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Analysis of Innovation in the Video Game Industry

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Alla mia famiglia, che c'è stata
quando più ne avevo bisogno e che mi ha
sostenuta nei momenti in cui non credevo
di farcela.

A tutti i miei amici, vecchi e nuovi,
per tutte le parole di conforto, le risate e
la compagnia.

A voi che siete parte di me e che,
senza che vi chieda nulla, ci siete sempre.
Siete i miei fiorellini.

Senza di voi tutto questo non
sarebbe stato possibile.

Grazie, vi voglio bene.

Abstract

During the last couple decades video game consoles and arcades have been subjected to the unexpected, swift development and spread of mobile gaming. What is it though that allowed physical platforms to yet maintain the market share they have over these new and widely accessible online resources? The aim of this thesis is to provide a deeper understanding of the concept of innovation in the quickly developing world of video games. The analysis is carried out with qualitative methods, one based on technological development in the context of business history and one on knowledge exchange and networking. Throughout this examination it has been possible to explore what kind of changes and innovations were at first applied by this industry and then extended to other fields. Some examples would be motion control technology, AR (Augmented Reality) or VR (Virtual Reality), which were originally developed for the video game industry and eventually were used in design, architecture or in the medical field. The main companies under study are Nintendo and Sony, since they were both able to survive and thrive in the unstable and competitive economic environment that surrounded them. After reading this thesis, the reader will understand how they managed to stay relevant thanks to a constant drive towards innovation, itself fuelled by a strong competition going on between them.

Keywords

Innovation, Knowledge Exchange, Technology, Video Games

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1. Introduction

There are a lot of different ways to look at what a videogame is. As a game designer, it's not about what I'm putting on the screen and it's not about what's in my design. It's about what's going on in the head of the player (Warshaw, 2020).

The main question that this thesis is trying to answer is the question of how the video game industry evolved throughout time, what was the purpose of video games in the beginning and what is it now. From the beginning of their diffusion there has always been a conflictual vision on video games. Most parents saw video games as just a toy, useful only to kids for playing and, in some cases, even problematic due to the topics encompassed by some of them (e.g. too much violence or gory topics). In 1993 this contrast against video games grew to the point that US congressional hearings have been held on the violence in video games and the perceived impact on children (C-Span, 1993). However, probably also thanks to this resistance of adults, video games kept being very popular among children and as time went by, also by elder people (Riley, 2020). In fact, video games evolved in content, maturity of covered issues and difficulty of mechanics as the average age of the player increased; for this reason, the requests for more mature games increased and therefore the US congressional hearings took place. But this older audience led video games from being something used only to relax and spend free time with friends to a useful hobby. Content was more innovative and, in some cases, it became a way to learn something new.

The video game industry has grown to an estimated value of US$ 151,55 billion in 2019 and it is expected to reach US$ 256,97 billion by 2025, with more than 2,5 billion gamers across the world (Mordor Intelligence, 2020; Wijiman, 2019). What is driving the video game market

nowadays are cloud and online gaming, since people can stay home and play online with their friends rather than alone and offline (Mordor Intelligence, 2020). The development of smartphones, together with the introduction of new technologies in the video game industry such as augmented reality (AR), virtual reality (VR) and, precisely, cloud gaming, brought to the swift development and spread of mobile gaming, that accounts today for US$ 64,4 billion, against US$ 13,8 billion of console games (see Table 1). The reason why it was still chosen to study consoles and the software developed for them over mobile games is because it is thanks to consoles, their technology and media form, that it is now possible to appreciate an innovation-driven video game industry.

The main question this thesis will try to answer will therefore be what kind of process brought video games from simple toys to technologically advanced tools, what innovations, if any, were introduced by Nintendo and Sony that led them to be pioneers in some technologies and ensured them a place among the longest running companies in the industry.

Table 1 - Digital Games Industry Global Revenue, billion US$ for 2019 (Mordor Intelligence, 2020)

Type of Game	Revenue in billion US$
Mobile	64,4
Free to Play PC	21,1
Premium Console	13,8
Premium PC	5,2
Pay to Play PC	3,3
Free to Play Console	1,6

Related inquiries to the main question are, moreover, what are the innovations adopted to turn video games into something more appealing to the general public, expanding the audience so that not only core and hardcore gamers are able to enjoy them and potentially expand their knowledge and skill set (based on the played game). Additionally, there will be an attempt to see how, if true, it was possible for some technologies, developed for video game's purposes, to be applied outside their main field of usage. The analysis will specifically focus

on Nintendo's and Sony's paths, given that they are among the oldest and most famous videogame companies still active and running.

The method that will be applied in this thesis is what Perrin describes as the "*Best-Practices Approach*", an approach that evaluates innovation the same way venture capitalists assess the value of their investments, by expecting that probably just a small minority will strike big (Perrin, 2002). All the technologies that for some reason brought innovation in the video game field will be taken under analysis, knowing that some might have failed during the years.

Chapter2 will be a brief summary of the methods applied until now to measure innovation in various sectors, in order to see if any of them is applicable to the case at hand. As an addition, there will be a search to see if anyone already studied this sector, to see if there are viable methods suitable also for the aim of this thesis. Chapter 3 will then follow-up and describe the methods selected, among those analysed in the previous chapter, to perform the examination, so to have a better understanding of the various elements taken into consideration. After having explained all preparatory elements, Chapter 4 will encompass the changes each company taken under consideration went through and what kind of innovation, if any, they brought to customers and to their own and other industries. Lastly, Chapter 5 will sum up the findings and points out the steps to take to further develop the analysis and deepen the knowledge on innovation brought by this industry.

2. Literature review

While reading various papers you can come across many different definitions of innovation. According to Mitchell et al., innovation is *«Creating value through new products, new processes, business models and organisational structures to meet and anticipate customer demands and remain competitive in a global marketplace»* (Mitchell, Ray, & Van Ark, 2014).

Along the lines of the previous definition, but still different, Kühne et al. instead define it as «*The successful exploitation of new combinations of existing resources into new or improved products, methods of production, sources of supply, and ways to organize business, and the exploitation of new markets or new ways to reach existing markets*» (Kühne, Lefebvre, Cochez, & Gellynck, 2013).

However, it has to be considered that one of the first and most widespread definition of innovation, often quoted and recalled by many authors as foundation of their own definition, is Schumpeter's: «*This concept covers the following five cases: (1) The introduction of a new good – that is one with which consumers are not yet familiar – or of a new quality of a good. (2) The introduction of a new method of production, that is one not yet tested by experience in the branch of manufacture concerned, which need by no means be founded upon a discovery scientifically new, and can also exist in a new way of handling a commodity commercially. (3) The opening of a new market, that is a market into which the particular branch of manufacture of the country in question has not previously entered, whether or not this market has existed before. (4) The conquest of a new source of supply of raw materials or half- manufactured goods, again irrespective of whether this source already exists or whether it has first to be created. (5) The carrying out of the new organisation of any industry, like the creation of a monopoly position (for example through trustification) or the breaking up of a monopoly position*» (Schumpeter, 1961). The concept of innovation has evolved ever since this definition

was incepted but many current definitions, such as the OECD or the Eurostat still take inspiration from it.

Lastly, what seems to be a common ground on all the various definitions is that, as Vescovi said in his book, *«All the decisive events in the history of innovation can be described in terms of cross-fertilization between minds focused upon different disciplines»* (Vescovi, 2016).

So, as it is just been seen, there is no unique definition of innovation, they all differ in some measure from the others. This leads to think that it is somehow only adequate to say that there is no unique way to measure innovation, and that it is even more difficult to do so in fields that revolve around creativity.

In order to start to understand how it will be possible to analyse innovation in the video game industry for the purpose of this thesis it seems useful to see how studies and measurement of innovation have been applied to various fields other than in the creative industries, to see if it is possible to take something out of these that can be of use in the video game industry. It is important to highlight though, before taking a look at all the possible methods, that, as said by Nelson et al. in their paper «*Novel strategies, practices and other innovations that are not tied directly to an artifact can be especially difficult to measure*» (Nelson, Earle, Howard-Grenville, Haack, & Young, 2014). Hereafter are the different methodologies applied knowing that there might be some bias and that, eventually, there might be not even one method that could be used for the purpose at hand since, as already said by Johannessen et al. «*One of the greatest obstacles to understanding innovation has been the lack of a meaningful measure»* (Johannessen, Olsen, & Lumpkin, 2001).

2.1. Research and development budgeting

One of the most common methods to measure innovation is most certainly the amount of budget given by companies to the Research and Development Department. It is such an eradicated idea that even governments, in an attempt to incentivize industrial development and competition between countries, increased investments in scientific research and created funds to help companies that would increase their R&D budgets (Harris, Halkett, & Cox, June 2007; Corrado & Hulten, 2010). This comes from the idea that the more money devoted to the R&D department, the more innovative a company must be, since everything that is developed should automatically become a sellable product that generates revenue. This is unfortunately not true, since many of the analysed projects end up to never becoming actual products, but also many of the discoveries can become means for other companies, in a completely different field, to be able to innovate, and not used directly by the company that developed them. On the other hand, it is possible that this kind of indicator works just fine, but this is true for a very small number of companies in relation to the overall amount of companies existing in all the possible fields. For example, in the pharmacological and biochemical industry this kind of measurement is perfect, «*R&D has been proved to be an important driver for innovation performance. Innovation is a significant outcome of firm processes and has been shown as critical for organisational growth in the biotechnology industry. […] This research provides evidence that R&D resources enhance innovation performance and, indirectly, contribute to organisational growth*» (Alegre, Chiva, & Lapiedra, 2009). As described in other papers, such as "*Hidden innovation in the creative industries"* by Miles and Green (Miles & Green, 2008), this kind of approach cannot be applied in the case of videogames industries, and more in general to creative industries, since this kind of industry is much more related to hidden innovations rather than to concrete and physical innovations. As mentioned before, a physical innovation is what is studied in R&D, which can directly become something with a true economic value that could

be sold. But lots of projects are abandoned midway since there's no purpose for them in the market. This means that the majority of what is considered the *innovativeness* of a company could end up being sunk costs and not successful projects, thus resulting in a wrong categorization of a company's innovativeness. The reason why this technique is not suitable to measure innovation is because it takes into consideration something related or caused by innovation and not innovation itself, thus failing to pinpoint the exact subject of the measurement (Schroeder, Scudder, & Elm, 1989). Hidden innovation, however, as pointed out in a report wrote by Miles and Green, is much more proper to creative industries, where innovation does not take place in laboratories and it does not necessarily involve physical objects. What the authors suggest is that in this kind of creative industries the innovation is brought by *everyday problem solving* and that it is an *on the job* innovations, so much so that it is missed in innovation surveys or that it is ignored once finished the process and assessing the overall development.

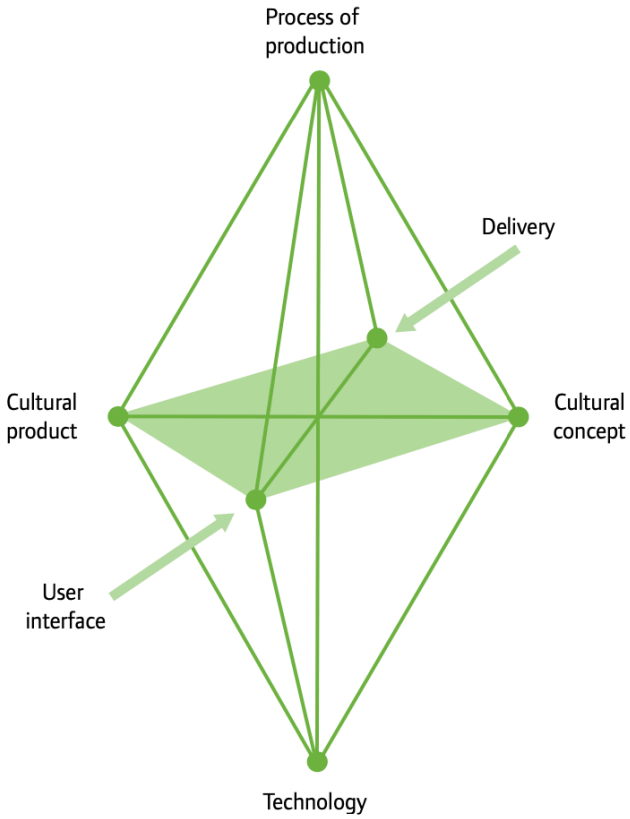

Figure 1 - The diamond of Innovation in the Creative Industries (Miles & Green, 2008)

2.2. Patent laws protection levels and number of patents

Another method that could be used in order to measure the innovativeness level is the overall protection offered over patent rights by the law. As demonstrated by Ginarte and Park in their paper "*Determinants of patent rights: A cross-national study"*, the development of a patent law that protects the rights of those who submit the innovation leads to a more generalized confidence in the system, that in return brings an increased number of people to try and innovate (Ginarte & Park, 1997). The authors considered five different categories of patent laws: «*(1) extent of coverage, (2) membership in international patent agreements, (3) provisions for loss of protection, (4) enforcement mechanisms, and (5) duration of protection. Each of these categories (per country, per time period) was scored a value ranging from 0 to 1[…]. The un-weighted sum of these five values constitutes the overall value of the patent rights index*» (Ginarte & Park, 1997). They found out that the more developed is an economy the stronger the protection provided. However, they also determined that a country must reach a set threshold in size of an innovating sector before there is an effective incentive in providing patent rights, so it is a symbiosis of development levels and protection levels (Ginarte & Park, 1997). And as this is true, it is also equally true that the level protection offered by a patent law directly affects the number of patents, and this is directly linked to the uncertainty avoidance proper of a determined culture, which strongly affects the power of the laws and their development (Kaasa & Vadi, 2010). Therefore, it becomes a vicious cycle where the level of protection depends on how many patents are asked to be issued and viceversa.

