TECHNOLOGY
WATCH REPORT

Gamification and Cultural Heritage

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Overview of innovation and tendencies in Gamification and Cultural Heritage

Gamification is the use of leisure **techniques, components and dynamics** in non-recreational activities. This concept arose more than a decade ago in the business world to resolve problems, encourage motivation and reinforce staff behaviour, as well as to activate learning.

Since then it has become a progressively popular tendency, and its application has extended to other areas as a result of the increase in **audio-visual and digital environments**, as well as the more and more numerous applied research projects in the field of **game studies**. This area of knowledge applies **game concepts and mechanics** to specific areas of everyday life, where the idea is to simplify **achieving certain objectives** related to information, training, creation, cohesion and loyalty, among others.

In fact, it is expected[1] that the world gamification market will grow from $3.3 Billion in 2016 to **$14.5 Billion in 2025**, disrupting major verticals such as **education, healthcare, banking and the automotive/aerospace industry**. However, with the growing number of start-ups in the field developing specific applications for different industries, it is expected that gamification will soon be an essential component of every enterprise irrespective of the industry type.

Fun is the reward for a brain that learns

Gamification is considering any type of process as a game, and this is very closely related to the **optimised design of ways of transmitting knowledge**. The participants are players and, as such, are the centre of the game. They have to feel involved, take their own decisions, feel that they progress, assume new challenges, become involved with other players... They have to get feedback and be recognised for their successes. In short, they have to **have fun while achieving the inherent objectives** of the game process.

Open situations, the possibility of re-trying, immediate feedback, progress and independent decision making are just **some of the keys** to these designs which must also include clear-cut rules and real time evaluation. **Fun is the reward of the brain** for learning new things, for remembering new information. In fact, many educational schools proclaim that the secret of optimal learning lies in entertainment.

Some investigations[2] point out that the more overtly "educational" one tries to make a game, the less effective such a game might turn out to be. This seems counterintuitive, but from a psychological perspective, some "distance" allows players to connect more with the content.

What is undeniable is that all games provide entertainment while contributing values and

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[1] Frost & Sullivan (2017) *Gamification in the Automotive Industry, Forecast to 2025.*

[2] Flanagan, Punjasthitkul, Seidman, Kaufman, Carini (2013) *Citizen Archivists at Play: Game Design for Gathering Metadata for Cultural Heritage Institution*s. Proceedings of DiGRA: DeFragging Game Studies.

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learning. **Analysing how good games, and especially videogames, are created** is of interest for designing similar strategies in other areas and transmitting the required knowledge. In this context; is important to bear in mind that the information transmitted in videogames is mainly practical in character. Videogames, as the basis of gamification, show us what we can do to produce more and better learning.

Strong impact on the educational sector

To date gamification has penetrated in the educational sector more than in any other industry. With the idea of improving process efficiency, the **maximum impact of gamification is related to on-line training.**

Education has always been a long-term investment that requires a large amount of time, effort and discipline. The short **concentration span** of new generations is one of the main problems that the education sector faces today, especially when using textbooks, blackboards, written homework and other traditional educational resources. People hardly recall 20% of the content of what they read just after few days from reading, however, this percentage increases significantly when this reading is associated with some action that is visual or a simulation of the reading process. In this context, the educational industry can attract children and so maintain its intention with added values through the use of digital methods.

RPG Methodology has been the basis of gamification in the educational sector. RPGs or Role-Playing Games have inspired a whole genre of videogames where the players individually or collectively control the actions of characters immersed in a virtual world. The majority of these videogames owe their origin to tabletop role games and use the same terminology and game mechanics, as well as a well developed history and character evolution. RPGs have therefore evolved from text-based videogames to enriching **3D visual experiences**. When these environments are competitive, the emotional nature of people and the desire to be seen in the classification, also usually encourages participation. In short, gamification leads us towards an educational system characterised by higher levels of interactivity in which students reinforce their memory and transform their skills and attitudes to obtain key benefits such as motivation and, in short, learning.

Adoption for citizen awareness and participation

In this area, various start-ups create innovative applications to transform traditional classroom learning processes into **intelligent, web-based learning environments**. All this indicates that by providing immersive environments for students to access virtual contents, gamification will play a vital role in e-learning. On a global scale the electronic learning industry is expected to increase its income to 51,500 million dollars.

One of the main objectives of the implementation of gamification is, whatever the sector, to **transform an administrative or register procedure** into a participation platform that motivates users. The result has been a rapid initial impact of this resource in Business to Consumer (B2C) sectors such as education and health.

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[3] Frost & Sullivan (2015) *Impact of gamification in key industries.*

The public sector is also paradigmatic in its attempt for on-going improvement of citizen services through active involvement; it is not in vain that mature democracies expect governments to interact efficiently with citizens. In fact, for some years now experts[4] have determined that in various countries gamification is adopting **strategies for public innovation** related to the need to make citizens aware of safety regulations, legal procedures and healthcare or other concerns.

