the latest function, “Instagram Stories”, in which multimedia content is created that disappears after twenty-four hours. The ultimate aim is to encourage users to interact with visitor information and take part in competitions featuring questions about Casa Batlló.

We will now take a look at the Tower of London, another historic monument with a particularly active internet presence. It has several social media profiles, notably Twitter, and also enjoyed an active presence on the no longer extant Vine, posting six-second videos with content relating to everyday life at the monument, the employees, other people working in its grounds and visitors.

To illustrate the variety of profiles found on the social media, we will cite the case of the Alhambra of Granada, which is represented on most of the social media and even has its own YouTube channel where it shares various videos promoting cultural activities, novelties and research, as well as more educational videos on the plant of the month, the piece of the month, or the place of the month. The latter take viewers on a tour of a significant area of the monumental ensemble, such as the Tower of the Infantas or the Casas del Partal, with audio tracks on the history of their construction and interviews with visitors.

**Folksonomy**

We should also underline the importance of the use of what is known as hashtags, a type of social tagging originating from Twitter that falls into the category of folksonomy. This term refers to a collaborative system of applying tags or keywords in a space without hierarchies or predetermined family relationships. The user can thus easily find content on a particular subject by following the links associated with each tag.

They are examined in this survey because they have been used to draw together events and campaigns related to cultural heritage and to
accompany publications on social media such as Twitter, Telegram, Facebook, Google+ and Instagram.

A recent case is the creation of the hashtag #Unite4Heritage for a global movement powered by UNESCO with the aim of celebrating and safeguarding cultural heritage and diversity all over the world. The campaign, which was started up as a response to the unprecedented attacks on heritage that have occurred recently, is an appeal to everybody to stand up to extremism and radicalisation by celebrating the places, objects and cultural traditions that make the world a rich and vibrant place.

#ARAcumer was the hashtag used by managers of the Ara Pacis in Rome and by visitors and users from all over the world to share their experiences of the virtual reality application with Samsung Gear VR based on the altar and monument, which will be developed until the end of 2017.

Another case worth mentioning is the hashtag #Ullastret3D, which is used to group together comments at various heritage sector events related to this project for the virtual reconstruction of the Iberian settlement of Ullastret (Gerona). An immersive experience using Oculus Rift or Samsung Gear VR headsets has been designed, enabling users to explore the streets of the settlement and the interior of the houses more realistically.

Crowdfunding

The Web 2.0 has boosted multiway communication and interaction between users via the internet. This has given rise in turn to new digital practices such as crowdfunding, which has become established as an alternative for fundraising for projects, both private and institutional, in any field, the culture sector being no exception.

A prominent example in Spain is Hispania Nostra Crowdfunding, a platform set up by the Asociación Hispania Nostra especially for projects related to cultural heritage. Some of the projects which have used this platform to raise funds collectively are the restoration of the Renaissance loggia of the palace of the Ribera family (Bornos, Cádiz) and the restoration of the eighteenth-century “Henhouse” of the palace of Boadilla del Monte (Madrid), which attained their goals. The platform is open to the submission and publication of projects and also provides a tutorial showing users how to make the most of the proposals they send in.

Tous Mécènes was the slogan of another crowdfunding campaign launched by the Louvre (Paris) to raise funds to restore and rebuild the funerary chapel of the mastaba of Akhethotep (2400 BC), which is decorated with an interesting iconography and has been part of the French museum’s collections since the twentieth century. This was the Louvre’s second initiative of this kind, as it previously succeeded in restoring the famous Greek sculpture from the Hellenistic period known as the Winged Victory of Samothrace through collective donations made through this system.

2.1.4 Educational platforms for heritage

When we speak of heritage dissemination we also mean knowledge and education – aspects in which the digital medium also plays a particularly important role and where we find various resources which have hugely modified our way of learning. The internet provided an ideal breeding ground for distance learning platforms, which for several years have been an essential vehicle for education and knowledge institutions. Today we find significant MOOCs (Massive Online Open Courses), a new type of online courses whose main characteristic compared to traditional educational platforms is that they are open to the user community and have many more
MOOC - Velázquez en el Museo del Prado

In 2016 the Museo del Prado joined the Miríada X platform for online courses, an initiative devised by Telefónica and Universia to promote free open knowledge in the higher education field in the Spanish-speaking countries via the internet.

Its first foray into the platform was with the course Velázquez en el Museo del Prado, which was developed using exclusive content from the Museo del Prado and is part of the Prado online programme, an initiative of the museum’s action plan for 2013–2016, which enjoys the support of Telefónica for promoting knowledge of the museum’s collection and activities over the internet.

This course traces the Sevillian artist’s career, identifying the influence of other masters and works that were essential in his formative period as sources of inspiration and, basically, in the shaping of his style.

As can be expected, the aim of the course is to show the evolution of the painter’s oeuvre and life through knowledge of the historical context of the period he lived in, the reign of Philip IV. It also sets out to identify the keys to his style of painting and his genius in the history of world art taking as a basis the Prado’s matchless holdings.

The multimedia content of the course consists of more than thirty videos with footage of real locations, dramatisations with an important educational value and, as a novelty, the use of ultra HD 4K technology, which make it a reference example for online courses offered by heritage institutions around the world.

MOOC - Europeana Space con Patrimonio Digital

A different perspective is provided by this online course which is part of the E-Space Project. Here...
the internet is used an educational resource not only for disseminating cultural heritage but also for teaching and training heritage managers.

This project sets out to show how digital cultural content offered by the Europeana network could be of great use to sector professionals, as well as underlining the importance of this institution in the community.

The course Europeana Space con Patrimonio Digital, available from Europeana Space’s website, presents the pilot schemes carried out at E-Space, sharing the results of research, analyses and validation cases.

This course is targeted at lovers of cultural heritage, including students and teachers and GLAM professionals (of galleries, libraries, archives and museums), who will gain professional knowledge of the sector, and developers, who will discover tools such as Europeana’s multiscreen toolkit and APIs. This MOOC consists of eight modules on photography, hybrid and open education, television, dance, museums, intellectual property in cultural entrepreneurship, and creative marketing.

The ultimate aim is to raise awareness of the need to break down the barriers that are hindering access to, and the reuse of, the cultural heritage resources offered by Europeana and similar sources. It will be essential to provide tutorials and test versions of applications and tools as part of this process, as well as reading materials and useful advice suggesting the most appropriate practices for each project.

2.1.5 3D digitisation of heritage on the Internet

High-definition digital photographs, 3D laser scanning and photogrammetric techniques are some of the resources for digitising heritage that have recently enjoyed significant impact on tasks involved in heritage recording and conservation, as we saw in the previous chapter. But this digitisation phase would be incomplete and biased unless it took into account the possibility of disseminating this important material over the internet. 360-degree virtual visits, 3D models and detail photographs are the most novel resources for learning about heritage over the internet. The possibilities of interaction provided by the digital medium allow us to obtain attractive and increasingly realistic images of heritage sites, as well as of cultural objects in museum collections.

In Spain, held to one of the countries with the most cultural heritage in the world, this resource was tapped into relatively early through a pioneering project run by Fundación Telefónica in 2000. arsvirtual was the first website to offer 360-degree visits of monuments all over Spain and remained on the Web for ten years.

Today there are many examples of sites offering these interactive visits of heritage from anywhere in the world. A few are listed below.

500 Challenge

The 500 Challenge project was started up in 2009 by CyArk, an international non-profit cultural organisation, with the aim of digitising a total of five hundred world heritage sites to safeguard them from possible threats such as wars, urban sprawl, terrorism, earthquakes, floods and arson, among others, and make them available to future generations through its website. The project, still at its developmental stage, spans from AD 1000 to the present. When users select an interval of time on the website, all the digitised resources on the cultures and heritage sites of that period in history are displayed. For each case the project provides descriptions of the site, a three-dimensional model enabling it to be explored in detail, a virtual tour of the monument’s setting (sometimes difficult to access), full historical documentation and a map where it can be located in satellite view mode. CyArk not only runs this project for digitising and preserving heritage, but
Since its launch in 2012, the Giza3D experience, which is available in thirteen languages, has been enriched every year with new monuments digitally reconstructed from data from the excavation currently under way in Giza and from materials and studies contributed by international collaborating partners from institutions in Berkeley, Berlin, Cairo, Hildesheim, Leipzig, Philadelphia, Turin and Vienna.

This project, which features an example of the so-called digital archaeology, was designed to show part of the studies (both artistic and academic) of the excavations carried out in ancient Egypt so that they can be enjoyed by professionals, enthusiasts and users all over the world.

Spain is Culture

The Spain is Culture portal belonging to the Ministry of Education, Culture and Sport offers various digital services, prominent among which is “3D Heritage”, which consists of 360-degree visits to monumental ensembles that have been designated World Heritage Sites by UNESCO. The virtual visits allow users to tour monuments such as Covaciella Cave (Cabrales, Asturias), the church of Santa María del Naranco (Oviedo), the Alhambra (Granada), the Lonja de la Seda (Valencia) and Casa Milà “la Pedrera” (Barcelona), providing views and additional information of both their exterior and interior.

#newpalmyra

#newpalmyra is the hashtag of a campaign designed to start up an international digital archaeology project aimed chiefly at recovering the heritage of the ancient Syrian city of Palmira, whose monumental ruins were partially destroyed in 2015 during the war waged by Islamic State. It is intended as a collaborative cultural development project open to the participation of archaeologists, professionals in the fields of 3D modelling and digitisation, historians, artists, curators, programmers, educators, journalists, researchers and Wikipedians, as well as a long list of affiliated institutions. They will all take part in reconstructing Palmyra’s important heritage by gathering as much information as possible to document and draw up a digital database that will be available on the internet. This content is provided as open data resources on the GitHub platform under a Creative Commons license that allows users to access 3D reconstructions of elements as important as the Arch of Triumph or Temple of Baal Shamin, now destroyed, and the Temple of Bel or Roman Theatre, which still survive but are in danger of disappearing.

Giza Project

Harvard University and the Boston Museum of Fine Arts, together with the French company Dassault Systèmes, are collaborating on the Giza Project, which involves using modern 3D digitisation systems to produce a three-dimensional model of the existing structures in the Giza plateau.

The project took as a basis the studies of the expedition conducted more than a century ago by the Egyptologist George Reisner of Harvard University. The large collection of photos, diaries, drawings and records relating to that expedition to Giza were painstakingly digitised from 2000 to 2011 and made available online by the Boston Museum of Fine Arts on the Giza Archives website.

This documentation work made it possible to create the Giza3D^39 online experience whereby Dassault Systèmes was able to reconstruct the Giza necropolis as accurately as possible.

A multidisciplinary team made up of archaeologists, Egyptologists and graphic designers worked in close collaboration to ensure that all the structures and objects from the pyramids, temples and tombs of Giza were represented as accurately as possible in the Giza3D virtual model.
Since its launch in 2012, the Giza3D experience, which is available in thirteen languages, has been enriched every year with new monuments digitally reconstructed from data from the excavation currently under way in Giza and from materials and studies contributed by international collaborating partners from institutions in Berkeley, Berlin, Cairo, Hildesheim, Leipzig, Philadelphia, Turin and Vienna.

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2.2 The digital medium in heritage sites

The presence of cultural heritage on the Web overcame unprecedented cultural and geographic barriers some time ago, giving rise to countless possibilities that showed the versatility of the digital medium. But in recent decades we have been witnessing a reinvention of the medium that is highlighting its huge capacity for communication, enabling it to boost its presence and coexist in real physical space. Today desktop computers are not the only windows through which we can explore virtual worlds; the proliferation of other portable devices like smartphones and tablets or wearables, especially smartglasses, has ushered in a new age for heritage sites.

Actually this situation is not entirely new: the digital medium soon aroused the interest of cultural institutions with the possibilities offered by interactive kiosks or immersive rooms for showing multimedia content in situ, enhancing the experience by combining perception of the cultural object with multimedia interpretative resources.

Today digital practices involving cultural heritage take place in a hybrid space in which the boundary between these two worlds, real and virtual, is becoming increasingly blurred, owing in particular to the spread of technologies such as augmented reality. This has marked a new milestone and is mutually beneficial to both the cultural object and the digital resources.
It should be stressed in connection with portable devices that, unlike other cultural spaces such as museums, archaeological heritage or monumental heritage refer to spaces that are not always controlled, and this has a decisive influence on which technologies can be used to disseminate and enhance the value of these monuments. Portable devices equipped with geolocation systems and wireless connections have thus enhanced in situ digital experiences with heritage, making it possible to forge a closer relationship with the public in which the emphasis is on the cultural object.

2.2.1 Virtual recreations

Cultural heritage is one of the most important areas of application of virtual reality and the so-called virtual techniques. This increasingly promising technology has been around since the 1960s, though its popularity has been growing rapidly since 1990. Technology and techniques have improved to the extent that digital graphics are more realistic, while technological advances have perfected their application and interactivity in real time, helping improve user experience.

Virtual reality thus makes it possible to reproduce a site or object using 3D virtual elements and software technology, the main characteristic of such reproductions being that they are very lifelike. Some of the applications of this technology in the heritage field involve simulations – representing real sites that once existed but no longer survive.

Although the virtual can never take the place of the real, it does fulfil the function of informing us reliably and in detail about cultural heritage, just as the real element gives shape to the virtual element. This is why virtual technologies have a significant component of learning and training, and are becoming very useful techniques in the cultural heritage field for representing, showing and explaining explain historic and architectural objects, including the setting and landscape, to the public at large. The latter fact is of great importance, as it makes it possible to situate heritage objects in their original historical context, which in most cases has been greatly modified by the passage of time.

We have pointed out that digitising heritage is one of the key factors in heritage dissemination. However, we should not forget that virtual recreations are another essential element for interpreting heritage. Indeed, thanks to the improved performance of devices and more advanced software, in recent years they have succeeded in lending movement to 3D objects and their environment.

Audiovisual presentations on screens or CAVE-type (Cave Assisted Virtual Environment) immersive rooms enable us to embark on a genuine journey through time that leads us to admire a previous state through an innovative and different vision of our heritage.

