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of Economics
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MESTRADO
GESTÃO DE SISTEMAS DE INFORMAÇÃO

TRABALHO FINAL DE MESTRADO
DISSERTAÇÃO

THE IMPACT OF CLOUD GAMING IN THE VIDEOGAME INDUSTRY

ANTÓNIO MIGUEL DA SILVA REIS DE MIRANDA RELVAS

ORIENTAÇÃO:

PROFESSORA DOUTORA WINNIE PICOTO

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I think that inside every adult is the heart of a child. We just gradually convince ourselves that we have to act more like adults.

- **Shigeru Miyamoto**

Acknowledgements

I would like to dedicate this work to:

My family for supporting me through this journey and above all the patience in these last difficult months.

To my grandfather, who fought hard for his health during these months while I was writing this document. This is for you!

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Abstract

Cloud gaming is a concept that is becoming more and more common within the videogame industry. Through the use of cloud technology, players can enjoy their videogames through internet streaming of data from datacenters around the world without the need of owning a piece of very powerful hardware like in previous times. Not only this, but the price of entry is considerable smaller when comparing to the previous paradigm within the world of gaming. Despite these advantages, this concept has struggled to gain traction over the past few years. Plus, it is not very clear what are the impacts of this technology in the industry it resides.

This study aims to identify these factors by answering the following research questions: 1. How does cloud gaming impact the videogame industry?; 2. What drives cloud gaming adoption by the videogame industry?; 3. Which are the key critical challenges and opportunities when implementing a cloud gaming solution?. In light of this, the objectives to achieve are the following: 1. Analysis of the main characteristics of cloud gaming and its differences from traditional gaming; 2. Present the main challenges of cloud gaming; 3. Understand the main opportunities of cloud gaming. To achieve this, it was opted to follow an exploratory approach given the lack of research in the area alongside a series of interviews to industry experts to collect data for analysis. Following that, transcripts were built, analyzed and discussed.

It was possible to conclude that cloud gaming impacts the industry in three main dimensions: technology, value chain and the industry's revenue streams. On the first dimension, the low barriers of entry in terms of hardware, the higher set of mobility and the ability to work on multiple devices were appointed as major opportunities for this technology which increase accessibility to this industry. Looking over the value chain, the opportunities reside in the developers through cheaper and faster development and finally, more revenue streams arise due to the advantages of this technology. There are, however, several factors that hinder this adoption of cloud gaming. The lack of quality internet infrastructure and skepticism among consumers prove to be two challenges that are difficult to overcome which may be one of the reasons why this technology has not really taken off.

Keywords: Cloud gaming; Videogames; Technology; Value-Chain; Revenue Streams

Resumo

Cloud gaming é um conceito que se está a tornar cada vez mais comum na indústria dos videojogos. Por meio do uso da tecnologia *cloud*, os jogadores podem desfrutar dos seus videojogos via *streaming* de dados de *datacenters* espalhados pelo mundo sem a necessidade de possuir hardware dedicado como antigamente. Adicionalmente, o preço de entrada é substancialmente reduzido, quando comparado ao paradigma anterior. Apesar dessas vantagens, o conceito tem tido dificuldades em ganhar tração nos últimos anos. Além disso, ainda não está definido quais serão os impactos desta tecnologia na indústria dos videojogos.

O presente estudo visa identificar esses fatores por meio das seguintes questões de pesquisa: 1. De que forma o *cloud gaming* impacta a indústria dos videojogos?; 2. O que impulsiona a adoção de *cloud gaming* pela indústria dos videojogos?; 3. Quais são os principais desafios e oportunidades na implementação de uma solução de *cloud gaming*?. Diante disso, os objetivos a alcançar são os seguintes: 1. Análise das principais características do *cloud gaming* e as suas diferenças em relação ao paradigma tradicional; 2. Apresentar os principais desafios na adoção da tecnologia *cloud gaming* na indústria dos videojogos; 3. Compreender as principais vantagens da adoção do *cloud gaming* na indústria dos videojogos. Para tal, optou-se por seguir uma abordagem exploratória dada a escassez de pesquisa na área seguido de uma série de entrevistas por forma a realizar a coleta de dados. Posteriormente foram construídas as transcrições das entrevistas, analisadas e discutidas.

Foi possível concluir que o *cloud gaming* impacta a indústria em três dimensões principais: tecnologia, cadeia de valor, e nos canais de receita da indústria. Na primeira dimensão, as baixas barreiras de entrada em termos de hardware, o maior conjunto de mobilidade e a capacidade de trabalhar em múltiplos dispositivos foram apontadas como grandes oportunidades para esta tecnologia. Este conjunto de características permite um maior nível de acessibilidade na indústria potenciando um maior número de oportunidades disponíveis. Olhando para a cadeia de valor, as oportunidades residem maioritariamente nos *developers* sob a forma de desenvolvimento mais rápido e barato. A nível de fluxos de receita, foi possível identificar um maior nível de inovação devido às vantagens inerentes da digitalização da indústria. Existem, no entanto, vários fatores que impedem a adoção desta tecnologia. A falta de infraestrutura de internet de qualidade e o ceticismo entre os consumidores são desafios difíceis de superar.

Palavras-chave: *Cloud gaming*; Videojogos; Tecnologia; Cadeia de valor; Fluxos de receita

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1. Introduction

1.1. Context

The video games industry is currently one of the world's largest markets surpassing, in value, the movie and the north American sports industry put together (Witkowski, 2021). Just in the United States of America alone there is an estimated count of 214.4 million players (*2020 Essential Facts About The Video Game Industry*, 2020) and the forecasts, presented by the world's largest intelligence companies, predict that this number is set to increase in the upcoming years.

Today, it is possible to play a videogame in a variety of devices. Ranging from the portable smartphone to the most hardcore gaming PC, the market is quite flexible in letting the consumer decide on how he/she wants to play his/her videogame of choice. The common ground in today's scenario though is that the software is ran locally. In other words, the frames and logic are being proceeded inside the silicon of the player's chosen device. The progress of technology allowed games to become increasingly more complex as computational and graphical capabilities in the hardware, among other factors, improved over the years.

The introduction of cloud computing to the world, however, brought new possibilities to this market in the form of cloud gaming. As put up by the words of *The Verge*, "*Today, you slide a disc into your game console, or download a game's files onto a drive. Your game only looks as good and only runs as fast as the processors inside your box. With cloud gaming, that "box" lives in a datacenter full of servers, miles and miles away. You stream games, just like you'd stream a YouTube or Netflix video, as a series of compressed video frames — only now, those videos are reacting to your inputs*" (Warren & Hollister, 2019, p. 1).

This new way of playing is leading many to believe that in a near future consumers will be able to scrap their hardware and simply stream their videogames across the internet (Patterson, 2021). In fact, companies that have little to no connection to this industry, such as Google and Amazon, have decided to set their operations and build Google Stadia and Amazon Luna. Both of these products are cloud gaming solutions that are available today for anyone who has an internet connection.

While, on paper, this seems like a concept that is ready for success, its journey has been quite a rocky one. On March 2010, the *OnLive* service was launched with the purpose of supplying customers, through a monthly 14.95 US dollars fee, the option to play games streamed directly from datacentres

without the need for local hardware. In other words, a concept superbly similar to the one's from Google, Amazon and Microsoft are using today. Yet, it only took two years for *OnLive* to layoff all of its employees and wait until 2015 to sell all of its assets to Sony Computer Entertainment due to poor sales and low publisher attraction (Mangalindan, 2020).

Today, the scepticism remains. The main reason appointed for this is the inability for cloud gaming to rival the quality of experience that a locally run game has (Mangalindan, 2020).

The cloud gaming phenomenon is of high interest to the author which has an extensive interest in the videogame industry. The motivation to research about the subject comes not only from that, but also from the desire to pursue a career in the videogame industry.

1.2. Gaps in literature and research questions

With a new generation of products being launched and with an increasing bet in cloud gaming from the big technological companies, it is only natural that scholars have started to turn their eyes into this technology. Despite of this, research is found to be quite scarce in understanding the overall impacts that cloud gaming may have at an industry level, especially, if more recent developments are taken into account (e.g., new players entering the industry).

While there are some studies (e.g. Cai et al., 2016b; Mariano & Koo, 2015) that really focus on the impacts of cloud gaming in the industry, by investigating two extinct cloud gaming services such as Gaikai and OnLive or by understanding if this concept is set to be the future of gaming, they fall short when looking at their development date. The above services, for example, no longer exist and have been integrated into other already existing products.

Others limit their research on certain pillars of the industry, such as game developing (Riungu-Kalliosaari, Kasurinen, & Smolander, 2013), gaming as a service (Cai, Chen, & Leung, 2014) or simply the technological underpinnings of cloud gaming (Cai et al., 2016a; Jarschel, Schlosser, Scheuring, & Hoßfeld, 2011).

Furthermore, other authors have attempted to research on the paradigm shifts of the videogame industry (Locke & Uhrínová, 2017; Rayna, 2014; Zackariasson & Wilson, 2010) at different levels but they never really took cloud gaming as focus, branching out to other aspects such as business model innovation, digital vs retail, revenue streams, among others. To add to this, the frameworks in these are based on existing literature and never seek to gather any data directly from the industry. This is

likely due to confidentially and nonpublic disclosure of data which organizations keep for competitive purposes. This limits research due to the layer of abstraction it has over the object of study.

