Emerging Technologies and Video Game Industry

Anticipation of Future Changes

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Abstract

The video game industry is a growing field by the number of players as well as the market value. Technologies are being developed at an exponential rate, creating different impacts on game development, user experience and the involved organizations.

The phenomenon of possible impact of emerging technologies on the video game industry was studied. The objectives were firstly, to provide an overview of current emerging technologies and establish their current applications in the video game industry, and secondly, to gather experts' and players' predictions on the future of the industry with regard to the emerging technologies.

Primary data were collected from narrative stories/scenarios of eight respondents and dissected using the multiple perspective method, which represented technical, organizational, and personal perspectives. This analysis was supplemented by secondary data in the form of desk study. The chosen methods, along with the context, established the research as qualitative with an exploratory purpose.

The analysis revealed numerous similarities and a few divergencies between the views of the players and experts, as well as between desk study and narrative research. From the responses, likely scenarios of the future were drawn: technologies such as artificial intelligence, virtual reality, wearable gaming, virtual studio production, ray tracing and 5G technology, with the notable exception of cloud gaming, have a substantial potential to influence game development and user experience in many ways. Different business models were also identified to be continuously used in the market.

Findings included herein contribute to the overall research domain of video games, a rather limited sphere at the present stage. Conclusions might influence and shape the decision-making process of executives within affected organizations and have an informative purpose for the consumers. Future research recommendations include in-depth studies on any of the aforementioned emerging technologies and their impacts on the video game industry.

Keywords/tags (subjects) Emerging Technologies, Video Game Industry, Business Models, Futures Studies, Narratives, Multiple Perspective Method

Miscellaneous (Confidential information)

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1   Introduction

1.1   Background and Relevance

Video games have been a part of people's lives for many years to provide fun and entertainment. The evolution of video games has been significant since their early days through computer games to first consoles. The limitations of technology are a thing of the past as games strive to mimic real life to create outstanding gaming experiences. Thus, technology is the main driver for the development of video games since they are becoming more complex. (Beattie 2020.)

The sector of video games is extremely large, provided that it is even bigger than the film and music industry together. Despite that, its audience is smaller, constituting over two billion players around the world, which is 26% of the whole population. Nonetheless, it has a growing tendency, and with analytical predictions, we can expect it to generate $196 billion in revenue by the year 2022. Hence, it comes as no surprise that more companies want to get involved in the creation of games and related services. Video games exceed other forms of entertainment because of their immersive nature and new emerging technologies can only enhance it. Experimentations with virtual reality or controls which make game mechanics more advanced are currently occurring among studios. Demographics of the market are also expanding with more people of different gender, age, or culture having an appeal for this kind of entertainment. Hence, the demand for immersion and easier access to games make the market grow on a large scale and create a bright future for anyone involved. After all, video games are influenced by innovation and shall strive to give the best experiences to their consumers. (ibid.) Similarly, video games give a different approach for people to consume entertainment media.

The video game industry is a rather undiscovered area for researchers, hence not a lot of studies have been conducted in relation to the industry. However, the importance of research is significant for any stakeholder who is a part of the gaming community. Since the development of technologies is rather rapid, several changes are possible to occur across industries, including video games. Thus, the study aims

at gathering predictions for the year 2025 to present a probable way of industry's development.

1.2   Research Objectives and Questions

The aim of this study is to present the possible impacts of the current emerging technologies on the industry of video games. Hence, the objectives of the thesis are to: provide an overview and describe emerging technologies and their current application and potential in the gaming industry, and to gather both video game experts' and players' predictions on future game development and experience.

The following research questions must be answered to reach the study objectives:

1. What are the emerging technologies and what are they being used for in the gaming industry?

2. How do experts and players think the emerging technologies will change the video game industry?

1.3   Motivation and Structure

The author of this research has been interested in the video game industry-related matters for many years; however, it was only recently that she developed a true passion. During her studies, the author successfully completed a course on multidisciplinary game development, where the concept of a game was created. The fascination over a combination of technology and art to create unique entertainment experiences is the main driver. In the future, the author desires to enter the video game industry as a professional, as opposed to the current status of a player.

The structure of this bachelor's thesis is divided into six chapters: Introduction, which describes the background and relevance of the study as well as research objectives and motivation; Literature Review, which aims to answer the first research question; Methodology, where research design is described; Results chapter, which presents the outcomes of the study and answers the second question; and finally, Conclusion and Discussion.

2   Literature Review

This chapter aims at answering the first research question of this study and provide general information about the emerging technologies and the industry of video games. Firstly, it introduces the video game industry and its development over time. Secondly, it describes the concept of emerging technologies and the existing applications of such technologies in the industry. Thirdly, it presents the business models that are popular in it.

2.1   Introduction to Video Game Industry

The gaming industry is not a niche area for a specific age group, gender, or customer segment anymore. With the development of the video game industry and advancements in software and hardware used in playing games, gaming has become a large form of entertainment for players from all backgrounds, ages, and cultures. In fact, gaming has become mainstream, which is a triggering point for an annual increase in revenue in the industry. The figure below represents the growth of the video game market since the year 2012, including estimations up to the year 2021.
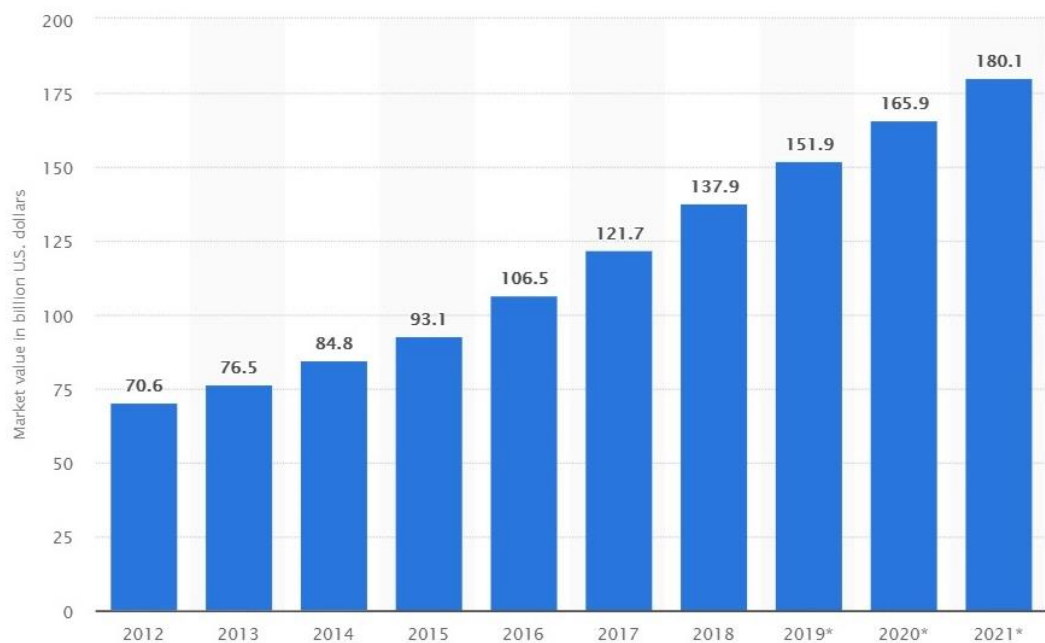

Figure 1. Video Game Worldwide Market Value (adapted from Statista.com 2019)

1950s and 1960s

The history of video games has its roots in the middle of the last century. According to Stanton (2015), the early days of video games started in the year 1952, when PhD student, Alexander Shafto Douglas, at the University of Cambridge in the United Kingdom, wrote his dissertation on human-computer interaction. In his work, he programmed EDSAC (Electronic Delay Storage Automatic Calculator – a custom-built computer) to be able to play tic-tac-toe against a person. The final program was named OXO, and it was the first game ever to display visuals. Nevertheless, it is disputable whether this program can be considered as the first game because it is only the computer representation of a real-world game designed to present various capabilities of a machine. (18-19.) Despite this fact, this was definitely a starting point for the development of the video game industry.

Stanton (2015) describes the year 1958 as significant for the head of the Brookhaven National Laboratory in the United States of America, William Higinbotham, who wanted to show the capacities of computers in an engaging and entertaining way with an intention to attract laymen. Thus, he developed a game called Tennis for Two. Higinbotham's design consisted of displaying ball, the net, and the court at separate times on the oscilloscope, making it look as if they were displayed all at once. The game, however, stayed unknown until the early 1980s. The last surprise of the 1950s was the Mouse in the Maze, developed by Massachusetts Institute of Technology (MIT) on the Transistorized Experimental computer zero, known as TX-0, also attempting to develop a form of interactive entertainment. (19-21.)

The abovementioned games, however, never spotted the light of commercialization. They were only released as prototypes at small and isolated events (Ivory 2015, 3). In 1961, the MIT struck again by creating Spacewar! on PDP-1 computer (Programmed Data Processor-1). Steve Russell, Martin Graetz, and Wayne Wiitanen created the basis of the first arcade game but were limited by an extremely expensive computer, only found in places such as MIT, unavailable to the public as most of the computers in the 1960s. Therefore, the feasibility of the game as a consumer product was not in perspective. (Stanton 2015, 33-36.) Nonetheless, Spacewar! was still the first video game that was commercialized, even though not in the way in which it was originally

programmed. The adaptations such as Computer Space and Galaxy Game were mass-produced arcade (coin-operated) games known in the 1970s. The Spacewar! definitely confirmed that video games were scalable to become a mass medium. (Ivory 2015, 4.)

Towards the end of the decades, a major step towards advancement in gaming technology was taken. Stanton (2015) tells, that at the end of the 1960s, the first video game console was being created. The television engineer Ralph Baer invented the first multi-program video game system that could be used with a TV set named The Brown Box. This first functional home game console worked on a principle of flipping switches and inserting cards. The idea was licensed later on to the company of Magnavox, that re-designed the invention and named it Odyssey. Due to his persistence, Ralph Baer has been considered the father of home video games. (23-31.) The 1950s and 1960s definitely started what we call the video game industry today.

1970s and 1980s

The most significant aspect of this time period can be considered video games becoming known to a larger audience. Stanton (2015) says that in the year 1972, Nolan Bushnell and Ted Dabney created Atari, Inc., a video game developing company. During their beginnings, they made an arcade legend, a game called Pong, which was and still is one of the most profitable coin-operated machines in history. In 1975, the home version of Pong was released, which faced a lot of imitators because the applied technology was easy to copy. Nonetheless, the company was already in the process of integrating the new technology of microprocessors, which allowed selling a machine and individual game cartridges separately. Subsequently, Atari released the Video Computer System (VCS), later known as Atari 2600. It had switches to change the display and the possibility to select different game modes and difficulty. The console was extremely successful until its discontinuation 15 years after it was first released. (41-55.)