Ullastret 3D

The Iberian site of Puig de Sant Andreu de Ullastret (Baix Empordà) was the object of the Ullastret 3D project in which a 3D audiovisual experience in an immersive screening room showed a virtual reconstruction of the Iberian city.

The initiative was devised as part of the Patrimoni en Acció programme to encourage the social use and knowledge of Catalan cultural heritage, which stemmed from the collaboration between the department of culture of the Catalan regional government and the foundation for social projects of the bank la Caixa.

This audiovisual experience recreated the Iberian city at its height of splendour during the fourth to the third centuries BC. During this period Ullastret was an important urban, administrative and economic centre of the Catalan Iberian world; the fact that it is the settlement best documented by the archaeological excavations undertaken enabled a more accurate reconstruction of the site to be made.
The project was produced by the IBAM CNR (Istituto per i Beni Archeologici e Monumentali) in collaboration with the Soprintendenza per i Beni Archeologici della Puglia, who were responsible for the 3D reconstruction of three of the Hellenistic hypogea from this necropolis.

The aim was to make “accessible”, and provide knowledge of, some of the ancient city’s underground tombs through a virtual reality installation that also featured some of the grave goods preserved in the museum. These virtual visits focused on three funerary complexes which, despite being preserved in situ, are difficult to access: the Tombe Gemine, the Ipogeo delle Gorgoni and the Tomba dei Festoni.

A decisive factor in this process was the participation of a multidisciplinary team of researchers from the IBAM CNR in virtual reconstruction tasks. They took as a basis the archaeological studies conducted on the site, from which information on the architectural, material and decorative features of the tombs was extracted. All this documentation made it possible to improve the realism of the virtual reconstruction with respect to the accuracy of the colours of the mural paintings and facings – which are no longer extant but known thanks to research carried out to date – as well as to reconstruct burial rituals through iconographic comparisons of the depictions on the walls.

In 2016 an immersive room was installed. The idea was to project the images of the virtual reconstruction on all or just one of its walls in order to recreate a virtual 360-degree experience that was as realistic as possible.

The audiovisual aid, which is available in Catalan, Spanish, French, English and German, features a story told by a member of the Iberian elite, who accompanies visitors on their virtual tour of the recreation of the site.

Another application of this virtual recreation in a different type of immersive experience was recently presented at several heritage events. Visitors can use VR headsets such as Oculus Rift or Samsung Gear to explore the streets of the city or the interiors of homes more realistically.

Marta Racconta. Storie Virtuali di Tesori Nascosti

Since 2014, the Museo Archeologico Nazionale di Taranto (MARTA) has been showing the results of the project Marta racconta - Storie virtuali di tesori nascosti, a virtual recreation of the ancient necropolis of the city of Taranto (Italy), where several monumental tombs dating from the fourth and second centuries BC were found.

The team, made up of archaeologists from the Museu d’Arqueologia de Catalunya and Ullastret, together with specialists in 3D modelling, focused on providing a reconstruction based on the archaeological studies conducted to date in order to gain the closest possible idea of the Iberian site. They also sought to make the 3D model as visually realistic as possible by using photographs of real materials (soils, inner and outer walls, stones etc.) to recreate the different textures. The games engine Unreal Engine was chosen for this purpose – a well-known suite of tools used in video game design with significant potential for creating landscape settings owing to its highly photorealistic results.

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One such project was the virtual reconstruction of the Muslim district of Sinhaya, which dates from the tenth to the eleventh centuries. This ancient district of Zaragoza appeared during the excavations carried out in 2001 beneath the Paseo de la Independencia to build an underground carpark. As it was impossible to leave the finds on view, the morphology of the entire district was thoroughly documented by a group of archaeologists and historians who provided all the documentation needed for the work. First the existing parts were photogrammetrically modelled and then the visual reconstruction was designed with the idea of presenting it by means of an audiovisual aid showing the Muslim quarter with its original appearance. While the work was being carried out, a 3D model was created of the district and of the interiors of a number of homes, in which priority was given to a few elements based on the visualisation. Several lighting resources were applied virtually and images of real actors playing the part of people of the day were included in the scenes to offer a more photorealistic image. The audiovisual aid also included an animation that simulated a stroll through the streets and homes, into which real actors were later incorporated, overlaying real images on the virtual model.

Church of San Agustín de La Laguna (Tenerife)

PAR - Tecnologías de Representación Gráfica del Patrimonio is a significant example of a Spanish company that uses new technologies for the graphic representation of heritage. Although it is particularly notable for its virtual archaeology projects and work on virtualising heritage, it also teaches online and face-to-face courses. The projects underway at PAR include infographics, 3D documentation, virtual reconstructions, virtual restoration, 3D facial reconstructions, virtual visits and 3D printing. Some projects are particularly relevant to this study, such as the virtual reconstruction of

(Castellón) that enjoyed unique importance as a territorial and religious centre for several centuries until it was confiscated and sold in 1835, after which it fell into neglect. As a result, during the twentieth century the movable heritage of the whole complex soon became dispersed and subsequently fell into ruin. However, the Asociación Cultural Cartuja de Valldecrist established in the 2000s has been attempting to restore this construction to its splendour by promoting and enhancing its six centuries of history. Recent research and archaeological restoration campaigns have gleaned important information about its art-historical past.

An example of the efforts currently underway to enhance its value is the virtual recreation made by Bihartech, a Spanish company that uses the most cutting-edge technology in different fields, among them the culture sector.

Taking as a basis the architectural remains in the current site and the above-mentioned information gleaned from the historical and archaeological studies, it was possible to create a virtual reconstruction of the entrance courtyard of the charterhouse of Valldecrist as it was just before it was abandoned in the early nineteenth century.

Although the project is still at the experimental stage, the possibilities of disseminating the research and of enhancing the value of the heritage site through these virtual reconstructions make it worth considering developing an application for mobile devices such as smartphones or tablets used by potential visitors to the Valldecrist complex.

Muslim district of Sinhaya (Zaragoza)

Some of the work related to cultural heritage has been developed at the Spanish company LSLuz, which offers innovative solutions based on new technologies such as virtual recreations as powerful tools for showing elements of our past that have partly or totally disappeared.
the lost pediment of the palace of Antonio de Mendoza in Guadalajara (sixteenth century). Taking as a basis an old photograph, it was possible to document the whole appearance of the palace’s façade by means of this digital model, which could be used for other dissemination or enhancement purposes.

A recent experience was aimed chiefly at recovering the historic past using 3D digital modelling techniques. To mark the exhibition _Cor ignis. Memoria y patrimonio de la iglesia de San Agustín de La Laguna_, a virtual reconstruction was made of the old church of San Agustín, in La Laguna (Tenerife). This eighteenth-century church lost its important artistic and religious heritage in the fire of 1964; all that remained were visual documents and oral testimonies which the initiative of Cultania – Gestión Integral de la Cultura y el Patrimonio Histórico has attempted to recover. The virtual reconstruction carried out by PAR is an example of the interdisciplinary work that is essential in projects of this kind; the existing historical records proved to be crucial, as was other virtual restoration work carried out on the frescos of the main chapel that were part of this effort to recover lost heritage. The extensive digital documentation obtained from this reconstruction project was published in the catalogue of the exhibition, where a viewer providing a 360-degree of the interior was installed [online resource - video].

### 2.2.2 Interactive kiosks

The purpose of interactive kiosks is to provide visitors with in situ interpretive digital content on a heritage asset. The fact that they already have a considerable track record underlines the efficiency of the role these installations play at heritage sites.

Cultural institutions are currently interested in these interactive kiosks as a means of making available a multilingual digital application that provides visitors who do not have a smartphone or tablet with additional information for learning about and interpreting the cultural object.

In interactive kiosks attention is not paid solely to the digital content they are designed to provide; they are also intended to instil heritage values in users by offering them an experience with an entertaining and rational focus. Therefore the installation must have an attractive appearance, functions and interactive multimedia content that arouse visitors’ interest and encourage them to learn.

### Virtual reconstruction of Ename

The projects developed by Visual Dimensions at the archaeological park in the Belgian town of Ename are part of the work carried out in collaboration with the Provincial Archaeological Museum and the Ename Centre for Public Archaeology and Heritage Presentation to study local heritage. Ename began to play a prominent role in 974, when it became an important fortress and hub of trade, although it was destroyed seventy-five years later by the Count of Flanders, who built on its ruins a Benedictine abbey which towered over the town until 1795.

For the past two decades work has been underway to produce a virtual reconstruction of the site, where a few archaeological traces still remain of the old fortress and the no longer extant Benedictine abbey of Saint Salvator.

This is how Ename’s archaeological park arose as an open air museum that uses new technologies to provide virtual information and raise the general public’s awareness of the importance of the site. This was the purpose of installing the Ename TimeScope kiosk, which was created to address the difficulty of interpreting the archaeological remains found at the site, as it was difficult for non-experts to identify specific structures such as houses, churches or workshops on the basis of fragments of structures or foundations. TimeScope consists of a touchscreen where visitors can enjoy interactive panoramic...
views showing the new virtual reconstructions\textsuperscript{165} of the medieval abbey of Ename over eight time periods, together with a detailed simulation of the historic landscape.

**Cuarto Real de Santo Domingo**

Opened in 2015 following rehabilitation work, the Cuarto Real de Santo Domingo (Granada) was the site chosen to install an interactive totem pole incorporating various resources for interpreting this palatial complex and its gardens. The complex was built by the Almohad monarchs and is an important example of residential architecture of thirteenth-century Granada. The installation designed by IdeosMedia,\textsuperscript{164} a Spanish company specialised in technological resources centred on interpreting cultural heritage, consists of a touchscreen that enables users to interact with various digital resources through a menu. An additional screen is used to view the content being shown on the touchscreen for visitors who are not interacting. This multimedia application\textsuperscript{165} makes it possible to obtain further information on the monument in question. One of its most important elements – owing to its educational value – is a digital reconstruction of the palace complex containing several hotspots with 360-degree views of the rooms with the appearance they would have had in the thirteenth century according to the archaeological and art-historical studies carried out. Another option shows the decorative panels of tiles and plasterwork in gigapixel photographs whose resolution allows every motif to be examined in detail. An audiovisual installation on the qubba, the most important part of the complex, and a cultural agenda featuring all the activities of interest staged at the site complete the information provided by the interactive totem, which is an essential interpretive resource for visitors wishing to learn more during their visit.

**Mayan city of Calakmul**

The Instituto Tecnológico y de Estudios Superiores de Monterrey (Mexico) presented an interactive kiosk offering virtual recreations of the ancient Mayan city of Calakmul (800 BC to 900 BC), a UNESCO World Heritage Site. The site is located in a nature reserve in the state of Campeche and is partially covered by the forest. As a result the remains of the buildings are almost concealed and it is difficult for visitors to understand and grasp the magnitude of the site (Ruiz, 2015).\textsuperscript{166} The kiosk presented three important aspects of the culture and a recreation of the interior of the tombs of the dignitaries interred inside the pyramids, including a reconstruction of the offerings left there; a reproduction of the frieze of the tallest pyramid of Calakmul, enabling an iconographic analysis to be carried out on its different elements separately; and an interpretation of the Mayan world view in relation to death and the afterlife by comparing archaeological pieces and graphic elements from various Mayan sites.

*Figure 13 – Visitors consulting the interactive totem at the Cuarto Real de Santo Domingo (Granada). Author’s photograph*
V-MusT project

A team from the CNR ITABC (Istituto per le Tecnologie Applicate ai Beni Culturali) and the Italian company E.V.O.C.A. developed an interactive installation reproducing a virtual tour of the Roman villa of Livia, the wife of the Emperor Augustus. The villa was an important residence of the imperial family until the period of Constantine (fourth century). The three-dimensional virtual models of the villa were taken from an earlier project called Virtual Museum of the Former Via Flaminia (2008–2010), which used 3D models of the terrain and archaeological site to make a 3D reconstruction of what the villa may have looked like in the past, drawing on existing archaeological studies.

An installation was subsequently designed based on body gestures and movements. Virtual reality and natural interaction interfaces were combined to enable the user to follow a route with absolute freedom, exploring the whole space and accessing audiovisual stories in each of the elements highlighted. The application, developed in Unity3D, used the Kinect motion capture sensor to allow users to act inside the virtual environment.

During 2014 and 2015 the installation – a demo of which can be found on the internet – was part of the Italia del Futuro and Keys to Rome exhibitions, which toured several cities worldwide.

2.2.3 QR codes

QR (quick response) codes were the first types of interactive viewers of the digital medium beyond the screen. They currently enjoy a major presence in the culture sector and were put into practice in various fields during the first decade of the twenty-first century. Despite the emergence of more complex technologies with a greater potential for providing information (such as augmented reality), they are still one of the most widely used for museumising all kinds of heritage sites.

We can liken how they work to barcodes – encoded information that requires the use of a reader to identify the information contained in the code. But it should not be forgotten that one of the key factors responsible for the spread of QR codes in the culture sector is their use in combination with mobile devices, especially the proliferation of smartphones and tablets, which has made them available and familiar to the general public. The appearance of various mobile applications that act as QR code readers led to a significant increase in their use.

Nowadays the application of these codes varies in accordance with the content associated with them. For example they can be used to access basic information on a particular product or object, making reference to catalogue-type data (and are particularly useful for reserved areas in museums). Another use of QR codes is to provide links to particular website without the user needing to type in a URL. The latter function is particularly useful with respect to heritage dissemination. The possibility of accessing information hosted on the internet has made QR codes an increasingly commonly used device for accompanying the multimedia content associated with a particular site or cultural object.

Town wall of Lorca

The Spanish cultural management company Patrimonio Inteligente Castilla y León, which applies new technologies in the fields of archaeology, restoration, historic heritage and museums, used QR codes efficiently in a dissemination project in the town of Lorca (Murcia). As part of the campaign on the tower known as the Torre Rojano and the town wall, in 2013 some panels displaying information on the restoration process were designed featuring text, illustrations, photographs and QR codes containing multimedia information hosted on the website. When visitors to the heritage site scanned the QR codes with their mobile devices, they were able to access various audiovisual aids available
in Spanish with English subtitles. QR codes thus made the information more accessible and boosted its dissemination.