The gamification initiatives outside the educational system not only include those that contribute to information and **awareness**, but also those that encourage the user to perform certain tasks normally considered tedious, such as filling in **surveys or forms**. As the majority of gaming platforms require credentials to begin the session such as the verification of e-mail addresses or social data that provide the opportunity of gathering **precise, updated information** about beneficiaries who interact in real time.

Initiatives of this type aimed at wide layers of society require platforms that are not only interactive, interesting and immersive, but also transparent. User input about certain problems could help non-profit organisations receive **suggestions for improvements** so that they can confront their management more efficiently and thus promote collaboration and commitment.

Gamification has great potential for cultural purposes

Immersive technologies also have a clear potential to support the large public interested in culture, complementing the current tools and practices based on tangible goods such as museums, exhibitions, books and visual content. In fact, it could be considered that, in cultural worlds, the use of virtual environments and serious games (or videogames designed to go beyond pure entertainment) is on the rise, enabling a broad public to appreciate **remote cultural content** (in space and time) with immersive experiences.

Appealing to cultural content leads to enormous diversity[5]: on the one side, there is the **physical, or "tangible", cultural heritage**, such as historic sites and buildings, monuments, documents, works of art, machines and other artefacts, which are considered worthy of preservation. The natural environment is also an important factor of a society heritage. **Natural heritage** includes landscapes, flora and fauna, as well as geological, paleontological and morphological elements. Together with the architectonic and artistic legacy of a place, such elements are the target of cultural tourism, which is gaining increasing interest. Nevertheless, there are many further factors which deeply characterize a culture. The so-called **"intangible cultural heritage"** includes social values and traditions; customs and practices; philosophical values and religious beliefs; artistic expression, language and folklore.

Cultural awareness and learning is particularly focused on language, customs, traditions, spiritual beliefs, folklore and rules of behaviour in a society. In this context, these resources have the potential to **recreate accurately not only a physical setting** but rather: provide a **holistic experience** including sounds (spoken language, traditional music) and aesthetic elements. This enables for example, bringing folkloristic and religious events to life; providing the opportunity to practice in first person behavioural codes and habits through in-game tasks. Architectural or natural heritage awareness games usually offer an **immersive, realistic**

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[4] Frost & Sullivan (2015) *IT, Computing and Communications Technology (TechVision).*

[5] Mortara, Catalano, Bellotti, Fiucci, Houry-Panchetti, Petridis (2013) *Learning cultural heritage by serious games.* Elsevier Masson SAS.

reconstruction of a real location to appreciate and learn the architectural, artistic or natural values of a site, or simply offer engaging mechanisms to motivate users.

It is well-known that many **virtual museum** applications, which offer the opportunity of exploring a remote site in first person, manipulating fragile relics with no risk of damage, benefiting from additional multimedia information. Although they are helpful, these applications make no attempt to ensure spectators are motivated to create their own knowledge rather than to passively receive information about material cultural heritage. This commitment is evident, on the other hand, in **computer games** which provide amusing and compelling experiences to transmit a broader range of cultural contents. Intangible heritage is particularly difficult to preserve and transmit, thus making it especially susceptible to gamification techniques.

Digital games appear to be exactly such a visual media able to recreate both **tangible and intangible cultural artefacts** in a highly interactive and dynamic way6. They provide a powerful and increasing appeal and engagement for all user ages by possessing an integrated form of fun and play.

Empathy with a game and plot character could be extremely useful for understanding historic events, different cultures, feelings, and the problems and behaviour of other people. As well as to appreciate the beauty and value of nature and cultural heritage: architecture, art, cultural expressions, etc. Games can encourage curiosity, motivate players to delve into topics and diversify the type of knowledge due to the possibilities of collaboration with players who have other interests and areas of expertise.

Serious Games (SGs) are becoming more and more popular

Thanks to the available technology, it is possible to generate a graphically rich and immersive virtual reality; the session can be much longer, even if the mechanics is simple. For this reason, games with educative purposes or Serious Games (SGs) are becoming more and more popular. In fact, the learning content of a SG has a predominant role, but the interactions and game mechanics add fun. Considering several factors like storyboard, graphics, usability, collaboration/competition mechanisms or interaction devices, this **layer of entertainment ensuring engagement**.

SGs in this domain appear in a wide variety of forms, spanning from trivia, puzzles and mini games to engage in interactive exhibitions, to mobile applications for museum or touristic site visits, to simulations of past events, adventures and role-playing games set in faithful reconstructions. **These games for virtual cultural site visits** are usually not simple virtual reconstructions, but in many cases integrate related objects which in reality reside in different places or enable creating dynamic personalised experiences which for example generate new collections according to the user's interests.

Coexisting models of deployment

In addition to gathering valuable metadata, games also offer opportunities to **physically draw audiences** to cultural heritage institutions. Indeed, virtual tourism and virtual museum games can be played before or after the real experience. But the real challenge for a virtual museum is engaging the visitor and raising emotions, and experts point out that an earlier virtual experience helps visitors to better understand and participate more in a later real visit.