As presented by Jalles in his paper about patents as a measure of innovation, however, patents per se are a limited mean to measure innovation, «*as patents can either encourage or deter innovation and diffusion, depending on […] particular features of the patent regime*» (Jalles, 2009). This is because, as said in turn by Eggink, «*patent registration measures*

inventions – not innovations» (Eggink, 2012) and as previously said by Schumpeter, «*innovations […] need not necessarily be any inventions at all*» (Schumpeter, 1961).

This kind of method is therefore not particularly suited to measure the innovative development of video game firms since it does not really make sense for such a company to apply for patent rights for a product that is not innovative in the means of production rather than in the content. It is true that the consoles bring also a certain amount of innovativeness in the technologies they employ but it is just as much true that this kind of innovation is brought together only with video games paired with them effectively, because as a stand-alone product they do not do anything. It is also true that many innovations introduced by video games are reframing of previous ideas, which are not patentable, hence reducing even more the effectiveness of this measurement method.

2.3. Technological innovation

Another way to measure innovation is to review and analyse, after a certain amount of time has passed, a new technology introduction or, in general, just the introduction of a new element that is not necessarily innovative. For this reason, this method differs from R&D budgeting, since the newly added feature is most likely not a revolutionary aspect, but it is something that in a certain environment and in that precise process makes the difference. An example of this is cited in "*Benetton: I colori del successo"* where the author explains how the Benetton family has introduced some features and some new technologies in their clothing production that for the time were not exceptionally revolutionary but that afterwards proved to be those elements in the production that brought innovativeness in the whole product and process (Favero, 2005).

An alternative example of technological innovation that also happened in Italy is Giovanni Rana's tortellini case. He started by producing a few kilos by hand and in a matter of just few years, due to the economic boom and newly hired women in the workplace, he managed to open an establishment where he could produce more than a hundred kilos of tortellini per hour with an equipment modified by his team of engineers in order to have a better fit machinery for his purpose. He did not create something new, as fresh handmade pasta already existed as much as the devices he used in his production; he just repurposed them in order to obtain something new that could have success at a global level.

IKEA and Amazon also have this kind of history with an innovation that was not disruptive in the sense that they introduced something never seen before, but they just changed their perspective and thought of a different way to offer their products to the public. In the case of IKEA, the innovation was in the physical way in which the product was sold. They created a showroom for their products, so that customers could see the finished products, but what people was buying were the dismantled pieces of the furniture they saw in the showroom. What IKEA did is just facilitating the process of transportation for the clients, saving themselves lots of wages for delivery guys that would have had to transport the already built furniture to the customers' house (Edvardsson & Enquist, 2011). Amazon, likewise, did not introduce a disrupting innovation, they just made the purchasing of products easier for the clients by expanding their offering and making them cheap. Jeff Bezos started selling books online and soon enough, understanding the needs of the people around him, he started selling other products, till this day, when Amazon sells fresh produce or meat that get delivered daily.

2.4. Knowledge exchange and knowing communities

Broadly speaking networking and the knowledge that comes from it could be considered as a form of developed and re-purposed intellectual property. That is because from networking comes also an exchange of knowledge that eventually allows to use pre-existing concepts, machines and processes to be seen and applied in a novel way. «*Networks are more and more seen as the locus of innovation as they facilitate, stimulate and provide access to the necessary knowledge and the exchange of knowledge*» (Kühne, Lefebvre, Cochez, & Gellynck, 2013), thus supporting how networking in SMEs allows to develop, for all parties involved, a better chance at being competitive by exploiting each other's knowledge in ways that could not be of thought before and without the *cross-contamination*.

Another similar concept to the one just explained is the knowing communities' one. A knowing community, as described in "*Knowing Communities in the Front End of Innovation"*, is «*an umbrella term for all of these manifestations of formal and informal knowledge-sharing groups, which can broadly be defined as entities that rely on repeated and continuous interactions between individuals sharing a common interest or objective. […] Through this regular exchange, group members come to share common mental schemas, social norms, and even a language, all of which can help to guide creative activities and accelerate innovation*» (Harvey, Cohendet, Simon, & Borzillo, 2015). What they say is that to let innovation happen you have to broaden your discussion and contaminate with other groups, inside and outside of the company, and this in order to change your perspective, enrich concepts and, in the end, co-produce something with the very same people that is going to be your customer.

2.5. Conclusions

Before focusing on the analysis methods, it seems useful to sum up the findings of this chapter in order to see which ones might be applicable to the case at hand.

- **R&D expenditures**: as described by Eggink, this method is very popular due to its comparability over time and across countries (Eggink, 2012). Even though it could be a very valuable method, as previously discussed, the industry about to be analysed in this thesis does not provide enough information about R&D since innovation happens mostly outside of this department. For this reason, this method will not be further considered.
- **Patent laws levels and number of patents**: the main issue of this method is that it considers innovation as the number of patents issued, but not always a company that holds many patent rights is innovative. It is also not true that an innovative company might be able to patent the innovation they have produced due to a number of considerations. For this reason, this method too will not be further considered.
- **Technological innovation**: it is a method that can measure innovation only in retrospect, since the change introduced is not, per se, disruptive, hence only time will allow to understand if the remodelling was a harbinger of innovation. This clearly is more of a qualitative method and it cannot be scientifically measured unless there is a direct link between the feature introduced and some kind of output, which is not always as predictable as it might seem. Since this is a retrospective study this method could be applicable for the task at hand and will therefore be considered.
- **Knowledge exchange and knowing communities**: also in this case the analysis is feasible only in retrospective, given that a creation of a network is not innovative per se. Additionally this is also a practice that is more focused on qualitative aspects and

as such seems more fit than quantitative methods for this particular analysis. As a consequence, this method will be given due consideration.

In the next chapter there will be then a further exploration of the methods that seemed more fit for this research in order to deeply understand and easily detect all the important features that will need to be searched for during the case studies analysis.

3. Analysis methods

Now that the main different kind of methods used to measure and analyse innovation have been discussed, it is much clearer how there is a strong distinction between quantitative and qualitative methods. As said in Chapter 2.1, the reason why qualitative methods have been chosen over quantitative methods is because innovation does not only happen in the research and development department; it can happen in any sector, during any activity, just as shown in Figure 2 (Miles & Green, 2008).

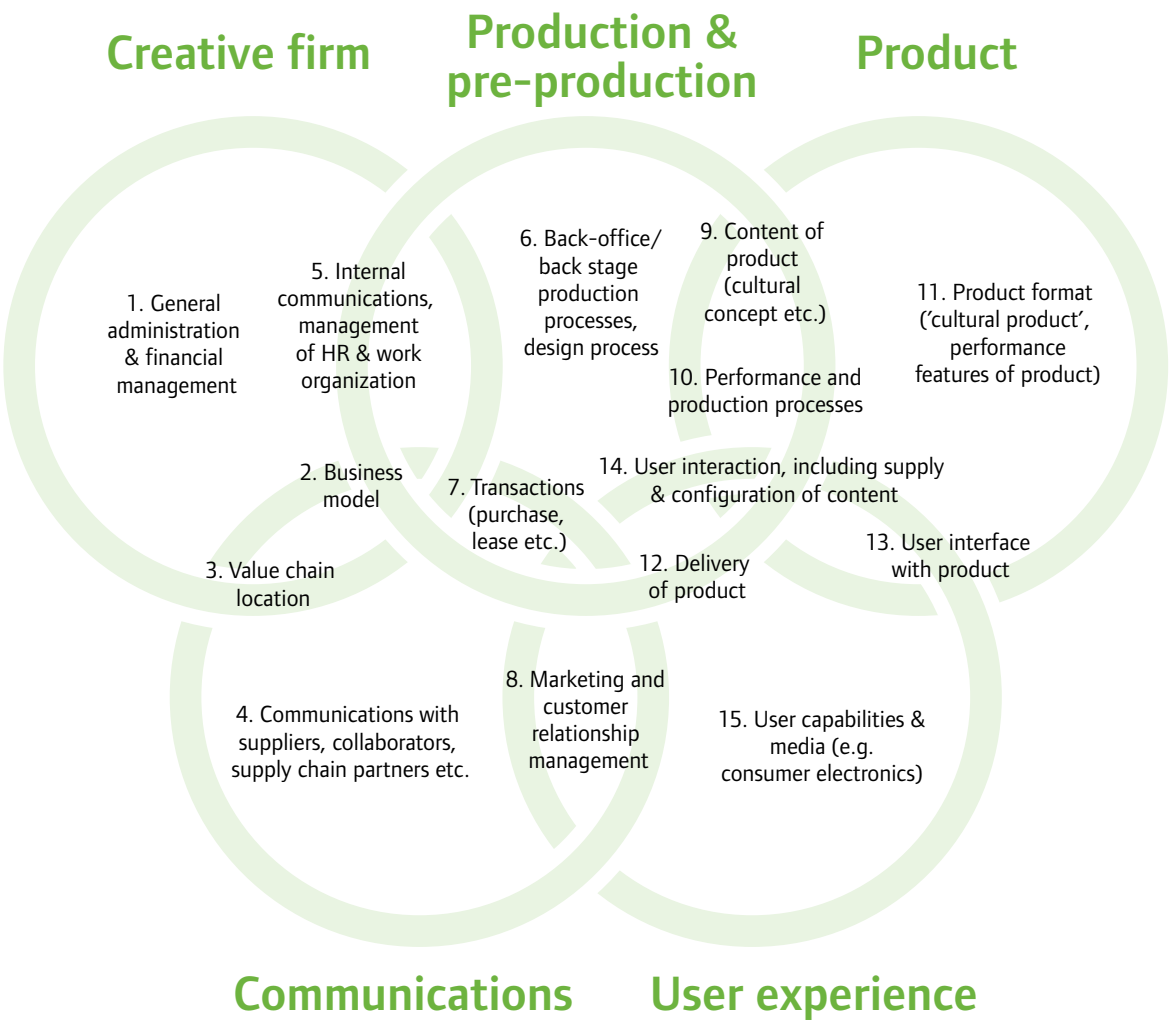

Figure 2 - Sites of Innovation in the creative industries (Miles & Green, 2008)

«*Developers and studio managers interviewed describe innovation not as an extraordinary aspect of games development, but something inherent in the routine process. It does not sit above standard manufacturing or production processes; it involves solving current problems on projects rather than developing new commercial opportunities in their own right. Innovation is more commonly a rational response to continual change in the industry. It addresses demands that stem from new hardware or software, and the creative demands associated with new games projects. Such content, design, process or artistic innovation is part of the 'normal' process of developing video games, and so remains hidden from traditional analysis*» (Miles & Green, 2008).

Therefore, the next step will be an in depth explanation of the methods that are going to be used in this thesis to provide an accurate analysis of the innovations brought by the companies under scrutiny to the whole economic system.

3.1. Technological innovation

The first method to undergo a thorough explanation clarification is the one previously discussed in chapter 2.3, concerning technological innovation and the innovative exploitation of intellectual property. As mentioned before this is an analysis that is only possible in retrospective, meaning that a certain amount of time needs to have passed in order to consider the main consequences of the actions undertaken in a specific moment.

Taking as a reference what Rowlinson et al. define as "*Analytically structured history*" (Rowlinson, Hassard, & Decker, 2014), to perform an holistic objective analysis of a certain corporate, rather than an organization theorist perspective, an historiographical one will be preferred. This means that the focus, while looking at the historical performance of the

companies under analysis, will be on three aspects, namely, as summarized in Table 2: narrative as explanation of the events, sources as evidence of those same facts and periodization defined by the actors and/or historiography for the temporality of the events.

Table 2 - Epistemological Dualisms (Rowlinson, Hassard, & Decker, 2014)

Dualisms	Stylized Narrative Organizational History	Stylized Historical Organizational Theory
Explanation	**Narrative** of logically and chronologically related events organized by a coherent plot	**Analysis** of relationships between concepts and categories—for example, 2 x 2 matrices of variables
Evidence	**Sources** cited from an extensive search of multiple documents and texts with verifiable locations in archives; verisimilitude through verification logic	**Data** constructed from specified replicable procedure for analyzing a predefined and delimited set of sources; verisimilitude through replication logic
Temporality	**Periodization** of events as defined by actors or historiography in historical time derived from historical context and sources	**Chronology** of predefined regular occurrences, with sequences measured against clock/analytic time—for example, event history analysis

3.1.1. Narrative as explanation

The first of the three dualities identified by Rowlinson et al. is the *dualism of explanation* or, to put it simply, how to write the research. Even though the thesis could be structured as an analysis, the focus will be on creating a narrative, i.e. «*a sequence of logically and chronologically related events organized in a coherent plot*» (Rowlinson, Hassard, & Decker, 2014)), meaning that the study will try to connect and relate the facts in a coherent way so as to create a causal and comprehensive plot. This does not mean that there is going to be an imposition of what appears to be a false narrative, this is just going to be one of the possible *interpretations* of the chain of events that brought the companies to their success. As Chandler described in his "*Strategy and Structure*", the intent is to create a link between strategy and structure through the anecdotes that will be necessary for the construction of the concepts, in order to have them connected correctly (Rowlinson, Hassard, & Decker, 2014). There will be

a strong focus on each technological innovation in the specific context, in order to avoid an excess of description for the sake of description, which is one of the critiques advanced by objectivists.

3.1.2. Sources as evidence

In a second instance, there is now to consider the duality that is next in line, the *duality of evidence* or, in other terms, which are the best data to explain the matter at hand.

First of all, there has to be a distinction between primary and secondary data, and then, as a follow-up step, the distinction within primary and secondary sources.

- **Primary data**: data that are found, collected and prepared by scholars themselves (e.g. through a questionnaire or such);
- **Secondary data**: data that come from other researches and therefore gathered for other scopes;

Sources, that in this case can be considered as just secondary data, according to what the scholar is studying can be distinguished into:

- **Primary sources**: sources produced at the time during which the events under study occurred; their author was temporally close to the described events (e.g. a diary).
- **Secondary sources**: sources that were created far from the described events; usually a re-elaboration (e.g. a memory of some events that occurred in the past). Due to the fact that they are developed after lot of time has passed, they are generally deemed of lesser reliability.