**QRio project**

The city of Rio de Janeiro (Brazil) also tapped into this technology’s communicative possibilities to promote its tours and offer visitors the chance to gain a new perspective on the city’s cultural heritage using their smartphones or tablets. The most interesting feature of this project was the combination of tradition and modernity in devising an original use for QR codes. The *QRio project*, the brainchild of Máquina PR group and the design and digital technology agency Zói, was implemented in 2013 and consisted in placing a series of QR code designs in certain historic areas and tourist attractions, on pavements or monuments. The striking feature was the material the codes were made of: traditional Portuguese stone in the form of mosaics similar to those typically found in Rio’s pavements. QRio was developed to make known and disseminate the city’s culture to visitors, who, by reading the QR codes with their mobile devices, could access online content with information about certain tourist attractions such as the Corcovado and Pan de Azúcar, including photographs and curiosities.

2.3 App universe: mobile heritage for dissemination and enhancement

Today portable devices such as smartphones and tablets are indispensable elements for twenty-first-century societies and are used in all aspects of our daily lives, both professional and personal. This fact has also influenced our approach to cultural objects, giving rise to a new form of cultural leisure based on the use of mobile devices. This is why over the past few years these omnipresent gadgets have captured the attention of various culture institutions, which are adapting their interpretation and dissemination work to this new reality, basically to reach larger audiences.

The possibilities of presenting content with multimedia information and offering a higher degree of personalisation and interaction during in situ visits through these new devices have led heritage managers to consider the need to create applications for visitors to download from digital distribution platforms (mostly free of charge) as part of their educational and enhancement efforts.

These applications, often referred to as apps, have become an interpretive tool par excellence for visitors to heritage sites, as mobile connectivity options are one of the main allies in accessing multimedia content hosted on web pages.

A novel feature of these apps is virtual technologies that offer users a different, much more exciting experience with respect to interpreting heritage objects. Apps whose content features virtual reconstructions or augmented reality are currently in highest demand in the sector and are a growing trend that looks set to continue for a long time.

In short, apps emerged in response to the demands of an increasingly large audience with different profiles. It is therefore essential for these apps, whose purpose is to convey knowledge to visitors, to offer access to broader and more customised information on cultural content.

2.3.1 Mobile guides

Multimedia guides have been a means of disseminating heritage sites for several decades and allow tours to be tailored to visitors’ interests.

As mentioned previously, the recent emergence and proliferation of portable devices like smartphones or tablets has revolutionised how we visit and interpret heritage, giving rise to a new type known as mobile guides.
With these guides, visitors can choose the options best suited to their needs and interests and design customised tours, as well as obtaining full information about the heritage assets before, during and after the visit. They are therefore an effective means of dissemination, which is a fundamental and increasingly priority task in the day-to-day functioning of heritage institutions.

Áppside project

Promoting accessibility is the main purpose of the Áppside project, which is focused on creating applications for mobile guides that enhance the experience of visitors to cities with unique heritage sites and improve tours of museum galleries by providing additional information on the objects. This is a joint initiative developed as part of the Accessible Museums project of the Fundación Orange and GVAM, a company specialised in creating content for personal guides. As is typical of mobile guides, these are available in several languages and offer different routes or theme-based tours that allow visitors to personalise the content in accordance with their own interests. The varied multimedia content offered includes interactive maps, commentaries, videos and infographics. The most prominent feature of the design and creation of the various apps developed at Áppside is their accessibility to people with impaired sight or hearing, as they incorporate audiodescriptions, subtitles and sign language – an essential means of engaging with a larger number of visitors to heritage and cultural sites.

So far they have designed twenty or so apps. That of Tarragona, World Heritage City, features four routes accessible to people with impaired sight or hearing. That of Santiago de Compostela, World Heritage City, includes four routes: Santiago inside the walls, Santiago outside the walls, a culinary tour and an accessible route. And the guide to the city of San Cristobal de La Laguna (Santa Cruz de Tenerife) includes four thematic tours: Ruta de los Encuentros (social gathering places), Ruta de las Musas (art), Ruta Sacra (buildings from the period of the Crown of Castile) and Ruta Monumental (architecture). All the apps can be downloaded free of charge from the digital downloading platforms and can be used by visitors on their mobile devices, as well as by cultural institutions that provide devices for visitor use.

**Zona Arqueológica de Paquimé app (Mexico)**

The Zona Arqueológica de Paquimé app is designed to provide information to visitors to the archaeological site of Paquimé, an ancient pre-Hispanic settlement in the state of Chihuahua (Mexico).

The app was developed by the Centro Cultural Paquimé in collaboration with the INAH and the Centro de Estudios Tecnológicos, Industriales y de Servicios (Cetis).

Available since 2016, it brings together several features that enable visitors to organise their visit beforehand, while there, and afterwards. It provides information put together by archaeologists (along with explanatory videos in sign language) on contact details, visiting times and even a map allowing potential visitors to locate the settlement and work out how to get there using Google Maps. Other content such as an audioguide, QR codes and a 360-degree tour with commentary on the various structures.
along the route and the nearby places make it possible to personalise and add to the available information on the settlement. For more demanding visitors, the app also provides access to news, information about other places of interest and the INAH’s YouTube channel.

Among other activities, the project involved an application for mobile devices, which was designed by Patrimonio Inteligente, a Spanish company with vast experience in the cultural tourism sector. The app, which can be downloaded free of charge, has been available since 2014 and is structured in the form of a multimedia guide of the various places that were once part of the Cora de Tudmir. The multimedia content created for the application focused on the existing cultural heritage in the region that is linked chronologically to this period in history.

El Arte del Bordado de Lorca app

The fact that apps are used as a means of disseminating and interpreting heritage underlines their versatility. An example is the mobile application on the art of embroidery in Lorca (Murcia). Also designed by Patrimonio Inteligente, it is related to the campaign in support of the art of embroidery in Lorca’s candidature for UNESCO’s Intangible Cultural Heritage List.

The menu of this app, which has been available for downloading on mobile devices since 2015, provides information about this expression of intangible heritage through the history of the biblical Passion parades and an introduction to the confraternities and processions that gave rise to Lorca’s treasures of embroidery. Multimedia information, thematic maps and an agenda with the activities carried out during the town’s Easter Week festivities complete the content of this app devoted to an aspect of key importance to local tourism.

La Alhambra, Castillo Rojo app

One of the particular features and advantages of apps for mobile guides is that they can adopt different discourses depending on the type of audience. The app entitled La Alhambra, Castillo Rojo developed by Granavisión Grupo Turístico for smartphones and tablets, is a good example, as the multimedia content it offers is designed specially to provide children with an enjoyable and educational experience. In this 3D audioguide (available in English and Spanish) the animated characters Boabdil, Morayma and Charles V accompany young visitors on their tour of the monument in Granada. These characters are contextualised in the parts of the palace complex they lived in and give a first-person account in inclusive language of the history and curiosities of each place. At some points of interest the app also includes educational resources for this age group such as interactive and guessing games in the manner of a treasure hunt to ensure that they enjoy and, above all, learn from the experience.

2.3.2 Virtual recreations in situ

By virtual reconstruction we mean creating models using data acquisition techniques that enable us to represent existing structures or structures no longer in place but of which there is sufficient evidence (ruins, plans, photographs, etc.) to ensure a good likeness of the original. These new instruments, with their ability to transmit knowledge and the results of art-historical research, enable experts to draw conclusions or devise various hypotheses about lost worlds, but they also provide new means of disseminating heritage.
The use of digital technologies in the conservation, analysis and dissemination of cultural heritage thus allows us to go back in time to present to the general public a large portion of our history through the testimonies that survive to the present day.

This possibility has spurred the widespread use of applications entailing virtual visits with 360-degree panoramic images. The proliferation of mobile devices has made it possible for these reconstructions to be viewed in situ, improving the experience of visitors to heritage sites and enabling them to learn more about them.

**Rome MVR**

*Rome MVR* is one of the first applications for mobile devices to provide a tour of several historic parts of the city of Rome through time, showing what it looked like across the ages using the Time Window system.

Designed by the multimedia firm Altair4 Multimedia, this app is based on 3D reconstructions of the city’s history that can be viewed in situ using the Time Window device. It is a mixed virtual reality system that contains virtual reconstructions of the city’s main monuments, allowing users to see what it looked like in earlier periods with an interactive overlap, fading over between the 3D reconstruction of the past and their current appearance.

Visitors to the Colosseum can access a virtual reconstruction of this building during the period of the Roman Empire using this application and through the camera built into their mobile devices. Also, using GPS, digital compass and gyroscope data, it allows visitors to explore a virtual 360-degree perspective of the area to learn about the original context of the monument in question.

This app is available for download in the App Store for iPhones/iPads and features a free version for the Colosseum and a paid version for visits to the Roman Forum, Palatine Hill and Imperial Fora.

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The virtual recreation of heritage elements that no longer exist or have been drastically modified with an enjoyable and educational experience. In this 3D audioguide (available in English and Spanish) the animated characters Boabdil, Morayma and Charles V accompany young visitors on their tour of the monument in Granada. These characters are contextualised in the parts of the palace complex they lived in and give a first-person account in inclusive language of the history and curiosities of each place. At some points of interest the app also includes educational resources for this age group such as interactive and guessing games in the manner of a treasure hunt to ensure that they enjoy and, above all, learn from the experience.
Baelo Claudia - La Sibila (Cádiz)

A Spanish case of virtual reconstruction is the work carried out by La Sibila to develop the recently launched mobile application for the Roman site of Baelo Claudia (second century BC to the seventh century AD). Its layers of geolocation information provide a virtual reconstruction of the surviving archaeological remains. Novel features include the possibility of viewing the different structures through the camera on the user’s mobile device and adjusting the transparency of the layers superimposed onto the real image – this is what they call “selected reality”. The realism of the graphics, the perfect alignment of the overlaid virtual layers and the use of audio resources to recall the uses of each place make the visit an immersive experience and a genuine journey into the past, as well as a good example of the possibilities of this technology in the field of archaeology. The content and settings of the virtual reconstruction include the so-called Temple Terrace, the West Portico, the Temple of Isis and the Temple of Jupiter, all of which are part of the archaeological complex of Baelo Claudia. In addition, during the tour of the site captions appear to indicate what we are viewing when we point our camera in that particular direction [online resource - video].

The Labyrinth of Fables

The Labyrinth of Fables is an application that allows visitors to the maze that existed in the gardens of Versailles castle in the seventeenth and eighteenth centuries to enjoy a virtual experience. This labyrinth, built around 1665, was commissioned by Louis XIV and designed by the famous architect André Le Nôtre. The maze extended over an area of more than two hectares in the vast grounds of the palace of Versailles and included 39 fountains, each of which illustrated one of Aesop’s fables. It was destroyed in 1775 on the orders of Louis XVI and replaced by Marie Antoinette’s “Bosquet de la Reine”. The labyrinth was recently the object of several academic studies which highlight the historical and artistic importance of this example of garden design and landscaping, such as that carried out by the University of Massachusetts Amherst and the French technological company JonLab. They created the website with the same name, from which it is possible to enjoy a virtual tour of the labyrinth or access the same content in situ via the app that can be downloaded from digital platforms.

The virtual reconstruction was designed for the Labyrinth of Fables in Unity3D software to offer a virtual experience to users who visit the labyrinth with their mobile devices. By using the geolocation (GPS) system on their smartphone or tablet, users can explore the current “Bosquet de la Reine” while viewing on the screen of the device the appearance it would have had more than 250 years ago, when the labyrinth occupied the same place.

The app comes with two modes enabling users to visit the place and enjoy a different experience. One of the options is a “stroll” through the maze created during Louis XIV’s day. The other option is a game to arouse users’ interest using the “edutainment” formula – content that is both entertaining and educational. In game mode visitors must read one of Aesop’s fables and try to find the moral. When they give the correct answer, the fountain illustrating that particular moral appears, so that as visitors come up with the correct answers the virtual labyrinth appears around them.

The creators of this app for mobile devices have lately been studying the possibilities of using this virtual construction of the maze to create a more immersive experience which would involve adapting the application to optimise interaction with newer immersive systems such as Oculus Rift virtual reality headsets.
The use of digital technologies in the conservation, analysis and dissemination of cultural heritage

2.3.3 Augmented reality

Augmented reality is a digital technology that has made a huge impact on the heritage field, as pointed out in the section on conservation, but perhaps where it has achieved greatest success and is being applied the most is in the interpretation and dissemination of heritage. Augmented reality offers significant novelties and is one of the most fruitful areas of experimentation in combination with three-dimensional virtual reconstructions based on photogrammetric techniques and 3D laser scanning. This technology makes it possible to view the earlier appearance of an object or building and discover what a no longer extant work or elements would have looked like by producing a copy or virtual recreation.

The potential of augmented reality to interpret heritage has early precedents in the field of archaeology: the experiences of Archeoguide (Vlahakis et al., 2002) at Olympia (Greece) and Lifeplus (Papagiannakis et al., 2002) at Pompeii (Italy), which demonstrated the possibilities and versatility of this technology. Historic heritage was also represented in the iTacitus project (Stricker et al., 2010), which had as its test-case scenario the Royal Palace of Venaria (Turin, Italy). These early experiments stemmed from an interest in augmented reality as an interpretive resource for recovering parts of the past.

This interest has grown exponentially in recent years, giving rise to a broad spectrum of possible uses of this new technology in the field owing to its ability to combine the virtual and real worlds.