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6 Bontchev (2015) Serious Games for and as Cultural Heritage. Sofia University "St. Kliment Ohridski".

Gamification services can be classified under three technological deployment models, each of which has its own attractiveness ranging from cost benefits to convenience in usage.

- **Software as a service:** Cloud-based gamification services are among the most common deployment models used by enterprises. They eliminate the need for any specific hardware or software from the client side, thereby reducing cost of ownership significantly. This model also expands device compatibility as it can be accessed with Internet connectivity.

- **Custom Software Model:** Made-to-measure deployment is mainly followed by specific industries with custom software requirements. Solutions are developed with unique game mechanics and user interfaces to suit the workflow of specific enterprises and their business models.

- **Hardware model:** Some organisations have uniquely implemented software-based technology into the hardware for their customers. Reward cards used in stores are a classic example of this technology.

Smart phones have decisively expanded this horizon because gamification applications can reach a wide customer base in a cost effective way. Serious games are increasingly being played on-line (on the browser) and/or on mobile devices (especially for augmented cultural visits). While the majority of games are still based on keyboard/mouse interaction, mobile applications typically feature images, SMS, bar-codes and QR codes. Actually, games on mobile devices have a great potential to engage museum visitors.

Even if customers seem still happy with the traditional mouse/keyboard devices, in relation to **interaction criteria**, the tendency is for it to be as natural as possible, including for example tactile devices. Indeed, other emerging means like gesture recognition and the multi-modal interactions offered by low-cost Kinect devices appear very promising because of the natural interaction supported, which allows the player to use his/her entire body to interact, thus enhancing usability and motivation because of the huge feeling of embodiment.

Towards technological convergence

Further **convergence with technologies** like cloud computing, augmented reality, big data analytics and wearable devices could significantly improve opportunities for brands to diversify the product line with innovative applications and penetrate industries, such as retail, automobile, digital media, hospitality and many more in the coming years.

Examples of **tendencies in technological convergence** in gamification could include the following:

- **Gamification + Wearables + Cloud computing + Big Data Analytics:** There are interesting opportunities for developers to design specific games that lead to price advantages for products or services.

- **Gamification + Virtual Reality + Augmented Reality:** The suppliers of gamification solutions could improve data visualisation for a more interactive and immersive experience.

- **Gamification + Affective Computing + Big Data Analytics:** Developers can

provide more suitable contents for users through algorithms which can recognize interpret, process, and interrelate contexts and behaviour patterns.

Of the several elements in gamification solution designs, two key elements are believed to be most important: **intuitive design and behavioural analysis**. For improving the design aspect, it could be expected that **augmented reality and virtual reality** will experience extensive implementation to provide an immersive experience to users.

For providing more effective behavioural analysis, on the other hand, computing has to improve performance of the system based on massive amounts of information collected from different data sources. This means that organizations already using big data technology will be in a better position to successfully implement gamification technology. Applications for industries, such as healthcare that significantly depend on historical data will benefit significantly from the technology in the coming years. The **artificial intelligence (AI)** and the customisation also are essential aspects of all games, whether serious or entertainment based.

The **customisation process** involves two distinct challenges:

- **User identification**, considered to be the process of identifying and inferring the characteristics of who is playing the game. There are two subtopics that are extremely relevant for identifying a user and keeping him actively involved in the interactive learning process:

    - user models for interactive learning
    - detection of user engagement

- **Content adaptation**. Steered by the underlying data and models stemming from user identification, content adaptation uses this data to generate or customize personalized game content.

Learning Adaptation and Intelligent Tutoring Systems techniques have been widely used outside the gaming field; in combination with Interactive Storytelling they provide important methodologies to manage user experience. In this area, **Natural Language Processing** plays an important part since it provides to non-player characters the ability to converse with users using natural language, a much more natural way of communicating for humans.

AI and personalization are crucial aspects of SG, but their effective and efficient design and implementation still represent major challenges, including **simplifying the process of authoring and adjustment** of SG by people without programming skills.

Along these lines, supporting effective and efficient design, development and deployment of SGs requires better recognition of the different levels and use engagement with the game and learning goals, for example. It will also be necessary to face technological challenges in the future, including:

- New and accessible game engines

- Novel technologies for augmented and mixed reality

- Advanced techniques and tools for graphic rendering such as realistic control of transparency, reflection and refraction

- Annotated entities and artificial intelligence for planning and controlling crowd simulation

- NPC Behaviour (non-playing character)

- Metadata; content generation.

An expanding market

Thanks to a synergy of story, art and technological achievements including affective and adaptive gameplay, the market for entertainment and serious games, as well as gamification applications, is expected to continue growing over the next few years.

Collaboration between experts is necessary

Games applied to cultural heritage sites with nonlinear interactive stories are being used more and more often for cultural presentations, education, evaluation and immersive training.