While organization theorists prefer primary data, since this kind of information delivers a replicable procedure, historians mostly use secondary data, hence the reason why in this thesis there will be a broad, if not total, use of secondary data. Lastly, it seems important to highlight that, as Evans and lately Rowlinson et al. say, «*historians are used to reading sources against the grain*», which means that what the sources do not say is just as important as what they explain, because historians can infer a meaning beyond what is written (Rowlinson, Hassard, & Decker, 2014; Evans, 1997). This kind of operation requires a very critical eye, in order to identify not only what it has been said but what could have been said and what has not been said in the light of the context.

3.1.3. Periodization as temporality

Lastly there is the issue of how to consider time, or the *dualism of temporality*. In this case the problem is how to work inside history and how to treat time. Historians are used to build their own periodization from sources and historical contexts in order to not reduce it to a simple chronological order of facts. This kind of assemble — and here lies the difference from organization theorists — is due to the fact that periodization in history takes into account both historical context and historiographical debate. Organization theorists, on the other hand, treat time as a constant or import periodization as given by historiography, hence treating temporality as clock time in order to be able to have a consistent measure for the sequencing of events. Once again, in this case the dualism is going to be considered from the historians' point of view. This is due to the fact that historians consider time for an understanding of events in their historical context, context that, generally, embeds events. Temporal time is then deemed as constant from periodization, it is the definition of social time and space that is the object of

research (Rowlinson, Hassard, & Decker, 2014), so as to be able to study potential path dependencies.

3.2. Knowing communities

The second method that has been chosen in order to perform a thorough analysis of the companies that have been chosen is the study of knowing communities. This would be the examination of the networks created by the firms inside and around them, and how these circles allowed to further promote innovation. As said by Harvey et al. «*The activities of knowing communities build competencies and support the development of deep knowledge in particular domains*» (Harvey, Cohendet, Simon, & Borzillo, 2015), and the particular domain in which the study will focus in order to see if there has been any kind of impact is the video game industry. This kind of reasoning is supported by what has been said, once again, in the "*Knowing Communities in the Front End of Innovation*", where it is said that knowing communities heavily influence a firm's creativity and innovation in a different way, with a different impact than formal R&D activities (Harvey, Cohendet, Simon, & Borzillo, 2015).

The term ***knowing communities*** is used in the paper just mentioned, as it will be in this thesis, as an umbrella term which regroups under the same expression all of the formal and informal knowledge sharing manifestations in groups (Harvey, Cohendet, Simon, & Borzillo, 2015). After a thorough investigation the authors could identify four main types of activities that knowing communities deal with:

- unscripted internal activities;
- unscripted external activities;
- scripted internal activities;
- scripted external activities.

As summarized by each of these four categories of activities has a specific set of actions that are performed either in an internal or external (relatively to the firm) environment. All of them are going to be analysed separately, to be able to differentiate the different types of influences received by the firms when dealing with the case studies.

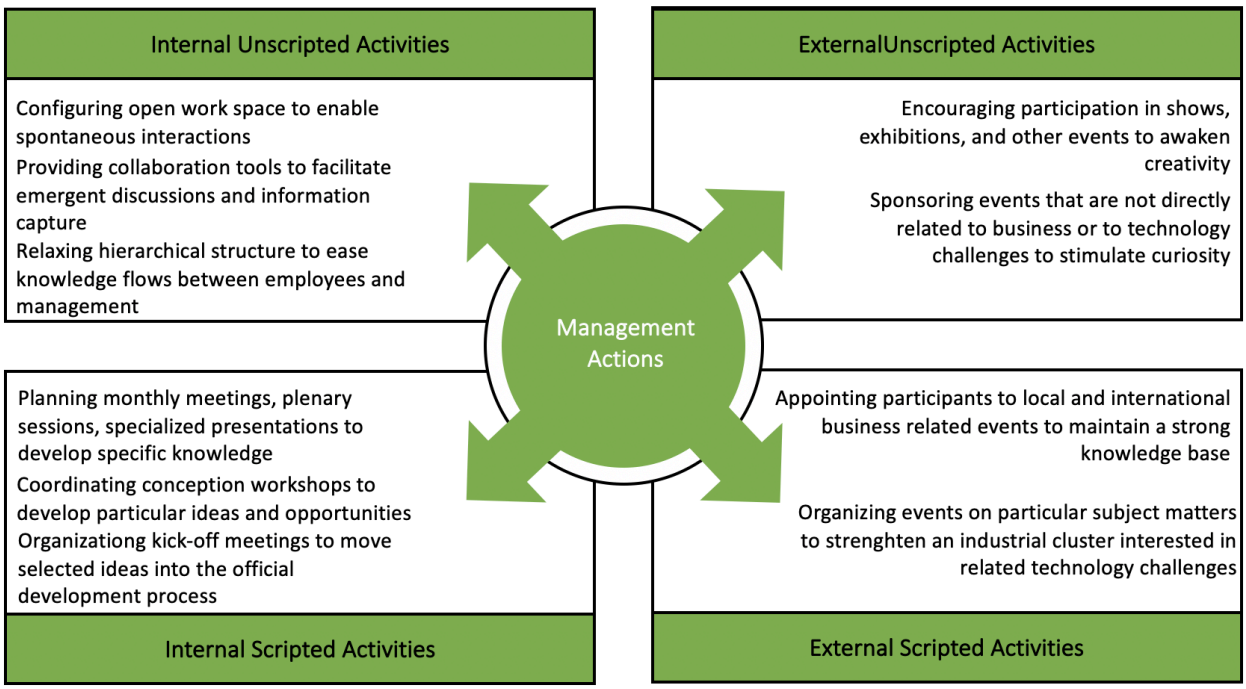

Figure 3 - Management actions to nurture knowing community activities (Harvey, Cohendet, Simon, & Borzillo, 2015)

3.2.1. Internal Activities

First of all, the analysis is going to focus on *internal activities,* which are the kind of activities that happen inside the organization and that are potentially better handled by management, since they happen under their jurisdiction.

Internal, creative, and potentially innovative activities are that kind of actions that are taken by an individual to find a solution through a collective effort which, generally speaking, is supposedly encouraged by the company. In this method too, as in the one described in Chapter 3.1, what it is considered to be innovation is not disruptive innovation but a creative

recombination of pre-existing ideas. This basically means that, to find innovative ways to remix old ideas, different people have to interact between them creating a sort of collective problem-solving phenomenon. The collective part is crucial since «*The same mechanisms that allow individuals to make sense of novel situations in terms of old ones often encourage them to recall more recent, familiar, or expected ideas and, as a result, to misinterpret new situations as familiar old ones rather than see them as opportunities for creative insights […]. Thus, finding novel solutions is inherently linked to the issue of defining problems*» and community judgement is fundamental to define problems with a novel point of view (Hargadon & Bechky, 2006). What is done in this kind of mindset is to rely on each individual's cognitive skills and experiences which are then brought together in order to create new solutions.

The analysis conducted by Hargadon & Bechky in "*When Collections of Creatives Become Creative Collectives*" can then be defined as a study of the types of internal activities that are performed in a firm, which are then further differentiated into scripted and unscripted activities. According to them, as shown in Figure 4, the actions that trigger a collective creativity moment are:

- help seeking;
- help giving;
- reflective reframing;
- reinforcing.

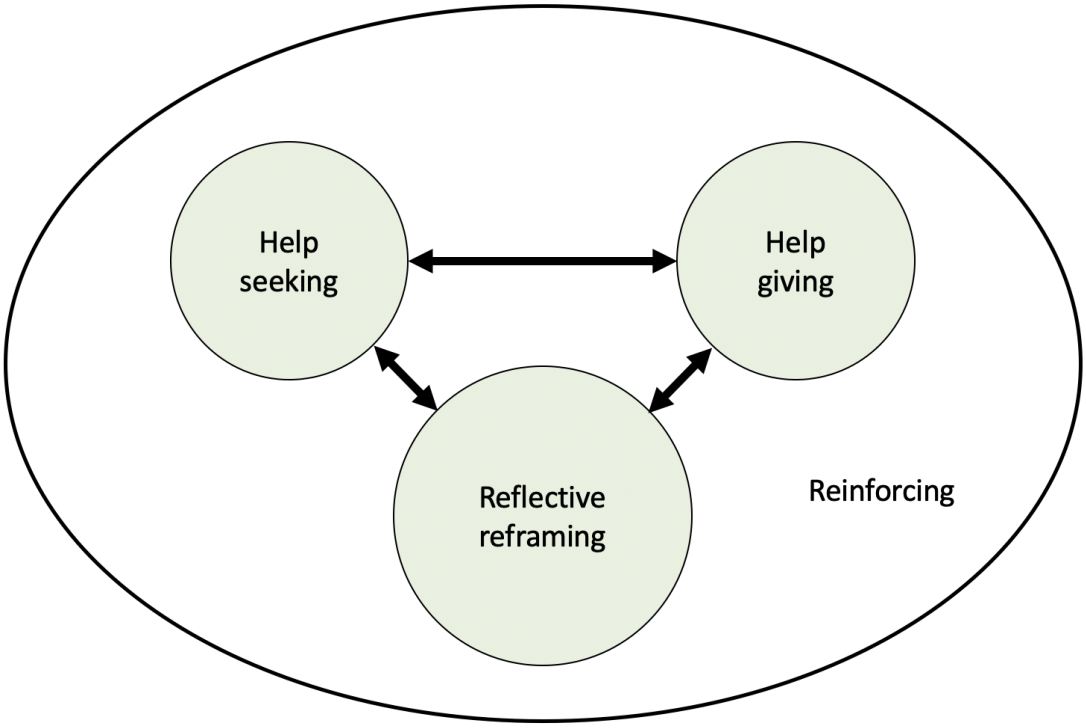

Figure 4 - Interactions between moments of collective creativity (Hargadon & Bechky, 2006)

Help seeking is the sum of activities that leads individuals to approach others rather than generate a solution alone. It can lead to the generation of unexpected paths due to the fact that each person can ask for assistance in various ways, and every time these can be different from the previous one and from other people. It is important to note though that help-seeking actions are often ignored in favour of an individual solution due to the stigma of ignorance and implication of failure that they carry (Hargadon & Bechky, 2006).

Help giving is the behaviour of people willing to dedicate their time and attention in order to assist other in their tasks. As aforementioned this kind of activities is central to general creativity, since it is thanks to different interpretations and the miscellaneous experiences of each individual that innovative ways of solving problems are found and novel insight is generated (Hargadon & Bechky, 2006).

Reflective reframing happens during this kind of social interactions and is the attitude towards the opinion of others. In a knowing community environment, it is central to maintain

acceptance of people's experiences and shared thoughts in order to be able to pass over contributions which then inspire others to also actively participate sharing their ideas and reframing problems from another point of view after the whole creative process. The key point of this stage is that «*Beyond just building on each other's contributions, however, in reflective reframing, one person's suggested framing of the problem shifted others' awareness in ways that made new frames visible. Such shifts in the framing of a problematic situation allow participants to recall details not easily recognized in the original framing of the problem*» (Hargadon & Bechky, 2006).

Reinforcing activities serve as a method of promotion among company members of those activities that allowed the establishment of a creative community that is based on the mutual help and knowledge sharing. Individuals that pursue these collaborative and synergic moments are positively reinforced by the company, so that it will be more likely that the subject will be penchant to this type of behaviour.

Among these four types of practices actually only the first three can be thought as proper of internal activities, since reinforcement can happen to both scripted and unscripted, as much as internal and external activities.

Internal Unscripted Activities

Internal unscripted activities are basically all of the processes described as generic "Internal Activities". This means that it is not something that is regulated in the first place by the management, but it is a spontaneous system which, eventually, if successful, can be reinforced and transformed into scripted internal activities. These activities are completely in the hands of the workers and their own knowledge and experience inside their working life;

thus, it seems likely that the older the employees the more likely they can be prone to being helpful in such contexts.

Internal Scripted Activities

Internal scripted activities, contrary to unscripted activities, are organized and programmed by the management of a firm, they can be periodical as they can be occasional, but the important part is that they ensure interactions between co-workers, so that a stimulus for synergies and innovative points of view is kept alive.

3.2.2. External Activities

The second category of actions that is going to be analysed is the one concerning *external activities*, which, as said by the name, happen outside the jurisdiction of the management and thus are more likely to happen without their knowledge. External activities depend much more on an individual's personal preferences, much more than just speaking about a task with a colleague rather than the other as happens in internal activities. Here a knowing community can be based over hobbies, festivals, random events to which people participate, anything that can be inspiring and strictly unrelated to the working field.

External Unscripted Activities

External unscripted activities go beyond the firm's ecosystem and are able to escape any kind of corporate control. As said in "*Knowing Communities at the Front End of Innovation*" «*Unscripted external activities have a double benefit. On the one hand, they serve to keep employees' minds open and to ignite and excite their imaginations, providing the inspiration that sparks creativity at work. On the other hand, they produce knowledge that may become*

important to the firm's business projects and goals» (Harvey, Cohendet, Simon, & Borzillo, 2015). These activities thus have a dual aim, to keep active people's creativity and to have them learn something new that could be, in the future, useful for the tasks they are assigned. It is within the firm's power to somehow affect this kind of behaviour since they can choose, as well as they cannot, to encourage employees to participate in the social scene surrounding the company and it is also possible that the firm might sponsor these events.

External Scripted Activities

Lastly, there are external scripted activities, which are actually a sort of mix between internal and external, since the firm has control over this kind of actions. Scripted external activities are strictly guided by the company and are created by it in order to deepen the knowledge on a specific domain. It is therefore the firm, and not a spontaneously created network, that organizes events, in order to allow the creative community to enrich its experience and for the knowing community to expand.