Its versatility is due to its use in conjunction with portable devices, as a result of which the screen

Athens Parthenon

We find very interesting cases of 3D virtual reconstruction in real time at archaeological sites such as the Athens Acropolis. The Greek company Moptil (Mobile Optical Illusions) was entrusted with developing an app for mobile devices that visitors to a particular site can use as an educational resource. In the case of Athens, the application, called Acroptilis, consists of a virtual reconstruction of the ancient Acropolis based on archaeological studies and offers a comprehensive view of the buildings and original polychrome decoration, allowing visitors to explore the complex as it was in the fifth century BC using movement sensors and the device’s orientation. It is possible to zoom into the virtual models for a close-up view of the architectural details of each construction and to go inside these spaces, which recreate the areas devoted to the cult of each of the gods. The application is used in other sites of ancient Greece such as Knossos, Olympia and Lindos, and during 2017 it will be extended to other places like Delphi and the Asclepeion of Kos [online resource - video].

Casa Batlló

We find one of the most significant examples of the use of augmented and virtual reality in a unique landmark building, the Casa Batlló in Barcelona: a videoguide for mobile devices that provides exceptionally thorough information about Antonio Gaudi’s architecture. Available for visitors since 2014 in as many as ten languages, the video guide was developed by the ARTE research group belonging to the University of Valencia’s Institute of Robotics, which has further experience in the sector.

During the tour of the house, visitors go back in time as a virtual reconstruction shows the original furniture that once decorated the various rooms, such as those of the famous main floor, and the stages of construction on a model of the building today, which they will experience during the visit by means of augmented reality technology. The videoguide also includes animations of the many organic and plant forms characteristic of Gaudi’s architecture, which come to life on the screen of their mobile devices, revealing the brilliant architect’s sources of inspiration [online resource - video].

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This interest has grown exponentially in recent years, giving rise to a broad spectrum of possible uses of this new technology in the field owing to its ability to combine the virtual and real worlds.

Its versatility is due to its use in conjunction with portable devices, as a result of which the screen
of our smartphone or tablet can display an imagine combining the heritage site or object with overlaid information or virtual reconstructions in order to complement our perception of it (unlike recreations of heritage using virtual reality).

This feature has spurred the application of this technology in the heritage sector in the form of apps that use different techniques such as recognition of markers, geolocation or visual mapping (through the recognition of natural features) to visually combine real images with information or virtual 3D models of heritage.

The following cases have been chosen to represent the latest applications of this technology in the heritage field which provide visitors with a fuller image of reality through the incorporation of virtual content that recreates an enhanced view of the cultural asset in question.

**eARt**

2015 saw the presentation of eARt, an augmented reality app for mobile devices that allows users to view the cave paintings of Eastern Spain more clearly by means of overlaid HD digital pictographs. The coastal region of Eastern Spain has a large number of caves containing paintings, among them 757 sites designated as World Heritage by UNESCO in 1998. A Spanish company, Cineproad, was hired to design this app, which is a fundamental part of the guided tour of three sites: the cave of la Ermita in Ulldecona (Tarragona), that of Las Covas de la Saltadora in Les Coves de Vinromá (Castellón de la Plana) and the Cova Centelles in Albocàsser (Castellón de la Plana).

The importance of this application lies in the difficulty of interpreting the features depicted in these cave paintings, as most of them are incomplete. Thanks to augmented reality technology, visitors who use the app can point their mobile device’s camera at the cave painting and the outlines of these paintings will instantly appear (using visual mapping techniques), allowing them to appreciate the complete image. Additional information is provided (in Spanish, Catalan and English), as well as full technical specifications, a map of the location and the history of each of the caves, thereby disseminating the studies carried out on them to date.

**Taula app**

The objectives of the Menorca Talayótica 3.0 project include this augmented reality app that is designed to enhance the experience of visitors to the Talaiotic settlement of Torre Tencada (Menorca). This archaeological site on the abovementioned Balearic Island has a Talaiotic settlement that is highly significant, as it includes several constructions that tell us about this Iron Age culture. It is particularly notable for the presence of the local type of taulas (stone monuments) with a side column as reinforcement.

Visitors who use the app can consult a map of the site showing the points of interest with multimedia information in several languages (Catalan, Spanish, English and German) on who the Talaiotic people were, how they lived, and in what period of history they inhabited the island, among other facts. The visitor experience, enhanced with the augmented reality content that appears on users’ mobile devices, is notable for its interpretation of the archaeological remains, as visitors are shown how this early society and the monuments found on the site functioned through augmented images. Virtual reconstructions of the surviving structures are overlaid to provide the best possible idea of what they would have once looked like, and animated characters show visitors what the local inhabitants were like in their original context. The objects found at each site are also shown virtually, along with the artificial burial cave, the so-called hypostyle hall and the anthropomorphic tombs dug out of the rock.
EAGLE (Europeana Network of Ancient Greek and Latin Epigraphy)

The EAGLE project (Europeana Network of Ancient Greek and Latin Epigraphy) was devised by the Europeana Network to provide a database of Greek and Latin epigraphy that would be available online. According to its website, it will collect more than a million and a half items relating to twenty-five EU countries as well as the east and south Mediterranean. The database will allow users to access the digitised content intuitively and features various search options and visual graphics. Since 2016, these services have included the Eagle Flagship Mobile App which is available from digital download platforms. It enables tourists to take a picture of any inscription from antiquity with a mobile device and look it up in the database, which can be consulted in situ. This makes it a very useful tool for both professionals and enthusiasts in general. EAGLE’s promotional video in the style of an animated comic strip with a humorous slant shows the advantages of this app for tourists.

Cástulo Virtual

As part of Cástulo’s Forvm MMX Project, an augmented reality app has been developed with the collaboration of the company esTRESd Patrimonio Virtual on the Ibero-Roman site of Cástulo (Jaén). It allows visitors to use mobile devices such as smartphones or tablets to view virtual reconstructions of the most significant archaeological finds. The app, available since 2016 from digital platforms, comes in English and Spanish and provides a route map with information about the points of interest, which have panels with a marker that visitors need to capture with their device’s camera to access the reconstructions. One of the places of interest is in a building believed to have been devoted to the cult of the Emperor Dominican (first century AD), all that remains of which is part of the foundations and one of the four mosaics found on the site, known as the “Mosaic of Love”. Augmented reality technology allows visitors to visualise a virtual reconstruction of the whole building with its original decoration superimposed onto the surviving remains in situ. Another salient feature of this tour of the site is the place where the Paten of Christ in Majesty – a Christian liturgical vessel whose iconography is partially preserved – was found. Augmented reality is used to show on the device’s screen a complete virtual reconstruction – based on art-historical studies on Cástulo – overlaid on the image of the paten, and helps disseminate and add to the interest of the site.

Figure 17 - Reconstruction using augmented reality of the Paten of Christ in Majesty from the Ibero-Roman site of Cástulo (Jaén). Screenshot. Source: app Cástulo Virtual

The Roman baths of l’Albir

Another example of the important role augmented reality technology can play in the field of architecture is the interactive guide for mobile devices available to visitors to the open-air museum Villa Romana de l’Albir. Some of the features of this site can be reconstructed in situ by means of virtual reconstructions based on archaeological studies. The guide was designed by Patrimonio Virtual and the University of Alicante in collaboration with the council of Alfaz del Pi (Alicante) and was launched in 2014. Visitors to the site are lent an iPad with information in four languages (Spanish, Valencian, English and Norwegian) to use during the tour, during which they come across a number of panels with markers indicating places of interest, such as the ancient baths. They can view on the screen an overlaid virtual reconstruction of the
baths, showing each of the rooms identified by their original Latin names. This helps both the visitors and the accompanying archaeologists interpret and disseminate the site.

2.4. Wearables: VR and AR smartglasses

The past few years have seen a decisive increase in the use of devices known as wearables, which can be distinguished from portable handheld devices (smartphones and tablets) in that they are worn on some part of our body. The best known kinds are smart wristbands, smartwatches and virtual/augmented reality glasses.

Of these wearables, smartglasses have been used most widely in the heritage field in recent years, as they are gradually beginning to share the scene with smartphones and tablets, as shown by commercial models such as Samsung Gear VR, Microsoft’s HoloLens and Google Glass, among others. The interest they have aroused in the field of heritage is partly due to the implementation of virtual reality and augmented reality. Using these smartglasses, it is possible to explore, observe and examine a particular virtual environment and even interact with it as if it were a real physical space. These experiences based on virtual techniques allow for an intuitive, unconscious, almost childlike first-hand approach – our most natural way of learning – and demonstrate their entertainment and rational potential.

The importance of this aspect is borne out by the growth and interest in virtual applications offering truly cutting-edge experiences – some particularly futuristic, such as that of the Italian financial company Filas – which reflect their major possibilities for interpreting cultural heritage in the near future.

Tarraco project

Imageen Reliving History is a Spanish company that has created one of the most impressive apps for mobile devices (smartphones or tablets) and, more recently, for virtual reality headsets (Samsung GEAR VR). The app provides a 360-degree reconstruction of archaeological sites with several pioneering projects to recover aspects of Roman culture in the cities of Tarraco (present-day Tarragona) and Cambrials (Tarragona province) or to learn about the past of medieval towns such as L’Espluga de Francolí (Tarragona province).

The Tarraco project is notable for the importance of the enclaves of the ancient Roman city of Tarraco, designated a World Heritage Site in 2000, such as the circus, forum, amphitheatre and cult area with the temple of Augustus. Each of these places appears in the app, which allows users to access various types of content such as 360-degree views, a video contrasting the Roman city with its current appearance and another video with a scrolling display that compares the current appearance with the virtual reconstruction, accompanied by a recreation featuring real actors who play the part of people from the period engaged in activities characteristic of each place: for example, in the amphitheatre we can watch a gladiator fight in the ancient construction restored to its former splendour [online resource – video].

The app also includes a location map that can be connected to Google Maps and is available in several languages, including Spanish, Catalan, English and French.

Figure 18 - 360-degree view of the Roman amphitheatre of Tarraco with the scrolling display. Screenshot. Source: app Imageen
Numancia and Samsung Gear VR

The Celtiberian archaeological site of Numancia (Soria) was the object of an experience in which a virtual recreation of the settlement during its height of splendour could be enjoyed using Samsung Gear VR. The virtual content was created using visual documentation from the Museo Arqueológico Nacional to ensure the archaeological accuracy needed to recreate the scenes. Several Spanish organisations were involved in this project: El Ranchito, Empty, VR Zero and Cirugía Gráfica. Using the virtual reality headset and a pad, visitors can experience a stroll along the oppidum as it was in the second century BC and gain first-hand knowledge of daily life in a Celtiberian town (Azpitarte et al., 2015). The 3D virtual environment shows the utensils in detail and the customs of this culture, based on the objects and archaeological remains found at the site. The virtual reality system provides a 360-degree view and a sensation of immersion that allows virtual visitors to walk along the streets and go inside homes. To further enhance the experience – especially with younger visitors in mind – the project includes a game consisting of searching for three characteristic objects of the period on which additional information on their use and features is provided.

L’Ara com’era

The altar known as Ara Pacis Augustae (first century BC) is the focus of the project entitled L’Ara com’era, which sets out to restore the splendour of this monument commemorating the victories of Augustus in the provinces of Hispania and Gaul. Once again augmented reality was the technology used by the cultural company ETT SpA to carry out this project, which was promoted by Roma Capitale, Assessorato alla Crescita Culturale - Sovrintendenza Capitolina ai Beni Culturali and organised as part of Zètema Progetto Cultura.

The prototype Samsung Gear VR headset was installed with a Samsung S7 smartphone in order to implement the augmented reality application, so that the experience provided both virtual and augmented content.

To implement the project, which was designed to show the original appearance of the Roman altar, a 3D monitoring system was used for the augmented reality experience, so that the application would be capable of recognising the three-dimensionality of the sculptural bas-reliefs and of identifying each of the figures represented. This made it possible to overlay the virtual elements on the visual perceptions of the visitors, who could observe the beautiful sculptural reliefs and their complex iconography by means of additional multimedia information. An especially significant feature of this visit to the Ara Pacis was the reconstruction of the original polychrome of the marble based on hypotheses devised from the studies and analyses carried out to date; and the audio track narrating the scenes represented in relief, from the mythical origins of Rome through the figures of Aeneas and the twins Romulus and Remus to the solemn liturgical procession in which the imperial family of Augustus is represented, and even the history of the vicissitudes the monument suffered following its discovery and subsequent restoration process [online resource - video].

Immersive Worlds - inMediaStudio

An example of edutainment is provided by inMediaStudio, a Spanish company specialised in developing immersive and educational experiences – a combination designed to achieve the best results in the field of education.

The use of a device with 3D and 360-degree viewing enables users to enjoy the virtual content of Immersive Worlds. It is designed as an installation that can be controlled by a teacher, who supervises the content provided during the activity. Users interact with the elements of the virtual environment and, depending on their responses, their conduct can be evaluated to establish the learning process. An example is
the recreation of an Egyptian temple with a tour of each of its rooms. On arriving in the hypostyle hall, users must explore the space and decide which of the surrounding columns is the odd one out [online resource - video].

El primer rascacielos - Fundación Telefónica

As part of the exhibition on The History of Telecommunications hosted by Espacio Fundación Telefónica (Madrid, 2017), an immersive experience was devised to show a virtual environment where visitors could trace the history of the company’s former headquarters. The installation, called “El primer rascacielos” (The first skyscraper), was a journey through time for one of the landmark buildings of twentieth-century Spanish architecture. Visitors could discover what the Telefónica building on Madrid’s Gran Vía looked like in the early days and trace its history – which dates back to 1924, when Compañía Telefónica Nacional de España (CTNE) was established – through a recreation featuring actors and a 3D reconstruction of the different settings and phases.

This experience combined all the virtual reality techniques: use of a 360-degree stereoscopic camera to film the actors, real-time video game sequences, and interaction with the hands using the Leap Motion system.

By using virtual reality headsets (Oculus Rift or GearVR), visitors could become the main characters in the story, as the linear storyline provided for interaction at certain points: they could activate the time machine, walk along the Gran Vía in the 1920s or look out of a zeppelin flying over Madrid, thus enjoying an even greater degree of immersion in this journey in time [online resource - video].

