Economic
Research
Working Paper
No. 84/2024

Heterogeneous Development Paths to Growth and Innovation

The Evolution of the Video Game Industry across Four Hubs

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WIPO

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Abstract

This study explores the evolution and success drivers of the global video game industry, focusing on key hubs within Finland, Poland, Japan, and the United States. Using a qualitative methodology, the research delves into how unique capabilities and historical development have contributed to the industry's growth across these nations. The findings reveal diverse pathways to building video game industry clusters, emphasizing the role of cross-industry skill transfer, intellectual property, and government support. In traditional hubs like Japan and the United States, the crossover of capabilities from entertainment and hardware industries has been crucial, whereas, in newer hubs like Finland and Poland, the growth is attributed to unique local developments such as hobby coder communities or leveraging the initial localization efforts to build globally appealing games. It further highlights the pivotal role of education in sustaining the growth of video game industry hubs.

INTRODUCTION

The global gaming industry is massive, estimated at 187.7 billion dollars in 2023[1]. In comparison, the combined global theatrical and home/mobile entertainment market (streaming, disc-based movies, and cinema box office all combined) has a size of 99.7 billion dollars (in 2021)[2]. Today's gaming industry is also very heterogeneously distributed across different devices, global regions, and demographics. The size of the video game industry is distributed between mobile (49%), console (30%), PC (20%), and browser (1%) games[3]. In terms of the regions, this market is distributed between Asia-Pacific (46%), North America (27%), Europe (18%), Latin America (5%), and Middle East and Africa (4%)[4]. Finally, in many countries, there are as many women who play games as men do. For example, 48 percent of gamers in the US are women[5]. Therefore, the industry is more mainstream and relevant than ever.

Considering these numbers, having a successful local gaming industry hub is very important. Although the number of such hubs has increased globally in the last two decades, many countries still show little such activity. What explains the growth and evolution of successful gaming industry hubs?

This case study aims to provide the evolution of the industry for the global video game industry and provide detailed accounts for four nations with their key hubs. In particular, it aims to uncover the unique capabilities and how they have driven the innovation and success of these four cases. The scope of the study covers the industry's main segments, including PC

[1] Newzoo, Global Games Market Report Free Edition, 2023.
[2] Theme Report 2021, Motion Picture Association, 2022.
[3] Newzoo, Global Games Market Report Free Edition, 2023.
[4] Ibid.
[5] Entertainment Software Association, Essential Facts About the Video Game Industry, 2022.

(including a short coverage of esports in each country), consoles, handheld, and mobile games, with categories such as serious games not focused on. A qualitative methodology is followed in uncovering the history and capabilities of the selected key hubs, with the data coming from secondary sources such as specialized gaming websites, gaming associations around the world, and published academic works on the topic.

The main takeaways of this study include: First, despite the complexity of the capabilities required to develop and nourish video game industry clusters, there are multiple pathways to do so, which themselves are path-dependent and evolved by building on the relatedness of the capabilities between the videogame industry and the existing capabilities in other activities. While this has taken the form of a cross-over of capabilities, intellectual property, and human capital from the existing entertainment and hardware industries to the gaming industry in the traditional hubs of Japan and the United States, in Finland, it was built upon the capabilities of hobby coders and the Nokia ecosystem. Second, the diffusion of video game development capabilities around the world allows the creation of new videogame development hubs alongside the traditional hubs such as the US and Japan, which in this case study exemplified by Poland and Finland, with both new hubs' industries growing in the 2000s, compared to the traditional hubs being already established by then. Third, government support with subsidies and other forms of support have been essential for the industry's growth in new video game development hubs. For example, between 2012 and 2015, the Finnish main R&D funding body, Tekes (now Business Finland), funded 28 million euros specifically for the industry[6]. Fourth and finally, successful hubs have made long-term

[6] 10 Years of Funding and Networks for the Finnish Game Industry, Tekes. http://www.neogames.fi/wp-content/uploads/2015/08/TEKES-SKENE_Info_Graafit_99x140_12-08.pdf, accessed 27 October 2023.

investments in education related to video game development, such as high school education in Poland, higher education in Finland, and arts and animation schools in Japan.