4. The video game industry

«Although the industry was first established by Atari, an American firm, most industry insiders today agree that without Japanese firms such as Nintendo and Sony Computer Entertainment (SCE), it would not have amounted to more than just a passing fad. In fact, after the famous video game industry crash of 1983, which virtually wiped all demand in the US, Nintendo played a significant role in re-establishing the industry as a profitable business. More recently, Sony, armed with significant reputation in consumer electronics, successfully combined hardware and software resources to dominate the global market with PlayStation and PlayStation 2» (Aoyama & Izushi, 2003).

Video games have been for many years at the front end of innovation, leading many sectors, other than their own, to the offering of new products and services that were created only thanks to the development of technologies introduced for recreational purposes.

First of all, it should be decided which companies will be the object of the study. Those shown in Table 3 are the most prominent publishers in the video game scene. According to Aoyama and Izushi, even though it was the United States that started the video game industry, it was Japan that eventually carried on and brought this industry to success (Aoyama & Izushi, 2003). It seems then interesting to analyse progress made by Japanese companies, namely Sony Interactive Entertainment, Nintendo, Bandai Namco, Square Enix, Sega and Capcom. Among these firms, the two that have the longer history, and therefore that are more likely to show a richer insight in the innovations adopted and created to resist in the market, are Sony Interactive Entertainment and Nintendo. For the reasons just described these two will be picked to perform an analysis with the methods detailed in Chapter 3.

Table 3 - The 13 Most Prominent Video Game Publishers in the World (Pickell, 2019)

Company	Employees	HQ Location	Major Titles	Original Products	Revenue∗ (FY 2019, USD millions)	Year of Establishment
Tencent Games	54.309	Shenzhen	League of Legends Clash of Clans PUBG	Mobile messaging and internet services	54.802	1998
Sony Interactive Entertainment	75.600	Tokyo	Uncharted God of War Marvel's Spider-Man	Consumer electronics/recording	76.920	1946
Microsoft Studios	47.000	Redmond, WA	Halo Gears of War Forza	Personal computer	125.840	1975
Activision Blizzard	9.200	Santa Monica, CA	World of Warcraft Call of Duty Diablo	Software development/manufacturing/ distribution	6.489	2008
Electronic Arts (EA)	9.700	Redwood City, CA	The Sims Star Wars Battlefront FIFA	Software development/manufacturing	4.950	1982
Nintendo	5.944	Kyoto	Super Mario The Legend of Zelda Pokémon	Toys	10.914	1889
Bandai Namco	7.871	Tokyo	Tekken Pac-Man Dragon Ball	Toys/arcade games	571,71	2006
Take-Two Interactive	5.214	New York	Grand Theft Auto Borderlands NBA 2K	Software development	2.668	1993
Ubisoft	18.045	Montreuil	Assassin's Creed Tom Clancy series Far Cry	Computer hardware	2.029	1986
Square Enix	5.077	Tokyo	Final Fantasy Kingdom Hearts Dragon Quest	Game software/publishing	2.480	2003
Konami Games	10.454	Tokyo	Metal Gear Silent Hill Dance Dance Revolution	Jukebox rental/repair	2.500	1969
Sega	7.993	Tokyo	Sonic The Hedgehog Yakuza Total War	Jukebox mfg	3.158	1960
Capcom	2.988	Osaka	Street Fighter Mega Man Resident Evil	Arcade games	120	1979

∗Total, corporation-wide revenue

All data except revenues retrieved from each company's website, revenues retrieved from Statista.com

Before the case studies' analyses are approached, there has to be first an understanding of the main working categories in the video game industry, in order to be able to see if there was an innovation also in the skills required to people, and not only in the products offered by the companies. As shown in Table 4 many of the occupational categories in the video game industry require some degree of creativity, which is where, as discussed in Chapter 2.5, processes that have eventually brought about innovation are going to be searched.

Table 4 - Occupational categories in the video game industry (Aoyama & Izushi, 2003)

Occupational category	Summary of major tasks	Skills/training required
Game designer	Write the blueprint of the game; decide the mission, theme, and rules of the play; lead game designer determines overall concept, level designers work on smaller sections of the game, and writer designers write text and dialogue	Writing and communication skills; management skills; technical skills including computer programming and software design; most designers earn a college degree in English, art, or computer science
Game animator/artist	Create graphics; in a 2D game, artists used to draw images on paper and then scan them into the computer, while now in both 2D and 3D games artists create most of their images within the computer; character artists design and build creatures, animators make them move; background artists create video game settings; texture artists add detail to the surfaces of 3D art	Visual imagination; ability to apply basic math concepts; ability to use modelling and animating software; most video game artists have formal training in fine arts or art-related subjects, bachelor's degrees are an advantage
Sound designer/audio engineer	Compose music and sound in game; research appropriate music options for particular games; choose creative sound effects with the correct balance of realism and entertainment value of exaggeration	Musical creativity; training in audio engineering; knowledge of the basics of computer hardware and software; many sound designers have a bachelor's degree in music, some have education in film scoring
Game programmer/software developer	Plan and write video game software; translate ideas into mathematical equations the computer understands; specialists include engine programmers who write code to make computer-controlled characters act realistically; graphics programmers, sound programmers, and tool programmers who write software for artists and designers	Strong math skills; knowledge of computer programming (C and C++); most programmers have a bachelor's in computer science
Game tester	Play games to find errors in software, graphic glitches, computer crashes and other bugs; write reports describing the problem they find	Ability to communicate clearly; familiarity with technology and expert game playing skills; does not require formal education but testers are encouraged to earn computer technician certificates
Game interpret/translator	Convert a game's story, its characters, the dialogue and basically everything in the game world from one language to another. They also localize the marketing content that comes with them, such as websites, marketplace descriptions and even the packaging text.	Fluency in the language(s) there is the need to translate to and from; perfect command of your own native language; broad general knowledge of idioms, history, politics and pop culture in several languages; deep knowledge of the countries there is the need to localize games from and for; many translators have a bachelor's degree in more than one language

4.1. Case studies

As discussed in Chapter 4's introduction, the firms that will become case study in this thesis are going to be Nintendo and Sony Interactive Entertainment. Both have Japanese origins, and both were able to survive and thrive in the unstable and competitive economic environment that surrounded them. The analysis will start with Nintendo, since it's the oldest, and then it will proceed with Sony.

4.1.1. Nintendo

HISTORY

Nintendo Co., Ltd. is a Japanese multinational company that currently has subsidiaries in the USA and Europe and produces electronics and videogames. The firm, based in Kyoto, Japan, was founded in 1889 by Fusajiro Yamauchi and produced *hanafuda* (花札, literally flower cards), traditional Japanese playing cards. As explained in their company's website (Nintendo Co., Ltd., 2020), in **1902** Yamauchi started a production of western style cards, at first created for export only, but then, due to the huge success they earned also in Japan, sold also inside national borders. In **1959** the Nintendo Playing Card gained even more notability thanks to their partnership with Disney — each card of the deck portrayed one of Walt Disney's characters. In **1963** there was a change in the company's name, from Nintendo Playing Cards to Nintendo Co., Ltd, and concurrently they started selling other kinds of games. In **1976** the microprocessor was introduced in game systems and therefore in **1977** the first Nintendo devices for home-playing video games were developed. Lastly, in **1979**, Nintendo of America was established and from that moment on there has been, within a certain amount of issues and fluctuating markets, a history of success and prosperity for Nintendo Co., Ltd., now helmed by

Minoru Arakawa, the late ex director Hiroshi Yamauchi's son-in-law (Nintendo Co., Ltd., 2020).

TECHNOLOGICAL INNOVATION ANALYSIS

In **1980**, in Japan, the first LCD portable video games with microprocessor by Nintendo are being sold. Before them there were only 2 other handheld consoles that were commercialized but with poor reception: Mattel's LED-based Handhelds and the Milton Bradley Microvision. The two were revolutionary for the time: Mattel's due to the fact that it was proposing handheld video games, and Milton Bradley's since they were proposing a portable console with interchangeable cartridges, though the first was too early in being conceived and the second one was prone to all kind of problems, thus their failures (Melanson, 2006). The Game & Watch series, the first handheld console by Nintendo, was a stepping stone for the company's success; it was easy to use, with its simple design, and many of the titles that were published for this device gained so much approval among the general public that they eventually became series of their own (e.g. Mario, Donkey Kong, ...).

Figure 5 - First Game & Watch console with "Ball" game (©1980 Nintendo)

The following year, **1981**, was the year in which "*Donkey Kong*" was developed, produced and distributed worldwide in arcades, and it easily and quickly became the most popular video game at the time. Between **1980** and **1982** the success of arcades in the US, Europe and Japan skyrocketed, and for this reason it seems plausible to assume that Nintendo's fame grew for the widespread use of both arcades and "*Donkey Kong*". The Game & Watch series earned immediate acknowledgment and swiftly prospered since it was in high demand from gaming stores: after all, it was a game that could be played anywhere, without the need to wait in line for your turn at the cabin or the excessive amount of coins spent on it. With the Game & Watch series got released also the handheld version of "*Donkey Kong*", that featured the D-pad for the first time in its current popular form. The D-pad is a control pad, shaped like a cross, used by players to move in the main four directions. Similar features existed before this one, but Nintendo's particular patented design earned popularity among customers, therefore it got included in all of their consoles' controllers and in many of their competitors.

Between **1983** and **1985** the famous video game crash happened, what nowadays is commonly named *Atari shock*. This was a large-scale recession revolving around Atari, an American-based company responsible for the arcade development and the video game industry as it is conceived today. This huge disaster was mainly due to the oversaturation of the market with lots of repetitive and low-quality games, in addition to arcades not being profitable anymore since the games could not be updated that much: at some point customers knew the levels by heart, leading them to spend less and less money to play. For these reasons Atari stopped being a competitor for Nintendo and, even though the American market took some time to recover, the Japanese one thrived.

Therefore during 1983, in Japan, Nintendo started the development of Famicom (Family Computer), eventually renamed in NES (Nintendo Entertainment System) in **1986** for the global launch of the product. The Famicom is a home console, meaning that it cannot be used

outside of the house since it needs a monitor, and it uses personalized CPUs (Custom Processing Unit) and PPUs (Picture Processing Unit), which were ultimately copied when the popularity of the NES increased and many clones of the console started appearing. Due to the fresh memory of the Atari crash, when Nintendo started selling the NES abroad, they developed and installed a *lockout system*, a chip that prevents unlicensed cartridges from being able to run in the console. Different regions had different chips, in order to prevent any kind of unapproved sale or business between different states that could lead to a depreciation of games. With this system every game that came out was developed and approved by Nintendo, and great and very popular titles like "*Super Mario Bros*.", "*The Legend of Zelda*" and "*Metroid*" were produced. This though brought to a great demand for this console and eventually lead for consumers to ask for more high-quality games.

Figure 6 - Famicom and NES, respectively top left and bottom right (©1986 Nintendo)

For this reason, Nintendo introduced a working model that is still used today by lots, if not all, the video game publishers and console developers in the world, licensing. This kind of system had already been used sporadically by Atari, but the games that were produced with this method were not successful thus leading Atari to end this practice. What licensing allowed was

for Nintendo to focus on upgrades of already existing products, such as SNES or new adventures for the Mario brothers. Outsourcing the development of games allowed for both Nintendo and the company to which the work was outsourced to be able to better focus on the task at hand, resulting in higher quality product on both ends. Further, Famicom and NES would be able to offer the public completely different games, from music, to characters, from animation style to gameplay. Some examples are Konami's "*Castlevania*", Enix's "*Dragon Quest*", Capcom's "*Mega man*" and Square's "*Final Fantasy*", all games that eventually became best sellers, known to any gamer to this day and present in the collections made for the next consoles.

As early as in **1988** Nintendo promoted research and development for hands-free, and eventually all other types of controller, in order to promote inclusivity in video games, which was previously kind of overlooked. For sure the first releases of these peripheral devices were kind of overly cumbersome and bulky, but at the same time it shows that the company wanted to innovate in order to allow anyone to be able to play. Another famous gadget that helped Nintendo gain more fame was the NES Zapper light gun that came with the Duck Hunt game. This set was sold, in the initial bundle, with the game "*Gyromite*" that required the peripheral R.O.B., which has been more known for its cute looks rather than for its objective utility, since there are only 2 games that make use of it. Both these devices were innovative in their ways, since there was nothing quite like it, just as for the hands-free controller. In fact, even though it soon failed due to a lack of challenging games, R.O.B. was the first accessory to be sold with a video game that was an integral part to the gameplay. On the other hand, the NES Zapper actually used a technology that was not previously used in video games, that was only compatible with CTR displays but that did not allow for players to cheat, like previous technologies, thus allowing for a more realistic experience.

Figure 7 - R.O.B. peripheral device (©1985 Nintendo)

Figure 8 - First Hands-free peripheral device (©1990 Nintendo)

Figure 9 - NES Zapper light gun peripheral device (©1984 Nintendo)

In **1989**, in Japan, the Game Boy was presented, marking the turning point for portable consoles. Game Boy is not the first handheld console with interchangeable cartridges, since, as mentioned at the beginning of this paragraph, that is Milton Bradley's Microvision. The Nintendo console though is the one that brought fame and fortune to this type of console. It got released with "*Tetris*" worldwide, thus increasing the amount of sales, given that "*Tetris*" was one of the most popular arcade games. The success of this console, however, could have been increased also by the commercial activity of PepsiCo. As a matter of fact, the soft drink company, in the same year of release of the Game Boy, promoted an under-the-cap contest with its beverages that allowed to win a total of 4.000 video game consoles. In addition to this marketing initiative, at Nintendo of America, in order to further sales even more, they started a hotline to help US gamers to get over difficult parts in games, get tips and tricks and, in general, to get counselling. This kind of system worked very well because the internet was just born, meaning that it is not like today, and therefore gamers in need of help to clear a level could not turn to the web in search for the answer. The so-called "Power Line", in helping people playing games, allowed players to finish them, and as a consequence, encouraged people to buy new video games, creating a vicious cycle. This telephone line eventually transformed into a

magazine, Nintendo Power, that was a monthly-released publication with tips and tricks, guides to solve dungeons and maps of levels of different games.