Charles III and the dissemination of Antiquity

An exceptional event – the archaeological discoveries at Herculaneum, Pompeii and Stabiae – prompted Charles III to undertake the task of disseminating the antiquities found there, chiefly at the Villa of the Papyri in Herculaneum, before departing for Spain in 1740. Draughtsmen and engravers were enlisted to document the Roman antiquities, though plaster casts were subsequently made of the bronze and marble sculptures and sent to the king from Naples.

This special connection between the Naples originals and the plaster copies (which passed to the collection of the Academia de Bellas Artes de San Fernando) became even more complex when some of the plaster casts were sent to the Real Academia de Bellas Artes in Mexico.

The existence of these three places linked by archaeological heritage inspired the exhibition Carlos III y la difusión de la Antigüedad (2017), which took place simultaneously at three venues, the Real Academia de Bellas Artes de San Fernando (Madrid, Spain), the Museo Archeologico Nazionale di Napoli (Naples, Italy), and the Academia de San Carlos (Mexico) and was designed to show the importance of this feat, using digital technologies to focus on the role played by the enlightened king.

The novel feature was that the virtual reality environment made it possible to visit all the locations where this story took place, from the amazing discovery to the plaster casts in their respective destinations, as well as the three exhibition venues.

The virtual experience was designed at the initiative of Acción Cultural Española (AC/E) and Future Lighthouse. An immersive space was created at each venue where, with the aid of 4K 360-degree VR devices, visitors could go back in time to the moment of the discovery before visiting all three exhibition venues and personally
The use of digital technologies in the conservation, analysis and dissemination of cultural heritage

This experience designed for the exhibition was not the only example of cutting-edge technology, as digital models of each of the original pieces were made using photogrammetric techniques and displayed on tablets located beside the plaster casts, so that visitors could view the (virtual) originals alongside their copies. In addition, two 3D printers showed how the virtual models were printed, proving to be the twenty-first-century equivalent of casting [online resource - video].

2.5 Materialising digital heritage

The major advantages digitally documenting heritage has to offer in the fields of conservation and dissemination have been recognised for some time, but in recent years they have been hugely broadened by the appearance of other techniques that allow three-dimensional models of cultural objects to be taken beyond the screen.

This new dimension has brought highly interesting prospects in the field of dissemination as it is based on digital technologies that are non-invasive and respectful of heritage. Some of these are projection mapping, which gives these virtual graphics material form using light projections, and 3D printers, which are hailed as the twenty-first-century solution to casting.

The prospects and lines of work offered by these resources for materialising digital heritage have led their applicability to be explored, and their results are continuing to amaze – so much so that, although relatively new, these technologies already have a fruitful track record in a number of cases.

Google Glass and Google Cardboard

While on the subject of devices of this kind, we should stress the work of the French firm GuidiGO, a pioneer in designing an app for Google Glass targeted at cultural spaces. It offers various options ranging from choosing one of the thematic routes to following the plan of the floor we are on or stopping to view a significant work while listening to a commentary and accessing multimedia content that illustrates and contextualises what we are viewing.

In 2015, GuidiGO’s app for Google Glass was one of the resources used at the Velázquez exhibition held at the Grand Palais in Paris (France). It was one of the options offered to visitors and was designed especially to attract a younger audience or people not fond of traditional audioguides.

In 2016 the company tested the possibilities of virtual reality on mobile devices by incorporating into the Imaginary Tour app the possibility of enjoying 3D and 360-degree views compatible with Google Cardboard, the virtual reality platform also developed by Google based on a foldable cardboard base that allows mobile devices to be used as virtual reality glasses. The company’s website displays a few examples of the virtual visualisations using Google Cardboard that make it possible to explore the room depicted in one of Van Gogh’s famous paintings, visit the temple of Hathor in Dendera (Egypt) or see the Colosseum in Rome through a gladiator’s eyes.

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of fields, spearheaded by companies and institutions that are fully convinced of their potential and benefits for heritage.

2.5.1 3D printing

In recent years the application of 3D technologies to cultural heritage has reaped successful results which are having an impact on the preservation, enhancement and dissemination of heritage. Today the emergence of 3D printers is opening up further new horizons in this sector.

There is no doubt that 3D printing has gained a strong foothold in the heritage field and that, despite being the newest technology, it has already proved its interpretive potential and capabilities. We should not forget that resources such as models and mock-ups have been around for a long time in this field owing to the advantages of physical models that are tangible and permanent – aspects which have traditionally ensured their popularity and longevity. This quality has been inherited to an extent by 3D-printed models, which have spurred something of a revival of such resources thanks to the accuracy of 3D models and the ease of reproducing and physically materialising them. We have already discussed the importance to cultural heritage of 3D scanning and photogrammetric techniques, which make it possible to extensively document cultural assets, and the existence of 3D models of them with a high degree of detail and realism. These models have been used for virtual reconstructions in several applications which help visualise and disseminate heritage assets, but what 3D printing does is give the vast collection of records we call digital heritage additional functions by physically materialising it beyond the screen.

Virtex and Virtex Light

3D printing plays an important role in disseminating heritage through small-scale reproductions ideally suited to exhibition venues which, in combination with other technologies, enhance their educational value. Such is the case of the Virtex and Virtex Light[^43] systems developed by Visual Dimension[^44] which were used for the international exhibition Keys to Rome during 2014 (Capurro et al., 2015). For the first system, called Virtex, the Roman sculpture from the first century BC known as the Augustus of Prima Porta, housed in the Vatican Museums in Rome, was used. The 3D model was based on the work carried out as part of The Digital Sculpture Project[^45] which enabled a digital copy of the sculpture to be made for printing and previously adjusted to install a device to be subsequently incorporated into the printed 1:6 scale replica. This system consisted of orientation sensors which, together with tactile sensors, sent data via a wireless USB connection that relayed it to an external processor. When the user handled the Augustus of Prima Porta, a three-dimensional virtual copy of the sculpture with its original polychrome appeared on a screen next to the installation and reproduced the user’s movements on the real model. There were also a number of points of interest which, when pressed, activated a video explaining the characteristics and iconography of this unique Roman artwork.

The Virtex Light system took as a reference the monument and altar of Ara Pacis Augustae (first century BC), located in the city of Rome. The monument was erected to commemorate Augustus’s victories in the provinces of Hispania and Gaul, which led to peace. In this case the system consisted solely of tactile sensors on the surface of the 3D-printed 1:37 scale model, as here the user did not handle the piece but pressed each of the points of interest. An augmented virtual copy would then appear on the screen showing the details of the complex iconography contained in the reliefs decorating the altar, including a reconstruction of the original polychrome and historical records on the excavation and subsequent reconstruction by means of anastylosis [online resource - video].[^46]
Taking as a basis other complete putti in the decorative scheme, the necessary information was gleaned to produce digital models from which two new heads were obtained. The new heads were made from polymer, and were modified to fit the incomplete figures perfectly. The resulting effect was of visual unity in the chapel’s sculptural decoration, and this non-invasive and totally reversible technique that respects the original materials proved to be a valid means of reintegrating losses.

**Church of the Annunciation of Our Lady of the Newarke (Leicester, United Kingdom)**

Models of landmark architectural buildings have been one of the most popular interpretive resources for several centuries as they are highly educational on account of their tangibility. Recent advances in scanning, modelling and 3D printing techniques have made it possible to create extremely accurate physical models simply. Tooteko was specially designed to be placed in situ at each of the monuments, making them accessible to visitors of this kind by enhancing the tactile experience with additional resources. So far it has also been tested at the basilica of San Giorgio Maggiore in Venice and during 2015 at the monument of the *Ara Pacis Augustae* in Rome. There is a version with a video guide for smartphones or tablets for the general public [online resource - video].

**Church of the Castello di San Martino dall’Argine**

The importance of 3D technologies to cultural heritage has been stressed on various occasions, such as at the event *La Rivoluzione dello Spazio 3D*, which showed the results achieved by [Fab. Lab Imprimatvr-lab](http://example.com) in the use of 3D printing to reassemble figures from one of the chapels of the church of the Castello di San Martino dall’Argine (Mantua, Italy). The aim of this project was to use low-cost resources such as data acquisition techniques and free software to create digital models and 3D-printed copies. They focused on sculptures of two putti that were part of the decoration of the chapel and were missing their heads and some limbs. Taking as a basis other complete putti in the decorative scheme, the necessary information was gleaned to produce digital models from which two new heads were obtained. The new heads were made from polymer, and were modified to fit the incomplete figures perfectly. The resulting effect was of visual unity in the chapel’s sculptural decoration, and this non-invasive and totally reversible technique that respects the original materials proved to be a valid means of reintegrating losses.

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2.5.2 Projection mapping

Projection mapping (or video mapping) is another example of how, following the data acquisition and 3D modelling processes, heritage can again be given a material form in a real environment.

Projection mapping can be considered a twenty-first-century technology as the concept was developed only recently in connection with digital technologies and has proven highly useful, especially in disseminating heritage. In this case it consists of video projections on a solid surface – an architectural structure or a particular object – to create new, illusory forms and transform reality through projections of light.

Here the physical environment is transformed by images which are integrated into the user’s environment, not only their field of vision. This is why, compared to other technologies applied to heritage, projection mapping has the advantage that visitors do not require an intermediate display (such as mobile devices) to view the digital information overlaid on the real space.

Images are projected onto real objects using digital projectors to create the illusion of virtual objects that coexist with the real world. These images can be in 2D, aligned on a flat surface, or in 3D, projecting textures or images onto uneven surfaces or real objects.

The main challenge of projection mapping is to correctly align the digital images and the geometric forms onto which they are to be projected in order to achieve an accurate image resulting from the combination of real object and digital projection. An additional characteristic of the application of video mapping to heritage sites is that they are static installations that can only be used in spaces with dim lighting, such as interiors, to create the desired illusion.

Projection mapping has been widely used in activities involving the dissemination and promotion of cultural heritage over the past two decades. There are many examples of audiovisual shows. In Spain, we might cite the video projection entitled "El despertar del dragón" (The awakening of the dragon) on the façade of the Casa Batlló (Barcelona), and the projection presented in 2016 as part of the exhibition La poética de la libertad marking the 4th centenary of the death of the writer Miguel de Cervantes on the façade of Cuenca cathedral (Spain). In both cases they involved recreating moments in the history of the buildings, showing the state of the Casa Batlló before it was remodelled by the architect Antonio Gaudí at the beginning of the twentieth century, and the architectural elements of the unfinished cathedral of Cuenca. Both cases illustrate the potential of projection mapping for disseminating heritage, apart from the audiovisual show factor.

Taüll 1123

A notable case of the use of projection mapping was that carried out on the Romanesque church of San Clemente de Tahull (Vall de Boí, Lérida), whose original paintings are housed in the Museu Nacional d’Art de Catalunya (MNAC), in order to safeguard them. The project, called Taüll 1123, began by restoring the plaster copy of the original paintings decorating the apse and led to the recovery of the original remains still preserved in situ. This made it possible to digitally restore and document them through comparison with those housed in the MNAC.
in order to produce a digital reintegration that showed the appearance of the original paintings. Projection mapping was put into practice by projecting the digitally restored paintings onto the walls of the church’s apse, thus returning it to its full splendour as in 1123. An animation was also designed by Burzon*Comenge in collaboration with Playmodes to provide an audiovisual show that displayed in detail the compositional elements of this gem of Catalan Romanesque architecture which was granted World Heritage status by UNESCO in 2000 [online resource - video].

**Pórtico de la luz - Cathedral of Santa María (Vitoria-Gasteiz)**

Fundación Catedral Santa María implemented a complex plan to fully restore the cathedral of Santa María de Vitoria (Álava), which has so far undergone various types of work using state-of-the-art technology with a view to opening it permanently.

There are several proposals for disseminating this heritage. One is the use of projection mapping to trace the evolution of the polychrome over time, from the sixteenth to the twentieth centuries, based on the studies conducted during the restoration process which have brought to light the original colour of the materials that had faded over time.

This dissemination tool, called “El pórtico de la luz” (Portico of light), is a 3D projection system installed in the chapel of Paternina, which is located at the front of the atrium and named after the abbot who had it built. It creates an environment where visitors can visualise the evolution of the chapel’s decoration and the fresco paintings that were once there, while an off-commentary explains the details.

In this case projection mapping has made it possible to use digital projection techniques to recover the historic polychrome decoration that is no longer extant [online resource - video].

**Digital restoration of Caesarion**

Some of the most significant technological tools for disseminating heritage assets were used during the international exhibition on the culture of Imperial Rome, Keys To Rome, which took place simultaneously in Rome, Sarajevo, Amsterdam and Alexandria during 2014. One of them was Revealing Flashlight, which was developed at the LaBRI - Laboratoire Bordelais de Recherche en Informatique of Bordeaux University (France) and used projection mapping technology applied to damaged sculptures and reliefs that could not be fully appreciated (Ridel et al., 2014). For example, a bust of Ptolemy XV, known as “Caesarion”, with badly blurred features was used at the exhibition in the Library of Alexandria (Egypt). By means of 3D projections, visitors could view a digital restoration of the bust with the missing fragments reincorporated. At the exhibition at the Allard Pierson Museum in Amsterdam, video mapping was used for a relief onto which the original polychrome decoration was projected, thereby restoring elements that were lost but known from academic studies [online resource - video].
This section will focus on academic studies on digital technologies which have yet to be widely used or implemented in practice but are of far-reaching importance to the heritage field and illustrate the potential and versatility of these technologies.

As in the previous sections, we will include cases of good practice in the sector, though here priority will be given to recent pioneering scientific research.

The experiments in question are known only through specialist publications and have been widely discussed at scientific events. They are among the most important research projects and results achieved in the scientific community.

We will include recent studies still at the experimental stage owing to their pioneering and ground-breaking nature, as well as research which has achieved very promising results that indicate the new way forward for heritage and which we can expect to see in the relatively near future. Some of these national and international projects are government-aided and conducted by public institutions, while others are part of private entrepreneurial initiatives where collaboration between different areas of knowledge through multidisciplinary teams has reaped excellent results.

We also include analytical studies which differ from other similar experiments in that they offer new ways of using technological resources and are a point of departure for implementing these projects outside the empirical field.