On the other hand, it is expected that commercial entertainment games will include topics relative to tangible and immaterial cultural heritage, mainly in an implicit way.

In spite of the good perspectives, one of the key challenges that could impede the future adoption of gamification strategies is the **availability of specialised developers**. Programmers are required to be skilled enough to understand business processes and align appropriate game mechanics to develop applications. In this context, prescriptive analytics could prove to be the essential tool for providing ideal recommendations during decision-making processes.

But the competition to generate a persuasive approach should clearly be combined with the **rigour of scientific method**, a balance not easy to achieve. The reality is that professionals with sufficient knowledge and time are also needed to identify the archival images and other heritage assets and tag them properly to **generate metadata**. Without precise and exhaustive metadata, valuable components are impossible to manage to make them accessible for various motives, such as group dynamization, scientific disclosure, learning and the proposal of developed or related activities in emblematic sites.

In short, the design of a SG, due to its nature, requires the iterative collaboration of various experts with specific skills: educators, art directors, game designer, writers, software developers, and graphic and sound designers. But there is no way to ignore staff who are experts in the cultural domain as they are the suppliers of content, guarantors of the **scientific reliability and validity** of the projects.

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[7] Brisson, Pereira, Prada, Paiva, Louchart, Suttie et.al. (2012) Artificial Intelligence and Personalization Opportunities for Serious Games. Association for the Advancement of Artificial Intelligence.
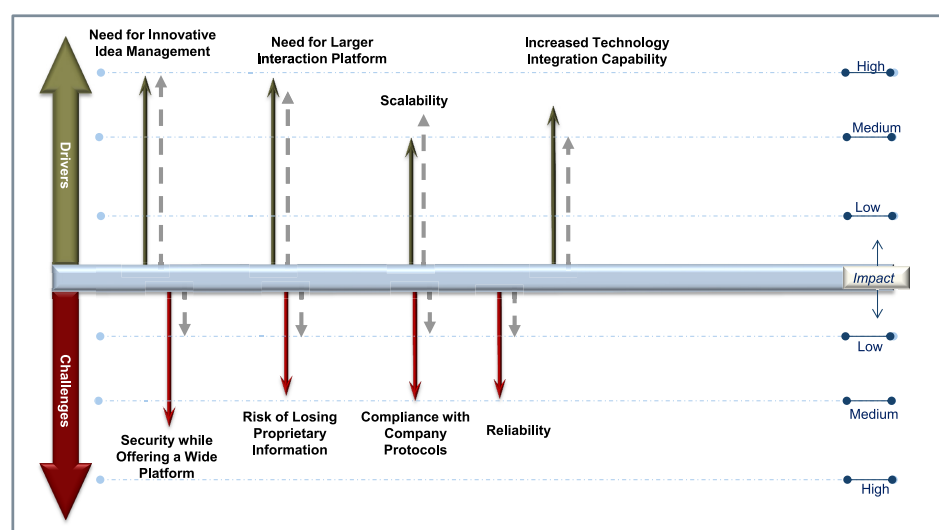
2
Gamification and Cultural Heritage: Key infographics