New personal computers were being created during this period of time as well. Sinclair ZX80 or Commodore 64 were accessible and affordable to young generation

of people, compared, for instance, to Apple II (ibid., 71-85). Yet, it was difficult to determine whether the computers were purchased for the partial or whole purpose of playing video games due to their multiple functions in serving a household (Ivory 2015, 5). However, home gaming was still not developed enough, lacking visuals, sound effects, and processing power. Hence, the arcades were the most popular at the time. They were easy to mass-produce and maintain, located in bars, bowling places, or even restaurants, until the venues dedicated to them were formed. The games such as Space Invaders or Pac-Man were huge phenomena. (Stanton 2015, 95-101.) Be that as it may, the new era of home video gaming was about to begin.

In the 1980s, Nintendo, which originally started as a handmade playing card manufacturer, realized that its destiny was to be in the industry of video games exclusively after the release of the game Donkey Kong (a predecessor of Super Mario). Therefore, they started working on a cartridge-based console the Famicom (Family Computer) which was used with a keyboard and a floppy drive and released in Japan. After its success, two years later it was also released in the USA under a different name – Nintendo Entertainment System (NES), resulting in the success of 30% of American homes to own a NES. Super Mario Bros and The Legend of Zelda were released at the time and are still around these days. (ibid., 117-126.) Nintendo also saw a potential in the demand for handheld game consoles and in the late 1980s it launched a Game Boy, which became a very attractive hardware. Tetris – a puzzle game classic - was developed by a Russian AI researcher at the same time and could be played on the console. (ibid., 244-245.)

1990s and 2000s

During this time the home video gaming became even more popular, hence larger production budgets, new technologies, and innovations were introduced. According to Ivory (2015, 6), three-dimensional (3D) graphics, faster processors, LAN connections, and the switch from ROM cartridges to CDs influenced more generations of home consoles by allowing for incremental advances in graphics, data storage and processing capacity, control interfaces, and online accessibility. A new company called Sega appeared in the market, first introducing their Master System and Mega Drive consoles, and later on, when the microprocessor prices were

decreasing and using this technology became feasible, they launched a video game console Genesis, which became the biggest competitor for Nintendo's NES. Along with the consoles they developed an iconic game Sonic the Hedgehog, which provided unique gameplay to the users. Nintendo's response was to release SNES (Super Nintendo Entertainment System), which is, however, not remembered for the technological advancement, but rather for greater versions of Nintendo's classic games. Nevertheless, the SNES system was still able to provide outstanding visuals, and improvements were also made in the cartridges that consumers buy. Thus, the approach to new technologies and learning from mistakes was the main difference between the two rival companies – Nintendo and Sega. (Stanton 2015, 159-177.)

Afterward, a new competitor entered the market. Stanton (2015) describes, that in the year 1995, Sony Interactive Entertainment with its PlayStation 1 overshadowed Sega's Saturn console. The reason for this was that Saturn was sold for $100 more than PlayStation, even though in the initial stages it performed well. However, at the end of 1996, Saturn was lagging badly and the release of Nintendo 64 dropped the sales resulting in Sega losing its customer base. (183-184.) PlayStation was also ahead of Nintendo 64 because the console was still using the cartridges instead of CDs, which were becoming a standard at that time. However, the main reason for PS's success was that they secured numerous exclusive games for the console from third-party developers. (ibid., 193-196.) In the light of this, it is essential to say that the wars between any consoles and companies, have not ceased until the present day.

At the end of the 1990s, Sega released their new console Dreamcast which started the sixth generation of home consoles. It was accompanied by many famous game titles and considered as a console that was ahead of its time especially because of its capability for online gaming suitable for Massive Multiplayer Online Games (MMOGs). Sega was pushed away from the game console market and became a software company ever since. (ibid., 205-217.) As a result, Sony did not stop being a market leader for many years. In 2000, they released PlayStation 2, which was already a strong brand, maintaining a substantial amount of third-party games. PS2 also used a new technology – a DVD player, which made it also the cheapest console

on the market. In 2001, Microsoft entered the business of video games, launching its first home console: the original XBOX. Representing only a small fraction of the firm's business, it still created a global brand and found its way into the market. (ibid., 217-220.)

The new way of gaming availability was created in 2003, when the company Valve released a digital distribution platform for buying, downloading, playing, and updating games. Stanton (2015, 324), estimates that 70 to 80% of the PC games market is found on Steam, making it a major player in the industry. In the years 2005 and 2006, Microsoft XBOX 360 and PlayStation 3 introduced HD visuals and online multiplayer services, with PS3 using Blu-ray as a storage medium and a custom chip design called the Cell CPU. Meanwhile, Nintendo dominated the handheld consoles market and portable gaming, but also released a new home console called Wii. It was rather cheap compared to the above-mentioned ones, but it also lacked the HD visuals. Nonetheless, it brought a different perspective on gaming by making it more active and innovative with the motion-sensitive technology. (ibid., 303-307.) And as technology constantly advances, so does the video game industry with new consoles and platforms to be discovered.

2010 until present

The era of mobile phones significantly affected the video game industry as well. Stanton (2015) states that the most widespread way of playing games, surprisingly, does not involve game consoles or PCs, but mobile phones. A study shows that in 2013, 91 % of Americans owned a mobile phone and another 43% had a tablet. These devices happen to be the most popular platforms for gaming in the world, with games being developed mainly for Google's Android and Apple's iOS. In the early stages of mobile gaming, phones were incapable of running more complex games and a centralized marketplace from which to download them was missing. When smartphones entered the market, everything changed for the mobile gaming industry. Full-colour displays with touchscreens allowed people to play games anywhere and anytime. Game designers became challenged by a new free-to-play business model, which is also very popular these days. (259-265.) All in all, gaming

for mobile phones is still growing, with a huge amount of games being released every day for the large audience it has.

When it comes to the newest and the most recent generation of consoles, the 8th generation includes PlayStation 4 and Xbox One which were released in the year 2013. These consoles are known for the advanced visuals and online subscription services, also acting as multimedia centres in the households. Nintendo also released a console in 2012, named Wii U; however, it was not as successful as the company anticipated. (ibid., 349-352.) Nevertheless, some years later, in 2017, Nintendo launched a sale for the console suitable for both television and handheld gaming - the Nintendo Switch. Sony also produced a more advanced version of the console which is called PlayStation 4 Pro. (Video Game History 2019.)

The video game industry has also managed to create a new form of sports competition. Stanton (2015) says, that Electronic Sports, also known as eSports, are about the mentality, skill, and tactics of the competitors playing the game. There are many types of eSports, including strategy games, first-person shooter games (FPS), or Multiplayer Online Battle Arena Games (MOBA). Regardless, the eSports were never attractive to television, and it was only in recent years when it gained a mainstream prominence via streaming services, namely YouTube and Twitch. Twitch has allowed the spectators to watch eSports tournaments live and as a result, the growth of the community of spectators was exponential. Broadcasting the tournaments to the large audiences created profitable, money-making opportunities for companies and attracted substantial sponsors. (267-275.) The most compelling evidence is that according to Reyes (2019), Business Insider Intelligence estimates that the overall eSports viewership will annually increase by 9% between the years 2019 and 2023.

The video game industry is ever-changing and with the technological advancements and improvements the world experiences, the game developers' skills are challenged to create an outstanding gaming experience for the players and make the industry grow. As the technology develops, different ways of gaming are coming to the market and their success depends on the customer perspectives and the way they respond to the changes.

Trends

The gaming industry is expanding quickly and new technologies, or technologies used in new ways, are making their way into the market; some of them with power to transform the industry. Verdict Magazine (2020) introduces the top gaming software technology trends which are bound to create new formats of gaming experience. One of these technologies is cloud gaming, which allows a player to have direct access to the game which is not hosted on a PC or a console, but in the cloud. It is believed that cloud gaming can replace the traditional one. The next technologies are virtual (VR) and augmented reality (AR). Even though these technologies have been on the market for some time already, it is only now that they are becoming more mainstream. The gaming industry has the highest potential for these technologies to be used. For VR, headsets are becoming cheaper and new content is being created. As for the AR, mobile phones are the most popular devices where AR can find its audience. Subsequently, mobile gaming will keep growing due to its accessibility, and with the 5G network coming into the picture it will become more enhanced. (Top gaming software and technology trends 2020.) Artificial intelligence (AI) can also contribute to the industry, especially to game development. AI is able to help the game developers in creating content, for instance in level generation. Nevertheless, it is not yet the case that AI would create a whole game with high-quality game experience from scratch, at least in the foreseeable future. (Koss 2020.) Non-technology-wise, the biggest trend in the video game industry is the sense of community. Whether it is a large audience following the eSports tournaments, friends together playing MMOs or AR mobile games, it is a trend which emerging technologies can only boost up.

The new generation of consoles is also coming to the market in 2020, bringing new developments to the industry. One of the consoles is Sony's PlayStation 5 (PS5), which so far revealed what the new controller will be like. It will be distinctively different compared to the previous controllers, with black-and-white colours and a different name. However, what is the most important is the technology that will be implemented in the console. PS5 is confirmed to have an SSD disc which is the most important improvement for the PlayStation experience. SSD discs are known for

faster loading screens. Furthermore, they allow game developers to create bigger open worlds and use the system memory more effectively. This proves that one of the PS5's goals is to be very developer-friendly. The next console will also be compatible with the games that were released for at least PS4 through its GPU design. PS5 hardware will have a raytracing power, built-in 4K Blu-ray player, as well as 3D audio technology, bringing a new experience to the players. Characteristic features of the new controller will be its haptic feedback, adaptive triggers, and built-in microphone. (Hood & Lynch 2020.)

Another new game console will be released by Microsoft, and it has been called XBOX Series X. It is known that the new console will be twice as powerful as its predecessor. The XBOX Series X will have quite similar technological improvements as PS5, especially the SSD drive which makes usage of the console faster, improves latency, and makes gaming more responsive. The GPU of this console will also offer ray tracing technology for more realistic lighting. It appears that the console will have the graphical power that can be compared to gaming PCs; however, it still can't equal the most powerful ones. When it comes to the optical drive, Microsoft is targeting the 4K format, but still saying that the console will be potentially capable of 8K. Like the PS5, Microsoft's console will also have backward compatibility, allowing gamers to play older games with different resolutions. What Microsoft also introduces is the forward compatibility in a system called Smart Delivery, which will make sure that a player has the correct version of a game, regardless of which XBOX console it was purchased from. Microsoft is also releasing a new controller to go with the new console. It will have a slightly different design and be more accessible. When it comes to the overall design, XBOX Series X will look very different compared to the previous consoles. All in all, XBOX Series X is looking very promising; however, the third-party game studios so far are more interested in developing games for the PS5. (Hood & Thomas 2020.)