Figure 10 - First issue of Nintendo Power magazine (©1988 Nintendo)

Figure 11 - Last issue of Nintendo Power magazine (©2012 Nintendo)

In **1992**, in competition with the SEGA Genesis, Nintendo released the Super Nintendo Entertainment System (Super Famicom/ SNES), a 16-bit home video game console. Along with the console started the distribution of the Super Scope, an upgraded version of the Zapper, and the NES Mouse, useful to play the newest title in the Mario series, "*Mario Paint*", the first drawing game for console, apparently inspired by Windows' program paint, that eventually gained much more success with the advent of touch screen consoles. During this same year Nintendo published what was to become the revolution in the tactical RPG (role-playing game) world, "*Fire Emblem*". Before this video game tactical role-playing was happening only physically, around tables, where games of "*DnD*" (Dungeons & Dragons, the most popular fantasy tabletop role-playing game) took place. The innovation brought by "*Fire Emblem*" is in its conversational part, as every choice you make in the game has to be planned in order to be able to finish the game, and in its experience bar's concept. Similar features in games were already present in PC games like "*Bokusura Wars*" and "*Ultima*" but were successfully brought to fame with Nintendo's game.

This is also the year of publishing of "*Super Mario Kart*", the first ever go-kart game in which the protagonists are mascots from other series, opening the world for many games of this type, including the very same Mario Kart series. Yet one game that the SNES produced was even more revolutionary in terms of aim, "*Packy and Marlon*". It is a video game aimed at children with diabetes, to help them improve their diabetes self-management. In a study conducted few years after the release of the game it has been shown how the kids that played at the game for 6 months (the treatment group object of the study) had a 77% decrease in diabetes-related emergencies (Kato, 2010). Similarly, "*Bronkie the Bronchiasaurus*" (a video game developed to help kids with asthma) has been proven to be helpful to promote self-care behaviours in asthma patients (Kato, 2010). Therefore, already form this early on in development of consoles, video games have proven to be helpful in different sectors than just their own.

In **1993** the Super FX Chip got announced and released: with this chip, home-based consoles were able to run 3D games, shaking-up the video game industry, along with the cult game "*Doom*", the first episodic first-person shooter video game in 3D. The first Nintendo game to feature 3D graphics is "*Star Fox*" that along with "*Kirby*", also released that year, became hit games. Nintendo, unlike other companies such as Fujitsu and Atari, that respectively produced 32-bit and 64-bit consoles this year, decided to focus on making a chip that would allow the newly structured graphics to work on already existing ones and just launched one console, the SNES. This move allowed to keep the market share and not to lose the race for both 3D games and technologically advanced consoles, other than keeping at a minimum the loss, since producing a new console after SNES got released the year before would definitely mean a huge drop in sales for something that could have been sold for much longer. It is probably due to this reason the development and distribution of the Super Game Boy peripheral,

a device that allowed players that bought it to have several more titles among which to choose what to play, since it was a tool that allowed Game Boy games to run on SNES.

In **1994** Nintendo also developed the game that set a new standard in graphics quality, "*Donkey Kong Country*", developed with Advanced Computer Modeling (ACM) graphics. With this technique the 3D graphics of games were drastically changed, allowing for more details and textures to be featured in-game and for a more advanced animation to take place in the gameplay. Due to its huge success, in **1995** this graphic technique was applied also to Game Boy video games.

This is also the year during which the *Play It Loud*! series gets released, innovating the way in which video game consoles are perceived. If before the only way a console, either home-based or hand-held, could look like was greyish and tech-y, now Nintendo added colour to the case and, in some way, fun to it. In fact, from this moment on, many consoles released both the serious black/grey version and at least one coloured version. 1995 is also the year in which the Japan-limited SatellaView was released. This peripheral device allowed Super Famicom owners to download original games, magazines and broadcasts for free and they could also play "SoundLink" games: titles that could only be played for a limited time during the streaming service, but that featured a live voice-actor in the gameplay. This service allowed Nintendo players to take part in live tournaments from their own houses, showing how it truly was an innovation ahead of time, since it was in these years that the world wide web started to expand and take over.

In fact, in 1994, the Internet was released for the first time for public and commercial use (it was a US military project before), Tim Berners-Lee published the first website, and the general growth of internet usage (creation of websites) for this year was estimated to be 2000% (Austin, 2019; Bort, 2014). Nintendo already tried to introduce a similar service as early as

when they released Famicom, the Family Computer Network System. This device granted access to downloadable content for their games, to cheats even, but also it was useful to look at stock trades and the weather forecast; as said before though it was not successful, and it became discontinued pretty soon.

Even though it failed, during 1995 Nintendo also released Virtual Boy, a virtual immersion system in 32 bit, that provided one of the first VR experiences without glasses for a game console (Edwards, 2011). The previous year SEGA started developing a similar system, but in the end, they halted the development due to worries for the customers. This led Nintendo to be the first but, unfortunately, they did not believe enough in this product, probably because of its heaviness and the few games available, and it got discontinued pretty rapidly.

1996 was a major year for Nintendo; they started off the year releasing, through a second party firm, Game Freak, one of the most successful games they ever made, "*Pokémon*". This is an adventure game that introduces a set of challenges and tasks to be done, cute monsters as companions, a history and customization of the main character. This game got published in the same year when "*Tamagotchi*" was released. This was another handheld game, even though way simpler, in which the player had to take care of a tiny cute monster. During this same year the Harajuku style and Gyaru style, two very colourful, very cute but monster-y kinds of style, became popular. It seems therefore safe to assume that the three things might have inspired one another, all the three being innovative in their own sector, "*Pokémon*" as a video game, "*Tamagotchi*" as a toy and both fashion styles as a way to express.

Figure 14 - Example of Tamagotchi (©2018 Bandai)

Figure 13 - Girls showing Gyaru style (©2012 (Tokyo Fashion News, 2012))

Figure 12 - Girl showing Harajuku Kawaii style (©2017 (Donna, 2017))

1996 was also the year in which Nintendo released two consoles, the Game Boy Pocket, a 30% size-reduced version of the already existing Game Boy and the brand-new Nintendo 64 (N64). This is the new-generation home console, one of the first with 64-bit that pioneered the industry with four features: the rumble pack, an add-on device that for the first time ever allowed the controller to let the player feel the actions happening in-game through vibrations, forerunning the first integrated controllers. N64 also featured an innovative controller, even without the rumble pack; this controller in fact introduced the analog stick, which is now normally found on any controller. Before this innovation controllers used to only have the already mentioned, Nintendo-patented D-Pad, the cross-like button that allowed the player to only move in four fixed directions; the stick allowed the player to have much more freedom in the movements, enabling 360° turns with smooth transitions. Another innovation was the Voice Recognition add-on, a microphone that worked as a controller, basically introducing voice commands in video games. Finally there is the Memory Expansion Pak, a device that granted 4 more megabytes of RAM, even though the N64 was provided with 4 MB, therefore doubling the power of the console, in order to allow particularly heavy games, such as "*Donkey Kong 64*" and "*Perfect Dark*", to run on the console without crashing (Giudice, 2018).

In 1998 Nintendo released the Game Boy Color (GBC), a handheld console that featured an LCD screen that allowed players to see up to 16 colours in some of the games produced for it. This was not an innovation in terms of what the industry already had produced, but with the competitive price it had, half the price of the similar Atari console, it quickly became popular. Together with it came the peripheral devices Game Boy Camera and Printer, innovative tools that had huge success.

In 1997 the first coloured digital picture was published, probably leading to the development of these two devices that allow players to take black & white pictures of themselves, use them as avatar for minigames included in the Camera & Printer pack, and even print these pictures, thanks to a system that burned a special kind of paper, adding cute stickers and frames beforehand.

Figure 15 - Game Boy Color with peripheral devices Camera & Printer (©2018 Nintendo)

During the year **2001** Nintendo, after releasing 2 new consoles, Nintendo GameCube (home console) and Nintendo Game Boy Advance (handheld console), and plenty of new games, released an innovative peripheral device that allows the player who uses it to gain extra items, unlock secret levels and secret missions in-game, the Nintendo E-Reader. The peculiarity of this tool is that it is not an external instrument to unlock already existing on the device itself,

but it allows to read the data contained in cards that can be bought separately, and it applies them to the game. It is an innovative employment of a simple barcode reader, that allowed to upgrade games without the need of an external update.

In **2002** they produced the GameCube WaveBird Controller, a wireless controller that worked with radio frequencies, that allowed people to play without having to worry about the length of the cable. It was not the first Nintendo wireless controller, or the first in general, but it is one that can be considered quite successful since it solved the existing problem with various interferences due to the signal being too strong (Littrell, 2018).

In **2004** Nintendo once again revolutionized the video game industry introducing for the first time a touch screen handheld console, the Nintendo Dual Screen (DS). The touch screen is not the only revolution that this console features, it also allows for wireless multiplayer games and backward compatibility with games for previous consoles. This console was the first one to offer the built-in service that supported local wireless multiplayer, without the need for local gamers to connect together via cables. Before, for consoles like Game Boy Color or Advance there were adapters that worked as a substitute for the link cable, but never a built-in system (Riperiperi, 2020; Wikipedia, 2018). As wi-fi started to become something common, and many had a router at home, Nintendo saw the opportunity and introduced also a wireless online

Figure 16 - First edition of the Nintendo DS (©2004 Nintendo)

multiplayer feature, so that gamers from all over the world would be able to play video games together from their houses.

Even if it is true that touch screen devices existed well before the DS was commercialized, such as palm devices and such, it is also equally true that Nintendo DS made it become mainstream, probably because of the lower cost of the device and touchscreen itself. In **2006**, due to the huge success of the Nintendo DS the company coined the brand *Touch! Generations*, in order to show to people who never were into video games (mainly adults) that this technology and this specific console was definitely also for them. In fact, with the release of games like "*Nintendogs*", "*Dr. Kawashima's Brain Training*", travel guides and "*Personal Trainer: Cooking*" the aim was to appeal to a broader public than before, not only video games enthusiasts.

Nintendo successfully achieved this result, since it is true that the DS has been Nintendo's best-selling console of all times, with 154.02 million units sold worldwide, almost doubling the number of handheld consoles they were able to sell. Riding along the success of the DS in 2006 Nintendo released the Nintendo Wii, an innovative console due to its remotes. The revolution of this device is generated in the motion control sensors built in the controllers, basically allowing you to physically interact with the game you are playing. It allows people that never held a gaming pad to intuitively play and, more important, it allows video games to be physically engaging, finally breaking the sedentary image that video games created throughout the years. Gaming becomes an immersive experience, the Wiimote (Wii remote) becomes any object that you would need to use in-game, from a baseball bat to a sword, from a steering wheel to your hand that holds a bowling ball or a bow, all wireless. This technology has successfully been used in other fields, such as:

- Educational: Wiimote-based interactive whiteboards (Bossetti, Pilolli, Ruffoni, & Ronchetti, 2011);
- Accessibility: Wiimote can be used to control motions of robots or to help handicapped people to have a better computer control (Azmi, Alsabhan, & AlDosari, 2009);
- Arts: Wiimote, applied to Virtual and Augmented Reality, to implement a multi-wall virtual reality theatre (Schou & Gardner, 2007);
- Logistics: Wiimote used, with a video camera, to perform real-time position tracking of an aerial vehicle (Vargas, Preza, & Velazquez, 2009).

Figure 17 - Various accessories for Wiimote (©2013 Nintendo)

Therefore, for the first time of which there has been confirmation of, video games innovations were actually exported in other fields and improved the living standards of some weak categories. Other than simulating sports (like Wii Sport and subsequently Wii Sports Resort), this console, among its titles, has "*Wii Fit*" and "*Wii Fit Plus*", the latter of which exploits the new technology of the Motion Plus, an expansion device that allows for more complex movements to be recognized and interpreted in-game. These games can be played to get or keep fit in the house, creating exercise routines that can be followed simply by possessing

the game and the Wii Fit Board, a peripheral device that comes with the game, therefore without other external tools.

In **2011** Nintendo tried again to launch a console that supports 3D technology and released the Nintendo 3DS, the first handheld console that uses a stereoscopic technology that does not require glasses. This technology is at the base of Augmented Reality (AR), and even though it was invented in 1838, it is true that this technology has been largely popularized by Nintendo with its console. 2011 was the year during which Nintendo also launched the Nintendo eShop, the online shop that allows people to buy games online for anyone of their Nintendo consoles, unifying the pre-existing digital video game online stores. With the introduction of the eShop customers did not need to go to stores anymore but could buy games and, as they could before, download DLC (DownLoadable Content) content from the comfort of their own houses.

In **2012** Nintendo launched a new home console, successor of the Wii, the Wii U. The innovation brought by this console was given by the innovative GamePad that is the standard controller for the console. It basically is a tablet that also incorporates the features of a normal Nintendo controller, that is the dual analog sticks, the D-pad and the four main buttons. This "monitor" can be used for three main purposes: as a second alternative screen rather than the main monitor, as a further different view of the in-game footage or as a proper screen, without the use of an external monitor. Of course, the GamePad, in the games that support the feature, is using a touch screen controller that allows for a more intuitive use. This pad also includes a front camera that supports video chat and, as the Wiimote, it has motion detection sensors, to increase the type of games that can be played. In spite of all these innovative features this console did not sell, due to lack of strong titles and advertisement, and therefore it was discontinued as the console with the second shortest lifespan, also considering that the average life of a console up until now has been 8 years (see Table 5).