All these experiences are an evident reflection of the fact that the relationship between cultural heritage and digital technologies is becoming more active than ever and is bringing better ways of preserving and promoting our society’s knowledge of heritage.
3.1 Data acquisition and 3D digitisation

Digital technologies have made it possible to produce amazingly accurate 3D digital models of cultural heritage. This is due to the development of new techniques and methodologies that have perfected the task of acquiring data and digitising heritage.

It is therefore not surprising that much of the specialised research conducted in recent years has focused on this area and has aroused interest not only because of the high-quality, accurate digital models produced but above all because it shows the many applications 3D modelling can have in safeguarding and making heritage known.

Some of the proposals highlighted here concentrate specifically on digitising heritage as a means of measuring, selecting and analysing cultural elements with a view to carrying out art-historical studies to improve on the recording and diagnostic methods known so far in this field. It can be concluded that extremely accurate digital data allows 3D models to be handled in different ways and makes it possible for experimental tasks to be conducted with different degrees of depth and detail, leading to greater refinement in our analyses of heritage assets.

Finite element method in 3D models

The military fortress of Rocca Roveresca in the town of Senigallia (Ancona, Italy) was chosen as the object of study for the development of 3D models that could be used to conduct analyses by means of the finite element method (FEM), a numerical system for detecting flaws caused by unknown structural tension.

The research was carried out by an interdisciplinary team at the Scuola di Ateneo di Architettura e Design “Eduardo Vittoria” (SAD) in collaboration with the Ministero dei beni e delle attività culturali e del turismo (MiBACT), who devised FEM models for obtaining efficient structural evidence to detect local abnormalities caused by internal discontinuities and cracks in the walls. The choice of Rocca Roveresca was justified by the fact that its structural system is characterised by architectural layers with different materials and construction techniques (Meschini et al., 2015).

First of all data acquisition tasks were carried out using 3D laser scanning and endoscopic techniques that made it possible to delineate the traces of the layers and, accordingly, obtain different detailed 3D models to apply the finite element method. The point cloud obtained for each element was then used to apply the method whereby, by means of algorithms, a “mesh” was produced from clusters of points that enabled a comparative analysis to be carried out to locate structural tensions.

The results revealed that certain elements such as cornices played a structural role in the ensemble, evidencing the usefulness of the approach and the potential of the various phases of the method in combination with data from 3D laser scanning.

The ultimate aim was to propose and test a working scheme to define a method, that is, an operational process that could be used to study vulnerability to earthquakes – not only that of the Rocca Roveresca fortress in Senigallia, but other similar architectural contexts.

3D laser scanning and structural diagnosis

The Faculty of Engineering and Architecture of the Università Kore di Enna (Sicily, Italy) also used 3D laser scanning as an experimental method for analysing structural deterioration and damage in the church of San Cataldo (Sicily) (Versaci et al., 2014). This monumental masonry building had been plagued by evident...
structural problems stemming from the geological differences in the land on which it stands and earlier restoration work.

Although traditional methods and technologies detected major structural issues from the outset in the façade and side chapels, the use of new technologies identified abnormalities not visible to the naked eye owing to their location in physically inaccessible areas of the church, such as the part of the vault concealed behind the cornice of the nave or microfissures in the ceiling, which required the use of a quadcopter, a type of unmanned aerial vehicle (UAV) that incorporated a camera and a Wi-Fi system with remote control by smartphone. A 3D laser scanner was used to evaluate each of the structural deformations and cracks. Together with the information gleaned by the quadcopter, it made it possible to produce a considerably detailed and complete geometric plan of the church.

The data collected was used to carry out an in-depth study by means of a thorough analysis of digital models. Compared to other traditional techniques, this process makes it possible to evaluate deteriorated materials and structural modifications that were taking place, including those that could be potentially serious in the future.

The application of technologies to acquiring digital models of heritage assets also has an experimental aspect that is currently proving to be very fruitful in recovering lost art historical elements. This aspect has aroused the interest of the academic community, especially in the field of archaeology, though research of this kind is increasingly being carried out on other types of historic heritage. The current appearance of many of our monuments differs from that of the past, but today, thanks to the possibilities of experimentation and digital recombination that 3D digital models provide, it is possible to convey their past appearance based on surviving records, achieving truly unique and hitherto unseen recreations of heritage.

Equirectangular images and projection mapping

In this connection, Zaragoza University has run a pioneering project to return the chapel of the Monument (or of San Marcos) of Zaragoza cathedral to its height of splendour ([Monzón, 2015]).

The chapel was remodelled in the eighteenth century to house the Holy Week Monument in its interior. The architectural and sculptural richness of the portal, and the Baroque layout of the staircase and the complex painted backdrop canvas (no longer extant) which acted as a mock altarpiece that concealed the Monument are significant elements that can be studied using new technologies.

In this case reverse engineering techniques were used to document the chapel graphically and geometrically, namely 3D laser scanning and photogrammetry. The importance of using these metric techniques in documenting heritage compared to photography and traditional surveying techniques was highlighted here, as they are very accurate at recovering lost elements and obtain data that can be processed digitally to produce elevations, cross-sections, profiles and maps of damage enabling a diagnostic study over time to be carried out.

The data gathered was used to create a 3D digital model of the interior, the portal and the nave where the chapel is. The equirectangular images obtained from photogrammetric techniques were employed for this purpose to gather better graphic details.

In addition, a proposed layout was designed for the chapel using projection mapping to highlight architectural features of the chapel by means of light. Images, textures and videos showing earlier states or emphasising elements of its sculptural iconography were projected onto the portal. The most important use to which projection mapping was put was to create a fictitious restoration...
of the no longer extant altar backdrop, which is known through archive photographs, making it possible to show an earlier state of the chapel of the Monument using digital technologies.

**3D modelling and augmented reality**

Another Spanish example is the pioneering experiment carried out by the Universidad Politécnica de Valencia on the cathedral’s main chapel. This experiment is an excellent example of the use of augmented reality in heritage contexts and involved employing photogrammetric techniques to create virtual reconstructions.

The experiment, on which the Department of Cartographic Engineering, Geodes and Photogrammetry and the Department of Conservation and Restoration of Cultural Heritage of the university collaborated, consisted of an augmented reality visualisation of the cathedral’s main chapel, reproducing its Baroque appearance with the recently dismantled Baroque vault and the silver altarpiece illustrating themes of the Virgin, which was melted down during the Peninsular War.

For the Baroque vault, the 3D digital model produced using photogrammetric techniques and a ground-based laser scanner during the work carried out prior to its dismantling was taken as a basis. For the Renaissance altarpiece, the only known visual source was used: a small panel painting housed in the cathedral archive, from which the digital model to be overlaid on the extant altarpiece for the augmented reality experience was created. (Portalés et al., 2009).

This experiment involved a prototype head-mounted display or augmented reality headset to enable users to view the Baroque vault as it was until the end of 2005 (the date it was dismantled) on the HMD screen, as well as to appreciate the silver Renaissance altarpiece in the main chapel, which disappeared during the Peninsular War.

Experiments in recovering the past through 3D digital data acquisition techniques are not limited to recreating a moment in history of a heritage asset; many more recent research projects are focused on the virtual anastylosis of art historical objects currently in a fragmented state. These are cases where elements of the past are not lost or destroyed but have been dispersed owing to various circumstances, either to be reused in other works or distributed among several museum collections worldwide.

The potential of this method for unprecedented visualisation of historic heritage in its original form and context is boosted when it is used in conjunction with new fast prototyping techniques such as 3D printing, which have succeeded in taking these efforts to recover the past one step further.

**Tudor tomb monuments in Norfolk**

The University of Leicester (UK) is notable for an important case in which digital technologies played a decisive part in helping reassemble scattered historic heritage using an effective combination of three essential aspects of research involving cultural heritage and new technologies. Sixteenth-century art historical documentation together with 3D laser and 3D scanning techniques made it possible to recreate two tomb monuments belonging to the Tudor dynasty.

The project, run by the University of Leicester, is one of the results of the research carried out by the team at Representing Re-Formation, who analyse and recreate important Tudor monuments with funding from the Science and Heritage Programme (AHRC and EPSRC).

The two tomb monuments studied were commissioned by Thomas Howard, third Duke of Norfolk, for himself and for Henry VIII’s illegitimate son Henry Fitzroy, Duke of Richmond. Both were originally intended for Thetford priory
Griffoni Polyptych

The Griffoni Polyptych, a late fifteenth-century altarpiece with paintings by Francesco del Cossa and Ercole de’ Roberti, members of the Bolognese school, is the object of one of the most interesting projects conducted by Fundación Factum (Madrid). This work was commissioned by the Griffoni family for the chapel of San Vicente in the basilica of San Petronio (Bologna, Italy). As in many similar cases, the altarpiece was removed when the chapel passed to another family in 1726 and was later dismantled and sold to other owners. Sixteen paintings from the original altarpiece still survive, scattered among nine museums and foundations in various parts of the world.

The work of Factum Arte consisted in virtually reassembling the complete altarpiece with all the paintings currently housed in various institutions to produce an interpretive resource.

A 3D laser scanner was used to create a three-dimensional digital model of each of the pieces, both front and reverse. High-definition photographs were likewise taken in order to capture the slightest details and the colour of the paintings of the polyptych. The data acquisition phase ended in October 2015 with various files to be used to document and study the original pieces accurately.

There are future plans – showing the potential of digital tools as allies of heritage – to use 3D printing to create a replica in order to “recover” this Italian Renaissance work; it will be placed on display in the former Griffoni chapel, which was recently restored.

3.2 Analysis and interpretation

As 3D acquisition and digitisation technologies develop and broaden their scope of application, the next step will be to make available this huge amount of information to researchers and sector...
professionals. However, in order to provide access to 3D digital content and allow it to be used creatively and analytically, it is necessary to address challenges such as the availability of open repositories for this type of content, and the need to sort and classify each element using suitable metadata to retrieve data without losing the stored information. This entails different applications and mechanisms for making sense of all this digital information by allowing each of the items to be incorporated and cross-searched, building semantic narratives, analysing data, supporting scientific discourse and, no less importantly, attracting users who demand this digital information.

To tackle these challenges, one of the most significant areas of research involving the digitalisation of heritage is the development of technologies and systems to support the organisation and detection of 3D digital content in the field of cultural heritage. This has given rise to many pilot projects devoted specifically to designing and implementing databases specialised in cultural heritage.

ITN-DCH project

This was the purpose of the European ITN-DCH project (Initial Training Network for Digital Cultural Heritage: Projecting our Past to the Future), which arose as a collaborative effort between the academic world, research institutions, industries, museums, archives and libraries to document, preserve and protect cultural heritage through digital technologies networks.

Coordinated by the Digital Heritage Research Lab of the University of Technology in Cyprus, it was begun in 2013 for a four-year period.

ITN-DCH is aimed at both tangible and intangible heritage and its purpose is to create a network for sharing the various experiments and research carried out in the field of heritage and new technologies.

To date four case studies have been developed: the Church of the Virgin or of Asinou (Troodos region, Cyprus), the ancient Roman military encampment of Carnuntum (Austria), the ruins of Donaustauf castle (Germany) and the tombs found at Ilmendorf (Germany), which date to the late period of the Hallstatt culture.

All these cases entailed developing digital tools for personal devices, mixed and augmented reality interactives, new metadata procedures, forms of representing tangible and intangible heritage in 3D and 4D, and new ways of storing and exchanging data via the internet.

Geodatabase for data management

The concept of geodatabase refers to a primary model for storing ArcGIS data. Its main advantage is that it stores many different types of GIS data, making it a major ally in forming databases made up of complex, highly heterogeneous data, as in the case of heritage assets.

With this idea in mind, Cirgeo (Interdepartment Research Center of Geomatics), an Italian centre belonging to the University of Padua (Italy), developed an online management and documentation system for handling data gleaned from various resources and documentation phases related to a particular cultural asset. The data management system is based on a geodatabase for storing different types of datasets (Guarnieri et al., 2016).

The chosen test-case scenario was the Villa Revedin Bolasco complex in Castelfranco Véneto (Treviso, Italy) and its grounds, which was built in the nineteenth century following several restorations of the original fourteenth-century area.

The Web-GIS platform, an interactive map, was implemented using NASA satellite images through the Web World Wind application. It was used to enable visitors to navigate and explore the villa’s grounds, a large park.
The geodatabase elements consisted of historical information, documents, ground plans extracted from 3D models and descriptions in the form of text and images specifically showing the artistic features of the architectural complex. An unmanned aerial vehicle was employed to document the exteriors of the complex by capturing aerial images of this large area.

The most innovative feature of this GIS-based database was that it allowed visitors to explore the villa from various perspectives (geometric, spatial and time sequences) by means of specific consultations or using the timeline function.

TOVIVA Project

The TOVIVA project (Torres de Vigía y defensa del litoral VAlenciano. Generación de metadatos y modelos 3D para su interpretación y efectiva puesta en valor [Watchtowers and defence towers of the Valencian coast. Generating metadata and 3D models for their interpretation and enhancement]) research project is run by the Instituto Universitario de Restauración del Patrimonio of the Universidad Politécnica de Valencia. It is designed to enhance the historic and heritage value of the military architecture along Spain’s east coast which dates from the sixteenth century, when the socio-political context called for naval defence measures. When this context changed owing to the disappearance of piracy and the development of other economic activities, these constructions were progressively relieved of their functions and became part of the urban agglomeration of subsequent centuries, as a result of which their original morphology was altered or they were eventually demolished. The TOVIVA project is designed to rescue these coastal heritage elements from the past by using state-of-the-art techniques and technologies for documentation (photogrammetric and 3D laser scanning techniques), research, interpretation, recovery (creation of inter-institutional databases) and enhancement (design of applications for mobile devices) purposes.