As such, there is a research gap in this subject. More data and analysis are required to understand what the impacts of cloud gaming in the industry are and how they manifest on the several layers of its structure. Plus, given previous research is outdated, it is especially relevant to look at this concept once more due to the recent developments such as new players entering the market (e.g., Google and Amazon joining the market) alongside the further proliferation of cloud computing in organizations.

This study aims to understand and investigate further on the impacts of cloud gaming in the video game industry through the following research questions:

1. How does cloud gaming impact the videogame industry?
2. What drives cloud gaming adoption by the videogame industry?
3. Which are the key critical challenges and opportunities when implementing a cloud gaming solution?

The research objectives are the following:

1. Analysis of the main characteristics of cloud gaming and its differences from traditional gaming.
2. Present the main challenges of cloud gaming.
3. Understand the main opportunities of cloud gaming.

To fulfill these objectives, we saw fit to collect data directly from the industry by querying experts on the area about their views on how cloud gaming impacts the industry. This will not only give us a broader view on the impact, without restricting ourselves to a certain pillar of the structure, but also fill research with more data to explore upon. In sum, this paper will contribute to research on the area by providing new insights and ideas alongside collecting new data.

The remainder of this document is organized as follows: the next chapter will present a literature review about cloud computing, the videogame industry and cloud gaming. In chapter three, a description of the research methodology used will be showcased. Next, in chapter four, the document goes over the results presentation followed closely by the discussion chapter. Finally, the

study ends with the conclusions, limitations and future research alongside the interviews data available in the appendix.

2. Literature Review

In this chapter, we start by defining what exactly is a videogame, what type of videogames there are alongside the several devices one can use to play them. Afterwards, we explore the unit of analysis, the industry. We go through its structure, value chain, revenue streams so as to have a general understanding of how a new breakthrough force can dissipate and cause disruption.

With a deeper understanding of the industry, we dive directly into cloud technologies by analyzing its concepts, applications, advantages and disadvantages through the already written literature.

To finish off the literature review we introduce the concept of cloud gaming and describe, through the available literature, how it works, its applications, advantages and associated issues.

2.1. Cloud computing

Cloud computing had its roots set back in 1961 after John McCarthy, from MIT, delved into the wonders of how actual computing power would become a public utility, just like electricity or water (Surbiryala & Rong, 2019).

While very accurate in its prediction, it wasn't until more recent years that this concept came into fruition. With cloud referring to the "(...) carrier or provider who provides the services over the internet." and computing to the "(...) processing or computations or calculations or various resources that are provided by the computer" (Surbiryala & Rong, 2019, p. 1) one can put both quotations together and define cloud computing as the ability to provide computational power over the internet.

More formally, Peter Mell and Tim Grance (2011) introduced the following definition for this phenomenon: *"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models"* (Mell & Grance, 2011, p. 1).

The applications one can have for cloud computing are immense and can be applied to a variety of industries and scenarios (Shilpashree, Patil, & Parvathi, 2018). For it, as mentioned in the previous definition, there are currently three types of service models, each encompassing different

characteristics depending on the requirements of the targeted workloads (Vaquero, Rodero-Merino, Caceres, & Lindner, 2008). These are:

- **IaaS (Infrastructure as a Service):** Infrastructure resources (e.g., servers, processing capabilities) are managed by the service provider and are dynamically assigned to users depending on their needs and requirements (e.g. Microsoft Azure Virtual Machines).
- **PaaS (Platform as a Service):** Integrating IaaS, PaaS provides a development platform supporting the full software lifecycle allowing users to develop applications directly in the cloud (e.g., Google AppEngine).
- **SaaS (Software as a Service):** Integrating IaaS and PaaS, SaaS allows users to run applications through the cloud without the need for infrastructure or licensing costs as this included from get-go (e.g., Microsoft Office 365).

What distinguishes each of them is the layer of management one can choose (Shilpashree et al., 2018). For example, for SaaS the user or organization is only responsible for managing the application. All the underlying infrastructure (e.g., servers) and platform (e.g., databases, AppServer) is managed by the service provider. To add, cloud computing also has four different deployment models available: public cloud, private cloud, hybrid cloud and community cloud (Dillon, Wu, & Chang, 2010).

In a cloud deployment, resources need to be elastic as different workloads can run on the same shared hardware. Due to this reason, service providers, for public cloud environments, developed resource abstraction technologies which make this a possibility (Shilpashree et al., 2018). Depending on the organization, one may see different concepts and approaches such as Microsoft's Hyper Virtualization. Thus the ability to virtualize servers, storage and network (Shilpashree et al., 2018) opens many opportunities and provides numerous advantages to organizations.

Companies have the possibility to save money as the up-front costs that would otherwise be necessary to maintain a complete infrastructure are no longer required (Ananthi & Hariganesh, 2015). Organizations can reduce the number of IT staff needed to maintain the resources given the maintenance is mostly offset to the service provider (Aljabre, 2012). The level of resource elasticity allows for on-demand scalability depending on business needs as opposed to fixed capacity in a local datacenter (Shilpashree et al., 2018). Also, inevitably, public clouds have a greater level of disaster recovery and backup possibilities due to multiple options for data redundancy available on a public cloud (Ananthi & Hariganesh, 2015).

To leverage these advantages, companies have started to adopt cloud computing in a larger degree, due to the increasing need to become more digital. In light of this, the videogame industry is no different hence the rise of cloud gaming as a possible new paradigm.

2.2. Videogame industry

To understand the industry, we must first understand what encompasses a videogame and the technology associated with it. Over the years, scholars have had a hard time finding an exact definition to what exactly is a videogame due to the variety of experiences and shapes one may take (Tavinor, 2009). As suggested by Frasca (2001, p. 4), videogames are *“any forms of computer-based entertainment software, either textual or image-based, using any electronic platform such as personal computers or consoles and involving one or multiple players in a physical or networked environment”*.

They consist of four main elements - Game, play, story and audiovisual apparatus - that manifest differently in each exemplar (Esposito, 2005). Albeit flawed (Clarke, Lee, & Clark, 2017), videogames are often categorized within genres (e.g. RPG, Action games, Racing games) which group videogames together, with similar themes, topics and characteristics within a single domain for identification purposes (Arsenault, 2009).

2.2.1. Videogames and technology

Videogames can be played on a wide variety of devices available today. According to NewZoo, the market is currently separated between three major platforms encompassing different segments inside each (Wijman, 2019):

- **Mobile:** Characterized by tablet and smartphone videogames available on both the AppStore and Google Play.
- **PC:** Characterized by videogames that can be played on any operating system (e.g., Windows, MacOS, Linux) or through a browser.
- **Console:** Characterized by videogames that are played on dedicated hardware such as the Xbox Series X/S, PlayStation 5 and Nintendo Switch.

Videogames are inherently linked with technology (Zackariasson & Wilson, 2014). Its natural evolution led to many forms and takes over the past 40 years. In the beginning, systems were built

to run a single compatible game when in 1977 the first console with interchangeable cartridges was introduced (Zackariasson & Wilson, 2014). This was a major technological step, given the player now had the ability to use the same system to play different videogames.

To add, the increasing development of new hardware, which in turn, increased graphical fidelity in videogames alongside new and improved tools for developers, which facilitated workflows and game design, alongside other factors made us go from the simple Pong game to the photorealistic Cyberpunk 2077 game in the short span of 40 years (Zackariasson & Wilson, 2014).

It did not stop there as the proliferation of smartphones and other devices, with their ever-increasing raw power, were now opened to run demanding videogames just like previous dedicated hardware.

2.2.2. Value chain of the videogame industry

According to González-Piñero, a “*value chain is the breakdown of an organization into its strategically relevant activities in order to understand the behavior of costs and existing differentiation pathways.*” (González-Piñero, 2017, p. 18).

Zackariasson & Wilson (2014) define that the dominant value chain of the videogames industry encompasses six players:

1. **Developers:** the agent who makes the actual videogame itself. It can include a large number of individuals or a smaller team depending on the scale. It is responsible for building the software’s characteristics such as sound, design, graphics and code and putting it all together on a cohesive experience for the player.
2. **Publishers:** they are responsible for bringing the final product to consumers. Working with a variety of developers they build a portfolio of products that are deemed attractive to customers and fund them accordingly. They can also be responsible for the marketing, manufacturing and distribution of the final product.
3. **Distributors:** Responsible in moving the product to the end customer they are often forgotten given most publishers have their own distribution networks.
4. **Retailers:** They sell the product to the end customer. They can range from specialty stores to more general media stores, supermarkets or grocery stores.
5. **Customer:** The individual of who buys the product.
6. **Consumer:** The individual who consumes the product.

González-Piñero (2017) added another layer to this chain, with hardware manufacturers sitting on top of developers. This agent is responsible for supplying the required hardware for videogames to be played and is one of special importance given software titles performance have a high correlation to the hardware they are running on (Marchand & Hennig-Thurau, 2013). It is perhaps one of the reasons why console gaming, even today, works through generation timestamps. To put it in other words, every set of years, hardware is refreshed marking the beginning of a new generation. With better specifications, videogame studios now have the possibility to improve on a variety of characteristics of their software such as graphical fidelity and push customers over to a new platform.