Nintendo is also planning on releasing a new console; however, not as early as the other companies. The information and features about the new console are not confirmed, but the possibility of new hardware with improved graphics and processing power can be expected. There are rumours that the new console could

have a dual screen and be a premium version of current Nintendo Switch. Important to say is that Nintendo does not feel pressure from the other companies like Sony or Microsoft to launch their new consoles simply because they are targeting a different audience. (Hood, Leger, & Boyle 2020.) Nintendo is very different compared to the other companies, mainly because it still develops its own games. All in all, the future of console gaming is advancing, and the developing technologies enhance the gaming experience.

2.2   Emerging Technologies

During the past few years, emerging technologies have been a topic of discourse and increasing attention. Thus, the term 'emerging technologies' has been used by many professionals in the field of technology, as well as by academic researchers. Despite this fact, no agreement has been reached on what labels a technology as emerging (Rotolo, Hicks, & Martin 2016, 2). The unanswered question of when a technology can be called an emerging technology and when it can be named as an already well-established technology is still posed. Generally, there is no widely accepted definition of emerging technologies. A clear scope and completeness in definitions are missing. (Halaweh 2013, 109.) Nevertheless, the following definitions have been selected to illustrate the general meaning of an emerging technology:

The Business Dictionary (N.d.), defines emerging technologies as "new technologies that are currently developing or will be developed over the next five to ten years, and which will substantially alter the business and social environment". Furthermore, the international law firm points out that the term emerging technology is "used to describe a new technology, but it may also refer to the continuing development of an existing technology." They also emphasize, that the term can have different meanings in various fields. Their definition agrees that the technology is expected to be available in the next five to ten years, and that it can have significant social or economic impacts. (Winston & Strawn LLP 2019.)

Halaweh (2013, 109), Day and Schoemaker (2000), and Srinivasan (2008) explain emerging technologies as "science-based innovations with the potential to create a

new industry or transform an existing one". The definition from the Business Dictionary must also be criticized, based on the fact that it only refers to new technologies as emerging. They explain, that a technology can be considered emerging in one discourse, while in another it is already established. The place, domain, and application strongly relate to the discourse. Moreover, according to his study, they also state that the technology can be viewed as emerging, when it is not widely and commercially accepted and used by consumers. (ibid.,109.)

All in all, the most recent and the most accurate definition based on the previous academic research was made by Rotolo, Hicks, and Martin (2016) and it is as follows: *"Emerging technology is a radically novel and relatively fast growing technology characterised by a certain degree of coherence persisting over time and with the potential to exert a considerable impact on the socio-economic domain(s) which is observed in terms of the composition of actors, institutions and patterns of interactions among those, along with the associated knowledge production processes. Its most prominent impact, however, lies in the future and so in the emergence phase is still somewhat uncertain and ambiguous."* This definition takes into account five reviewed factors for emerging technologies which are radical novelty (emerging technology can apply a different basic principle to complete a task, compared to previous alternatives); relatively fast growth (compared to established technologies); coherence (emerging technologies are distinguishable from others and have certain identity); prominent impact (changes caused by emerging technologies in terms of interactions, process knowledge, institutions, and actors composition); and finally, uncertainty and ambiguity (the impacts and results of emerging technologies may be unwanted and are unknown. (13-29.)

There is a number of emerging technologies that have great potential to transform the video game industry and impact the game experience and game development in the future. The choice of the following technologies is based on the current trends that occur in the industry, as well as author's own observations to introduce the idea of the future gaming industry by presenting technologies which are currently emerging and in the development process to either disrupt traditional processes or enhance and support the other technologies.

Artificial Intelligence

Artificial intelligence is a very wide term for many technologies that are being used and developed within this technology. In the video game industry, artificial intelligence has been used for creating non-playable characters (NPCs) that appear in games, as well as for analytics and content creation. However, when it comes to the emergence of these applications, they are at different stages. As Koss (2020) explains the NPC concept, he states that even though more complex approaches are being used when creating them, their behaviour is still influenced by the code and the designers who wrote it. In order to keep the experience enjoyable for the player, NPCs will most likely not have a mind of their own. However, in the distant future, it is rather possible. Nonetheless, the AI is not only present in the video gaming experience, but also in the game development where it is capable of creating content. A technique called procedural generation is widely used in game development. There is an example of a fully AI-generated game and that is No Man's Sky. Its algorithm generates new planets or animals into the game in substantial numbers. Similarly, as with the NPCs, to produce a high-quality game, AI is not capable to design it by itself from scratch, therefore developer's insights are still needed in the future. All in all, the author of this research considers AI as emerging in the video game industry mainly because of its uncertainty and the impact on both game experience and development. AI is fast-growing and constantly brings new applications to use.

Virtual Production

Virtual production is an innovative technology that helps mainly film producers to create settings in a digital space before using the physical set. Game engine platforms have been used to imitate live-action production into immersive, virtual reality space, in combination with CGI (computer-generated imagery) to look at the scenes in real time while they are being captured, as well as move objects or adjust lighting and camera angles. This process enhances the production because it is more efficient and less work is needed in post-production. The innovation brings no limitations in terms of physical space since the virtual one has no boundaries. (The Focus 2019.) The emergence of this technology is definitely in its novelty and the

impact it has on many creative industries including the video game industry. It transforms it greatly by creating easier ways to produce a game. The full potential of this technology has not yet been explored; therefore, its growth is uncertain.

Ray Tracing

Ray tracing is an advanced technology of 3D rendering light and shadow in graphic images with a purpose to create real-life images. It is based on an algorithm that is able to trace the way of the light and create a simulation of its interaction with other virtual objects. This technology allows the generation of realistic computer-generated images that are challenging to distinguish from real life. Ray tracing is slowly replacing a technique called rasterization, which has been traditionally used in rendering. Nonetheless, it is expected that rasterization will be still used for some time, at least until ray tracing whole games will become fully feasible. For now, there is also specialized hardware such as Nvidia's graphic cards which use real-time ray tracing. Since the technology is very new, there are currently only five games that use ray tracing in some of their features. Nevertheless, in the future, the growth of released titles with ray tracing can be expected, since this is one of the most significant changes in the graphics technology in years. There are still some issues with the technology, such as that it requires a lot of power to render images, and the less powerful graphics card a consumer uses, the more likely it is that they will have to play a game with smaller resolution. (Thomas & Hayward 2019.) The author considers ray tracing an emerging technology because of its novelty in the industry since the fully ray-traced game has not been made until now. The ability to replace and transform the current techniques and production processes is another reason to describe the emergence of this technology. Ray tracing is relatively fast in being implemented into the game development and creates a great impact on the graphics of video games, which is the most crucial aspect of the gaming experience. Nevertheless, the technology leaves the gaming community in uncertainty in regard to its own performance.

Virtual and Augmented Reality

The VR as a technology has appeared in the world many years ago, but it was only recently when it gained momentum and started developing at a rapid rate.

Virtual reality is fundamentally an application of computer technology which creates a simulated environment. A user is placed inside an experience by interacting with a 3D world instead of looking at the screen, which is much more immersive. All senses of a user are put into almost full use. In contrast, the Augmented reality places virtual objects into the real world and uses sensors where algorithms determine the positioning of a camera. Both VR and AR use similar sensors and algorithms, but VR unlike AR determines the position of the user's eyes and tracks the head movement to move the imagery inside the simulated world. (Bardi 2019.) To interact in VR, special equipment must be used, which is the head-mounted display. Currently, there are three major firms that manufacture this equipment: namely Sony with its PlayStation VR, Oculus, and HTC. The other companies such as Valve or Samsung are also known for making headsets for VR. For AR, smartphones or tablets are enough to be able to display the content.

Despite VR/AR's constant development, there are some obstacles that hinder its acceptance by a wider audience. The most substantial one is the lack of good user experience (UX) design because it is expensive and rather difficult to create. The next ones are the convenience in which VR must be both available and accessible to the consumers and that affects both cost and functionality when it comes to equipment; control is another element that faces challenges in being more immersive and in meeting the user's expectations. Lastly, the augmented reality is a competition to virtual reality because it mainly operates with smartphones which are already widely spread across the world. (Pettey 2018.) In spite of the fact that VR has been around for some time, the author classifies this technology as emerging because it still isn't fully adopted by the consumer world and it keeps being developed at a fast pace. Rogers (2019), also supports the idea that VR will become more user-friendly and reliable and with 5G technology, the obstacles that the VR is facing will be eliminated.

Wearable Gaming

Wearable gaming is a part of wearable technology that serves the purpose of playing a video-game. According to Kenton (2019), wearable technology is a group of devices that people can wear on their bodies as accessories and can be inserted in clothing or

be in the form of wireless devices which contain microprocessors and Internet connection. In the gaming industry, wearable technology is taking the form of a game controller. With motion-tracking sensors, a shirt or gloves can become a tool via which a user can play a game. There are several start-ups which develop gloves as next-generation game controllers with the purpose of adding a sense of realism and delivering a realistic experience. In the light of that, Vyas (2018) also describes a smart shirt called e-Skin, which is developed by a technology start-up, and was constructed to monitor user's upper body motion and transform it into software data input. This technology mixes artificial intelligence with AR and VR. The virtual reality has especially boosted the development of such sensor applications, and while VR is growing, so are the new ways of controlling the game, transforming from hand-held to body controllers. (Vyas 2018.) The author believes that wearable gaming is emerging in the field because it is radically new and growing. The ways of playing a game may be impacted in the future due to this technology; however, we do not know that with certainty.

Cloud Gaming

Cloud gaming has been around for some time already; however, it is only recently that the Internet speed was optimized for its implementation. Cloud gaming can be explained as a method of playing a video game while using different (remote) hardware than player's own, which is taken from the servers that belong to a providing company. A player does not download or install a game onto his computer or a console but rather streams the game via the Internet. Therefore, a player does not rely on his own system to support the game, hence the hardware limitations are eliminated and the game does not run locally but via the cloud. For this reason, a strong Internet connection is needed for smooth, uninterrupted gameplay and remote storage of data. The servers which the game is played on are high-end computers that are suitable for running the game at high settings. The companies providing this service tend to improve their hardware regularly, ensuring smooth processes for customers. As mentioned earlier, the data is also stored in the cloud, making it easy to switch between devices. Important to note, the most common business model for cloud gaming is a subscription monthly fee for accessing

the game library. In some cases, games must be purchased as well. (Gurwin 2019.) There are currently several providers of cloud gaming and in the foreseeable future, we can expect more of them coming to the market.