Statistics applied to art catalogues

The project entitled Investigación histórica y representación digital accesible. El patrimonio artístico durante la guerra civil y la posguerra (Historical research and accessible digital representation. Artistic heritage during the civil war and post-war), which has been run since 2015 by the research group Museum I+D+C. Laboratorio de Cultura Digital y Museografía Hipermedia of the Universidad Complutense de Madrid, involves using digital technologies to explore and catalogue the works salvaged and deposited in safe places by the Republic during the Spanish civil war and compare them with the locations of these works immediately after the war. The research into the vicissitudes and whereabouts of each of these artworks relies on the digital medium to manage such a huge number of works. An open and collaborative internet database has been designed for this purpose so that researchers or anyone else can provide information. The use of Web 2.0 tools and the possibilities of the semantic web have facilitated the process of cataloguing each item and the related analyses, establishing statistics that provide a number of joint results characteristic of metadata handling platforms. A few results already displayed on the project’s website relate to statistical data gleaned to ascertain the number and percentage of works that were moved out of Spain and those that remained; they also indicate what percentages were returned to their original owners or passed to others, mapping the itinerary of each of the works. The ultimate aim of this project is to establish the confluence between historical research and the management of knowledge using the possibilities the digital medium has to offer.

PREFORMA project

Cataloguing heritage is an activity that is rapidly growing in pace with the development of technologies that enable this data to be acquired and processed in order to be consulted and used by the community in databases. Europeana, the
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The new applications of artificial intelligence have thus provided opportunities for producing innovative tools for managing the large amounts of existing data which is growing day by day; for interpreting this data leading to results that prioritise knowledge and enhancement; for promoting cultural heritage by offering new paradigms for interaction that make use of the large amount of data; or for protecting heritage assets through fast, minimally invasive research.

These applications explain why the use of artificial intelligence in the heritage field has been the focus of various research projects that explore how it can help improve the enhancement, conservation and promotion of cultural assets.

**EffeHDDT method**

The following example comes from China and is a study on creating a heritage monitoring system based on complex algorithms. Its salient feature is that it focuses on detecting deformations in the architectural structures of heritage buildings – one of the pathologies that affect their long-term conservation.

The research was carried out by two Chinese research institutions, the Department of Information Science and Engineering of the University of Ningbo and the Zhejiang Fashion Institute of Technology (Ningbo), with the collaboration of two Australian institutions, the School of Information Technology of Deakin University (Melbourne) and the College of Engineering and Science of Victoria University (Melbourne), which coordinated their efforts to design an effective heritage detection and tracking method (EffeHDDT) using wireless sensor networks (Xie et al., 2014).

The main concern sprang from the importance of monitoring and identifying early evidence of the deformation of the elements of heritage sites, especially in Asia. In contrast to most world heritage monuments, in countries like China much of the historic heritage is made of...
clay. This fact often leads to damage to their inner and outer structures as a result of natural deformations in the construction materials.

However, traditional methods for monitoring heritage objects are often insufficient to obtain a large amount of specific data on the whole structure or else merely gather environmental information on the place. Although they help diagnose the main pathologies and analyse the causes, as well as the erosion mechanisms, they do not provide an in-depth study of the detection and monitoring of the deformation of these heritage sites.

By designing a specific system of sensors such as EffeHDDT, it is possible to deploy a network of wireless sensor nodes to a large area or complicated structure in order to thoroughly monitor every part of the monument. This system was also designed to continuously monitor the site online for several years to capture the gradual deformation often caused by natural forces.

As was concluded in the study, both the technical analysis and the results of the experimental phase proved that the EffeHDDT method based on algorithms outperformed existing methods in terms of network traffic as well as in its accuracy in detecting structural deformations.

Algorithms in Islamic architectural decoration

There are cases where the use of computational techniques makes it possible to study heritage using algorithms – something that would be next to impossible with traditional methodologies – thanks to the operational speed of computers and the existence of software to facilitate the analytical tasks.

This method was used, for example, to study historic Islamic architecture based on evolutionary genetic algorithms in an initiative run by the Department of Civil Engineering of the Future University of Cairo (Egypt). This research took into account the fact that Islamic architectural design is cosmogonic, shaped by the laws of nature (Alrawi, 2014). This conception led to the consideration that the patterns of Islamic architecture would mirror the development of genetic algorithms derived from the observation of nature, which was tested in order to obtain new data or theories on Islamic architecture never previously considered.

This experiment was designed to be conducted at different levels, beginning with urban spaces and ending with architectural details. The results clearly show that Islamic architecture could be regarded as the result of the application of evolutionary genetic algorithms, as both the spaces and the archetypes were genetic, parametric and generative and therefore compatible with the universe, which became the measure for all things and extended to all aspects of everyday life, embodying the idea of unicity.

This confirmation that the evolutionary algorithmic system underpins Islamic art, architecture and town planning was considered of great importance to future research, which will be centred on capturing the patterns of these algorithms and treating them as a point of departure for preserving the identity and character of modern Islamic cities.

Ontology for 3D documentation

The Cultural Informatics Research Group at Brighton University (United Kingdom) designed a database system for which it developed an ontology for documenting 3D digital models of decorative architectural elements (Echavarria et al., 2015). The purpose of ontology in the field of computational sciences is to find the variables that appear in dataset analyses and it allows relationships to be established between them. This method was used on a collection of Regency (an architectural style in vogue in nineteenth-century England before the Victorian period) plaster mouldings. These mouldings were chosen because they provided a rich dataset
on which to explore issues common to many cultural heritage artefacts, such as design styles, patterns and motifs, which in this case were relevant to a particular time and place.

An ontology was developed for documenting architectural mouldings decorated with different ornament, making it possible to retrieve them with the assistance of the system that identified similar mouldings. The proposed ontology thus allowed 3D digital models to be catalogued based on information on their artistic style and method of execution.

A shape analysis method was also designed to improve the information automatically extracted from 3D digital content, allowing different users to consult a particular repository using the semantic connections underlying each element.

The idea is to make this system applicable to other heritage objects, as the shape analysis algorithm developed here could also be applied to a variety of heritage shapes in order to learn about their semantic significance.

**Soft computing tools in archaeology**

Continuing with the diversification and applicability of tasks using artificial intelligence, we find a research project entitled “Aplicación de técnicas soft computing y modelado 3D en el tratamiento masivo de datos en arqueología” (Application of soft computing and 3D modelling techniques in the mass handling of data in archaeology, 2015–2017), which set out to explore the potential of soft computing techniques – a branch of artificial intelligence – for analysing archaeological data.

The issue examined here was the increasing amount of data obtained from archaeological excavations. The sheer quantity of variables to be considered and their interaction subject to multiple combinations prevents them from being analysed and classified in greater depth. For this purpose the use of soft computing techniques was proposed. Based on advances in artificial intelligence, these techniques make it possible to manage a large amount of partial information and find classificatory and/or statistical parameters.

To test the use of soft computing, three archaeological sites dating from prehistory, early history and antiquity were chosen.

The first was the Palaeolithic settlement of El Salt (Alicante), where evidence was documented of the existence of three game species during the period: deer, horses and mountain goats. The many small fragments found make it difficult to recognise the species, and zooarchaeological identification rates were low. Computational analysis based on soft computing can facilitate this task by establishing parameters for identification and saving time with the classification and cataloguing of the fragments.

The second case was the Theban Tomb 209 (Luxor) belonging to the 25th dynasty, where evidence had been found of differences in the execution of decorative funerary inscriptions, suggesting the hand of at least two scribes. Using computational tools, it is therefore possible to analyse types of hieroglyphic writing in depth, paying special attention to elements that could otherwise go unnoticed, such as the distance between signs or the ratio of sign size to column width, which would enable the different authorship to be identified.

The third case was the Roman Punic city of Carteia (San Roque, Cádiz), where the aim was to study typological characteristics such as constructional and stylistic patterns for the surviving Punic and Roman architectural remains. Ceramic ware was also taken into account as an important area where soft computing can be particular useful: the variety of types and the fragmented state of the pieces made them extremely difficult to classify and catalogue on the basis of variables such as geometric shapes, colours, textures, decoration or modelling, among others.
Lastly, this project sets out to stress that studies of this kind require a multidisciplinary research team with knowledge of both computer science and archaeology – something that is still rare, even though we are living in the digital society.

### 3.3 Computer graphics and 3D environments

One of the most recurring objectives of cultural heritage research is to be able to visualise assets in interactive environments, in order to recreate historic sites that enable us to analyse and learn about them in greater depth.

The power of such resources for interpreting heritage lies in their ability to show places that are not normally accessible and/or to allow users to explore environments showing an enhanced or totally new image of this heritage asset.

Computer-generated graphics give rise to first-person interactivity between the user and the cultural object, leading to a closer relationship. This is what makes virtual reconstruction of a heritage asset a valid tool for analysing the same reality from different perspectives, where users each reconstruct their own version on a common platform that interacts with other agents involved.

It is not surprising that virtual technologies – referring both to 3D viewing and to virtual reality and augmented reality – have become the object of pilot experiments which, despite offering a predominantly futuristic image, are heralding a hybrid trend for heritage and its virtual counterpart.

### 1930s Albion Street

Some of the most original and interesting projects involving virtual recreations stem from local initiatives to explore the potential of new technologies applied to cultural heritage without involving highly complex and costly equipment. Such is the case of this project, 1930s Albion Street, which is based on a games engine – the programming routines for designing, creating and representing a video game (together with 3D digital software) – and recreates virtual environments inspired by the past architecture.

#### Art-Risk Project

From the Universidad Pablo de Olavide (Seville) comes another case of the application of artificial intelligence to the preventive conservation of cultural heritage in urban centres: the Art-Risk research project (Artificial Intelligence applied to preventive conservation of heritage buildings), funded by the Ministry of the Economy and Competitiveness and the European Regional Development Fund (ERDF).

The aim was to develop a new analytical method for identifying the degree of vulnerability and risks of monumental heritage – specifically churches, city walls and bastions – using the predictive model based on fuzzy logic (Ortiz et al., 2016).

Both environmental and climate-related risks were taken into account, as well as structural and functional risks, together with the historical records of each building in order to establish different patterns for calculating the degree of incidence of each variable. To prove the efficiency of the system, a diagnosis was carried out by a multidisciplinary team who tested the correspondence between the computer forecast and the decision of sector professionals.

This new tool based on free software could have important implications for assessing regional policy decisions on heritage planning and management, where cross-cutting parameters would be taken into account such as planning, architectural, heritage value, or the analysis of monuments’ environmental and socio-demographic backgrounds.
and urban development of the city. This innovative proposal was developed by games design students of the Hull School of Art & Design (Hull, England), who combined the video game production process with virtual reconstructions of historic parts of the city.

The project was called 1930s Albion Street after one of the landmark streets in the Georgian quarter of the city of Hull, which was badly damaged by bombing during the Second World War and lost much of its identity and unique character. The architectural splendour and social and educational concerns of the original city planners and architects had largely disappeared owing to the construction of new, modern buildings. Therefore, based on existing visual records of the district before the 1940s, a virtual tour of Albion Street was designed featuring full details of the city design and recreating the Georgian residential architecture and lost landmark buildings such as the Albion Congregational Church (1842–1949) and the Royal Institution (1854–1945). The final version was shown in the Central Library and toured several exhibitions that recalled the city’s historical past.

Medieval Trinity Square was a more ambitious project developed by the team at the Hull School of Art & Design. It showed the area around Trinity Church Hull with the appearance it would have had during the fourteenth century. For this project thorough research was carried out in local archives, historic buildings and oral sources to gather full historical information about the place and the activities that took place in the square during the medieval period. In this case a sophisticated interactive games engine (UDK) was used to develop a moving atmospheric visualisation and virtual tours of the fourteenth-century square. Lastly, an interactive module displaying the results of the project was installed near the church as an interpretive resource for visitors.

Virtual environments with HMD

In the field of cultural heritage, research is increasingly being carried out on recreating virtual environments with elements of the past, as they make it possible for a particular historic site to live on without having to be physically reconstructed.

Such is the case of the no longer extant palace of Darul Aman, located in the city of Tanjung Pura (West Kalimantan, Indonesia), which was virtually reconstructed from early images dating from before it was destroyed in 1946. The Department of Communication and Information Sciences of the University of North Sumatra in the city of Medan (North Sumatra, Indonesia) was commissioned to create the 3D model of the palace of Darul Aman and integrate it into a virtual reality environment that could be accessed using a viewing device such as a HMD or virtual reality headset (Syahputra et al., 2016).

Here a virtual environment was designed using 3D digital models of the palace, which were reconstructed from visual documentation housed in archives and museum collections. This documentation made it possible to extract structural parameters by superimposing the photographs onto the digital model, and the textures that would shape the virtual recreation imitating the original construction. As most of the photographs of the palace were of its exterior, other palaces of the same type were taken as models for recreating the palace’s interior.

The Unity3D games engine platform was used to create the virtual environment. This made it possible to reconstruct the various outdoor and indoor settings, which were constantly compared with the visual documents to ensure the greatest possible accuracy.

The result was a virtual tour whereby users with head-mounted display devices could explore the surrounding area and interior of the former
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Improving their understanding of the structure and providing them with real-time georeferenced information on the state of preservation of the cathedral’s various architectural features as well as reports on earlier interventions.

Future developments of the application include the possibility of users interacting with the BIM virtual reality system not just in read mode but being able to modify the data shown in the immersive environment.

Finally, the system was presented as a fundamental tool for addressing the main difficulties in managing the information and maintaining such huge spaces as the cathedral.

Virtual reality-BIM environments

Milan cathedral (Italy) was the chosen scenario for testing the application of virtual reality visualisation techniques in the management of BIM (Building Information Modelling) installations in order to assess the role this technology could play in the cultural heritage sector in supporting conservation and maintenance activities (Fassi et al., 2016). The project was developed by a multidisciplinary team from the Department of Architecture, Built Environment and Construction Engineering of the Politecnico di Milano (Italy), and the Department of Civil Engineering of the University of Salerno (Italy).

The point of departure was a multidisciplinary research project conducted on Milan cathedral for eight years (2008–2015), in which an accurate and detailed 3D model was built to use for taking measurements, and a building information system (BIS) was developed to collect all the data relating to the restoration projects, as well as full information on past, current and future maintenance activities on the cathedral.