Until the introduction of the internet, this structure remained largely unchanged, as games were still sold as physical products despite being digital in their nature (Zackariasson & Wilson, 2014). After its democratization though, a new option of purchasing videogames was introduced under the form of an online store where the consumer has the possibility of downloading a copy of his desired game onto the internal storage of their system and play it from there (Mattioli, 2021). This prompted a disruption in the value chain as the main endeavor involving retailers and distributors was no longer required (González-Piñero, 2017).

2.2.3. Revenue streams in the videogame industry

According to Zott and Amit (2010), a business model is defined as a system of interdependent activities that allow for an organization to capture and deliver value across all parties involved in the interaction.

The democratization of the internet allowed for an increased number of individuals to have access to digital platforms which, in turn, brought companies to invest far more in these channels utilizing new revenue streams (Gatignon, Lecocq, Pauwels, & Sorescu, 2017). Inherently, these shifts due to technological progress had direct impact in how organizations built their revenue channels and implemented them in the videogames industry (Zackariasson & Wilson, 2010).

With this in mind and seeing we are trying to study the impact of cloud gaming on our object of study, we see it as important to understand the current and past revenue streams on a broad fashion. González-Piñero (2017) proposes three different revenue models currently in usage:

- **Pay-To-Play:** The videogame is locked behind a one-time fee payment. The purchase can either be done digitally (e.g., digital store) or physically (e.g., retail store).
- **Free-To-Play and Freemium:** The player is free to enjoy the video game without any up-front costs. Revenue is obtained through in-game purchases of extra content through microtransactions.
- **Advertising:** Through different strategies, revenue is obtained in the form of ads displayed in the videogame.

More recently, subscription models have also gained popularity among organizations in the industry with examples such as Xbox Game Pass and Google Stadia. Under a monthly fee, the consumer has access to a library of videogames at its disposal to choose from (Davidovici-Nora, 2014).

2.3. Cloud computing applied to the videogame industry

2.3.1. Cloud gaming

As seen in the previous chapter, technology advancements have impacted the videogame industry in several ways over the past years. The concept of cloud gaming leverages technology once more by utilizing cloud computing to stream videogames across the internet. Instead of using local hardware, such as a videogame console, smartphone or PC, to render the image and process the logic, this activity is offset to datacenters far away from the player. The resulting output is then sent back to the client's device where the player is enjoying the game (Jarschel, Schlosser, Scheuring, & Hoßfeld, 2013). This client's device only needs to connect to a designated controller and decode video through a cheap decoder (Cai et al., 2016a).

In many ways, it is very similar to services like Netflix or Amazon Video. The key difference here is that data is constantly flowing between the client and the servers due to the inputs generated by the player (Jarschel et al., 2013).

Using a practical example, if one is playing Destiny 2 through Google Stadia, a cloud gaming product, the gunshots triggered by the remote controller (input) are sent to the servers which then process the upcoming frame upon receiving this signal (output). Traditionally, this process was done locally inside the device's hardware.

Arguably, cloud gaming may be confused with a simple multiplayer match. However, it is important to highlight that in a traditional online videogame experience, such as P2P FIFA Game, the frames are still being rendered and processed locally (Jarschel et al., 2013).

During the end of the 2000's, this concept started to gain traction in the industry with services such as Gaikai and OnLive, two extinct cloud gaming services. With a positive prospect as the future of the videogame industry, the outcome was not so good given the shortcomings and limitations that prevented it from gaining more attraction between players (Mariano & Koo, 2015).

Naturally, scholars have attempted to identify the key advantages and compromises this technology has when applied to the videogames industry. Ranging from technological factors (Cai et al., 2016a; Silva & Martins, 2019; Ungureanu, Panu, & Alboaie, 2015), value chain transformations (González-Piñero, 2017) and disruption in the business models' revenue streams (González-Piñero, 2017; Jarschel et al., 2013; Ojala & Tyrvaainen, 2011), we categorized each below:

A: Technological impact

Cloud gaming technology brings the player's system user requirements down significantly given videogame's required processing is offloaded to the service provider's datacenters. Before, demanding software was ran locally which required potent enough hardware. With this concept, the user's device acts as a thin client which doesn't require powerful silicon to run. To add, given hardware is managed by the service provider, the player no longer needs to upgrade its platform on a constant basis which results in a much lower price supported by the user (Ungureanu et al., 2015).

As videogames file sizes grow larger, local storage becomes a weak point. With cloud gaming this limitation is completely overcome given the software is stored in the datacenters. Moreover, patches and updates are installed directly on the source and given there is no local version, players no longer need to wait or install big and lengthy new versions of their videogames of choice (Ungureanu et al., 2015). The digital nature of cloud gaming and the low requirements of the thin client provides the ability for players to access their videogame on any device at any time (Cai et al., 2016a).

Additionally, cloud gaming allows for videogames to become cross-platform and work on multiple devices with the same base code as opposed to the previous paradigm where one developer had to build multiple versions for the same game to work on different platforms (Ungureanu et al., 2015).

Finally the high capacity of data centers in processing power brings new opportunities for virtual reality and augmented reality videogames (Cai et al., 2016b)

Despite the potential advantages, cloud gaming also has technology shortcomings. Network quality is of extreme importance for cloud gaming operations (Cai et al., 2016b; Jarschel et al., 2011, 2013). Low latency and high bandwidth are mandatory requirements in order for the player to have an enjoyable experience or, at least, one that matches the already traditional paradigm in existence (Jarschel et al., 2011). Some videogames are far more dependent on these parameters than others with reasons appointed to responsiveness necessities (Cai et al., 2016b). For example, a motorsport simulation game like iRacing, where players race against each other on virtual representations of racing cars and tracks, a high latency value will cause the inputs to have a delayed response on the screen. This will, in turn, hamper the ability to control the car, hence hampering the experience for the player.

Additionally, as more players adopt cloud gaming in the future, networks will naturally suffer from increased traffic. This change may prove to be a problem given the current internet infrastructure is not ready to withstand the needs for such usage (Mariano & Koo, 2015).

Lastly, cloud gaming providers need to design high performance, stable and scalable infrastructure alongside acquiring high-end hardware in order to provide a high-quality experience to their players. This tall barrier presents itself as a challenge for adoption of this concept (Ungureanu et al., 2015).

B: Value-chain impact

The emerging videogame industry value chain is presented with several opportunities and challenges when exposed to cloud gaming (González-Piñero, 2017). On a developer's level, with videogames becoming cross platform, developers no longer need to develop different versions of their products. This allows for a reduction in production costs and development time (Ungureanu et al., 2015).

Publishers can use the digital nature of cloud gaming to better manage digital rights as combating piracy becomes easier since the software is only present in the service's provider datacenters only (Gupta & Dutta, 2016; Ungureanu et al., 2015).

Distributors and retailers lose their role in the value chain given, in a cloud gaming environment, there is no physical object present in a transaction with the customer (Mariano & Koo, 2015; R, P, Mahdhor, & Kumar, 2017). Adversely, developers and publishers can take advantage of this factor as they are no longer dependent of these agents to channel their products to the customer (Mariano & Koo, 2015).

The main impact caused by cloud gaming in the value chain of the industry is the introduction of a new agent in the form of service provider (González-Piñero, 2017). These take the form of Microsoft, Google and Amazon, for example, each owing their own service. They oversee and operate the data centers that keep the service up and running and also have their own stores and channels to provide videogames to consumers. This level of convergence contributes to the increasing disintermediation, given service provides stop being dependent of publishers, distributors and retailers alike (González-Piñero, 2017).

C: Revenue streams impact

With cloud gaming, developers have further access to more ways of monetizing and commercializing their products (Mariano & Koo, 2015) and above all, transition from a packaged software industry to one which embraces Software as a Service (SaaS) (Ojala & Tyrvaïnen, 2011). In fact, the term Gaming as a service is often attached to cloud gaming (Cai et al., 2014) in order to describe the impact this concept has on the industry's business models and its components.

This enabler for change is only compromised by the uncertainty of the consumer in adopting said new revenue channels as, at the moment, it is not entirely clear players are willing to forfeit the more traditional models in existence (Marchand & Hennig-Thurau, 2013).

2.4. Impact of cloud gaming in the videogame industry

Below, Table 1 and Table 2 describe the challenges and opportunities that each discussed dimension of the videogame industry is faced with when exposed to cloud gaming according to explored literature above. These were used to build the questions for the interviews available in Appendix A.

Table 1: Challenges

Dimensions	Challenges of cloud gaming	References	Questions	
Technology	Network quality is of extreme importance for cloud gaming operations.	(Cai et al., 2016a; Jarschel et al., 2011, 2013)	4. From a technological standpoint, which factors do you consider to be the main challenges of cloud gaming?	1. What is the future of the videogame industry? 2.2. What main differences can you identify between cloud gaming and traditional gaming? 3.1. In light of this, what other areas can/could be impacted by cloud gaming? 8. What are the critical factors that you believe that cloud stop cloud gaming from becoming more widespread in the industry?
	Low latency and high bandwidth are mandatory requirements for a high-quality playing experience.	(Jarschel et al., 2011)		
	Current internet infrastructure is not ready to withstand increase in network traffic as cloud gaming adoption increases.	(Mariano & Koo, 2015)		
	Cloud gaming providers need to invest and design a high-quality infrastructure to support cloud gaming.	(Ungureanu et al., 2015)		
Value Chain	Retailers and distributors see their activity drop due to the 100% digital nature of cloud gaming.	(González-Piñero, 2017)	5.2. What challenges does it bring?	
	Convergence of the activities of the value chain to one single agent (service provider) eliminating the need for intermediaries.	(González-Piñero, 2017)		
Revenue Streams	Uncertainty regarding the revenue streams result of the transition from a packaged software industry to one which embraces software as a service (SaaS).	(Marchand & Hennig-Thurau, 2013; R et al., 2017; Soliman, Rezgui, Soliman, & Manea, 2013)	6.1. These new revenue channels, how do you see customer's reception on them?	