2.1. Gamification Market: Revenue Forecast, Global, 2016-2025
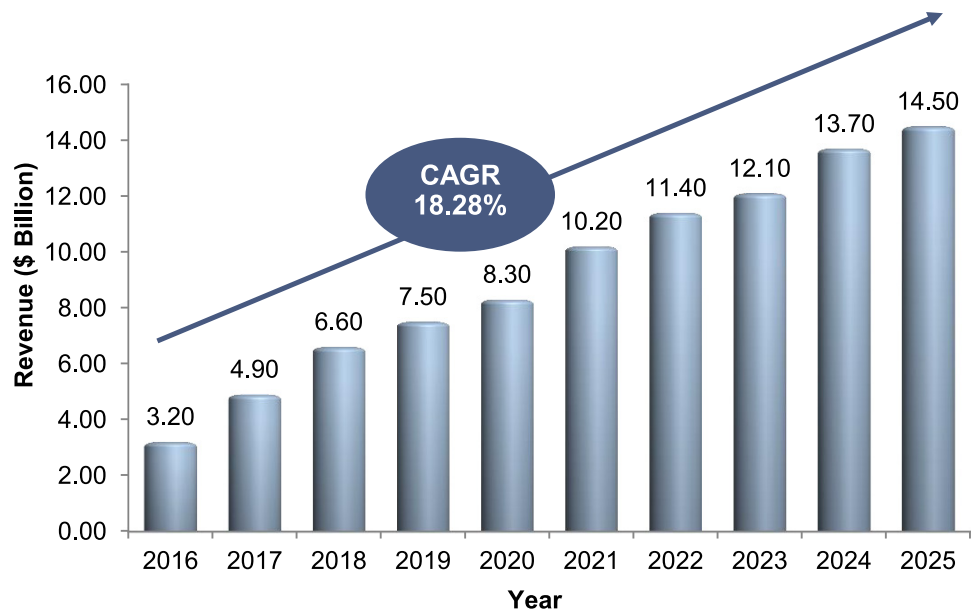
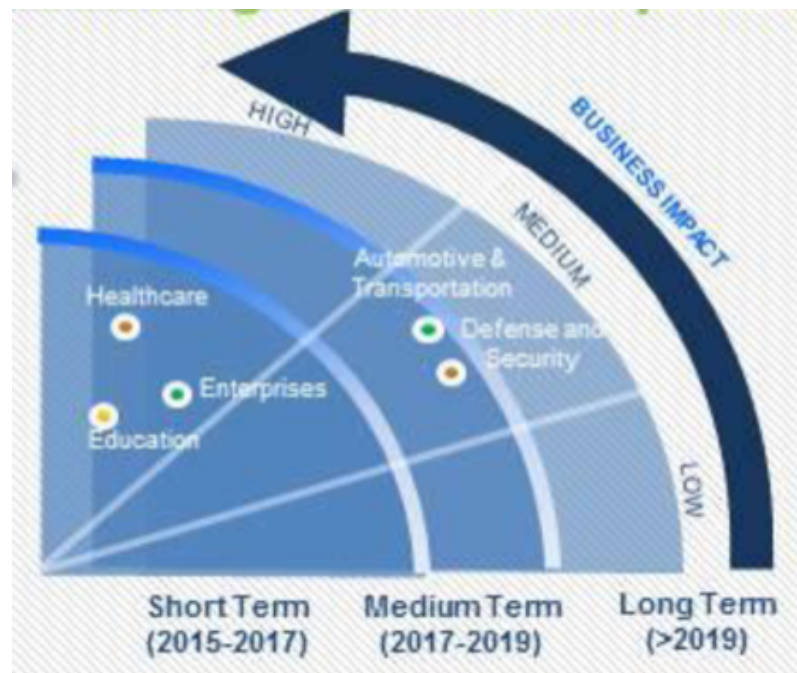
Source: Frost and Sullivan (2017) - Gamification in the Automotive Industry, Forecast to 2025

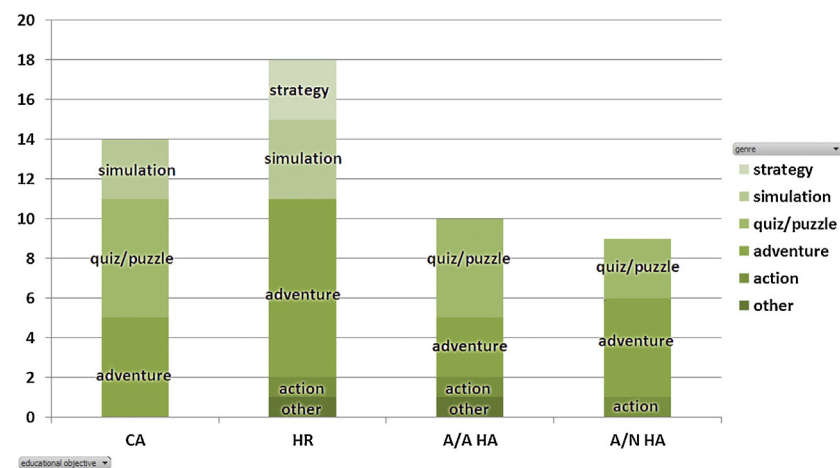## 2.2. Gamification in Key Industries: Factors Influencing Adoption-Drivers and Challenges

Source: Frost and Sullivan (2015) - Impact of Gamification in Key Industries

2.3. Gamification convergence and adoption
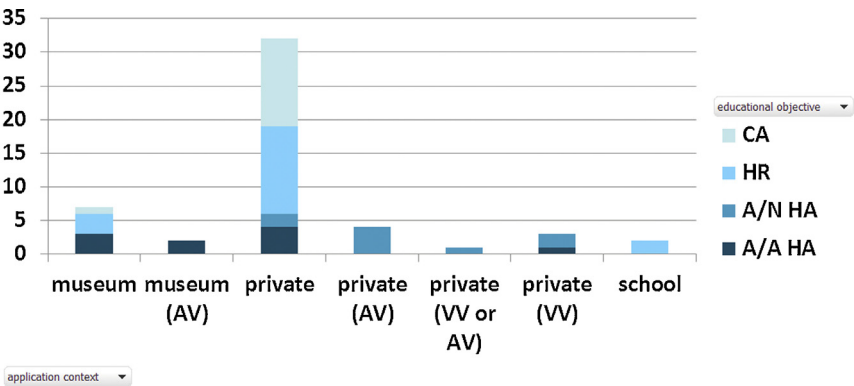

Source: Frost and Sullivan (2015) - Dimensions of Gamification

2.4. Serious games (SG) for cultural heritage according to the primary learning objective

CA = cultural awareness;
HR = historical reconstruction;
A/A HA = artistic/archaeological heritage awareness;
**A/N HA** = architectural/natural heritage awareness.