The last step entailed tapping into the potential of immersive and visualisation techniques to incorporate a VR environment into the BIM system. For this purpose 3D digital models were optimised and simplified in order to be implemented in a virtual reality environment, while the virtual reality system was created using Unity software.

Lastly, connecting the augmented reality application to the BIM database would make it possible to create an immersive experience by using a virtual reality device, an Oculus Rift headset, in which in addition to exploring a virtual cathedral environment, users could access the technical information stored in the BIM system. This would enable it to be used by sector professionals, improving their understanding of the structure and providing them with real-time georeferenced information on the state of preservation of the cathedral’s various architectural features as well as reports on earlier interventions.

Geometric algebra and augmented reality

Augmented reality already has a long track record in the twenty-first century and an increasing number of applications are using this technology. The cultural heritage sector is among those that have been benefitting the most from it.

Nevertheless, the fact is that researchers are constantly conducting studies to perfect its functioning, especially the correct overlay of virtual graphics onto the real image of our environment to achieve a realistic perception where the boundaries between the real and the virtual are increasingly blurred.

The Computer Science Department of the University of Crete and the Foundation for Research and Technology - Hellas, both of which have significant experience in applying augmented reality in cultural environments, are one of the research teams that have joined forces in recent years to create augmented reality simulations (representation and animation) with life-sized virtual characters in open-air settings (Papagiannakis et al., 2014 and Papaefthymiou et al., 2015).
Commercial systems for detecting natural features were used in these tests to study the correct rendering of virtual graphics – in this case animated virtual characters – in a real setting. It was demonstrated that even these commercial systems still offer unsatisfactory results, and comparison was made with the system developed by the team based on open-code application programming interfaces (APIs) that enabled this experience to be implemented in a real setting.

The setting was the ancient Roman Forum of Thessaloniki, an important site where many of the original structures still remain. This space was taken into account from the outset of the study, as the animated virtual characters had the appearance of the ancient inhabitants of this historical place – a resource commonly used to design augmented reality applications for heritage dissemination. The possibility was discussed of creating an application with these historical characters in 3D for a mobile application that would be made available to the thousands of visitors to the place (online resource - video).

The research is still underway, though the initial results indicate that the new geometric algebraic model for animations is solid and has great potential. The team is discussing the possibility of applying geometric algebra to the rendering of characters in real time in order to achieve more effective augmented reality environments.

3.4 Audience case studies

Although studies of audiences at heritage sites are not unusual and are gaining importance with a view to attracting new visitors, the fact is that there is a significant dearth in studies on digital technologies as instruments of cultural mediation.

While we are aware of the recent proliferation of apps for portable devices, which are enjoying unprecedented prominence, we should not forget other mediation tools like installations, kiosks and audioguides, among others. Their interpretative and educational role with respect to cultural assets has been assessed, but it is less common to find analyses showing the actual relationship between digital content and the end user.

That is why a few initiatives are gaining particular prominence in the field of research – especially new apps, which focus on highlighting the intrinsic relationship between digital technologies and audiences in connection with disseminating and promoting knowledge of heritage.

**Madrid Industrial, Itinerarios**

In Spain we have recent audience evaluation experiences in relation to apps providing digital content on heritage. In 2015 the Universidad a Distancia de Madrid and the Universidad Autónoma de Madrid teamed up to conduct a study that highlighted the use of new technologies as an essential means of enhancing industrial heritage. For this purpose an app called Madrid Industrial, Itinerarios was designed to provide users with closer knowledge of what this heritage consists of and what it means to the city (De la Peña et al., 2015).

The app took into account the possibilities of e-learning – that is, learning through multimedia digital content which, thanks to the proliferation of mobile devices, has converted mobile apps into an essential vehicle for transmitting knowledge.

The app for smartphones or tablets was designed using Ibuild App software, which made it possible to create the content of the application. This content consisted of an audiovisual tour of the industrial heritage of the city of Madrid, for which a menu was created featuring routes, maps, audios and podcasts and a gallery of images and videos.

Once the app was available, it was tested by a group of thirty people with various profiles in order to gather more heterogeneous data. In this
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The GPS-based virtual reality and augmented reality application for mobile devices used 3D digital content from an earlier project called *Virtual Romans*⁹⁷ (2008). The virtual graphics were accordingly geolocated during the visit to the site, enabling users to view virtual reconstructions in situ such as of the Roman baths and the combination of virtual elements overlaid on the current ruins of the mithraeum or religious temple using augmented reality technology.

An important part of this project involved evaluating the application with a group of forty visitors who answered a questionnaire. On the basis of their answers, measures were taken to solve existing technical hitches or make improvements to meet users’ needs with a view to releasing an official app. Although the results of the surveys highlighted the fact that it was an intuitive, informative and realistic application that helped understand the site and the collections, the inaccuracy of the GPS and the small size of the screens were regarded as negative aspects of the visitor experience and immersion.

**Geolocation data on Twitter**

The importance of digital technologies, especially the presence and interactions of users on the social media and apps, is giving rise to audience and tourist studies focusing on cultural heritage.

A pioneering study on the use of geolocation data on Twitter has been conducted by a team from the Instituto de Física Interdisciplinar y Sistemas Complejos IFISC⁹⁸ (CSIC-UIB). It was funded partly by the Spanish Ministry of the Economy, the European Regional Development Fund (ERDF) and the European Commission.

The aim was to analyse the importance of geolocation data in providing information worldwide on the mobility of tourism related to cultural leisure. It was considered that the major impact this type of activity has on the local and global economy, as well as on the environment,
The use of digital technologies in the conservation, analysis and dissemination of cultural heritage warrants a survey. A method was devised for evaluating the appeal of the twenty most popular tourist destinations in the world using geolocation tweets (between 10 September 2010 and 21 October 2015), which have become an important tool for determining aspects relating to human mobility worldwide, in this case with monumental heritage as the main attraction (Bassolas et al., 2016).

The chief aim of this study was not simply to analyse the most visited places, but to ascertain which places attract visitors from most parts of the world. The results provided information on the most attractive tourist spots, which included the twenty in the sample; and on the most popular according to tourists’ place of residence, which were the Eiffel Tower (Paris), Times Square (New York) and the Tower of London. The study also built a global network of destinations connected by tourists’ preferences, the main connectivity being between the Eiffel Tower, Times Square, Plaza del Zócalo (Mexico) and the Tower of London.

The study was found to be a useful instrument for public authorities and private enterprise for assessing the impact of tourism on the local environment in fields such as geography, the economy and town planning.

CHESS project

The visitor studies initiative that is part of the CHESS project adds a new dimension, as the app is designed to monitor visitors in real time, analysing each of their interactions with the content of the application. There were parameters which, depending on the user’s choices, modified the dynamics and content displayed in the application so that it was in tune with the visitor’s preferences.

CHESS (Cultural Heritage Experiences through Socio-personal interactions and Storytelling) is a project that is co-funded by the European Commission. It aims to integrate interdisciplinary research in personalisation and adaptation of digital, interactive and mixed reality content oriented at promoting cultural sites from an entertaining and educational approach. Its principal objective is to research, implement and evaluate both the experiencing of personalised interactive stories for visitors and their authoring by cultural content experts.

Augmented reality technology was considered as part of the CHESS project to develop an interactive mobile guide that could be used to interpret some of the sculptures housed in the Acropolis Museum (Athens, Greece). For this purpose an application for smartphones and tablets was designed with augmented reality content for the Archaic Period (Keil et al., 2013). During the tests carried out in the museum, visitors were able to view the original polychrome of the female archaic sculptures or Korai and gain a complete view of a relief of Medusa, of which only a few isolated fragments survive, allowing the general public to interpret and learn more about the cultural object [online resource - video].

However, as stated earlier, the objectives of this innovative experience were not limited to the augmented reality content; this content was furthermore part of a personalised visitors’ guide showing the highlights of the collection as well as featuring other more traditional resources such as commentaries, videos and interactive games, etc.

To evaluate visitor conduct with this multimedia guide, the application’s “CHESS Profiler” monitored their conduct, considered interactions to be negative or positive depending on certain parameters and accordingly adapted the content to the visitor profile for the rest of the tour (Katifori et al., 2014).
CONCLUSIONS

The survey attests to the close relationship that exists today between cultural heritage and digital technologies as the result of the emergence of new techniques and devices that have marked a huge leap forward in ways of representing heritage. These technologies are an increasingly necessary tool for sector professionals and a means of boosting our society’s cultural knowledge.

The materialisation of digital heritage through 3D printing techniques has proven to be the main novelty as it gives cultural elements a physical presence beyond the screen. The high degree of accuracy of 3D models makes them a basis for producing replicas of originals and for replacing missing or deteriorated elements. The examples examined attest to the potential of this new resource.

Despite the reduction in the cost and improvements in the ergonomics of 3D data acquisition devices in recent years, the fact is that they have not yet succeeded in expanding and are normally linked to inter-institutional projects with substantial financial resources. However, small contributions such as the existence of open-code or free software offer prospects for collaboration which can effectively benefit a sector under constant growth.

Heritage digitisation has attained a hitherto unimagined degree of faithfulness to the original thanks to the technological developments of recent years, with artificial intelligence and robotics (drones/UAVs) at the forefront, making 3D models essential aids in recording and analytical tasks.

The imminent arrival of the so-called smart cities is ushering in an age in which heritage is an integral part of the Internet of Things (IoT) through its monitoring. This will enable us, more than ever before, to feel the “pulse” of cultural objects and will be beneficial to their preservation.

The educational role played by digital technologies in heritage dissemination can be positively regarded. Both multimedia and virtual proposals
enable users to interact with the cultural object, ensuring they learn as the content, while of a high standard, is presented from an approach that is both entertaining and rational. This makes it possible to go beyond the bounds of the academic world and present it to a non-specialised audience.

Although digital technologies are an educational resource whose growth has been boosted in recent years, there is a glaring shortage of specific audience studies on the use of cultural applications. In-depth analyses are needed to appropriately evaluate the transmission of the digital content provided in heritage contexts.

Virtual reality and augmented reality are currently the most popular resources on account of their representational and immersive characteristics, which make for an efficient cognitive experience and a highly realistic relationship with the cultural object.

Nevertheless, although virtual reality and augmented reality have been applied since the outset to disciplines such as archaeology, where we find the most significant examples, they have yet to be extended to other periods and elements of historic heritage in which there are considerably fewer experiences currently.

In the field of heritage dissemination there are still technological limitations that prevent state-of-the-art devices (smartphones, tablets, smartglasses…) from offering an ideal degree of realism in heritage representations, which are often not very attractive. This means that the major potential of virtual reality and augmented reality applications is still at an embryonic stage, though they have major possibilities and account for much of the research currently being carried out in this field.

Judging by the cases and examples examined, digital technologies in the heritage field are not necessarily taking the place of traditional means of conserving and disseminating heritage but are a major ally for the actors involved in these tasks, namely sector professionals, society and heritage itself.

Finally, the role digital technologies can play as a highly versatile tool for sector professionals largely depends on the trials and research carried out to test their potential.
General


Documentation, diagnosis and conservation


Piñas Azpitarte, Magoga; San Bruno, César; De la Barrera Montenegro, Luis; Martínez, Alberto; Alcalá Zamora, Jorge; Alfaro Ballesteros, Santiago; Egea, Víctor Manuel; Lupiáñez López, Paula; and Sopa de Sobre (2015). “The Mayan City of Calakmul-Interactive Showcases”, in Sofia Pescarin, Pedro Cano and Alfredo Grande (eds.),
The use of digital technologies in the conservation, analysis and dissemination of cultural heritage


Research


Notes

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Also involved in the project was the team from CHI (Cultural Heritage Imaging), who developed special software for viewing the digital images captured using this technology, called RTIViewer. It can be downloaded from their website (http://culturalheritageimaging.org/What_We_Offer/Downloads/View/). Also involved in the project was the team from CHI (Cultural Heritage Imaging), who developed special software for viewing the digital images captured using this technology, called RTIViewer. It can be downloaded from their website (http://culturalheritageimaging.org/What_We_Offer/Downloads/View/).
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The series of seminars held as part of this content showed local populations the possibility of tapping into the potential of heritage assets as a source of employment and wealth by promoting them as tourist and heritage attractions.
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The equipment and subsequent processing of the data were entrusted to 3DScanner (http://3d-scanner.es/es/), a spin-off company of Zaragoza University specialised in new technologies applied to heritage.

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We welcome your opinions and observations about this publication, which can be sent to raquel.mesa@accioncultural.es

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The AC/E Digital Culture Annual Report is a publication designed to promote digital culture on the internet and help sector professionals and creators understand how to incorporate digital technologies into their work.

This fourth edition of the Annual Report analyses the main technological trends that cultural managers will need to be aware of over the coming years and the impact of new digital technologies on the conservation, dissemination and study of cultural heritage. Its contents are divided into two main sections to make it easier for the various target audiences to read.

The seven articles that make up the first part provide an up-to-date overview of digital trends in the world of culture, or trends in the digital world that are applicable to culture. Content curation to tackle digital information overload, neuroscience applied to technology, the latest advances in artificial intelligence, the Internet of Things and Big Data and its applications to culture, and the use of technology in music are some of the subjects examined in this edition.

Just as the Focus section of the first Annual Report looked at the impact of the internet on the world of the performing arts (theatre, opera, dance, ballet, etc.), the second edition studied the use of new technologies in museums and the third carried out a thorough analysis of their use at fifty Spanish and international festivals, this fourth edition surveys the use of digital technology in the conservation, analysis and dissemination of cultural heritage. This sector is growing fast, leading to radical changes in methodologies and formats. Augmented reality to reconstruct archaeological sites, virtual reality to provide immersive experiences in historical contexts, the use of 3D printing to duplicate and preserve works of the past, drones, GPR and satellite imaging for archaeological prospecting, and 3D imaging to recreate contexts and disseminate historic heritage are some of the cases of good practice the study reports on in order to familiarise sector professionals with the most innovative experiences and where they are being carried out.