Source: Author

Table 2: Opportunities

Dimensions	Opportunities of cloud gaming	References	Questions	
Technology	User's system requirements are lower	(Gupta & Dutta, 2016; Ungureanu et al., 2015)	4.1. What about advantages and opportunities?	1. What is the future of the videogame industry? 3.1. Do you consider there are further areas of impact, by cloud gaming, in the industry? 7. What factors do you believe that positively increases cloud gaming adoption in the videogame's industry?
	User's system storage requirements are reduced to a minimum as storage is done at the service's provider level.	(Ungureanu et al., 2015)		
	As the thin client's requirements are low, cloud gaming supports a greater number of devices.	(Ungureanu et al., 2015)		
	Game installation, patching and downloads are no longer required.	(Ungureanu et al., 2015)		
	Cloud gaming's high processing power brings new opportunities for development of VR and AR videogames.	(Cai et al., 2016b)		
Value Chain	As videogames become cross-platform with cloud gaming, production costs and development time are reduced.	(Ungureanu et al., 2015)	5.1. What opportunities does this concept generate in said layers?	
	Improved management of digital rights as piracy is reduced due to software storage being offset to datacentres.	(Gupta & Dutta, 2016; Ungureanu et al., 2015)		
	Developers and publishers no longer need retailers and distributors due to the 100% digital nature of cloud gaming.	(González-Piñero, 2017; Mariano & Koo, 2015)		
Revenue Streams	Cloud gaming enables developers to access more ways to monetize and commercialize videogames.	(Mariano & Koo, 2015)	6. How can cloud gaming act as an enabler for innovation in the videogame's industry revenue channels?	

Source: Author

3. Research Methodology

With the objective of answering the research questions described in the introduction: “How does cloud gaming impact the videogame industry?”; “What drives cloud gaming adoption by the videogame industry?” and “Which are the key critical challenges and opportunities when implementing a cloud gaming solution in the industry?”, an exploratory study was chosen with a qualitative component that is described in the chapters below.

3.1. Qualitative study

Cloud gaming is a topic that is not well versed within existing literature, especially if we branch out of the technical aspects inside it. Given this scarcity of information and the existing one lacking recent update, an exploratory study was the most appropriate option chosen to answer these research questions. These type of studies provide the option for the researcher to gather new findings, insights and assess certain phenomena under a new point of view (Saunders, Phillip, & Thornhill, 2007). Not only is this compatible with the object of study at hand but exploratory studies also have the characteristic of being flexible enough to start with a broad initial focus which becomes thinner as work progresses (Saunders et al., 2007).

Within this exploratory study, a mono method qualitative approach was chosen. Qualitative research applies to subjects of study where little to no information is available and it is often used to generate new hypotheses and theories for future research. In contrast, quantitative research is often used to confirm already existing or developed premises by scholars and is supported by a numerical, less subjective, method of research (Antwi & Kasim, 2015). To collect said data, available in Appendix B, interviews to a panel of experts was the chosen option.

3.2. Data collection

Interviews have proven to be a reliable source of data collection which capture valid and reliable data to answer one’s research questions with the added value in which they provide the opportunity to lead the discussion into scenarios that have not been thought out previously or were never been explored before (Saunders et al., 2007).

To emphasize this last factor, this study opted to use semi-structured interviews to grab the most data as possible, even outside the pre-defined expected results (Saunders et al., 2007). In other words, some of the questions used in the interview guide, available in Appendix A, were not used in sharp contrast with others that were added as the conversation went by.

Given the unit of analysis is the videogame industry, it was opted to query individuals that have, or had, experience working in this industry, especially ones that had previous contact with this technology. Given the study looks over several dimensions, it was also decided to focus on interviewing people with a variety of roles in order to understand different perspectives that might exist.

As such, we can confirm that the sample of study was not picked out randomly and the criteria for choosing the individuals to interview was based on their relevance and knowledge of the subject, which is a component found to be important for the purpose of this study (Kothari, 2004). The approach and request for the interviews was done through *WhatsApp* with a small introductory text. The contacts were captured through the author's own professional network. All interviews were strictly made under the agreement of confidentiality in order to make the individuals being queried more comfortable in answering the questions with their honest opinions and views without the fear of backlash (Saunders et al., 2007).

The number of people interviewed was determined by achieving the saturation point of the data collected, in other words, after six interviews with experts it was found that the answers to the questions did not suffer much variation and the ideas retained were very similar within the invited individuals. This factor allowed us to extract reliable conclusions based on the provided answers (B. Saunders et al., 2018).

Table 3: *Characterization of the interviewed individuals*

Number	Role	Type of Company	Duration	Interview Tool
INT1	Communications Manager	Gaming Marketing Agency	1h 20min	Microsoft Teams
INT2	Program Manager	Videogame Developer	50min	Microsoft Teams
INT3	Community Manager	Cloud Gaming Provider	1h 18min	Microsoft Teams

Number	Role	Type of Company	Duration	Interview Tool
INT4	Marketing Coordinator	Cloud Gaming Provider	60min	Microsoft Teams
INT5	Consultation Specialist	Videogame Developer	57min	Zoom
INT6	Marketing Coordinator	Cloud Gaming Provider	1h 15min	Microsoft Teams

Source: Author

All interviews were performed in English and included a small collection of data, displayed in the Table 3 above. Interviews were recorded through Microsoft Teams with the option of automatic transcription enabled with the exception of INT5 where it was done manually. Despite this automatic process, all the transcripts were reviewed in detail in order to have a clean and precise dataset (Saunders et al., 2007).

3.3. Data analysis

To analyse the collected data, interviews’ transcript files were uploaded to MAXQDA, a software tool to perform qualitative data analysis. This software allows the researcher to build codes, that contain the topics and themes of their study, which then can be used to code the interviews’ output. In this study, an open coding process was used for the transcripts (Saunders et al., 2007) with several iterations around them. Each code designates categories and subcategories that can be associated to a certain topic or pattern spoken by an individual. This process helps to identify and organize the collected data allowing the researcher to analyse and draw conclusions from it (Saunders et al., 2007). Once a definitive structure for the codes was found another reiteration was done to make sure the consistency was good across all transcripts.

The codes exhibited on Appendix B follow the structure of the interview questions and are separated per the discussed dimensions. This configuration was done in order to be consistent with the literature review so that we are then able to compare the already found factors to the ones mentioned by the interviewees. The last two codes (Q8, Q9) represent the factors that experts found to be the enablers for cloud gaming adoption alongside said blockers.

4. Results Presentation

In order to answer the research questions mentioned in the introduction and fulfil the required objectives the following results will be structured in five sub chapters: adoption of cloud gaming; impact of cloud gaming: technology; impact of cloud gaming: value chain; impact of cloud gaming: revenue streams and impact of cloud gaming: other dimensions.

For the three dimensions sub chapters (Technology, Value Chain and Revenue Streams) we look over the opportunities and challenges individually so as to compare them to what was explored in table 2.4. This is to have a consistent match to what was written in the literature review. With this approach we will be able to validate the already identified characteristics of cloud gaming and bring newfound ones into perspective.

This data presentation is based on the output of the codification process, described above. In Appendix B and C, we list the codes created on MaxQDA used to narrow down the topics and themes of discussion during the interviews. With each code, a small description is attached, joined by the frequency of mentions of said theme alongside an example quote from one of the individuals. The quotations presented below were the product of this codification and analysis process.

4.1. Adoption of cloud gaming

Before venturing into each designated dimension, we interviewed the individuals about what the future of the industry holds and what will be the key factors playing within it. The purpose of this question was to make a bridge and to understand how the cloud gaming opportunities and challenges would fit in these scenarios and what the main reasons driving cloud gaming adoption are.

All of the respondents highlighted cloud gaming as being the future of the industry *“we’re seeing a big switch that obviously has happed gradually, but especially in the last few years. If we look specifically at cloud gaming, its nowhere near the same thing it was two or three years ago. In the past two years it skyrocketed”* (INT1). Additionally, they mentioned the increasingly higher bet in digital media for the industry, *“because they are preparing for a future where, we will no longer have consoles”* (INT1), gaming as a service, *“I mean it’s very clear that we are starting to go towards the subscription business model, which is in line with most streaming services these days”* (INT3) and virtual reality as other factors coming into a near future.

The interviewed individuals also focused on three main topics which overlap each other according to their feedback. They are accessibility, diversity and new applications for videogames. Quoting, *“So were getting up to a point where pretty much everyone independently of their capacity to purchase a device, can enter this technology and actually enjoy and take pleasure in gaming in general”* (INT3) which in turn has repercussions on the diversity of the industry due to the increased accessibility projected for the future – *“Where gaming is no longer for a single group of people or for a specific set of people. It’s for everyone”* (INT3). The increased diversity sparks more creativity among the players of the industry – *“the fact that everyone in any country, doesn't really matter, like their economic power or like where they come from or their background to be able to play any game from a pretty like you know, not even a super advanced device like mobile and everything I think will spark a lot of creativity”* (INT2) leading to new applications for videogames *“(…) and really we’re going to start seeing a lot of different applications for games”* (INT2).