Table 5 - Nintendo consoles' lifespan

Console Name	Launch date (JP/US)	Discontinue date (JP/US)	Lifespan (in years) (JP/US)
Famicom/NES	1983/1985	1995	12-15
Game Boy	1989	2003	14
Super Famicom/SNES	1990/1991	2003/1999	13-8
Virtual Boy	1995	1996	1
Nintendo 64	1996	2002	6
Game Boy Advance	2001	2010	9
Game Cube	2001	2007	6
Nintendo DS	2004	2013	9
Wii	2006	2013	7
3DS	2011	2019	8
Wii U	2012	2017	5
Switch	2017	NA	NA

2012 is also the year in which Nintendo started a series of online showcases and presentations of its products that still lives to this day, the Nintendo Direct. This kind of service is an innovative format since, before Nintendo, no other company in the industry showcased its news and projects before the E3, (Electronic Entertainment Expo) the most famous annual world-class event that showcases the latest news in the video gaming and computer world, or other conventions (Dring, 2018). It is though important since it allows with a certain frequency (at first it was annual but with the years it became more and more frequent) to spread important information for the company, to let the players know when the next game's release is going to be, but most of all it is useful since it creates hype and anticipation in customers, keeping them almost constantly updated.

In **2013** the partnership between Nintendo and the Louvre Museum revealed the "*Nintendo 3DS Guide: Louvre*". This game — if it can be defined as a game — is innovative for two reasons: it grants people unable to travel due to any reason the possibility to virtually visit the Musée du Louvre with a special footage designed just for the Nintendo 3DS. It lets users stroll around the museum's hallways with a detailed description for all the main

attractions. The second way in which this game brought innovation is that it is also an interactive guide available when you physically visit the museum. It reconceived the way in which museums are lived by the general public, that can therefore have an immersive cultural experience, as if they were walking around with a personal guide at their disposal. This collaboration paved the way for what today is done by smart devices, mobile phones and tablets, when used in museums combined with specific geolocation apps or QR code readers.

2016 was the year during which Nintendo released many mobile apps, for both iOS and Android users. In the first place there was "*Miitomo*", that is a freemium app that allows users to interact among them as if in a Twitter/Facebook-like social network. It features though the Miis, the characters created for the Wii, that can be customized by the player and that represents them in various games, such as "*Wii Sport*", as well as in this social media. In the same year there is the release of another app, "*Super Mario Run*", that is a simple mobile game that features the Nintendo mascot and has a gameplay that recalls the first Super Mario games. However, the one app that was truly innovative and earned the public's attention was "*Pokémon GO*". The app was developed by Niantic, the same company that in 2013 released "*Ingress*", a similar game in terms of functionalities and gameplay, that however did not gain as much following as "*Pokémon GO*" (see Table 6).

Table 6 - Pokémon GO and Ingress in comparison (Niantic Team, 2018; Iggy, 2019; Google, 2020; Google, 2020)

App	Lifetime downloads (until 2018)	N. of reviews	Average score (out of 5)
Pokémon Go	1 billion +	13.798.057	4
Ingress	20 mln +	421.549	3,1

This app features the tiny cute monsters from the main Pokémon series and, through the GPS installed in the mobile device, allows the player to catch the Pokémon. Its innovation resides in the use of Augmented Reality, since while playing the user can see Pokémon through the camera of its own mobile phone. It brought to popularity the concept of location-based

games, as in the real video game, different regions allow the user to catch different Pokémons, all mixed with the basic gameplay of an original Pokémon game, where you battle other trainers and gyms. Additionally, the game has been received positively from the greater public and this is due to the fact that the game promoted physical activity, since players have to walk around the city in order to gain items and to be able to capture Pokémons, but also because, since they walk around the city, local businesses were able to take advantage of it, thriving. But for the same reason, due to people walking around without paying much attention to their surroundings, many accidents happened, creating, in general, nuisance for the people around them. After this game's use of AR technology other apps started using it in a similar way: IKEA's "*IKEA Place*", that allow the user to furnish their rooms with IKEA furniture. There is Sephora's "*Visual Artist*", that applies make-up as users are looking at themselves through the front camera, and "*Google Lens*", that, among many features, for example provides an instant translation of any inscription from any language. All of these applications probably got inspired or, at least, got boosted by the huge success that "*Pokémon GO*" had.

Figure 18 - Example of in-game experience of the AR technology

In **2017** Nintendo released its latest console, the Nintendo Switch, which is, once again, revolutionary. The innovation brought in the first place by Nintendo Switch is that it is both a home and a handheld console. In fact, it features two Joy-Con controllers, each containing an accelerometer and a gyroscope, basically functioning as a Wiimote (Takahashi, 2017). Other than that, it has a capacitive touch screen and it can be docked in a docking station that, if connected to a monitor, allows you to play with the detached Joy-Cons, provided of wireless connection, as if it was a home console, with up to 8 Joy-Cons able to connect to one single device. There are some games that do not support all modes, like "*Super Mario Party*", "*1-2 Switch*" or "*Just Dance*", all only playable with a docked console. Even if this is the situation, and not all games allow for a free use of both modalities, all in all this console revolutionised the industry by being the only convertible console (Petite, 2020).

In **2018** Nintendo announced as an add-on peripheral device to the Switch, the Nintendo Labo, a new interactive game featuring the use of freely customizable cardboards that have to be wrapped around the Joy-Cons in specific ways and that lets the user create toys with which they can play, hands-on (Nintendo Co., Ltd., 2020) (Wikipedia, 2020) (Wikipedia, 2020) (Wikipedia, 2020).

Figure 19 - Example of the Nintendo Labo - Variety Kit (©2018 Nintendo)

KNOWING COMMUNITY ANALYSIS

Unscripted Internal Activities

As in any company, it is difficult to know how Nintendo works but, thanks to a series of interviews conducted by the late president, Mr. Satoru Iwata, there is the possibility to know some behind-the-scenes events that would not normally be public knowledge (Iwata, 2005 - 2015). Therefore, it is possible to know that the communities created by internal unscripted activities are quite a lot. It is in fact true that at Nintendo, and in the game development department to be more specific, there is a strong reliance on previous works and people with previous knowledge.

Help seeking, for example, happened in 1988, when Iwata, who was developing a racing game (that eventually turned out to be Famicom "*Grand Prix II - 3D Hot Rally*") in 3D technology, asked for Shigeru Miyamoto's help, that at the time had already experienced this kind of mediums thanks to their development of the Virtual Boy (Miyamoto & Itoi, 2011). Another example of unscripted internal activities is showcased when, for the development of the Nintendo 3DS hardware, Hideki Konno (one of the developers for Mario Kart Wii) was asked to help due to his previous experience in various fields and, mostly, for his known passion for handheld gadgets (Konno, Sugino, & Umezu, 2011).

However, as said by Satoru Iwata and Splatoon developer Hisashi Nogami, this type of spontaneous collaborative environment is created when the development concerns a new title from a popular series such as "*The Legend of Zelda*" or "*Super Mario*". There seems to be, however, a little bit more creative resistance when entirely new games are involved (Sato, Inoue, Sakaguchi, Amano, & Nogami, 2015). The tables turn though when new hardware is involved, for example in the case of the 3DS when, to decide the D-pad and circle pad placing, the developers could simply go around the company and ask random employees to try the

placement for a bit, and people would happily comply (Sugino, Umezu, & Konno, 2011). Once again, in the case of the gyro sensor for Nintendo 3DS, a strong reliance can be seen on previous but almost concurrent experiences, when Iwata gets called in from his work with the Wii Motion Plus to help Ryuji Umezu in his task (Sugino, Umezu, & Konno, 2011).

In general, during the development of the 3DS, in various brainstorming sessions that took place to decide the overall design of the new console, Yui Ehara, lead designer for the previous Nintendo DSi, brought up lots of weird ideas: he did so even if he knew that they would not be accepted just to stir up ideas, so that 3DS designers would not be stuck on previous designs, reframing the problem at hand (Miyatake, Ehara, Akai, Goto, & Koshiishi, 2011) Previous experience was also central during the development of the new gameplay of "*Splatoon*": most of the team members got at least once the opportunity to build a project on their own from scratch and got rejected without a chance to support their vision. Therefore they all were able to listen to each other's opinions, and this allowed for multiple reframing of issues to occur, eventually turning the game into a radically new experience (Sato, Inoue, Sakaguchi, Amano, & Nogami, 2015). It is hence clear how chatting back and forth with colleagues for work-related matters is strongly encouraged in Nintendo, also thanks to the working environment they set. In fact, they also provide common rooms for their employees where they can relax, play and therefore exchange opinions freely.

Scripted Internal Activities

As for the previous section "Unscripted Internal Activities", it is difficult to know what kind of methods are used inside Nintendo to carry forward the work. Therefore, once again, there will be an employment of what has been said during the "Iwata asks" interviews. For example, during one of the first meetings for the development of Nintendo 3DS, one of the

developers was invited to participate in the meeting even though he might not have had much experience. Not having knowledge of previous failures with 3D technology, like with the Virtual Boy, he was the one to propose to use 3D technology for the 3DS. This turns out to be one of the point of success of the console, and all of it has happened because one developer reframed, without properly knowing it, an issue Nintendo previously had (Miyamoto & Itoi, 2011).

Yet again while developing the 3DS, brainstorming were pivotal in order to create a mental environment that allowed designers to freely think of new designs, without being stuck on the precious ones (Miyatake, Ehara, Akai, Goto, & Koshiishi, 2011). This same team, further down on the project, discussed during many meetings on the best way to design the console and what could be the best material to use in order to have a resistant enough console (Miyatake, Ehara, Akai, Goto, & Koshiishi, 2011). There are some examples of collective working also in the case of the game "*Splatoon*", as in the very beginning of the development process. The team, through many brainstorming sessions, came up with an idea of gameplay, designed it and, at first, placed as main characters pieces of tofu. With some reflective reframing, thinking of how the issue was not the character per se but the set of characteristics it had to have, and also knowing that probably tofu would not sell, they came up with the idea of squids (Sato, Inoue, Sakaguchi, Amano, & Nogami, 2015). Hence it seems that also in this case, Nintendo has developed a working environment in which solo projects are discarded in favour of teamwork and collective thinking.

Unscripted External Activities

As mentioned in Chapter 3.2.2, external unscripted activities are the most difficult to acknowledge, due to the fact that they do not revolve around the working life of employees,

they are about their life outside of it. Luckily, also in this case, some of the interviews made by Iwata take a look at these behaviours, and some of them are encouraged in the "Benefit & Perks" and "Life at Nintendo" sections of the Nintendo website. For example, many of the headquarters offer fitness plans, that grow the hobbies, passion and activities undertaken by workers, creating connections and communities outside their job. The company also organizes picnics, events and competitions among co-workers and their families, once again letting them bond and experience something new (Nintendo of America, 2020; Nintendo of America, 2020). According to an interview made by Iwata, during the development of "*Splatoon*", the designs of characters, music and looks were made all following the preferred style of the team that was working on it. They all liked street fashion therefore the items used to customize characters are inspired to this style, BGMs (Background Music) all have a rock-ish sound, and it all comes from their experience outside of their working experience (Sato, Inoue, Sakaguchi, Amano, & Nogami, 2015).

Another similar case can be found in the process of development for the "*Wii Fit U*"'s Fit Meter: this device (created to measure calories burned, altitude and physical activities) was first designed thanks to the need of Sugiyama, main developer of the game, for an accessory that could do all of these tasks combined. While he enjoyed playing the first Wii Fit game, he also liked to hike or go for cycles, but all of the exercise that he did outside of the house was not reported in the game, and for this reason he created a tool that many like him could use, basically using his passions to improve the game experience of many (Hayashi, Matsunaga, Sugiyama, Kitado, & Tooyama, 2013). Likewise, while thinking what to do in order to create the perfect first game with 3D graphics, Miyamoto liked to stroll around Kyoto, and in particular he liked to hike mount Inari, where the Fushimi Inari shrine is placed. This temple is rich in gates and is dedicated to foxes, both things that inspired him in the creation of his game,

since the aim of the game is to pass through many gates while flying a spaceship, and the main character, who pilots this spacecraft, is a fox (Cuthbert & Goddard, 2020).

Figure 20 - Screenshot from Star Fox where arches are visible (©1993 Nintendo)

Figure 21 - Fox and arches from Fushimi Inari shrine (©owner)

Lastly, there are the Nintendo-sponsored "*Nintendo Fusion Tour*" (a rock music tour matched to a video games festival) and the sponsoring of the Fiorentina football club. From 2003 to 2006 the Fusion Tour gave exposure both to games and to bands, creating a community of young people across the US. This provided Nintendo with insight on what people targeted with the Tour likes, and therefore allowing them to create better suited games, just like "*Guitar Hero*" (Ashton-Magnuson, 2004). A similar result came from the sponsorship offered by Nintendo, from 1997 to 1999, to the Fiorentina, an Italian football club (Beltrami, 1997).

This marketing ploy allowed Nintendo to obtain the consensus and interest of the general public and encouraged their staff to take an interest into football. It then seems reasonable to assume that many employees at Nintendo use the expertise gained thanks to their hobbies and passions into the tasks they are assigned, resulting in works that are more credible and enjoyable. Equally Nintendo sponsors events that are not strictly correlated to its core business but, eventually, always gets something in return.

Scripted External Activities

Lastly, there are the scripted external activities, fairly public activities, which in Nintendo's case consist mostly of conventions. Almost all video game fairs and expositions feature Nintendo presence: the *E3*, *Indie World*, *PAX*, *Gamescom* and *San Diego Comic-Con* among the most known. There are also events like the *Nintendo Direct* and the Nintendo conference, that are directly and completely organized by Nintendo. In all of this events Nintendo actively participates showcasing new consoles and new games, anticipating to the public what's to come in the next year(s), competing with all the other video game companies for the attention of media and for the buzz generated by the news released at the events. However, there are also other kind of activities, such as the *Nintendo Game Seminar*, a crash course organized by Nintendo that teaches the basic skills needed to create video games to college and university students. This way the company encourages those interested to try the developer career path and while putting the minimum effort they create the basis for the future of Nintendo. It can also be safely assumed that inside Nintendo, like in any company, all kinds of different courses are offered to employees in need of specific skills. There is therefore no doubt that Nintendo takes part in many external activities that are related to the core business, participating in national and international conferences.