Source: Frost and Sullivan (2015) - Learning cultural heritage by serious games

2.5. Game application contexts with respect to educational objectives.

CA = cultural awareness;
HR = historical reconstruction;
A/A HA = artistic/archaeological heritage awareness;
A/N HA = architectural/natural heritage awareness.

Source: Frost and Sullivan (2015) - Learning cultural heritage by serious games

3
Patent analysis

## 3.1. Evolution of patents applied for and granted

The analysis of patents applied for and granted in the area of knowledge of Gamification and Cultural Heritage enables appreciating the **tendency for growth** over the last 25 years. While at the same time illustrating that the proportion of patents applied for and finally **granted** was **44.4%**.
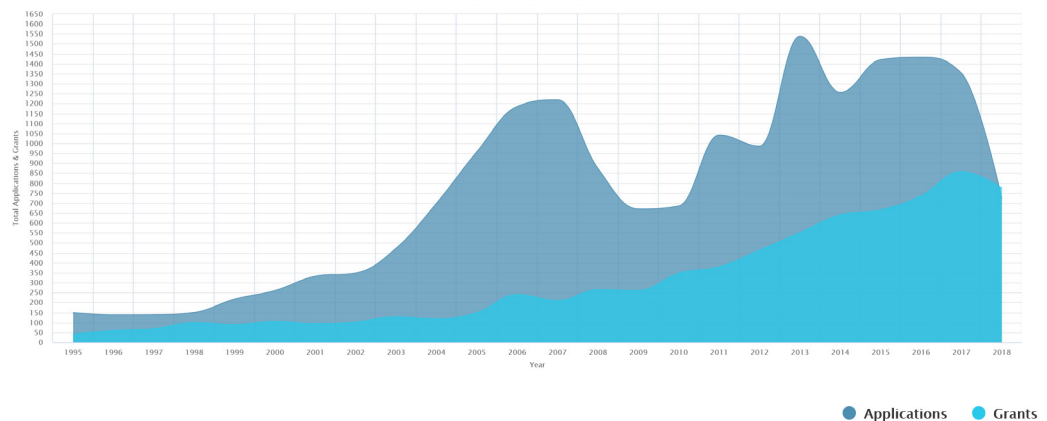
Source: PatBase. September 2019 Query

## 3.2. Technological sector of the patents applied for

Over the last 25 years, the most active technologies in patents applied for in this area of knowledge mainly belong to the following fields: **electrical engineering**, instruments, mechanical engineering and **other sectors**.
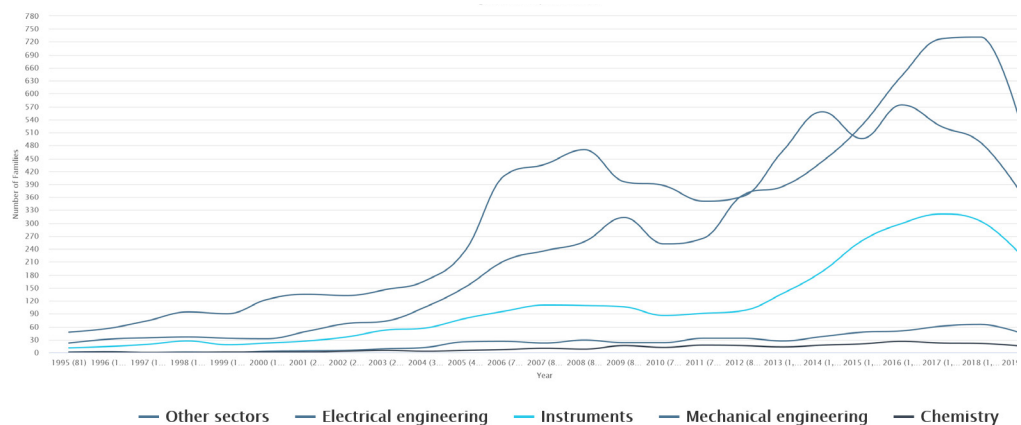
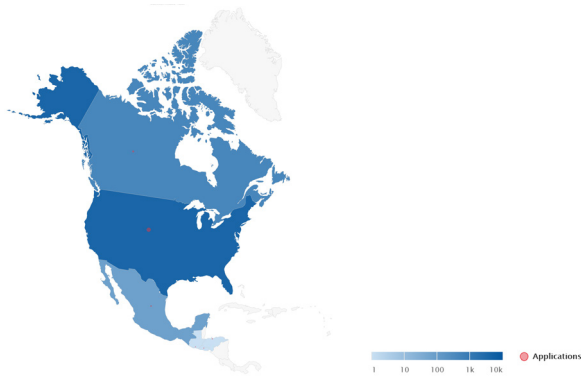