4.2. Impact of cloud gaming: technology

4.2.1. Challenges

From a technological perspective all of the respondents highlighted the difficulties in having a high-quality playing experience through cloud gaming with a less than optimal internet connection. Quoting, *“The main issue is actually around networking and how fast both Wi-Fi and landlines are right now”* (INT2) or *“Cloud gaming requires a good internet connection, right? What I feel about cloud gaming is that some places in the world are not ready for it because there are regions in these countries where you don’t have a good internet connection”* (INT4). While there was mention of some progress in this area by the individuals, they still focused on it being the main blocker for adoption of this technology - *“Internet is a big, big thing. Not everyone in the world has access to a quality internet connection which is one big issue with cloud gaming”* (INT4).

The respondents added that cloud gaming requires a costly and complex infrastructure to run on – *“(…) We set up datacentres, which takes years and years of work and cost investment”* (INT2) and that due to this reason companies that already have an implemented cloud infrastructure have a higher level of leverage compared to smaller companies that wish to use it – *“Development of cloud gaming is actually pretty locked into like one or two major companies of the world. So, it’s like it has to be Facebook, Microsoft, Apple and Google because the costs for these companies to build a reliable*

infrastructure that will actually make cloud gaming viable are massive” (INT2). The data shows that the outcome of this factor is quite polarized “I think it could be a mist of disadvantage or challenge and also opportunity” (INT3). It poses as an advantage for already established cloud service providers because it locks cloud gaming development to them and on the other side of the coin, it poses as a challenge for smaller, upcoming players that want to adopt this technology – “So obviously, for any other players in the market, it wouldn’t be as easy to get into these kind of technologies because they don’t have the resources (...) anyone that wants to get into this technology probably won’t have the same reach for those that are already there” (INT3).

The questioned individuals highlighted that there is a strong shift to digital media in the industry especially under the form of subscription services *“Just like Netflix and Spotify subscriptions, I think the trend for the future is a subscription-based model” (INT4)* and digital games *“Digital sales have rose up a lot in the last year, so not even talking about cloud gaming, but owning digital games has been a pretty big thing” (INT1)*. The transition of ownership from the consumer to the developer or service provider, due to the above, raised one topic of discussion with INT3 which argues that this ownership shift is set to raise issues among consumers, citing various questions with a high level of concern - *“If I bought a license or if I’m still paying the subscription, will I ever have control off my games or what happens when a platform holder vanishes from the scene?” (INT3)*. Additionally, one respondent highlighted that there is still a big market for people that collect physical media *“(…) still many people, not everyone, but many people still want something physical that they can hold onto and collect” (INT1)*.

The concerns and questions raised over the interviews about this topic, culminated in a discussion about consumer perception. This factor was identified as a major blocker and one topic of important consideration about cloud gaming’s popularity - *“Some youth might be more willing to accept as opposed to older people who might be scared of it because many people feel like they don’t own games, or they don’t own their own stuff which at some point is true” (INT1)*. It was mentioned as well that this service requires a compatible device to run on *“Well, one of the limitations that I think somehow is disregarded is you could be playing on your PC, phone, tablet or television screen and while you don’t need a lot of power, you still need some. So, someone that has a very old phone or a bad PC, they still won’t be able to play with cloud gaming.” (INT1)*.

Finally, from a technology perspective, the interviewed individuals identified service availability as a critical blocker for cloud gaming adoption or, in other words, the percentage of time that the product is unavailable or incurring downtime, *“In terms of availability, how can one ensure that*

sometimes, maybe a few hours, maybe a few days or who knows throughout the whole year, there aren't going to any outages, right? It's obviously not impossible" (INT3). Plus, they also expressed worries about the ability for the current infrastructure to handle the capacity in a scenario where there are multiple players consuming media in 4K, *"Let's say if everyone wants to play a game in 4K (...) it probably wouldn't be possible for the data centres to handle all the traffic"* (INT5).

4.2.2. Opportunities

From an opportunity level, all of the respondents agreed that cloud gaming provides a higher level of accessibility for the consumer due to the low barriers of entry – *"I think the main one for me is totally reducing the barrier of entry for games. I think that's the main thing that we're actually solving with cloud gaming and making sure that everyone basically has access and the ability to play any game that they actually want"* (INT2). This factor is vastly influenced by the characteristics that cloud gaming has in its architecture. The low hardware requirements - *"You don't need to have a very powerful machine to run things and that is a pretty big advantage"* (INT1), the ability to function on multiple devices – *"The biggest point is the ability to play across multiple devices"* (INT4) which in turn provides more reach to various consumers – *"You are no longer limited to a specific device, it's completely device agnostic, right? So, the kind of reach that one can have with cloud gaming is obviously both from a user perspective, but also from a developer, publisher and platform holder perspective, considerably higher when compared to previous times"* (INT3) and the higher level of mobility – *"Even if it's just your mobile phone, because of this technology you can just play your game from anywhere"* (INT2) all put up together provide an overall level of accessibility that could not be achieved with the more traditional videogame consoles paradigm. This, in turn, allows for a major growth in the pool of available customers around the world, according to the respondents.

Cloud gaming's storage capabilities were also appointed as an opportunity (INT1, INT4), with special mention to the ever increase age where videogames occupy a large amount of memory storage in the consumer's hardware. Naturally, as cloud gaming depicts a scenario where video games are streamed over the internet there is no physical need to have a hard drive but only a thin client to receive the data which is a sharp contrast to paradigm in existence. Ending this dimension, platform parity was also a topic of discussion among the interviewed individuals. This aspect is inherently linked to the value chain in the sense that all cloud service providers run the same version of the game as opposed to the videogame console paradigm that existed until now – *"Developers*

might want to try new stuff in how they build their games, and they will also only need to build one version of the game given the nature of cloud gaming” (INT6).

4.3. Impact of cloud gaming: value chain

4.3.1. Challenges

Following the structure of the literature review, the interviewed entities also highlighted some challenges at a value chain level. All of the interviewed individuals highlighted that retailers are no longer necessary in a videogame industry cloud gaming scenario - *“As cloud gaming ramps up and starts being a viable solution, for players everywhere, people will just buy immediately from this source. There’s no use case for a middleman like the retail stores” (INT2).*

More so, this disintermediation, apart from being applicable to the retailers, is also reference to publishers and developers alike in two, very similar scenarios, which appoint to the greater leverage that a cloud gaming platform and/or services providers have in the value chain equation.

From a developer perspective, platform holders have the ability to filter out which videogames they decide to publish or not - *“A platform holder can actually decide upon publishing your game or not, right? Which is something that we usually don’t have any problems in physical stores” (INT3).*

On the publisher side, they suffer from the same disintermediation that is present within the retailer’s agent. They are no longer required given the platform providers can publish their games directly with the developers – *“At the end of the day the platforms will be the ones owning the storefront” (INT3).* This individual particularly identified the aspect that in a cloud gaming environment, developers will go directly to platform holders for publishing given physical copies are no longer required. It provides a more efficient economy for developers in their development cycle that proves to be an advantage to the developers and platform holders’ parties. Naturally, this is a collective challenge for publishers.

4.3.2. Opportunities

Most of the opportunities appointed by the data reference the developers. Increasingly lower costs *“They don’t need to worry about the development cost so much because they are just developing to one platform in specific and then the platform will take of the rest” (INT3)* and faster development cycles culminate in the multiple new opportunities of development that this agent is presented with

when adopting cloud gaming – “(...) *the type of games that developers will make might be changed by this, because when we’re talking about cloud gaming obviously there are certain business models that need to be put in place*” (INT2). Plus, the platform parity aspect mentioned above highlighted the reach that developers can now have due to lower complexity of videogame development – “(...) *the kind of reach you can for your game is huge, I mean you are no longer limited to a specific device (...)*” (INT3). Additionally, the digital nature of this service allows for publishers and developers alike to build their videogame storefronts “(...) *so publishers are creating their own platform*” (INT1).

4.4. Impact of cloud gaming: revenue streams

4.4.1. Challenges

Lastly, we also approached cloud gaming’s impact in the industry’s revenue streams. It was mostly unanimous that cloud gaming is an enabler for innovation in this topic, however, the experts noticed that these new channels may prove to be difficult to be accepted by the customers - “*some youth might be more willing to accept this as opposed to people who are older where they might feel like they don’t own the games*” (INT1).

Additionally, when discussing the critical factors for cloud gaming adoption in the industry, the price and long-term profitability was also a theme of discussion highlighting the challenges that may arise when developing and implementing new revenue streams in a cloud gaming environment, “*it is difficult to understand how developers will survive the subscriptions models that are coming up nowadays*” (INT6) and “*I do think that right now companies are betting a lot on cloud gaming and potentially even like, taking a loss in terms of business and money with the prospect of it being the next big thing*” (INT2). The uncertainty surrounding these new revenue streams also reflects the critical necessity of the price of the product being correctly aligned with the customers’ expectations “*The price needs to be right and obviously this is always a challenge*” (INT3).

4.4.2. Opportunities

All of respondents agreed that cloud gaming is an enabler for the creation of new revenue streams within the industry - “*I do think new revenue streams will come up as part of this, cloud gaming revolution*” (INT2).