One of the streaming services is a PlayStation Now created by Sony, which lets players stream games that were originally released since the times of PS2 until current releases. The others are Microsoft's to-be-released Project xCloud, Google Stadia, or GeForce Now from Nvidia. The choice of a customer for either of these services is determined by their gaming habits, such as whether they are a console or a PC gamer. As a matter of fact, cloud gaming is gaining popularity among the gaming community and the reason for this is that companies promise no latency issues and high resolutions to play games. The other reason is that this technology is very convenient for a customer, and makes it attractive because they do not need to download the games and wait long hours in order to play them. However, going over the limit of an Internet provider may be an issue. (Gurwin 2019.) When we consider this technology as emerging according to the established definition by Rotolo, Hicks, and Martin, we can see that the usage of cloud in terms of gaming is relatively new and growing rather fast as more companies enter the market; the coherence and impact of this technology show in terms of disrupting the way consumers will play their games; lastly, further development of this technology is not completely known and all possible usage scenarios have not yet been explored.

5G
The fifth-generation cellular technology (5G) is designed to enhance data flow and make responses faster with great speed, hence transmit information instantly, be more reliable, and connect many devices with decreased latency. Therefore, the full potential of emerging technologies which require Internet connection can be made available and their adoption easier. (5G will drive effective adoption of emerging technologies 2019.) The 5G technology differs from its predecessors greatly. While 3G and 4G are centralised and transmit data through a base station connected to a device, 5G operates on higher frequencies and allows for higher speed and reduced latency. The technologies within 5G are for instance millimetre waves and small cell networks. There is also a question of whether 5G would replace Wi-Fi; nevertheless,

it is rather unlikely. (Woollaston 2020.) In effect, 5G can definitely enhance the performance of other technologies and support their functioning. According to Oliver (2020), 5G technology is the first one to completely support cloud gaming due to its features.

One of the valuable tools when researching emerging technologies is Gartner Hype Cycle. This tool identifies the technologies that are likely to have an impact. In the following picture, we can see the Hype Cycle from the year 2019. 5G technology is at the peak of inflated expectations, which represents the fact that there are some companies experiencing success with this technology already. Its plateau of productivity will be presumably reached in 2 to 5 years, making the technology mainstream and feasible.
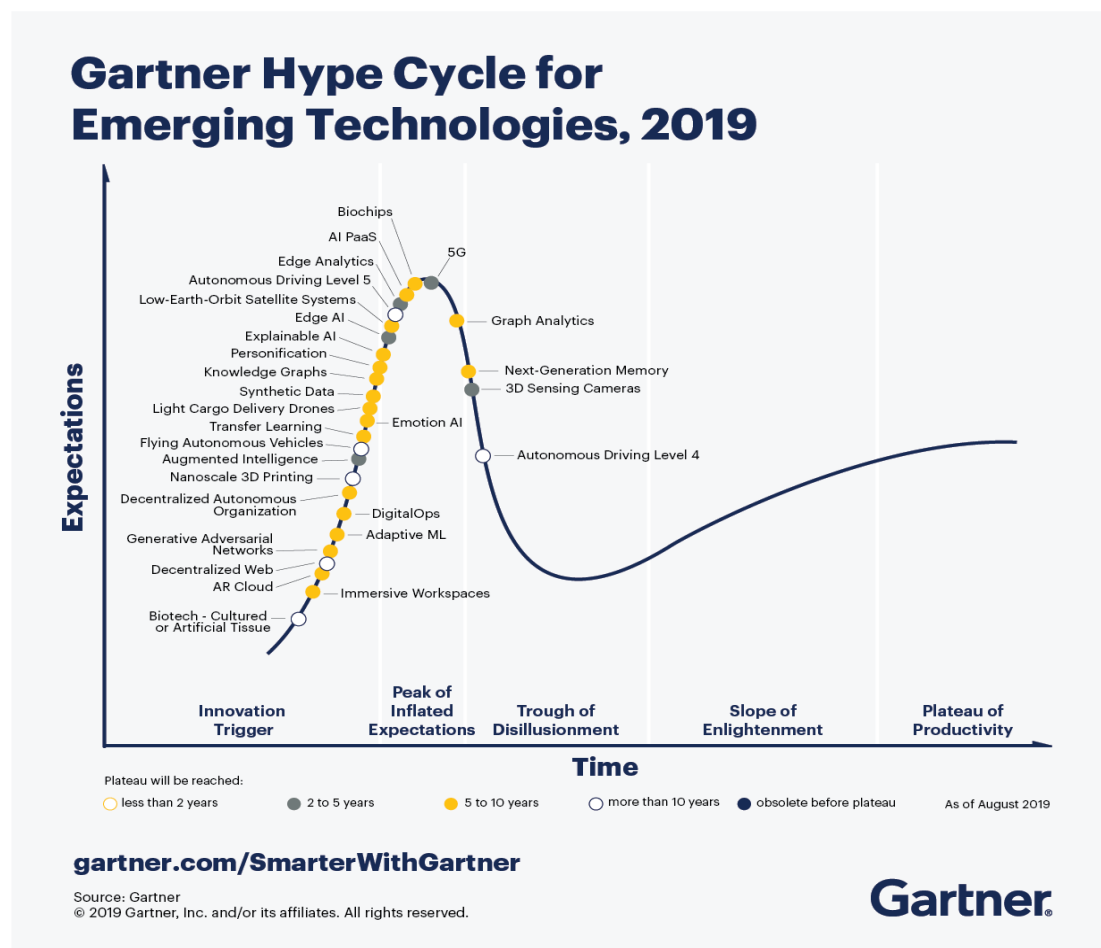

Figure 2. Gartner Hype Cycle for Emerging Technologies 2019 (adapted from Gartner.com 2019)

2.3   Business Models

Business model is a term which is used differently across organizations. There is a number of definitions that explain what a business model is. By all means, a business model should include the description of the environment in which a firm operates, the products or services it creates, and the way a firm is creating profit. Following are the definitions that describe the concept.

Definition

According to Kopp (2019) a business model is a plan for the company to make a profit while considering the services or products the business is selling, to whom they are selling, therefore the target market, and how they are selling, relating to the expenses. A business model is a plan for the firm's operations in a concrete market and it has to be reviewed and adjusted based on the current trends and circumstances in the particular industry. Magretta (2002), states that: *"Business modelling is the managerial equivalent of the scientific method—you start with a hypothesis, which you then test in action and revise when necessary."* The business model should include the value proposition of a company, explaining the products or services they are selling and what value it gives to their target customer. Subsequently, the description of a target customer segment, the resources, costs, and projected revenue streams with assessed competition must be revealed. (Kopp 2019.) Another definition emphasizes that a business model is a conceptual guideline which assists and explains the firm's ability to survive and work successfully in its operations. It also explains how the firm profits and achieves its targets, including policies and processes which belong to the model. Hence, the business model is a specification of the operational principles of a company, creating, delivering, and receiving value for both itself and its customers. (Sourobh 2019.)

The advantage of having a business model is that the customer's needs are fulfilled, the price is competitive, and costs are sustainable. When these targets are not met, the company should evaluate their business model and modify it according to the demand and environment. Nevertheless, the success of the business model is measured by assessing the gross profit of an organization. Furthermore,

benchmarking a gross profit with competitors reveals the efficiency of the currently used business model. Some analysts also emphasize that reviewing net income can show the real profit that a firm makes. All in all, both measurement tools can identify whether a business model works effectively. (Kopp 2019.)

Whereas business models have more advantages than disadvantages, there are some drawbacks that have to be pointed out. One of them is a disruptive business model that can be created by the company's competition. According to Bhadana (2019) it is a model that disrupts the existing market by responding to the neglected demands that were not addressed by the current market leaders. It is a result of disruptive innovation and creates a new market or a niche in the existing one. The disruptive business model gives new solutions to the industry and refines it. As Markides and Oyon (2010) observed, that established companies which want to compete with their disrupters must create a new business model which is different from the one that their competitors created and different from the one that is already established. They call it "disrupting the disrupters" by responding the same way as the disrupters did. To give an example, when Sony and Microsoft started targeting young men and adolescents with their products, Nintendo answered by developing a console for families. Nintendo emphasized different aspects of their console as compared to Sony and Microsoft and surprised their competition. (29.)

There are several business models in the video game industry which are used among video game development and publishing companies. Although this may be true, some of them are slowly becoming outdated and non-viable, while others are gaining their momentum. Consumer habits are changing and publishers have new opportunities to profit from them (Nowak 2018). The following are the main business models that companies use in the video game industry, either separately or combined.

Retail

Purchasing games from a traditional brick-and-mortar or online retail store is one of the oldest distributions and sales systems in the industry, where a retailer deals directly with an end user. According to van Dreunen (2011, 4), the retail model is

substantially hardware-driven. The retail revenue model is a part of the pay-to-play model (P2P). This traditional distribution is used for any products that a consumer simply pays for at the store, including games (Redefining the value chain of the video games industry 2017, 31). There are many stores that sell hard copies of video games, but notably, for instance, GameStop has been an exclusive store for selling video game hardware, software, and related products (Van Dreunen 2011, 4). Nevertheless, the company's stock value has been declining during the past years and it is very close to disappear from the market. One of the reasons for this is that GameStop's business model is suffering setbacks due to consumers purchasing video games through digital distribution. However, since the new consoles PS5 and XBOX Series X still support discs, GameStop has an opportunity to survive in the market for the time being, until the disc technology will become obsolete. (Gilbert 2020.)

Digital Distribution

Digital distribution is also a part of the P2P model and is rather similar to the retail model except for the place the consumers buy their games from. Höglund (2014) describes the process of purchasing a game via digital distribution platform as follows: *"After successfully purchasing the game, the owner can start downloading the game straight to the hard-drive. Once the game has been downloaded and installed; the game is ready for launch.* "He also mentions that the same idea applies when a customer wants to purchase downloadable content (DLC) for the game. As van Dreunen (2011, 7), also points out, this model can offer a substantial amount of games, and publishers are able to reach a wider audience. There are several platforms from which a player can purchase a game. For PC gamers, the most used platforms are Steam or Origin; for mobile gamers it is Google Play Store or AppStore, and the console manufacturers have their own digital distribution services as well, namely PlayStation Store, Nintendo Game Store and Microsoft Store for XBOX. The advantage of digital distribution is that it is convenient in terms of time and space when the customer can buy a game at any point in time and does not need to worry about the CD or DVD copy getting damaged. The other benefit is that digital stores offer an enormously large selection of games and physical stores simply can't compete in terms of supply. As it was already mentioned, publishers can easily

release their DLCs or expansions via digital platforms, making them more accessible to the consumers. On the other hand, digital distribution has some disadvantages as well. One of them is that a customer is often required to have a strong Internet connection to be able to download a game relatively fast, which is not always possible for everybody. The other disadvantage is the Digital Rights Management (DRM), which makes playing a game a user-unfriendly experience. In practise, it means that the digital distribution services have to be installed and the customer must be logged in to be able to play a game. (Höglund 2014.)