Source: PatBase. September 2019 Query

3.3. Territorial location of patents

The **United States** is, with difference, the most active country for patent applications in this field.
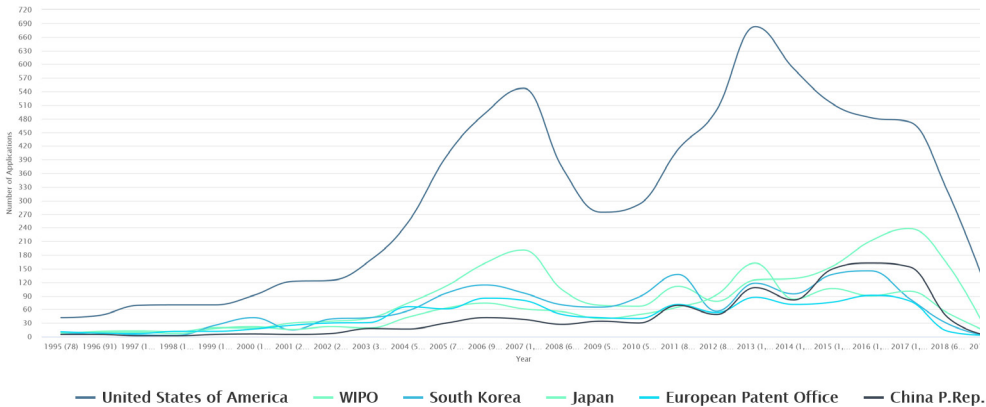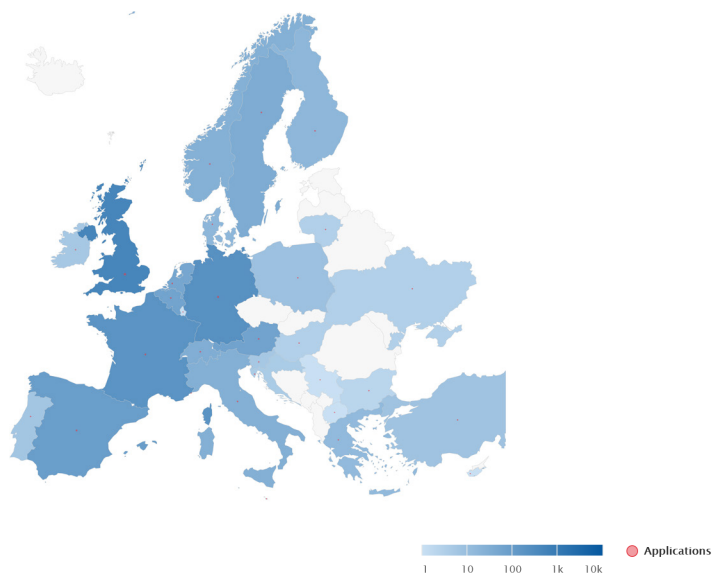

Source: PatBase. September 2019 Query

Following this country, the territories world-wide where most patent applications are processed are, in order of importance, Korea, Japan, Europe and China.

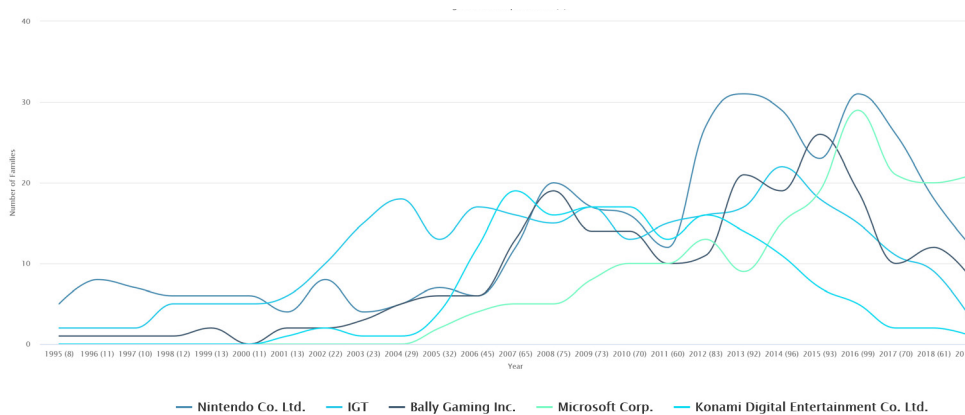Source: PatBase. September 2019 Query

Within the European Union, the countries with most patent applications are, as shown on the map below, England, Germany, France, Spain and Austria.

Source: PatBase. September 2019 Query

## 3.4. Most active patent applicants over the last 25 years

The graph below shows the eight most active organisations in patent applications over the last 25 years, as well as which time periods these applications were concentrated in. Outstanding among others are **Nintendo** Co.; IGT; Bally Gaming; Microsoft corp. and Konami Digital Entertainment Co.

Nintendo Co. Ltd. — IGT — Bally Gaming Inc. — Microsoft Corp. — Konami Digital Entertainment Co. Ltd.