Industry and Market Structure

The gaming industry traditionally had three key actors: developer, publisher, and the platform owner. Developers and publishers represent the game supply. Developers are firms responsible for creating, designing, and producing video games. Publishers are responsible for financing, marketing, production, distribution, and (sometimes) providing development technologies (especially for large publishers with in-house game development technology teams). Platform owners, like Nintendo or Sony, make licensing agreements that allow publishers and developers to release games on their platforms (while providing them with development kits, documentation, and other tools) and collect royalties from the sales of games released for their platforms. PC platform, represented mainly by Windows, however, initially had no such licensor or royalty fees to be paid by developers/publishers, yet with the advent of digital distribution via Steam (and later, other digital distribution platforms such as GOG.com or Epic Games Store), that replaced the physical infrastructure of distributors and retailers over time, essentially made these digital distribution platforms also to act as a sort of platform owner on PCs that collects commissions from game sales. That said, it is important to note that, historically, physical distribution likely meant more revenue cuts paid to distributors and retailers than these digital store commissions. Besides these players, new actors joined the industry over time, such as the game development tool ("middleware") providers that supply tools (such as game engines[7]) that ease game development for

[7] Game engines are the toolkits that provide the basic functionality for creating video games such as graphics rendering, gameplay, AI and so on. Unity, a major provider, explains it as "…the software that provides game creators with the necessary set of features to build games quickly and efficiently" (Unity, Game engines—How.

developers and publishers or various software development kits (SDKs) used in mobile games for advertising, monetization, analytics, and other functionalities.

How does innovation occur in the gaming industry?

Videogames are complex software and creative products. As such, defining what counts as an innovative game is not straightforward and can range a spectrum – on the one hand, one can say each new game can be considered an innovation since each game represents a new product. However, on the other hand, if we would like to apply some form of threshold for a game to be considered innovative, then it is possible to define innovation by considering components that make up a game (and its genre): gameplay, audiovisual presentation, story and context (Tschang, 2007; Handrich et al., 2022). From this perspective, a clear innovation – a radical one – is usually represented by the novel combination of all these components, which usually creates a new genre (Tschang, 2007). In the past, yet-to-be-discovered gaming possibilities have resulted in games forming whole new genres in the industry (e.g., "Wolfenstein 3D" and its technical successor "Doom" providing the foundation of a genre called "first-person shooter"[8]). An innovation can also be achieved within a genre or by recombining existing genres, for example, by creating new forms of gameplay. Finally, incremental innovation comes with refining existing gameplay elements combined with new audiovisual presentation and/or story and context.

do they work?, retrieved from the archived website: https://web.archive.org/web/20190720012557/https://unity3d.com/what-is-a-game-engine.)

[8] "A first-person shooter (FPS) is a video game centered on gun fighting and other weapon-based combat seen from a first-person perspective, with the player experiencing the action directly through the eyes of the main character", https://en.wikipedia.org/wiki/First-person_shooter, accessed 27 October 2023.

One can also point out more technical blocks of the game that can be innovated upon, such as the AI code of the game[9], gaming engine, real-world physics code, and so on. Eventually, one can also consider these technical blocks as part of the three elements above (gameplay, audiovisual presentation, story, and context), as these technicalities shape these components. Still, one may also consider these as separate innovations, especially from an upstream perspective – for example, a new gaming engine can be licensed to other game developer firms.

Finally, the business model is another important component of innovation in video games[10]. The most important business model innovation in the gaming industry has been borne out of mobile gaming through in-app purchases and advertising, such as Freemium or Free-to-Play[11] business models. Especially around 2014-2015, many firms in mobile gaming made massive profits with these business models, while PC and console segments focused more on the traditional "boxed game" (i.e., "premium") model, which required developers to come up with a complete individual product one after the other (which entails very high development costs and risks, as discussed in the later sections). This premium model in PC and console segments is also now changing, with the games as a service model ("GaaS": a model where games are designed to be kept alive and growing with new content, also known as "live service games") becoming the latest trend, perhaps mainly influenced after Fortnite Battle Royale's massive financial success since its launch in September 2017.