Subscriptions

A subscription model is a revenue model where in order to play a game, the customer pays an ongoing subscription fee to the company. This model can ensure that a company keeps its customer for a longer term with the returning profit of the customer's purchases. Van Dreunen (2011) states that this business model has already been used in many industries before entered the video game industry. The first games to use a subscription model were MMOs where a player pays a monthly fee, making a customer commit for the long term. (8.) Nowadays, this model is used by Sony, Microsoft, and Nintendo to offer an online gaming option and other additional services. Nevertheless, recently some on-demand gaming streaming (cloud gaming) services which are using this model appeared in the market, such as PS Now. The benefit of this model is that it can serve well when a company has high customer acquisition costs (Sourobh 2019). The other advantages are that a customer perceives a subscription fee as relatively small compared to buying full-priced games; a customer gets a large library of games at low cost; publishers and developers get information about playing habits of a customer; therefore, it enables them to create better future experience. Nevertheless, there are also disadvantages; for instance, the streaming services do not usually offer similar games as their competitors, therefore the games do not overlap, which creates higher costs for the customer who must subscribe to more than one service if they want to play several games. Due to the current low prices of the services, this article also forecasts that the subscription price will be increasing. (The Pros and Cons of a Subscription model in Gaming 2019.)

Microtransactions

Microtransactions are a business and revenue model that is widely used within the video game industry nowadays, ranging from mobile games through console games to PC games. Tomić (2019, 18), describes them as purchases that are performed after a game is obtained usually for free, therefore being a part of free-to-play (F2P) or freemium model. While microtransactions are mostly popular in F2P games, they may also occur in games that require the initial purchase as well. However, in these cases it is mostly for cosmetic updates rather than for advancing in the game. Tomić (2019) explains another type of microtransactions which are so-called loot boxes. Loot boxes contain an unknown collection of things that can be accessed after paying a fee. (20.) All in all, the gaming community perceives microtransactions rather negatively and are dissatisfied due to the fact that it simply is not fair to be able to buy abilities to create stronger competition, often also referred to as pay-to-win (ibid., 22). Be that as it may, microtransactions will most likely be in the industry for the foreseeable future. Therefore, Tomić (2019, 19), emphasizes that making purchases should be made very easy and simple for the player without disrupting the gaming experience.

Advertising

The use of advertisement is in growing demand as a business model, due to the fact that customers ask for free products and services on the internet, therefore companies providing them must make use of advertised sponsors in order to generate revenue (Sourobh 2019). The same applies to the games that are mostly F2P and that is why their developers usually integrate advertising inside the games. There are several types of advertising in games such as around-game advertising, where an ad appears before the game starts; or it is inserted inside the game such as banner ads; advergaming, which means that a game is created specifically for a brand in order to promote it; and lastly, in-game advertising or product placement, which is the least disruptive type of advertising, and creates a sense of reality where an ad is placed inside the gameplay (Redefining the value chain of the video games industry 2017, 35). The response of the player community towards advertising in games is disputable because it is a rather personal preference and view of a gamer.

3 Methodology

This chapter describes the purpose of this study together with the philosophical foundation to the research methods and approaches that were chosen by the author of this research. It explains the particular methods and justifies the decisions made. It provides insight into data collection and presents the data analysis. Lastly, it describes the research ethics.

3.1 Research Purpose

According to Saunders, Lewis, and Thornhill (2009) the purpose of the research has its foundation in the research questions the author is asking. Therefore, the purpose of the study can be classified into three categories: exploratory, descriptive, and explanatory. They can be used separately, or in combination, depending on the development of one's research. If the researcher aims to discover phenomena in new ways, explore new information about a topic, or study relationships between phenomena, the choice of research purpose shall be made accordingly. (138-141.)

Exploratory Study

This type of research purpose is suitable for researchers who try to understand the problem more in-depth and are unsure of the problem's nature. Exploratory research is flexible and adaptable to change; however, it does not mean that it lacks a sense of direction. The direction can be changed based on the data results when new insights come in. This type of research is usually initially broad but gets more narrowed down. It can also show at the beginning stages, whether the research is not worth conducting. There are three ways of implementing exploratory research: literature search, interviewing field experts, or focus group interviews. (Saunders, Lewis, and Thornhill 2009, 139-140.)

Sue and Ritter (2012) also explain the exploratory research as a way to theorise problems, elaborate concepts, and form hypotheses. When researchers conduct a survey for exploratory purposes, they choose individual expertise of the people who are experienced about the topic, rather than choosing a random population sample.

Creating hypotheses rather than testing them is another attribute of exploratory purpose. Subsequently, data for the research is mostly of a qualitative nature. (2.)

This research has an exploratory purpose due to the fact that the video game industry is not a very well researched area and there are no academic theories that can support the impact that emerging technologies can have on the video game industry. This study also aims at collecting present predictions about the future, and therefore the results are only probable. Utilizing the methods of implementation of an exploratory study also helps to understand the views of the people who have knowledge about the industry.

3.2 Research Design

The research design is a model to plan research and answer its research questions. It answers the questions of the type of data that is needed, the timescale, participants, and approaches taken to collect and analyse data. It gives guidelines on evaluating and concluding the findings. (McCombes 2019.) Saunders, Lewis, and Thornhill (2009) similarly emphasize that research design is a plan to respond to the researcher's questions. This includes objectives, the sources of data, and constraints the research may have. There should also be a reasoning for the choices a researcher makes to implement particular research approaches and techniques. (136-137.)

In order to construct a research design for this study, the author used 'The research onion' (see Figure 3.) which was developed by Saunders et al. The research onion represents the different levels of research that must be taken into account when a researcher develops a template for the study. Each level or 'layer' portrays a stage of a research process and gives a clear sense of direction and progress. The research onion can be used in any methodology for any type of study. It helps a researcher to have a coherent and consistent plan for their study and when followed appropriately, it can help to produce valuable and reliable results. All in all, the research onion contains the selection of philosophical stance, research approach, methodological choice, strategy, time horizon, and procedures with associated techniques of data collection and analysis.
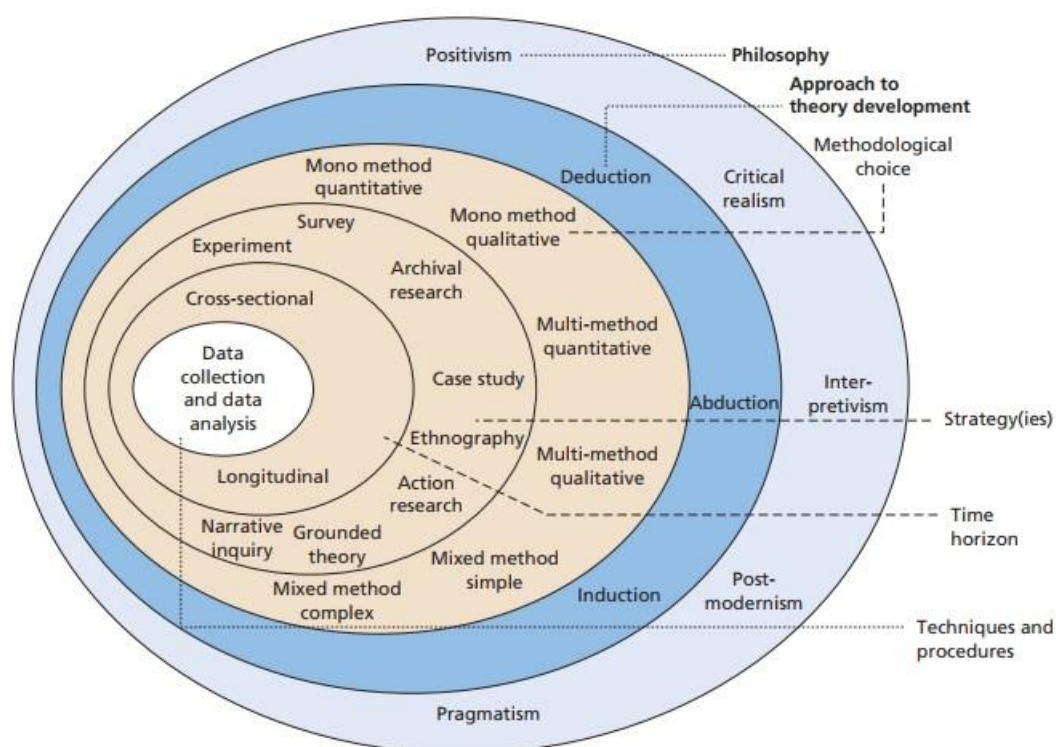
Figure 3. The research 'onion' (adapted from Saunders, Lewis, & Thornhill 2015, 124)

Research Philosophy

Research philosophy is the first layer portrayed in the research onion, which makes it the first topic to be addressed in the process and methodology of a research. It is derived from the research questions and it represents a researcher's view of the world. These underlying assumptions create a belief about the methods and approaches in which data will be used. Research philosophy gives a direction in which the research will be conducted and it also sets limitations. (Saunders, Lewis, & Thornhill 2009, 106-109.)

The **interpretivism** philosophy was used in this research. Interpretivism is designed to understand the differences between humans as social actors. The emphasis is put on the fact that the research is conducted among people rather than objects, and it deals with individual's actions. Researchers interpret their own social roles and the roles of others according to their own set of meanings. The interpretivism is subjective since an investigator cannot be separated from the research. The data in this philosophy is often qualitative and in-depth analysis from small samples is used. (ibid., 115-119.) Essentially, a researcher evaluates the world they are in and creates

own conclusions. In the light of this philosophy, the author of this research aims to discover opinions and gather perspectives of the player and expert community within the gaming world on the possible impacts that emerging technologies can have on video game development and experience. Hence, it is possible to use the narrative writing with semi-structured guidelines to gather respondent's views on the topic, identify patterned models, and create own conclusions and understanding.

Research Approach

In research, there is always an involvement of theory, especially in the findings of the study, hence it is necessary to determine how it is going to be used. This is defined by research approach (the second layer) which can be deductive, inductive or abductive. In deductive approach, the author develops a theory or hypotheses and tests it. In inductive approach, the data are collected and analysed and author then creates a theory. Abductive approach comprises the combination of both inductive and deductive approaches. While deductive approach is more closely related to the philosophy of positivism, induction leans to interpretivism. (ibid., 124-128.)