4.5. Impact of cloud gaming: other dimensions

The interviewees also emphasised two undocumented dimensions that are target of cloud gaming impact.

Firstly, the social dimension - *“I think there’s a social opportunity of bringing communities together through games and people that live apart from each other and just bring the closer and really have fun through cloud gaming”* (INT4). Most of the arguments over this topic were related to how cloud gaming is largely more accessible than previous paradigms which in turn increase the pool of players thus increasing diversity in the industry – *“We are no longer blocker to certain countries. I can make friends all over the world. This could be certainly an un-blocker, so from a social aspect, it’s also a very important aspect to take, but then again it all comes down to accessibility”* (INT3).

Secondly, INT5 highlighted upcoming possible environmental negative repercussions due to the increase of cloud gaming and the consequent growth of data centres around the world - *“because there is a lot of backlashes regarding it, servers are very expensive and need a huge amount of energy to run that is way worse than having a console at home”* (INT5).

5. Discussion

From a technological perspective, cloud gaming’s main blocker and challenge continues to be the reliance in the players internet connection which depending on its quality might impact the playing experience in a negative way (Cai et al., 2016a; Jarschel et al., 2011, 2013). Given cloud gaming relies on the transit of information from the service provider’s data centres to the players thin client it is only natural that a weak bandwidth will cause disruption in the player’s gaming experience. It is a difficult challenge to tackle - *“Offering high-quality cloud gaming experience with remove cloud through the public internet however, is no easy task”* (Cai et al., 2016b, p. 1) and is clearly echoed within all the interviewed individuals which refer that the main blocker for the adoption of this technology is the need for a high-quality internet connection that is not available in every place of the world. Additionally, this technology requires a high level of investment to be implemented especially due to its cost and complexity (Ungureanu et al., 2015). This sentiment is equally mentioned by some of the respondents (INT2; INT3) and the outcome of the conversation proved that this factor is a double-edged sword. For newcomers that wish use to cloud gaming they will be faced with the challenge of the service provider’s high leverage. They control the platform so the

developers will be succumbed by the rules and reach that said provider allows. On the other side of the coin, service provider's will have development of videogames locked to their platform, due to less companies offering the services, which in turn increases their position in the market. So, the high cost of investment due to the complex technology required to run cloud gaming also impacts the economics and competitiveness of industry. As per literature review, there is currently a shift to digital media occurring in the videogame industry (Cai et al., 2014) which is confirmed by two interviewed experts (INT2; INT4). This topic raised some important discussions around videogame ownership and consumer perception. INT2 mentioned that are still many consumers that want to collect physical media, a factor confirmed by the literature which mentions that this media format still has a very large presence in the industry (Zackariasson & Wilson, 2014). This is perhaps one of the main reasons why this industry struggled to move on to a complete digital platform as opposed to the likes of the music and cinema industries. To add, INT3 raised major concerns over the boundaries of videogame ownership and what will be the consequences of said change. It is with no surprise then, that consumer perception of digital media, and in consequence cloud gaming, was appointed as possible blocker for the adoption of this technology and one that organizations should take into account. On another factor, while cloud gaming only requires a thin client for its operation which is compatible with multiple devices (Ungureanu et al., 2015), INT1 countered this argument emphasising that a certain level of compatibility and hardware performance is still required which may interfere with the technology adoption. INT3 focused as well on the fears of downtime and service unavailability which become an actual cause of worry for service providers and is aligned with what is mentioned in the literature review (Mariano & Koo, 2015). This is strongly related as well with the ability for service providers to handle the capacity should a full shift to cloud gaming occur (INT5).

Moving on to the opportunities on a technological dimension, the respondents highlighted the major advances in broadening the accessibility of videogames to a wider audience due to cloud gaming. The lower hardware requirements (Gupta & Dutta, 2016; Ungureanu et al., 2015) were at the top of mentions in the interviews (INT1; INT2; INT4; INT5; INT6) followed by the ability to work on multiple devices (INT3; INT4) and a higher level of mobility (INT2; INT4). These characteristics combined bring a level of accessibility that allows for the videogame industry to grow its pool of potential customers to ones that did not have access to videogames before. Additionally, the transition from local storage to one that resides in the datacenters were appointed as innovative features (INT1; INT4) which are also highlighted in literature (Ungureanu et al., 2015). Lastly, and inherently linked with the value chain, cloud gaming allows developers to ease their production costs

and reduce development time given they only have to build one single version of their software (Ungureanu et al., 2015), factor that was on top of the respondents minds as well (INT2; INT3; INT5; INT6) under the concept of platform parity.

In the videogame's industry value chain, the new arising digital channels open a direct connection with the end user, eliminating the need to have intermediaries to perform previous actions such as distributing and printing physical disks (González-Piñero, 2017). For this very reason, all the interviewed individuals highlighted that retailers are no longer necessary and that they provide no actual value to consumers and will move onto extinction if cloud gaming ramps up. This is already visible with some dedicated retailers struggling to live in the new digital of the videogame industry (e.g., GameStop). Additionally, the literature review showed that this no use case scenario is not isolated to retailers. Publishers and distributors alike will suffer the same fate if service providers competitive advantage allow for developers to go directly with them for publishing purposes. In summary, the service provider will take the role of both of these agents given everything is now digital (González-Piñero, 2017), aspect that is confirmed by INT3. More so, this level of disintermediation also brought into the discussion the concern of the service provider having too much control over the value chain. INT3 provided a possible scenario where he demonstrated concern over the ability of service providers choosing whether certain videogames should be published or not. In contrast, cloud gaming brings natural advantages to the value chain agents, especially the developers. As before, the platform parity factor (Ungureanu et al., 2015) allows for developers to reduce development costs and complexity and was topic of discussion among the experts (INT2; INT3; INT5; INT6). On a customer facing level, the consensus among the data is not so clear regarding the use case for publishers. As we've discussed previously, platform/service providers have a higher level of leverage given they own the product that provides the streaming channel. There is no use case for both publishers and retailers should the developer get in touch directly with this agent. However, there were also mentions of the possibility of publishers and developers having their own storefront for selling their own videogames (INT1, INT3) which, naturally, has its own advantages. There is a sharp contrast in the data obtained through the interviews regarding this topic.

Looking over the last analysed dimension within the industry, the literature shows that there is still a considerable amount of uncertainty surrounding the new revenue streams that are arising in the videogame industry (Marchand & Hennig-Thurau, 2013; R et al., 2017; Soliman et al., 2013). This sentiment was also reflected in the interviews (INT1) with special mention to the difference in generations of people playing videogames. When discussing the critical blockers and problems

associated with the adoption of cloud gaming, five out of six experts (INT1; INT2; INT3; INT4; INT6) mentioned consumer perception as an upcoming issue that organizations need to take into account. Additionally, price and content were also identified as critical challenges which may affect the success of this technology. Despite this, all of the enquired individuals agreed that cloud gaming is a driver for innovation in this the industry's revenue streams, factor that is also referenced in literature (Mariano & Koo, 2015).

When quizzed about other dimensions of impact by cloud gaming, INT5 highlighted issues on an environmental level due to the energy consumption of data centres that run this technology. This new area of impact is indeed reflected in the literature and is object of investigation within scholars, as this large consumption of energy contributes, in a negative way, to the carbon footprint on planet (Jeba, Roy, Rashid, Atik, & Whaiduzzaman, 2018). As such, the management of data centres for cloud gaming may prove to be challenging given the nefarious impact it has in the environment. On an opportunity side, the higher level of accessibility that cloud gaming provides has quite a deep impact socially (INT1; INT2; INT3; INT4; INT5) due to the number of new individuals fluxing in the industry.

6. Conclusions, limitations and future research

In order to answer the three research questions presented in this study, we performed six interviews to industry experts who work directly in the industry and have extensive knowledge on the subject. It was opted not to focus directly on a specific role as to no induce bias for a certain dimension in the industry. In summary, cloud gaming was identified as a factor that will have its future in the videogame industry but for that to happen there are certain challenges that need to be overcome in order to capture both the crowd of players available but also all the other agents involved in a transaction within the industry.

From a technological dimension, it was clear that the internet infrastructure and quality is still not up to par in order to have a good cloud gaming experience in light of the interviews data. The literature also mentions the same, even though, the conclusions withdraw from said documents are based on data much older than this study. As such, it is possible to infer that the main drawback of this technology remains and continues to be highlighted as the main blocker for adoption of cloud gaming. Additionally, the high cost of investment in order to have a cloud gaming platform is a problem especially for smaller companies that wish to use cloud gaming. They will be stranded by

the big technological organizations given they already have the cloud infrastructure in place despite not being specialized for videogames. This in turn has a very important impact on developers given they don't have as much choice in terms of publishing as they did before. Another point highlighted in the results is the service availability which is found to be critical for a successful deployment of this technology. Given players rely in hardware outside of their households, should any problem arise at the datacentres they will not be able to use the product they paid for and as such, downtime must be reduced to a minimum. The compatibility of devices with cloud gaming and the digital ownership of videogames, which are a product of the transition to digital media in the industry, were also presented as challenges especially when consumer perception is inputted in the equation. Scepticism and lack of knowledge about the technology were appointed as major blockers for the take-off of this technology given it involves the consumer to change from one paradigm to another due to the decay of physical media. Keeping up within this dimension, cloud gaming appoints several opportunities on a technology level that trickle down to other dimensions. The main discussed one is accessibility due to the low of barriers entry (low to no hardware requirements), the ability to be accessed anywhere as long as there is an internet connection, the mobility and ease of access it provides and the capacity to work on multiple devices (phone, tablet, console, PC). These factors prove to be significant, given they work as enablers for the adoption of cloud gaming and allows for companies to grow their customer pool exponentially. This increase of players also brings an impact on a social level that is reflected on the diversity of individuals in the industry due to new flux of players from different parts of the world.