4.1.2. Sony Interactive Entertainment

HISTORY

Sony is a multinational conglomerate best known for their electronic goods; it was established in 1946 and the corporation headquarters are in Tokyo, Japan. As stated in the company website (Sony, 2020), it actually started out as Tokyo Tsushin Kogyo K.K., or Tokyo

Telecommunications Engineering Corporation, producer of the first Japanese tape recorder, the G type (**1950**). In **1960** the American branch settled out, establishing the Sony Corporation of America (SCA), expanding their business also there, producing and selling video tape recorders (**1965**) and the first portable transistor televisions (**1960**). They also extended their businesses to the music sector, founding CBS/Sony Records Inc. and afterwards also producing the *Walkman*, the first portable cassette player (**1980**), and the first CD players, both portable and not, respectively in **1982** and **1984**. 1982 was also the year in which the "*Betacam*" the first integrated VCR/camera got released for professional use, paving the way for commercial video cameras. In **1991** Sony further expanded its interests acquiring the US-based Columbia Pictures Entertainment Inc., developing knowledge also on the movie industry.

Figure 23 - First Walkman (©1979 Sony)

Figure 22 - First portable television (©1960 Sony)

TECHNOLOGICAL INNOVATION ANALYSIS

Sony Computer Entertainment Inc. (SCEI), known today as Sony Interactive Entertainment (SIE), was established in **1993** with Toshio Ozawa as the first President. One year later, in **1994**, the first video game console produced by Sony was released, the PlayStation (PS). This console has a graphic processor that allows for a resolution as high as arcade video games and it is the first console to solely focus on 3D games. This resulted in improved graphics

in comparison to its competitors, for the fact that many of them adapted to the new 3D technology, while Sony developed the console knowing that graphics would be three-dimensional. For this reason, Sony was able to sell PS at a very competitive price, therefore appealing to the general public, inducing for its initial success.

Along with the graphics, another important element introduced by Sony is its controller. It is evident that Sony took inspiration from the already established Super Nintendo controller, but they evolved from it, creating their own controller and giving it a three-dimensional design, featuring both a D-pad, similar to the Nintendo-patented one, and four buttons with what were to become the iconic symbol of PlayStation, triangle, circle, cross and square. With a subsequent evolution in 1997, this controller became what is known as the Dualshock, where Sony added two analog sticks provided with vibration-feedback technology. However, the huge success of this console is due to its immense line-up, that presented titles for any genre of video games, from RPG to shooters, from adventure to horror. Therefore, unlike Nintendo, since the beginning they had a much broader selection of genres that allowed them to appeal to the general public, that could definitely find at least one game that could interest them.

Figure 24 - PlayStation with a DualShock controller (©1994 SCE)

In **1999** Sony had their first attempt at handheld devices with the PocketStation, a peripheral Memory Card for the PlayStation. It cannot be properly considered as a console, and therefore it cannot be considered as an effective competition for the Game Boy, released in 1998, but it still had many interesting features. It combined together the features of a memory card, even if not very capacious, and those of a personal digital assistant, featuring a monochrome LCD, a real-time clock, sound and infrared communication capability. These last two characteristics allowed the user to play, on-device, low-resolution mini-games connected to original popular games for PlayStation, such as "*Final Fantasy VIII*" or "*Street Fighter*", proving Sony's capability to produce handheld devices (Byford, 2019). However, the PocketStation was never very successful due to the low storage space and the poor battery life, issues that also affected the VMU, a peripheral introduced by SEGA for the Dreamcast console, a predecessor of Sony's device (as can be seen also from aesthetical similarities in Figure 25 and Figure 26). For this reason, Sony produced PocketStation only for the Japanese market and eventually discontinued it after only 3 years. (Budmar, 2012)

Figure 25 - Sony's PocketStation for PlayStation (©1999 SCE)

Figure 26 - SEGA's VMU for Dreamcast (©2000 SEGA)

In the year **2000** Sony released Playstation 2 (PS2), the first console to ever use DVD, a storage format invented and developed for the first time in 1996, also featuring a 128 bit "*Emotion Engine*" processor, that exceeded the capability of many computers of the time (Mainelli, 2000). The PS2 is the first console ever to use DVD-ROMs, therefore transforming the console in both a gaming device and a home theatre, considering that it could play music CDs (like its predecessor) and now also movie DVDs. This decision was in fact driven by the success that the CD player had in the first PlayStation, so much that Sony decided to expand the multi-tasking capabilities of the hardware.

Many consoles afterwards, other companies, like Microsoft, adopted this technology given the success that the PlayStation 2 obtained, and also the very same PS2 became renowned as a cheap DVD player, to the point where people bought it instead of an actual player since it was cheaper (Baird, 2020). The multi-functionality of the console was actually introduced already with the PS, when users could both play a game or play a music CD, and the success of this feature brought Sony to implementing this possibility also for the PS2. This, together with the many titles that also this second console supported, titles also famous for their graphics such as "*God of War*" or "*Final Fantasy*", allowed PlayStation 2 to become the best-selling game console of all times, with 157,68 millions unit sold worldwide (Gough C. , 2020).

In **2004**, the same year of release of the Nintendo DS, Sony's PlayStation Portable (PSP) was released. It presented all the features that made the previous home console a hit: it had a high-quality media player for both music and videos, it introduced a wireless LAN, to connect to the internet without cables, and a far bigger screen than its competitor's (3 inches diagonal for the DS against 4,3 inches). This console was not innovative per se, but it introduced an innovative use of a handheld console; in fact by being able to play both music and video, other than video games, it became very popular among commuters in years where smartphones had not yet properly taken over (Wilhelm, 2016). It is true that in 2005 the newly released feature

for Apple iPod allowed to play video and therefore also served this purpose but, in favour of Sony's PSP, the console could additionally be used to play games, and this for either the same or even lesser price (iPod at launch was $299 (30GB) or $399 (60GB) while PSP was $249) (Casamassina, 2005; Michaels, 2006). PSP was also the first, and last, console to introduce the use of Universal Media Discs (UMD) as storage medium instead of cartridges, allowing for a much larger capacity that in turn resulted in better graphics compared to their competition. This innovation though was also one of the main reasons why the PSP was actually a failure compared to its direct competitor, the DS. In fact, as explained by Niko Silvester in his article (Silvester, 2020), the usage of UMD raised four main issues:

- the bigger capacity of the disc allowed for heavier games to be played, but it also increased the loading time; this is due to the fact that PSP, unlike home consoles, does not have the possibility to install onto the console's memory parts of the game.
- the console was a very easy target for hacking and therefore playing pirated games, lowering the overall sales of original games, which were the main source of income for Sony (Gamasutra, 2009). For this same reason Sony never released a burner for UMDs, and hence many developers who wanted to create their own games were not allowed to do so.
- the UMDs are prone to scratches and fingerprints, the plastic shell Sony had created in order to protect them was very inclined to split open and the UMD door on the PSP was itself very fragile, which led to an overall faulty system.
- lastly, UMDs have a size that is not so conventional, much bigger than cartridges used for Nintendo DS, and the system used to read them is equally big, taking a lot of space inside the PSP itself, causing the design to have to be of a considerable size.

It is thus clear how the innovation that UMDs were supposed to bring actually brought a series of issues, and even though general sales for PSP were quite high, when they were compared to Nintendo DS's it becomes clear how Sony performed rather poorly (see Table 7).

Table 7 - Nintendo DS and PSP global sales as of September 2020 (Gough C. , 2020) (Gough C. , 2020)

Console name	Launch date	Discontinue date	Unit sales (in millions)
Nintendo DS	2004	2013	154,9
PlayStation Portable	2004	2014	81,09

Figure 27 - PSP and UMD examples (©2004 SCE)

Despite the lack of success among gamers, PSP has been used since its release for projects outside the gaming industry. An example is the "*E-learning with PSP*" project, that consists of supplying PSPs to students in order to improve basic scholastic proficiency, provide individualized learning and motivate students with personal terminals (SIE, 2020). Another interesting project for which the PSP has become a central tool is the "*Written Translation*" (of on-speaker messages), where the PSP is used as the receiver to ensure information to hearing-impaired people (SIE, 2020).

In **2007**, the year after Nintendo Wii was released, PlayStation 3 (PS3) was globally distributed, and it had a series of innovative features. First of all, it was the first video game console to have a removable and upgradeable hard disk drive (HDD), allowing users to

customize their console according to their usage, basically letting them the freedom to make the overall system run faster. Also in this case, as previously with the DVDs, it was the first console to support Blu-Ray and to actually produce Blu-Ray video games, since this kind of technology has higher capacity and therefore allows for games for with better graphic quality to run (Blu-Ray discs record and play back in high-definition and high-resolution). By using Blu-Ray discs PS3 also promoted this technology, produced by Sony, and as it can be seen in Table 8 it definitely helped in increasing the overall sales of it (Welch, 2019).

Table 8 - Blu-Ray Disc software shipments to US and Canada (Schaefer, 2009)

Q	2006	2007	2008
1Q	NA	1,7	9,22
2Q	NA	3,54	12,62
3Q	NA	3,21	12,72
4Q	1,26	9,54	28,6
Yearly Total	1,26	17,99	63,16
Total (since launch)	1,26	19,25	82,41

The PS3 also featured a Cell broadband engine, a microprocessor that was able to deliver supercomputer-like performances (Gschwind, et al., 2006). This technology was developed in a joint effort of IBM, Sony and Toshiba, and it was first implemented in the PlayStation 3 but it was eventually used for other applications, such as medical imaging (large-scale modelling of the human brain) (IBM, 2020) or bioinformatics (Sachdeva, Kistler, Speight, & Tzeng, 2007).

In **2008** the PlayTv device was released in EU countries, and subsequently in Australia and New Zealand (2010 in Japan with the Torne device). This peripheral allows for PS3 owners to view HDTV and DTV, but also record programs in unencrypted channels, pause and rewind live programming and turn on and off subtitles and audio description. Once again, people would rather choose a Sony console offering many services in one single box, than another company's hardware, which would only be suitable for the specified use and would not allow the user to

play games. The competitors in this case were Virgin Media's set-top box V+ , Sky's Sky+ HD and Freesat HD, the first two launched before the PlayTV, the third concurrently, but all at a way higher price: Sky+ launched in 2001 at £299 + £10/month subscription, V+ launched in 2007 and required £49,95 for the set-top box + £27/month, FreesatHD was £120 for the HD box + £80 for installation (Wikipedia, 2020; BBC, 2008; Liquid_Entity, 2006). All the while PS3 PlayTV was £69,99, therefore a price way above competitors considering the fact that no subscription is needed (Purchese, 2008).

In **2010** Sony introduced for the first time a video game subscription service, the PlayStation Plus, a membership to the already working PlayStation Network, the online media content distribution service and shop for PlayStation. Taking inspiration from services like Netflix (whose online streaming-only service launched on 2007) or Crunchyroll (launched on 2006), which offered a huge list of programs and movies differing in genres and targeted audience, PlayStation Plus offers to members the possibility to play many of their top titles in catalogue for a monthly fee. This system of supply has actually caught on since, as demonstrated by the creation of *EA Play*, *Uplay Plus* by Ubisoft, *Apple Arcade* and *Xbox Game Pass* services.

In **2012** the new handheld console by Sony was released, the PlayStation Vita, which presents a couple of interesting features. First of all, it presents a multi-touch OLED/LCD capacitive touchscreen, a novelty for a portable console, which then will be introduced also in Nintendo consoles with Nintendo Switch. Secondly, PS Vita offers to users the exclusive possibility of playing with a 3G internet connection, therefore eliminating the need for a wi-fi in the version that supports this feature. However, even though these two technologies are actually revolutionary for handheld consoles, by 2012 smartphones were already popular, hence lowering the impact that this platform could have had (1,08 billion smartphones out of 5 billion total mobile phones globally) (Anson, 2012).

In **2013** the PlayStation 4 (PS4) was launched worldwide and with it came, once again, possibilities that would otherwise require external equipment. In fact, with PS4 the user has access to: video games, streaming services such as Netflix, Hulu and Amazon, music (Playstation Music streaming service), TV without cable or satellite (PlayStation Vue) and the PlayStation Network, that includes PlayStation Plus and the new PlayStation Now, a cloud-based service that allows players to stream games (Schwas, 2015; Sony Interactive Entertainment, 2020). This service along with the PlayStation Plus seems, as of now, to be the best way to fight back the success of mobile free-to-play games like Tencent's "*League of Legends*" or "*Clash of Clans*", since it offers the possibility to try and play famous games like "*God of War*", "*Final Fantasy XV*", "*Medievil*" and "*Uncharted*" (as of October 2019), without the need to purchase them first and with the possibility to play online with other people (Davidovici-Nora, 2014; Singer & D'Angelo, 2020).

Another innovation that came with the PS4 was the *Dualshock 4* controller, that introduced itself some important features: a lightbar on the upper side of the controller that also registers the position of the device. It is therefore able to re-adjust the split-screen in case of a change in the position of the players, it changes colour to let people know which side of the screen is associated to which player and to respond to in-game change of status (e.g. low life). The controller also features a multitouch touch pad, that grants new gameplay opportunities interacting with it, and a "Share" button, that allows for players and more specifically streamers to instantly share footage of their gameplay. This last characteristic hence eliminates the intermediate step that people had to take if they wanted to show online their in-game skills and has been highly appreciated by the increasing number of video-game streamers, reason why there is also a similar button in the Xbox One and Nintendo Switch controllers (Sarkar, 2017).