The author of this study applies **inductive** approach, which aims at understanding why or how something occurs, rather than what. In this case, the author strives to understand how the video game industry is changing due to emerging technologies. Thus, the first step is to observe the situation from the experts' perspective and then identify patterns or technologies that might shape the future of the industry. Finally, the author concludes on analysed data and creates a summary/theory of possible impacts on the gaming world.
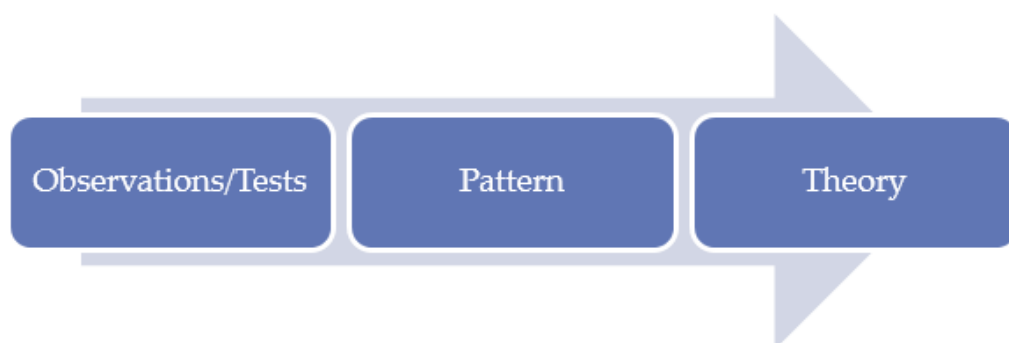

Figure 4. Inductive approach route (adapted from Research-Methodology.net N.d.)

Methodological Choice

The third layer represents the methodological choice of the author for the research. This choice distinguishes whether a researcher uses single or multiple data collection methods. A single or mono method allows a researcher to use only one method of data collection and corresponding analysis. When a multi-method is decided to be applied, it is limited within the data type (qualitative or quantitative). There is also a possibility to apply mixed method or mixed-model research which combines quantitative and qualitative data techniques. (Saunders, Lewis, & Thornhill 2009, 151-152.) For this research, a choice was to use **qualitative multi-method.** Since the research objectives and questions suggest the need for both primary and secondary data, narratives and desk study were used to conduct analysis on the relation between emerging technologies and the video game industry and provide an overview of its current state.

Research Strategy

Another layer of the research onion belongs to the research strategy. According to Saunders et al. (2009) a research strategy should allow a researcher to meet the objectives of the study, therefore the appropriate decision has to be made. A research strategy is based on research questions, the amount of time and resources available, and existing knowledge. Important to say is that strategies are not mutually exclusive, thus more than one can be used in a study. (141.) Since the methodological choice allows the author to use multiple strategies, desk study and narrative research were applied.

To understand the current situation in the researched phenomena and identify technologies, **desk research** was applied. Bhat (N.d.) says that desk research, also known as secondary research is a strategy that uses data which is already available. It serves to enhance the effectiveness of a study by summarizing and reviewing the collected data. The data may be in the form of reports, documents, or articles, and they are usually available via libraries or websites.

Furthermore, the practical part of this study was conducted using **narrative research**. Moen (2006) describes a narrative as a story that describes events in a particular

order which is important to the narrator. The connection between the individual person and the context in which he or she appears is important to note since they cannot be independent of each other. Hence, the narrator is representing his or her social, cultural, and institutional environment. Narratives are subjective stories influenced by the knowledge, experiences, values, and feelings of the narrators. (4-5.) Narrative research is an essential option to explore people's views on their own experiences. Simultaneously, narratives allow the researcher to see the structure of narrator's experiences. (Nygren and Blom 2001, 369-370.) The reason for using narratives as a strategy was to understand the phenomenon more in-depth from the perspectives of the experienced population in the area of study.

Time Horizons

The penultimate layer of the research onion is time horizons, which represents the time scale in which a study is being conducted. There are two types of time horizons: cross-sectional and longitudinal. A cross-sectional study aims at researching a certain phenomenon in a certain time, while longitudinal researches a phenomenon in a longer period of time. (Saunders, Lewis, & Thornhill 2009, 155-156.) That is to say, the aim of this research is to gather current predictions on a future of video game industry, the author implements a **cross-sectional** study.

3.3   Data Collection

Primary Data

Primary data is a kind of data that researchers acquire through data collection methods such as surveys or interviews from the sources of information. These data are collected directly from the population of people which is specific to the requirements of a particular study. The author of this study decided to collect primary information through surveying industry experts and players who were asked to write narratives/scenarios. The choice of respondents was purposive and based on the duration and level of experience in the video game industry (see Table 1). Thus, the informants were able to give relevant and valuable information on gaming experience, development, and the business environment and subsequently, answer the second research question. **Snowball sampling** was also utilized, which according

to Saunders et al. (2009), is a technique where an initial respondent points to another one and which allows the researcher to acquire more knowledge and data for the study. (240-241).

Position	Years of experience	Type of experience
Expert	30 years	Doctor of Philosophy in Video Games, professor; researcher; instructional designer; game developer; player; live streaming platform affiliate
Expert	28 years	former Quality Control Lead in video game development and publishing company; has own gaming experience
Expert	24 years	Project Coordinator in video game development and publishing company; has own gaming experience
Player	21 years	plays games recreationally; had a subscription to gaming magazine; consumes video games related media (videos, podcasts, articles, books); is editing and writing for a website which discusses pop culture topics including video games
Player	15 years	spends all his time playing and learning about games and industry; plays a wide genre of games; owns numerous platforms; has skills in 3D modelling
Player	14 years	spends most of the free time playing and learning about games; plays a few genres (RPGs, RTSs); owns a gaming PC; studies cinematics and storytelling
Player	11 years	spends most of the time learning and mastering games; multitasks turn-based games; learns about PC software and hardware setups; owns multiple platforms; has experience in story-writing and character design
Player	10 years	spends free time playing games (mostly single-player games with good stories); writes narratives occasionally; owns several consoles

Table 1. Profiles of informants

An implementation plan for data collection was also made and conducted. The researcher prepared a letter to respondents (see Appendix 1&2) based on their expertise, which included instructions for responding. The informants were asked to write a semi-structured narrative. Narrators were provided with guideline questions, which were open-ended and designed not to limit their ideation, but rather enhance the storytelling. The letter for informants and narrative responses were sent and received digitally via e-mail.

Secondary Data

Secondary data is the data that was collected in the past via primary data collection and analysis. This type of data is available for other researchers to conduct further studies of different types. In this research, the author collected secondary data via desk study, using different platforms such as Google Scholar, ProQuest and EBSCO databases and ResearchGate. Different online magazines, newspapers, journals, articles, and printed books were reviewed in order to answer the first research question, which required the use of secondary data by its nature.

3.4 Data Analysis

After the narratives from all respondents were collected, the researcher chose four main scenarios out of them to be applied in the study. The reason for this is the occurrence of primary data saturation, which is a situation in the data collection process when no new information is given, hence assuring the researcher that any other results would generate similar ideas. Subsequently, from these narratives, the ideas were highlighted and classified into corresponding perspectives of the **multiple perspective method**, depending on whether they represented technically, organizationally, or personally different future views. Later on, the patterns shaping the possible future of the industry were identified, results presented and concluded.

The multiple perspective concept was developed by Graham Allison, who was not satisfied that the decision-making processes were missing vital elements of understanding the causes and impacts of changes. Thus, he developed this approach with application to technology management. (Linstone 2009, 1.) When applying this

approach to research, a lot of flexibility is allowed. Multiple perspective method combines three perspectives (technical, organizational, personal) which form a greater view on decision-making as compared to single views. The aspects of each perspective are interconnected and linked. Nonetheless, the analysis of perspectives requires judgment and the weighting of the views is often uneven. The skill to choose and integrate perspectives is what makes decision-making effective in business. (ibid., 10.) Following are the perspectives of the multiple perspective approach explained:

- **Technical Perspective**: The technical (T) perspective represents the problems that are well-structured or docile. It is a scientific view that can be found in science, hence rational approaches to problem-solving take place. Nevertheless, the technical perspective is lacking in acknowledging that people tend to appear in communities and interact and have their own views. (ibid., 1-3.)

- **Organizational Perspective**: Linstone (2009) describes an organizational (O) view as focusing on processes and action instead of products or problem-solving. It is important to find out by whom and how are the things going to get done and what is the reason for it. (3-5.)

- **Personal Perspective**: Personal (P) perspective concentrates on an individual's view of the world and represents factors that are not mentioned in organizational or technical perspectives. It is important to note, that one individual can cause changes and alter other perspectives. (ibid., 6-7.)

3.5   Research Ethics

Saunders et al. (2009) describe ethics as a correctitude of the researcher's behaviour towards the rights of people who are affected by the research. It includes the way of collecting, processing, and storing data, as well as its analysis. Moral and responsible attitude shall be implemented and ethical issues addressed. The principles such as risk of harm, obtaining consents, protecting anonymity, avoiding deceptive practices, and giving right to withdraw are the fundamental basis for ethical research

implementation. (183-196.) In this research, all respondents participated voluntarily and were aware of the fact that their answers would be treated anonymously. Any other data about participants were written with their consent. Their narratives were not altered in any way and were used only for the purposes of this study. Equally important, the acquired secondary data were all referenced to avoid plagiarism.

4 Results

This chapter is designed to answer the second research question, therefore showcase how experts in the video game industry and affected players think that the game development, experience, and organization's business models will change. The participants were narrating the predictions for the future of year 2025. The patterns of possible changes in the future were found and are supported by respondents' statements. Important to note is that players and experts had mostly similar views on the future advancement of the industry; however, some differences can be found.

The Table 2. represents the ideas that were extracted from the narratives of the participants. These ideas were occurring several times among collected data; hence they represent the opinions on the future of gaming. We can see what the players and experts are predicting technology-wise, for organizational issues, and their own perspectives on the industry as a whole. Considering the scope of this research, the technical perspective is represented in a way that relates to the knowledge or methods used in science and industry, hence referring to technology used. The organizational perspective concentrates on issues which are related to the companies, their operations and business models and the overall supply and demand in the market. Last but not least, the personal perspective points to the ideas that are not addressed by the previous, aforementioned views, and it reflects on personal opinions of either players or experts. The personal views should be acknowledged and understood because they can give valuable insights and help in decision-making. It is important to state that the ideas presented in the table are interrelated between each other, and the researcher interpreted and classified them according to her own judgment, hence the importance of particular points can also be disproportionate.