Cloud gaming also has a noticeable impact in the industry's value chain as well. The retailers are no longer needed due to the digital nature of the technology and there are even mentions of the same for publishers given developers can work directly with cloud gaming service providers to publish their videogames. Most of the opportunities are reflected then on the developer. The technology advantages that cloud gaming provides ease the development of videogames for said agent. The lower cost and faster development due to platform parity and the new possible applications for videogames are set to bring innovation to the industry and new ways to play for consumers. Naturally, this level of evolution can only be taken advantage of if the revenue streams are designed correctly and aligned with the customers' expectations, as per the data. Closely related with consumer perception of the technology, the right price and abundance of content were appointed as major important factors for the success of cloud gaming.

Additionally, the data shows that cloud gaming is definitely an enabler for innovation in the industry's revenue streams due to the digital nature of technology and the transition to a gaming as a service paradigm in the industry however long-term profitability is a topic of concern among the interviewed individuals.

The limitations of this study belong to the digital interviews. They do not provide the same level of contact with the respondents as opposed to physical interviews. Additionally, the lack of literature in this topic, which this document aims to address and contribute to fix, might have led the study to miss other areas of impact which are important to analyse and investigate.

For future research, it would be interesting to enquire the consumer perception of cloud gaming as to make a bridge with what has been said by the industry experts. Additionally, it would also be interesting to quantify the social impact of this technology and understand the further psychological implications that it has on its users. Finally, another topic of interest would be to extend the study to more individuals as to capture further data and information to discover new challenges and opportunities that might have not been explored in this study.

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8. Appendix

Appendix A: Interview Questions

1. What is the future of the videogame industry?
2. Are you aware of the current implementations of cloud gaming in the market? Can you provide me examples?
 - 2.1. The organizations that adopted this paradigm, do you think they did it as an accessory to traditional gaming or with the prospect of it being the next big thing in the industry? Why?
 - 2.2. What main differences can you identify between cloud gaming and traditional gaming?
3. Cloud gaming, so far, has impacted the industry in its use of technology, its value chain and business models.
 - 3.1. In light of this, what other areas can/could be impacted by cloud gaming?
4. From a technological standpoint, which factors do you consider to be the main challenges of cloud gaming?
 - 4.1. What about advantages and opportunities?
5. Looking at the industry's value chain, in what layers do you feel that cloud gaming has the most impact?
 - 5.1. What opportunities does this concept generate in said layers?
 - 5.2. What challenges does it bring?
6. How can cloud gaming act as an enabler for innovation in the videogame's revenue channels?
 - 6.1. These new revenue channels, how do you see customer's reception on them?
7. What factors do you believe that positively increase cloud gaming adoption in the videogame's industry?
8. What are the critical factors that you believe are stopping cloud gaming from becoming more widespread in the industry?
9. Before we wrap things up, do you have any last comments to provide, regarding *cloud gaming*, that we haven't covered in this discussion?

Appendix B: Codes and subcodes for interviews

Code	Description	Freq.	Quotes
Q1_FutureIndustry	Future of the videogame industry		
Q1_TransitionDigitalMedia	Digital shift of the videogame industry	3	[...] Digital sales have rose up a lot in the last year, so not even talking about cloud gaming, but owning digital games has been a pretty big thing. (INT1)
Q1_NewGameGenres	New videogame genres	2	[...] I think what we’re seeing is that there are many more games coming out and many more genres as opposed to traditional genres where you have shooters, simulations games and RPGs. (INT1)
Q1_MoreAccessible	Videogames increased accessibility	3	“So were getting up to a point where pretty much everyone independently of their capacity to purchase a device, can enter this technology and actually enjoy and take pleasure in gaming in general” (INT3)
Q1_MoreMobile	Videogames increased mobility	3	[...] Basically, that’s something that is happening right now with cloud gaming technology where you have your mobile phone, your tablet, or well, your computer, and you are playing regular console videogames in there, wherever you are. (INT6)
Q1_MoreDiversity	A more diverse videogame industry due to a larger of number of people	4	“Where gaming is no longer for a single group of people or for a specific set of people. It’s for everyone” (INT3)
Q1_CloudGaming	Cloud Gaming	5	[...] “We’re seeing a big switch that obviously has happened gradually, but especially in the last few years. If we look specifically at cloud gaming, its nowhere near the same thing it was two or three years ago. In the past two years it skyrocketed” (INT1)

Code	Description	Freq.	Quotes
Q1_VirtualReality	Virtual Reality	2	[...] VR is actually going to become something that's really cool and meaningful, but hardware and technology just has to evolve a lot more. (INT2)
Q1_GamingAsAService	A shift to a gaming as a service model in the future	3	[...] Just subscriptions like Netflix and Spotify, I think the trend for the future is a subscription-based model. (INT4)
Q1_MultipleDevices	Higher number of platforms to play videogames	4	[...] So obviously we're seeing slowly a big shift between consoles and PC to being able to play wherever you want. (INT1)
Q2_CloudGamingOverview			
Q2.1_Implementations			
Q2.1_nVidia GeForce Now	Aware of the existence of nVidia GeForce Now	2	
Q2.1_Microsoft xCloud	Aware of the existence of Microsoft xCloud	6	
Q2.1_Amazon Luna	Aware of the existence of Amazon Luna	2	
Q2.1_Google Stadia	Aware of the existence of Google Stadia	5	
Q2.2_IsCloudGamingAnAccessory	Discussion about cloud gaming being an accessory to traditional gaming		

Code	Description	Freq.	Quotes
Q2.2_No	Agrees that it's not an accessory to traditional gaming	4	[...] Today they are doing it as an accessory because nowadays it is very difficult to implement cloud gaming in a proper way but in the future, I don't think it will be the case. (INT6)
Q2.2_Yes	Agrees that it is an accessory to traditional gaming	5	[...] For instance, when I go in a trip and I still want to play a few games, maybe I can use cloud gaming as an accessory bar extension. (INT3)
Q2.3_Characteristics	Cloud gaming characteristics		
Q2.3_DigitalOwnership	Cloud gaming videogame ownership characteristics	1	[...] In many of the examples, or at least the most popular ones you don't own the game [...] (INT1)
Q2.3_Mobile	Cloud gaming mobility	2	[...] So, I think the biggest point is playing across devices or taking your game everywhere. (INT4).
Q2.3_WorksMultipleDevices	Cloud gaming works with multiple devices	2	[..] I think the biggest point is playing across devices. (INT4)
Q2.3_StreamingVideogames	Cloud gaming is characterized by playing games over the internet	3	[...] data centers with all the games installed and everything and you basically just stream the games to your computer. (INT2)
Q3_NewDimensionsImpact			
Q3_Environment	Environment	1	[...] Because there is a lot of backlashes regarding it, servers are very expensive and need a huge amount of energy to run that is way worse than having a console at home" (INT5)
Q3_Social	Social	5	[...] I think there's a social impact by reducing the barrier of entry. (INT2)

Code	Description	Freq.	Quotes
Q4_TechnologyDimension			
Q4.1_Challenges			
Q4.1_InfrastructureAvailability	Cloud gaming service availability	3	Let's say if everyone wants to play a game in 4K [...] it probably wouldn't be possible for the data centers to handle all the traffic. (INT5).
Q4.1_RequiresCompatibleDevices	Cloud gaming requires compatible devices	1	[...] So, someone that has a very old phone or a bad PC, they still won't be able to play cloud gaming. (INT1)
Q4.1_HighCostInvestment	Cloud gaming investment requirements	2	[...] The costs for these companies to build a reliable infrastructure that actually will make cloud gaming viable are massive, we're talking about like billions of dollars in just building data centers. (INT2)
Q4.1_OwnershipGames	Digital licenses management	2	[...] If I bought a license or if I'm still paying for the subscription, will I ever have control off my games or what happens when a platform holder vanishes from the scene? (INT3)
Q4.1_InternetQuality	Cloud gaming requires quality internet	6	[...] The main issue is actually around networking and how fast both Wi-Fi and landline are right now. (INT2)
Q4.2_Opportunities			
Q4.2_WorksMultipleDevices	Videogame can be played on several devices with cloud gaming	2	[...] You are no longer limited to a specific device, it's completely device agnostic. (INT3)
Q4.2_HigherAcessibility	Videogames become more accessible to individuals	5	[...] I think the main one for me is totally reducing the barrier of entry for games. I think that's the main thing that we're actually solving with cloud gaming and making sure that everyone