Source: PatBase. September 2019 Query

3.5. The most active applicants

The fifteen most active **bodies** (companies, institutions or people) filing patent applications, including the **number of applications** for each one are shown below. It is noteworthy that there are no active public institutions in this field.
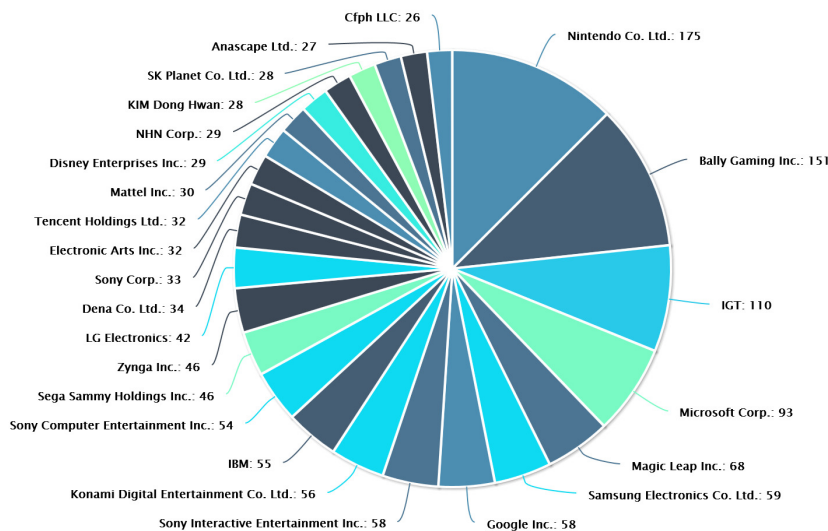
Source: PatBase. September 2019 Query

3.6. Keywords attributed to patents in this field

The main keywords associated with patent applications in the field of study are: system and game.
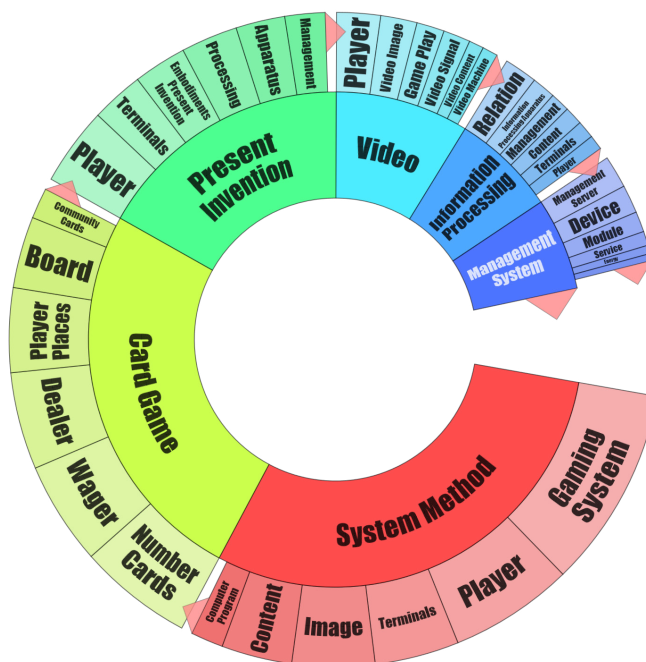
Source: PatBase. September 2019 Query

3.7. METHODOLOGICAL APPENDIX

The information provided in the "Patent analysis" section refers to a study performed on a sample of **19.530 patent applications** in the field of Gamification and Cultural Heritage, and included patents related to **music** and "Gaming" or **videogames**.

6.098	**3.494**	**19.530**	**26.254**
Patent family	Family of patents granted	Applications	Publications
Total number of families in this set of results	Total number of families with publications granted with this set of results	Applications with this result	Publications within this result

Source: PatBase. September 2019 Query

As this is an **area** closely related to social sciences and humanities and, therefore, more **restricted in fields and patents**, the criteria used for research and analysis was of the maximum scope in the field.

Patent databases are organised using different **international classification systems**, the most common being the International Patent Classification (IPC) and the Cooperative Patent Classification (CPC) for more specific fields.

Pursuant to this nomenclature, obtaining the sample for this report considered the inclusion of the following indexes:

- G10H2210/00: Aspects or methods of musical processing having intrinsic musical character, i.e. involving musical theory or musical parameters or relying on musical knowledge, as applied in electrophonic musical tools or instruments

- G10H2220/00: Input/output interfacing specifically adapted for electrophonic musical tools or instruments

- G10H2240/00: Data organisation or data communication aspects, specifically adapted for electrophonic musical tools or instruments

- A63F13/00: Video games, i.e. games using an electronically generated display having two or more dimensions

- A63F2300/00: Features of games using an electronically generated display having two or more dimensions, e.g. on a television screen, showing representations related to the game

- A63F3/00: Board games; Raffle games (racing games, traffic games, or obstacle games characterised by figures moved by action of the players

- A63F1/00: Card games (aspects of games using an electronically generated display having two or more dimensions showing representations related to the game

- A63F13/00; card games played on a gaming machine

- G06Q50/00: Systems or methods specially adapted for specific business sectors, e.g. utilities or tourism

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