Figure 28 - Dualshock 4 controller for PlayStation 4 (©2013 SCE)

In **2016** another innovation is brought on by Sony with the release of the Virtual Reality (VR) system. It is a network of four main devices: the PlayStation 4, a PlayStation *VR* headset, a PlayStation *Eye* camera and two PlayStation *Move* motion controllers. The headset features an accelerometer and a gyroscope (both three-axis motion system) to recognize a full rotation of the head, the field of view is 100 degrees wide, with an OLED display of 14,5 cm (PlayStation, 2020). It also incorporates 3D sound technology, in order to provide an immersive feeling of sounds coming to the user from any direction (Shuman, 2017). The Move motion controllers, interacting with the Eye camera, can operate with a minimal processing latency, allowing for movement and images seen through the headset to be displayed in real time in-game. This kind of technology therefore is able to generate a true immersion in the game, way different than what other video game consoles have offered up until now.

Set aside the PS4, whose innovativeness has already been discussed, the other three technologies used to create the VR set are also not innovative per se: both the PlayStation Eye and the Move already existed and were used for previous games, and VR headsets, not to include the older and outdated headsets like Virtual Boy, was already present on the market. In fact, Facebook-owned Oculus has been developing a VR set (Oculus Rift) since 2012, but it

was released only months before Sony's, while HTC Vive, developed by HTC (Consumer electronics corporation) and Valve (video game developer), had been unveiled in 2015 and also released months before Sony's (Oculus released in March, HTC in April and Sony in October of 2016). As many times before, however, PlayStation VR has the competitive advantage of the price, since Oculus Rift was $600, HTC Vive was $800 and PlayStation VR was $500, definitely not accessible to everybody but for sure more than its competitors (Stein, 2016).

Furthermore, Sony's VR has not only been used by users to play games. Thanks to a collaboration with NASA, VR equipment has been provided to the Jet Propulsion Lab that, with some high-resolution pictures taken by *Curiosity* rover while exploring Mars, was able to study the red planet's environment as if they were there. This project has been subsequently expanded for many other projects and the videos have been publicly released, so that anyone with a VR headset can enjoy them (Chapman, Nee, & Lowes, 2020; Davies, 2014).

Figure 29 - PlayStation 4 VR set: headset (left), motion controllers (right), camera (middle) (©2016 SCE)

KNOWING COMMUNITIES ANALYSIS

Unscripted Internal Activities

In this case it has been even more difficult than in Nintendo's case to determine the kind of internal activities performed by Sony's employees, given that there was no one to interview people working at the company about their processes and behaviours. However, it is also true that the company is very explicit, on their website, about the open-mindedness and the collaborative environment that they want to exist in their offices.

By working together, they aim at fostering a wide range of viewpoints and ideas (SCEA, 2020). This is the case, for example, when new projects are proposed: at Sony Computer Entertainment America (SCEA) they do not like to impose ideas down from the top, they let the creativity flow throughout the process. In fact, once a prototype has been made it is not just one person to decide if the product is good, the team actively seeks feedback from different teams, trying to see if different people can see different issues and maybe purpose different ways to solve them (Yoshida, 2007).

Another example of help seeking behaviour in Sony can be seen in the development of the first PlayStation, right after the deal with Nintendo fell apart. In fact, before Sony went all-out and produced its own proprietary console, the two companies were supposed to team-up and create an innovative hardware that showcased the best features of Nintendo and Sony. When the terms did not work out, the then-engineer Kutaragi Ken, head of the partnership project, created a new division in the company, Sony Computer Entertainment, and started developing what would become the first console by Sony, the PlayStation. To do so, Kutaragi created a team of engineers with knowledge in real-time 3D graphics; he knew that his knowledge alone would not be sufficient and therefore sought out for someone that could create the hardware he envisioned. During the creation process for PlayStation, the help of Shigeo Maruyama was essential. At the time, he was the head of the Sony Music Division (the place

where Kutaragi was sent to work on the console), and hence very knowledgeable on CD-ROM manufacturing, marketing and distributing. His expertise on this type of technology was fundamental in the decision-making process that led Kutaragi to implement it in his console (Edge, 2019).

Scripted Internal Activities

Throughout Sony's website there is a strong feeling of inclusion that comes across. In almost any page there is a mention to their working methods, specifically to how they solve tasks in teams and how they want to do so to encourage collective solving of issues, to adopt reframing processes, since, as the founders of Sony said «*Creativity comes from looking from the unexpected and stepping outside your own experience*» and «*Creativity requires human thought, spontaneous intuition, and a lot of courage*» (Ibuka, 1992; Morita, 1986).

An example of this mindset can be found in the way they structure work at SIE: while the majority of companies after greenlighting a project, i.e. approving it, just let it get developed, at Sony the process is potentially always under "red light" possibility (Yoshida, 2007). This means that while other companies prefer to approve a project and then only see the final result, at Sony they have periodical meetings so to follow up the progress of the team members and, if necessary, stop and therefore "red light" the project if anything is off. This way it becomes a collective effort from the beginning to the end to bring to players a good product.

Another example of this pivotal role of meetings in Sony's culture can be seen once again when it was decided that Sony would produce their own console. It was, in fact, thanks to a meeting that Kutaragi convinced Ohga, then president of the company, to give him a chance to make it up for the error he made (teaming up with Nintendo). It also was thanks to his team

at Sony Music and through the collective effort they made there that the final product turned out to be so successful. And once again it was thanks to many meetings held to showcase the potentialities of the newly made console, that many developers and publishers decided to produce for Sony, demonstrating how strongly people at Sony rely on confrontation and discussion (Edge, 2019).

Another side of Sony's internal activities are the network they encourage employees to build, based on both interests and demographics, to improve the working environment as much as to enhance their products and be closer to the target they want to reach (Sony, 2020).

Unscripted External Activities

Sony's working environment is built in order to grant people the possibility to create connections with people outside their working team. In fact, it is the company itself that pushes employees to join networks based on their outside interests or on their demographics (Sony, 2020). Sony also fosters relationships with some of the communities surrounding the company, to be more involved and active about what happens around them (Sony, 2020). Therefore they do cleanup activities, since also employees enjoy a clean surrounding, or they participate in conservation activities at local nature reserve, to maintain wildlife habitats (SIE, 2012; SIE, 2006).

Another example of successful networking is that done by Christopher Deering, International Chief Operating Officer at Sony Pictures Home Entertainment since 1990 and president of Sony Computer Entertainment Europe since 1995. Thanks to all of his contacts inside and outside of his job it was possible to promote and sell an incredible number of PlayStation when it first came out, selling it in many more countries than Sony expected (Edge, 2019).

Sony is also getting involved in a broader community's life by sponsoring events like:

- the "*Folding@Home Program*": a distributed computing project that uses CPUs and GPUs of any device put to their service to help scientists run simulations on protein dynamics that eventually help them develop new therapies and drugs (Folding@Home, 2020; SIE, 2007 - 2012);
- the "*Sony creators gate: U24 Co-Challenge 2021*": a competition among young creators to help them improve by using Sony's expertise (Sony, 2020);
- the "*Sony creators gate: Entertainment Camp*": as the name says an entertainment program with lessons that allows participants to broaden their skills in creating new forms of entertainment (Sony, 2020);
- the "*Sony STEAM Studio 2019*": workshops and contests held to provide STEAM (learning process that uses Science, Technology, Engineering, Arts and Mathematics as focal points) education in a fun way with Sony's technology (Sony, 2019);
- the "*Short Shorts Film Festival & Asia 2020*" (SSFF&ASIA): an international competition on short films, that acts as a chance to receive a nomination to the Academy Awards, for creators from around the world (Short Shorts Film Festival & Asia, 2020);
- the "*Sony Talent League by Trojan Horse was a Unicorn (THU)"*: a challenge for creators that want to produce out-of-the-box works, which provide to the winner mentorship and funding to further his/her project (Trojan Horse was a Unicorn, 2020);
- the "*Trialog*": a tripartite dialogue experimental platform that explores the creative ways and state of next-generation creators (Sony, 2020).

Unscripted External Activities

Just like Nintendo, Sony also participates in most of the expositions and conventions held throughout the year to showcase and anticipate to its followers what they have to look forward to in the next year(s). Therefore, they actively participate to exhibitions at *E3*, *Nordic Game*, *San Diego Comic-Con*, *PAX* and *GamesCom*. Just like Nintendo they also have their own event, the *PlayStation Experience* (PSX), with the same intent to reveal and advertise the latest news for the company but, instead of being online as Nintendo Directs, the PSX is held alongside a different convention every year. Other than that, in order to create connections with its local community, Sony organizes the PlayStation Science Program, an event hosted in junior high schools to explain how games are created starting from science and mathematics that are taught in school. This allows for students to get interested in these subjects and makes them consider also careers in the video game industry, making them lean towards Sony (SIE, 2009; SIE, 2007-2008).

Further on, as a means to improve their understanding of their target users, in 2008, SIE created PlayStation Home, a social gaming community where users can interact as in any social media. It allowed users to create custom avatars and interact, via chat and vocal messages, with users all over the world. It was an interesting instrument for SIE to strengthen their knowledge in what their customers want, all by means of creating a community with which they could interact (SIE, 2015).

In general SIE tries to leverage its knowledge and potentialities by creating internal and external networks. This is usually done by working in tight relations with many software publishers (such as Insomniac, Factor 5 or Sucker Punch) when producing games: teams are formed by taking the most knowledgeable people from each company. This way different

experts from different backgrounds help enrich the game until it is a complete experience that can be approved by all staff members (Yoshida, 2007).

5. Conclusions

The main question that this thesis wanted to answer is how the video game industry evolved throughout time, what was the purpose of video games in the beginning and what is it now. Since the beginning of their spread there has always been a conflictual vision on them, which then was reinforced when the Atari shock and the related congressional hearings happened. In fact, during these years (1983-1993) video games started evolving in content, maturity of covered issues and difficulty of mechanics as the average age of the player increased. But this older audience led video games from being something used only to relax and spend free time with friends to a useful hobby. Content was more innovative and, in some cases, as demonstrated, it became a way to learn something new.

Despite cloud and online gaming through mobile phone being the driving forces of the industry in the recent years, it still was the video game industry of consoles that introduced some of the new technologies, such as augmented reality (AR), virtual reality (VR) and, precisely, cloud gaming, that brought to the swift development and spread of mobile gaming. For this reason, this analysis focused on consoles and the software developed for them over mobile games, since it is thanks to consoles, their technology and media form, that an innovation-driven video game industry can now be appreciated by anyone.

Some related topics were considered in this thesis: what were the innovations adopted to appeal to the general public and to expand the audience from only core and hardcore gamers, and which technologies, developed for video games' purposes, were applied outside their main field of usage.

Applying what Perrin describes as the "Best-Practices Approach", it has been possible to evaluate innovation the same way venture capitalists assess the value of their investments, therefore taking under analysis all of the technologies developed by Nintendo and Sony,

acknowledging when some failed during the years but also pointing out which one worked out (Perrin, 2002).

There has been an objective evolution in games' quality and features, therefore it seems inevitable that the requirements for some of the major players in the video game development had to increase in specificity. The subjects that have seen a main change in what was asked of them in order to be hired are: game artists, who had to learn to create 3D designs, and video game developers, who had to adapt to the technological advancement of programming languages. However, as it has been demonstrated more than once, individuals with different capabilities than the ones specifically required were able to provide precious inputs that lead to the creation of innovative console or software. This is the case of "*Splatoon*", Nintendo Wii, Nintendo 3DS, where knowledge was shared in order to create radical innovation (Zhu & Zhang, 2006).

There has been a slow and steady introduction of new technologies and innovations by both Nintendo and Sony, transforming what started out as a normal hobby into a totally immersive experience. All the network of complementary products created in the first place to stay relevant and gain competitive advantage over competitors ended up being innovations that were adopted by other sectors (Gallagher & Park, 2002). Example of this are the PSP or the Wii, both very innovative and both now widely used outside the gaming landscape.

In general, video games have become an instrument for those who use them, to learn about things they would not be able to learn otherwise or that would take them much more effort, like specific skillset or topics (Williamson Shaffer, Squire, Halverson, & Gee, 2005; Henderson, 2005). Both hardware and software innovation enabled this general growth in the community of gamers, that has itself increased in the number of participants thanks to the sheer

amount of different existing games, ideally enticing anyone, and to the easily understandable consoles.

Not all innovations introduced by Sony and Nintendo were ground-breaking, for example 3D, VR and AR existed elsewhere, and were merely adopted by these giants; the companies were however able to mildly innovate on these two fronts, but so doing they popularized some of their characteristics. With a novel reframing of previous technologies, as in the case of PlayStation consoles or 3DS, both companies were able to create something innovative and somehow disruptive of previous work-frames yet without actually producing something new from scratch.

As for the knowing communities, it has resulted that both Nintendo and Sony strongly rely on internal as much as external collectives. In fact, both have a structural organization that allows for teams to seek for external help and both promote activities to help their employees find new hobbies and activities to do outside their working field. For what could be found without direct sources, Sony more than Nintendo has ties with local communities throughout all establishments around the world. This means that Sony more than Nintendo is able to exploit this direct knowledge of its surroundings to enrich what they produce with on-field experience, rather than partnering-up with local companies. This is also true with regards to sponsorships, were Sony seems to be much more prolific and active in helping the next generations of innovators, even through the "*Sony Creators Gate*" project.

FUTURE RESEARCH

As far as this thesis is concerned there is still much more to do in order to examine the extent to which Nintendo and Sony innovated and changed the industry of video games, along with others. Starting off from the work this thesis has done, there could be direct interviews with employees at Sony and Nintendo, to confirm and expand what has been found. Afterwards

it could be useful to provide an extensive analysis of the overall video game industry throughout the period of time taken into consideration, to understand to what extent some actions taken by both companies were made in a defence/attack attempt toward competitors and which ones were genuinely taken in order to advance the company. It would also be extremely interesting to understand, possibly with empirical methods based on quantitative data, if Nintendo and Sony would result as innovative as they resulted from this kind of qualitative analysis. Lastly, to bring forth the overall analysis, it would seem interesting to understand why mobile and online games have taken over consoles in this radical way, possibly marking the start of the decline for this technology, or merely affecting the casual-gamers market.

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