Code	Description	Freq.	Quotes
			basically has access and the ability to play any game that they actually want. (INT2)
Q4.2_HigherMobility	Ability to access games anywhere	2	[...] Even if it's just your mobile phone, because of this technology you can just play your game from anywhere. (INT2)
Q4.2_PlatformParity	No hardware differences between each cloud gaming platform	4	[...] I think it's a good thing that everyone has the same hardware and performance on cloud gaming. (INT5)
Q4.2_CloudStorage	Storage capabilities increase	2	[...] Storage is no longer local so it's virtually infinite. (INT1)
Q4.2_LowHardwareRequirements	Low hardware requirements	5	[...] You don't need to have a very powerful machine to run things and that is a pretty big advantage. (INT1)
Q5_ValueChainDimension			
Q5_Developers			
Q5.1_Challenges			
Q5.2_IncreasedPlatformHolderLeverage	Cloud gaming locks publishing to platform holders	1	[...] A platform holder can actually decide upon publishing your game or not. (INT3)
Q5.1_Opportunities			
Q5.1_DevelopersCanBuildStorefront	Developers can build their own digital storefront through cloud gaming	2	[...] You also have cases like I know Ubisoft has their own cloud gaming streaming service. (INT1)

Code	Description	Freq.	Quotes
Q5.1_NewDevelopmentOpportunities	Cloud gaming enables new development opportunities for the companies	4	[...] The type of games that developers will make might be changed by this, because when we're talking about cloud gaming obviously there are certain business models that need to be put in place. (INT2)
Q5.1_CheaperDevelopment	Developers can operate with cheaper development due to cloud gaming	2	[...] They don't need to worry about the development cost so much because they are just developing to one platform in specific and then the platform will take of the rest (INT3)
Q5.1_MorePublishingOptions	Developers have a wider variety on how to publish games	3	[...] Why do I need to pay a third party or middleman to take these costs and send my game to publish to the printers when I can share the cost with the platform holder? (INT3)
Q5.1_FasterDevelopment	Cloud gaming improves development processes	4	[...] I think accelerating a lot of development processes, testing developer builds, etc. is really huge and cannot be understated. (INT2).
Q5_Retailers			
Q5.2_Challenges			
Q5.2_RetailerHasNoUseCase	Cloud gaming removes retailer needs	6	[...] There's no use case for a middleman like retail stores. (INT2)
Q5_Publishers			
Q5.1_Challenges			
Q5.1_PublishersHaveNoUseCase	Cloud gaming removes the need of a retailer	1	[...] At the end of the day the platforms will be the ones owning the storefront. (INT3)

Code	Description	Freq.	Quotes
Q5.2_Opportunities			
Q5.1_PublishersCanBuildOwnStores	Publishers can create their own digital storefronts in a cloud gaming environment	1	[...] Publishers are creating their own platform. (INT1)
Q5_Consumers			
Q5.1_Opportunities			
Q5.1_MoreOffer	Cloud gaming provides more offer to the consumer	2	[...] Consumers are also obviously benefiting from this because they're getting more opportunity, more choices, more ways to play. (INT1)
Q6_RevenueStreamsDimension			
Q6.1_CloudGamingIsEnabler	Cloud gaming enables innovation in the industry's revenue streams	6	[...] I do think new revenue streams will come up as part of this, cloud gaming revolution. (INT2)
Q6.2_ConsumerReception	Cloud gaming revenue streams consumer perception		
Q6.2_Negative	Negative perception	2	[...] Some youth might be more willing to accept this rather than older people. (INT1)
Q6.2_Positive	Positive perception	4	[...] So, I actually don't think that is going to be a hard sell for players. (INT2)

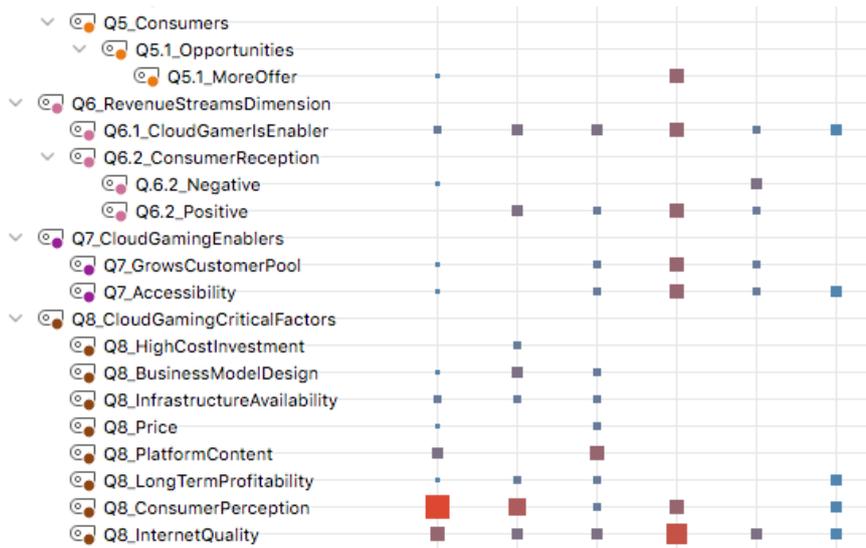
Code	Description	Freq.	Quotes
Q7_CloudGamingEnablers	Main factors that enable cloud gaming adoption in the industry		
Q7_GrowsCustomerPool	Cloud gaming enables more people to play	4	[...] So, the first one would be 100% more players, so big player pool. (INT3)
Q7_Accessibility	Cloud gaming higher accessibility	5	[...] Having cheaper access to games without having to buy a console. (INT4)
Q8_CloudGamingCriticalFactors	Main factors that block cloud gaming adoption in the industry		
Q8_HighCostInvestment	Cloud gaming investment requirements	1	[...] The costs for these companies to build a reliable infrastructure that actually will make cloud gaming viable are massive, we're talking about like billions of dollars in just building data centers. (INT2)
Q8_BusinessModelDesign	Business model design is critical for cloud gaming	3	[..] What I think is going to be a hard sell is if we have a bad version of this. (INT2)
Q8_InfrastructureAvailability	Cloud gaming availability	3	[...] If the service that is provided is not stable enough. (INT3)
Q8_Price	Cloud gaming pricing	2	[...] The price needs to be right and this is always a challenge. If I have a great price, I can actually reach out to all users in the planet because I can run it everywhere. (INT3)
Q8_PlatformContent	Cloud gaming content	2	[...] I mean if we don't have the content, no one will actually want to get it right? (INT3)

Code	Description	Freq.	Quotes
Q8_LongTermProfitability	Cloud gaming profitability	2	[...] Is the actual return of investment enough to justify improving data centers with specialized hardware? It's too early to say. (INT3)
Q8_ConsumerPerception	Cloud gaming consumer perception	5	[...] I think mentalities are also an important factor to consider because people sometimes don't have information about what is cloud gaming or how it works. (INT4)
Q8_InternetQuality	Cloud gaming dependency on internet quality	6	[...] So what matters is that you have a stable Wi-Fi connection. (INT1)

Source: Author

Appendix C: MAXQDA Code Matrix Browser for each interview

Code System	INT1	INT2	INT3	INT4	INT5	INT6
Q1_FutureIndustry						
Q1_TransitionDigitalMedia	●	●			●	
Q1_NewGameGenres	●	●				
Q1_MoreAccessible			●			●
Q1_MoreMobile			●	●		●
Q1_MoreDiversity	●	●	●	●		
Q1_CloudGaming	●	●	●		●	●
Q1_VirtualReality		●				●
Q1_GamingAsAService	●		●	●		
Q1_MultipleDevices	●		●	●		●
Q2_CloudGamingOverview						
Q2.1_Implementations						
Q2.1_nVidia GeForce Now			●		●	
Q2.1_Microsoft xCloud	●	●	●	●	●	●
Q2.1_Amazon Luna	●					●
Q2.1_Google Stadia	●	●	●		●	●
Q2.2_IsCloudGamingAnAccessory						
Q2.2_No	●	●	●			●
Q2.2_Yes	●	●	●	●	●	
Q2.3_Characteristics						
Q2.3_DigitalOwnership	●					
Q2.3_Mobile			●	●		
Q2.3_WorksMultipleDevices	●		●			
Q2.3_StreamingVideogames	●	●	●			
Q3_NewDimensionsImpact						
Q3_Environment					●	
Q3_Social	●	●	●	●	●	
Q4_TechnologyDimension						
Q4.1_Challenges						
Q4.1_InfrastructureAvailability	●		●		●	
Q4.1_RequiresCompatibleDevic	●					
Q4.1_HighCostInvestment		●	●			
Q4.1_OwnershipGames	●		●			
Q4.1_InternetQuality	●	●	●	●	●	●
Q4.2_Opportunities						
Q4.2_WorksMultipleDevices			●	●		●
Q4.2_HigherAccessibility		●	●	●	●	●
Q4.2_HigherMobility		●	●	●		
Q4.2_PlatformParity		●	●		●	●
Q4.2_CloudStorage	●			●		
Q4.2_LowHardwareRequiremen	●	●		●	●	●
Q5_ValueChainDimension						
Q5_Developers						
Q5.2_Challenges						
Q5.2_IncreasedPlatformHol		●	●			●
Q5.1_Opportunities						
Q5.1_DevelopersCanBuildSt	●		●			
Q5.1_NewDevelopmentOppr	●	●	●			●
Q5.1_CheaperDevelopment		●	●			
Q5.1_MorePublishingOption		●	●			●
Q5.1_FasterDevelopment		●	●		●	●
Q5_Retailers						
Q5.2_Challenges						
Q5.2_RetailerHasNoUseCas	●	●	●	●	●	●
Q5_Publishers						
Q5.2_Challenges						
Q5.2_PublishersHaveNoUse			●			
Q5.1_Opportunities						
Q5.1_PublishersCanBuildStc	●					



Source: Author