	EXPERTS	PLAYERS
TECHNICAL	**Gaming platforms** • Console gaming • Handheld consoles and portability • PC gaming – exponential leaps in technology • Performance gap between consoles and PCs **Technologies** • Virtual reality • Hyper-realistic visuals and graphics • Ray tracing • Virtual studio production • Procedural generation **Controls** • Dominance of keyboard, mouse and controllers • Touch controls **Style of gaming** • Prevalent sedentary gaming • Movement related gaming in fitness games	**Gaming platforms** • PC and console gaming • Performance gap between consoles and PCs due to hardware improvements in graphic cards and processors • Mobile gaming • Portability **Technologies** • 5G • Virtual reality • Higher resolutions • Better gaming engines • Rendering techniques (ray tracing) • Artificial intelligence for NPCs • Enormous open worlds **Controls** • Dominance of keyboard and mouse • Gloves and sensors **Style of gaming** • Prevalent sedentary gaming • Movement related gaming in fitness games
ORGANIZATIONAL	**Demographics** • Growing number of entertainment options • The number of players continues to increase • More start-ups in the market **Business Models** • Free-to-play games • Loot boxes	**Business Models** • Digital distribution services • Brick-and-mortar stores will disappear or shift their focus • Option to buy hard copies is still present • Microtransactions in Free-to-play games • One-time payment
PERSONAL	**VR** • VR controls still won't be consumer-friendly **Game attributes** • Immersion not depending on the graphics but world building and narrative **Miscellaneous** • Video games respected as a medium of choice	**VR** • VR price will drop and be more affordable • Less demanding, wireless VR, removing area restrictions • VR is less chunky and made out of lighter materials **Game attributes** • Immersion • Personalized experience • Realism – mimicking real life • Escapism **Miscellaneous** • Collectibles • Exclusives • Desire for transactional transparency

Table 2. Scenario ideas classified to T-O-P perspectives

4.1 Impacts on Game Development

There are several ideas that were identified to impact game development in the future. When referring to the statements from the narratives, respondents were marked as Player 1, Player 2, Expert 1, and Expert 2 to preserve their anonymity.

To start with, experts confirmed that the future of gaming is mainly concentrated on personal computers, but consoles are not far behind. The reason is that PC hardware is being developed at a faster pace than consoles. Expert 2 provides the statement: *"By the year 2025, even though we'll see a significant leap in technology, a lot of trends and specifics will remain unchanged…, it's safe to say that the upcoming console generation will still be active and in use in 2025. We'd also see a rise of popularity in handheld consoles … due to their portability and ease of access for multiple players. The PC environment will continue to see exponential leaps in technology, creating another massive performance gap between consoles and PC. "* Thus, developing games for all platforms is essential, with PC games leading in the area.

Moreover, **artificial intelligence** will have a big impact on game development with its content creation known as procedural generation. Expert 2 emphasized this factor, stating it can decrease the development time: *"Development technology will also advance a lot. I believe that we'll see procedural generation playing a bigger part in game development. This technology once tuned, has the potential to cut down development time massively, and will definitely be the future in content generation. "*

The other technology to progress and impact game development is **virtual production**. The usage of better gaming engines for media production is supported by Expert 1: *"I see the most progress in technology with virtual studio production - to clarify, the transition to using video game engines as part of the media production process, will have an incredible impact on the video games medium, … This is happening now, and I know that in 5 years it will be at the consumer level. This will change the playing field for engaging content, and will absolutely influence game development, …".*

The graphics is destined to be impacted as well. The visuals that imitate real life will be influenced by **ray tracing** technology that shall be implemented in game development. Expert 2 explains: *"The one thing we know for sure is that visuals and graphics will keep on improving the point of being hyper-realistic…. The future of graphics will be defined by the newly introduced Raytracing technology, which helps simulate more accurate and life like lighting in a game. The effect it has on a game environment is tremendous, … In the future with more powerful hardware, we'll see this turn into a staple, rather than a feature."* However, Expert 2's personal view on graphics related immersion pointed to other parts of game development as well: *"The better graphics will have a hand in improving immersion in the game world, but I believe that game world immersion doesn't rely on graphics as much as it does on world building, and narrative."*

The **virtual reality** technology is also very much expected to change the way of interacting with the game. In VR, players are demanding certain fixes which are described by Player 1: *"VR still requires too much power to operate which calls for a technological solution that will make it less demanding resource-wise. Making VR wireless would also remove the area restrictions."*

With immersion, new ways of playing a game can be thought of, hence their incorporation into the game development is needed. While the traditional way of playing a game will continue, there are other possibilities mainly for VR, hence Expert 2 says his personal view: *"Traditional Control schemes like Keyboard/Mouse and Controllers will remain dominant in my opinion due their nature, however with the leaps and bounds that are occurring in the VR and AR space are interesting. However, to provide a complete gameplay experience the technology and infrastructure required probably won't reach the point of being consumer friendly by 2025."*

4.2   Impacts on User Experience

The technical pattern of the performance gap between console and computer gaming addressed by both experts and players will shape the future of the gaming experience, with most of the gamers leaning towards PCs. Player 1 expressed this: *"I*

sit down to play at my upgraded PC…. I have replaced my processor and graphics card with the newest, cutting edge version" and *"Even if I do buy PS5, I will nevertheless use PC much more (as is my preference). The consoles simply cannot keep up with the progress of computers."*

Firstly, the technical aspect – **Artificial Intelligence** can also hugely impact user experience. While procedural generation allows for wider and faster content creation, bigger worlds can be created within the game and directly influence the experience the user has with a game. Player 2 pointed this out: "The *game I'm about to play has an enormous open world… "*. The other aspect of artificial intelligence is the one that is used in non-playable characters. The experts did not mention the development of this type of AI; nevertheless, players expect it for an enhanced and more personalized experience. Player 2 stated: *"Nowadays they let AI gain control of most of NPCs, letting them have different personalities according to your preferences and your decisions during gameplay. "*

The graphics in the game will naturally improve as it tends to do so in the video game industry. Higher resolutions will definitely enhance its improvement, as well as **ray tracing** technology which aims to create a real-life gaming experience. Player 2 describes the game of the future as such: *"Games aim for realism…This can also especially be seen in the graphics, with all the hardware improvements over the years…which are hard to tell apart from reality. "*

The technology that completely impacts the speed of download and in some cases the gameplay as well is the **5G**. Player 1 emphasized the importance of this technology: *"I have chosen my ISP so that I have the fastest connection available – most likely 5G. ….connection speed make(s) for a smoother and faster gaming experience."*

Virtual reality is a technology that makes gaming immersive and aims for allowing a user to escape the real world into the virtual one. It is expected that VR equipment will look different and is described by Player 1 and 2 from their personal views: *"Speaking of immersion, VR might be a leader in this area…VR increases your field of view which results in a higher degree of immersion.";* *"I'm already fitting the VR*

goggles onto my head out of excitement. They are nowhere near as chunky compared to the ones at the beginnings of VR and are also made of significantly lighter material."

The future controls of the game and **wearable gaming** can enhance the gaming experience for the user. While this is will mostly happen in virtual reality, players will still prefer the traditional ways of gaming as explained by Player 1 and 2: *"The basics of how I control the game haven't changed much, either. Since I'm playing a PC game, it's controlled with a mouse and a keyboard – as it's been for the past 30 years."*; *"The gameplay is controlled either by an old-school controller which some players use for nostalgia reasons, or the slightly more expensive gloves, which sense the movements you make with your fingers, giving you full control over your characters movements."*

The style of gaming can also be influenced by the technologies; nevertheless, in this case it is so far influenced by the type of the game. Expert 1 says*: "There are options for both sedentary, and non-sedentary games,"* while Player 1 continues: *"While VR allows for a range of motion, sitting on a chair or sofa is still going to be the main way of gaming. There will be a handful of fitness games for VR and other devices."*

4.3   Impacts on Business Models

Video games are becoming a respected medium, hence the number of players is increasing. With this demand, the supply must be equal, creating more entertainment options. These views were presented by Expert 1: *"In the year 2025, it would appear that, given our current circumstances, video games will continue to gain more overt respect as a medium of choice; As more entertainment options are available …will allow for more people to engage in games."*

Looking at the impacts, the technical aspect of **virtual production** has an impact on organizations due to the fact that new companies can appear in the market and potentially disrupt the market and create competition. Expert 1 stated the reason for this: *"…, because more people will be able to access these tools in their own homes, and in public libraries. We will see more start-up game companies in the space."*

Speaking of other technologies, virtual reality is expected to get cheaper based on the perspectives of Players 1 and 2. They state: *"The price of the VR equipment will surely drop which might enable it to go mainstream."* and *"Alongside being way more affordable to everyone, they are the console of choice these days."*

Subsequently, the organizational views from the narrators were based on the current business models of companies. The pattern of **digital distribution** was occurring the most. Player 1 described: *"I open my digital distribution service…; I predict more of them will pop up – some of them literally forcing us to use them."* Hence, it is predicted that traditional retail stores will only function online with the possibility to buy hard copies of games for collector's value and conventional stores will slowly disappear or change their business models. Players 1 and 2 explain: *"The traditional brick-and-mortar game stores will either disappear completely or shift their focus to renting consoles and/or selling merch.; I own a few hardware copies, too – but those are mostly for collector's value, I will still choose another digital service over buying hard copies - those may very well have disappeared by then, anyway."* and *"everyone is downloading digital copies".*

The other model was the model of **microtransactions,** which players generally do not prefer, hence have negative feelings towards it. However, from their personal views, they seem to prefer one-time payments because it gives them a sense of transparency when buying a game. Player 1 and 2 say: *"Gaming companies will keep pushing for shady microtransaction models. Regardless, one-time payment for games and downloadable content will remain the main mode of payment. This is the mode I myself prefer since it's highly transparent. Microtransactions will be used in free-to-play games as a way to provide a source of revenue for the developers. "*and *"Unfortunately, there is still such a thing as microtransactions for various personalization items or gameplay boosts, for there is always money to be made in these corners."* The microtransaction model is closely related to F2P games which are mostly provided by the mobile gaming market, which is most likely going to grow. The view of Player 1 was expressed*:" I expect the mobile gaming market to go big. Vast majority of people own a smartphone which makes it the most accessible way of*

gaming. Some companies like ASUS may release phones designed specifically for gaming. "

To summarize, Figure 5. represents the way how different perspectives can influence each other. Each aspect or technology identified has the potential to influence another one. To illustrate, when an F2P model is designed, the game development must be implemented based upon it; or when there are loot boxes hidden in the game, the experience for a user can be vastly different based on the way they are designed. Similarly, when a company develops games solely for consoles, as so-called "exclusives", it will surely influence organizational decision-making.

All in all, when looking at the future, multiple perspectives should be taken into account, for they give a holistic picture of the world, meaning that the sections of a phenomenon are linked and explicable only by a reference to the whole.
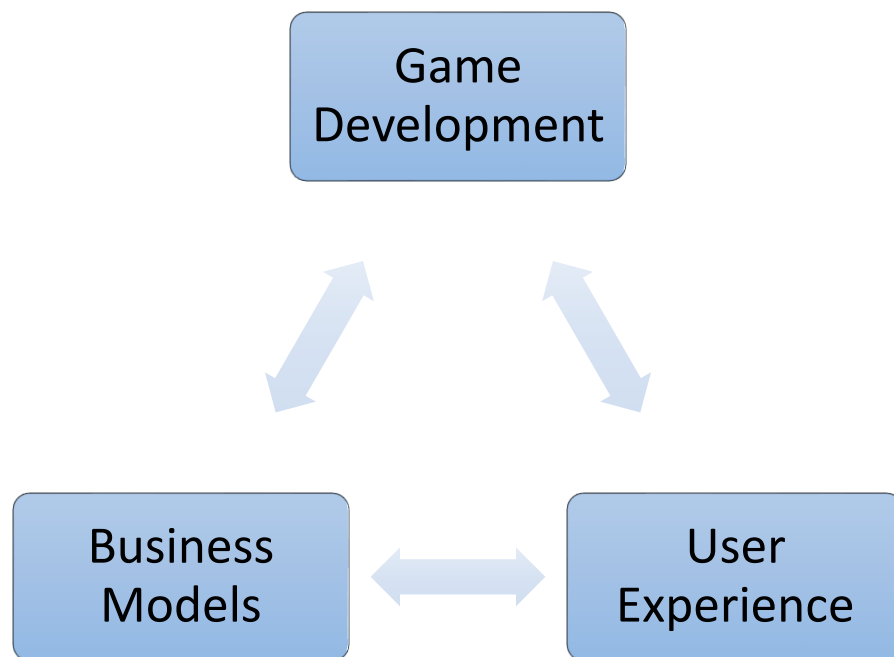
Figure 5. A schematic for interrelations between T-O-P aspects

5 Conclusions

5.1 What are the emerging technologies and what are they being used for in the gaming industry?

The researcher discovered that emerging technologies are defined as technologies that are considered novel and fast-growing. They are consistent and logical and have a big potential to influence the socio-economic sphere. Nevertheless, the overall and most significant impact of these technologies is unknown and lies in the future. Based on the literature review of this study, the technologies that are emerging in the video game industry were identified and they are:

- artificial intelligence, and its application in content creation and non-playable characters;

- virtual reality, used mainly as a console for fully immersive gaming experience;

- wearable gaming, designed to make the control scheme of playing a game different and more advanced by utilizing sensors and capturing motion;

- virtual production, creating different approaches to the creation of games and cutting time in post-production;

- ray tracing, which renders images in a way that makes them look realistic and undistinguishable from reality;

- cloud gaming, which allows many players to engage in games without hardware restrictions;

- 5G, which acts as a supportive technology to smooth video gaming with its high-speed connection.

To summarize, the gaming of the future may look rather different based on the advancement of the above-presented technologies.

5.2 How do experts and players think the emerging technologies will change the video game industry?

The patterns from the narratives were identified and result in probable ideas of the future of the video game industry that are presented below.

Pragmatic Scenario

This prediction comes from the views of experts and is based on practical rather than theoretical considerations. They predict that PC gaming will be the leading type of gaming due to the fact that there is a performance gap between consoles and the hardware of personal computers. Artificial intelligence will be one of the technologies to shape game development and user experience. Procedural generation can create content within games and cuts down the game development time. Furthermore, virtual production is the technology that will influence game development as well as organizations. With tools like this, it is essential to expect that new companies will appear in the market. Next, rendering techniques such as ray tracing will be used to create realistic-looking images, advancing the graphical aspects of the game and having a direct impact on both development and user experience, creating bigger immersion. Although experts consider graphical advancement one of the major contributors to creating immersion, they place much higher importance on other aspects of the game, such as world-building and narrative. When they consider the user's point of view, virtual reality will keep being the leader in immersion. Experts anticipate that game controls will remain the same, meaning keyboard, mouse, and controller, and that newly developed sensor gloves or similar controls will not be consumer-friendly by the given time frame. Hence, we can expect little to no change in this domain for the foreseeable future. Similarly, the style of gaming will be mostly sedentary with options to move in fitness games only. Regarding business models, things will not change drastically and they will most likely stay the same.

Idealistic Scenario

This prediction is derived from the views of players and has been heavily influenced by their wishful thinking. Nonetheless, some aspects of this prediction are more

realistic than others. Firstly, the players also think that PC gaming is going to overtake console gaming because of the more frequent hardware advancements. Secondly, they have envisioned game environments as big, open worlds – which points to the use of procedural generation, even though players lacked the vocabulary to describe the technology behind the development. Since procedural generation is one of the applications of artificial intelligence, we can assume AI's continued influence on user experience. Players have also predicted that AI in NPCs will be more enhanced and create a more personalized experience, though since there has been no similar response from the experts, we can conclude that this is one of the more unrealistic aspects of their forecast. Concerning graphics, players were quite adamant that ray tracing technology will complement the realism of games and together with virtual reality make them more immersive. Furthermore, they expect VR to become cheaper and lighter, so it can be considered a mainstream medium for playing games in 2025. There is definitely a demand for lighter versions and more consumer-friendly VR sets, and while some enhancements in this area are possible, probably not to the degree that players expect just yet. When it comes to VR controls, sensor gloves were predicted by the players to be used on a day-to-day basis. Again, this wish will most likely remain unfulfilled for the time being. The other predicted controls for a game of the future were mostly keyboard, mouse, or console controllers, hence the style of gaming will remain sedentary. Additionally, 5G technology acting as a supportive technology for downloading and playing games is anticipated to have a huge impact on the experience of gamers. Lastly, players expect disappearance or shift of conventional stores and more concentration on digital distribution, microtransactions, and one-time payments.

6 Discussion

6.1 Research Reliability and Validity

There are some limitations concerning this study, such as the choice of data collection. While narrative research can give very in-depth insights into the researched phenomenon, there is not a possibility for the researcher to ask

participants additional questions as there is, for instance, when conducting an interview. Another possible limitation to affect the results was the chosen sample of players. It was comprised of so-called "hardcore" players rather than casual ones. Thus, there might be different opinions when asking the other group of players, for they have different personal views on the industry. However, for the reliability of this research, the previous experiences and knowledge about the market helped in identifying different impacts.

As for the validity of this study, the author researched relevant technologies that are being developed in the video game industry and asked the sample of participants the corresponding questions. All of the narrators were either native, or fluent in the English language, hence the understanding of the questions was not a problem language-wise. When interpreting the data, the author strived to minimise bias. Even though there are usually assumptions about the results of the study, the researcher considered all different points of view and did not adjust them or purposefully misinterpret them to suit her purposes.

6.2   Research Implications

When comparing the literature review and the results from it with the practical part of this study, there are both similarities and differences. The most significant difference is that neither experts nor players pointed to cloud gaming as an impactful technology. Although some progress in the area of cloud gaming may be seen as of now, the narratives did not centre around this idea, which does not necessarily imply that it will not influence gaming in the future, just that the development so far hasn't been sufficient enough to point at its speedy implementation until 2025.

To conclude, this research can be beneficial for different organizations and decision-makers that are operating in the video game industry. The results may potentially shape the decisions of executives, especially the ones related to the impacts that technologies may have on the industry. It can also point to the direction that organizations should go, based on the wants and needs of the players. However, all results should be looked at and reviewed critically.

6.3   Ideas for Further Research

The industry of video games is a very broad, limited, and undiscovered research domain due to its novelty and constant development. However, there are many possibilities to research various phenomena related to organizations, game development, and user experience. As mentioned earlier, this study could be expanded by researching views of casual gamers, since they might be different from the ones implemented in this study. Secondly, it is possible to build upon more technologies that might be currently emerging. A more in-depth study can be done on the impact of particular technologies, such as artificial intelligence decreasing the time of game development or virtual production speeding up the process of game creation. Lastly, concentrating on a more distant future is also a possibility.

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Appendices

Appendix 1. Letter to the responding players

"Dear respondent,

I am currently writing my thesis on the topic - The Impacts of Emerging Technologies on Video Game Industry.

I would very much appreciate if you could write **a short narrative/scenario from the player perspective. Express your opinion on future development of video game industry with emerging technologies in mind.**

According to Rotolo, Hicks, and Martin (2016) emerging technology *"is a radically novel and relatively fast growing technology characterised by a certain degree of coherence persisting over time and with the potential to exert a considerable impact on the socio-economic domain(s) which is observed in terms of the composition of actors, institutions and patterns of interactions among those, along with the associated knowledge production processes. Its most prominent impact, however, lies in the future and so in the emergence phase is still somewhat uncertain and ambiguous."*

While writing your narrative, please consider the following:

Describe the gaming experience of the future (in the year 2025).

- What console will you - the gamer - use?
- Do you need to acquire special equipment you don't have yet?
- How is the game controlled?
- Is the style of gaming sedentary or is movement a part of the game/its integral part?
- What about graphics? Is there any way technology/speed of connection has changed it for the better?
- Is the game more immersive than currently available games? If so, why/how?
- Where will you get your games from? (e.g. physical copies from the stores, digital distribution services, streaming services)
- How will you pay for the games? (e.g. one-time purchase, in-game purchases, subscription)

I would appreciate having your approximately 1-page – MS Word or compatible – free-format stories before 13th of April. Your submissions will be treated anonymously and will be used and analysed in my bachelor's thesis. Please, send your narrative/scenario to: tina.semanova@gmail.com

Thank you!

Best Regards,

Martina Semanová"

Appendix 2. Letter to the responding experts

"Dear respondent,

I am currently writing my thesis on the topic - The Impacts of Emerging Technologies on Video Game Industry.

I would very much appreciate if you could write **a short narrative/scenario from your perspective as an expert in the field. Express your opinion on future development of video game industry concerning emerging technologies.**

According to Rotolo, Hicks, and Martin (2016) emerging *technology "is a radically novel and relatively fast growing technology characterised by a certain degree of coherence persisting over time and with the potential to exert a considerable impact on the socio-economic domain(s) which is observed in terms of the composition of actors, institutions and patterns of interactions among those, along with the associated knowledge production processes. Its most prominent impact, however, lies in the future and so in the emergence phase is still somewhat uncertain and ambiguous."*

While writing your narrative, please consider the following:

Describe the gaming experience of the future (in the year 2025).

- What console will the gamer use?

- Does he need to acquire special equipment he doesn't have yet?

- How is the game controlled?

- Is the style of gaming sedentary or is movement a part of the game/its integral part?

- What about graphics? Is there any way technology/speed of connection has changed it for the better?

- Is the game more immersive than currently available games? If so, why/how?

- Where do you see the most progress technology-wise in gaming right now?

- What emerging technologies do you see becoming a part of gaming industry in 5 years? What basis can you give for your prediction?

- Will the technologies in question influence game development/bring about new ways of game development?

- How will the introduction of these technologies change the business model (channels, revenue streams, etc.) of a game development company?

I would appreciate having your approximately 1-page – MS Word or compatible – free-format stories before 13th of April. Your answers will be treated anonymously and will be used and analysed in my bachelor's thesis. Please, send your narrative/scenario to: tina.semanova@gmail.com

Thank you!
Best Regards,
Martina Semanová"