[9] Please note that AI in the videogame context means the programming and behavior of computer-controlled characters, and hence, existed since the earliest days of videogames.
[10] Although there is no single definition of business model innovation, the concept in this case study closely matches Gambardella and McGahan's (2010) definition: "Business-model innovation occurs when a firm adopts a novel approach to commercializing its underlying assets."
[11] A Free-to-Play app could be monetized either through in-app purchases, such as additional lives or game time, or in-game items/attributes (which is the Freemium case), or it can also be monetized by advertising.

Given these properties of product development and innovation in this industry, it is also essential to consider important sources of innovation. The videogame industry, perhaps even more than any other creative industry, is directly linked to technology. Due to this combination of a technology-driven creative industry, a key source of innovation is the highly skilled human capital. Both technical and creative skills can drive innovation, and perhaps more often, it is driven by the combination of both technical and creative human capital and their skills. In line with this, there is evidence that the diversity of experiences and skills (subject to previous connections and familiarity between members) was influential in producing both innovative and successful games (De Vaan et al., 2015).

Innovation in this industry has also been boosted via several other developments: The community of game developers has expanded worldwide as the internet and other digital technologies developed and became more accessible. The knowledge exchange between developers – for example, through physical or digital game jams and shared open-source codes – has increased tremendously. The increasing diffusion, and some even freely available, game engines have allowed many more people to develop games with much less capital, technology, and knowledge requirements. Consequently, this allowed more developers to bring their ideas to fruition, increasing the number of innovative games. Finally, spin-offs are an important source of entry and innovation in the industry, which has had an increasing trend since the early 1990s (De Vaan et al., 2013) and only sped up even further with the developments above, allowing easier formation of spin-offs.

Lastly, hardware is a crucial enabler of innovation in this industry since a game's technical possibilities are usually defined by hardware limitations, functionalities (e.g., touch screen or motion sensor), and technical capabilities. Sometimes, such hardware's design also

largely drives the innovation itself, which currently virtual reality (VR) can be a good example of. Due to technology's important role in innovation in this industry, the following section explains the co-evolution of the industry and hardware technological disruption.

The co-evolution of the industry and hardware technological disruption

Industry segments in terms of hardware have evolved dramatically over time. Initially, the industry had three main segments: Arcade machines, PCs, and consoles. Arcade machines were the most powerful in terms of hardware as they were expensive custom-built machines. It was also the hardware for which cutting-edge games were developed, such as the Virtua Fighter in 1993 by SEGA (Japan), the first 3D fighting game. In the later 1990s, as PC and console hardware improved, arcades started to recede – especially in the West, since the same games with very similar versions (especially in terms of graphics) could be played on PCs and consoles. Both PC and console markets have grown over time as arcades were declining. However PC market segment, despite growing fast until late 90s, had slowed and went into a slight decline for the next ten years until late 2000s (while console market continued to grow) due to a combination of factors, including unlicensed consumption (i.e., piracy) (Claussen, 2011), although it was revitalized with the digital distribution's rise as it provided both a convenient way to purchase games for users, and also a form of DRM (digital rights management) for developers[12].

The console market has been historically analyzed in terms of its "generations," during which technological devices from multiple competing console owners are released around the same period. In each successive generation, the console segment has consistently grown

[12] However, not all digital distributors force a DRM, exemplified by GOG.com.

over time. Each new generation of consoles and the step-function leap in functionality brought by these new sets of competing hardware has resulted in innovation in the games (Ozalp et al., 2023).

In parallel, from the end of the 1980s and onwards, handheld gaming was also on the rise[13], primarily boosted by the success and popularity of Nintendo's Gameboy. Handheld gaming has also evolved as consoles did in generations, yet their market declined with the rise of smartphones and mobile games in the early 2010s[14]. Eventually, the last remaining primary handheld console owner, Nintendo, released Nintendo Switch, a very successful hybrid (stationary and handheld) gaming console, which absorbed the handheld market and even made it larger than it was, demonstrated by the entry of more recent players such as the Valve with their portable gaming PC, Steam Deck.

Different hardware segments also relate to a different distribution of the popularity of game genres on different hardware. This can be mostly attributed to the differences in each type of hardware being more suitable for different gameplay (supply-side differences) and the differences in users of these devices (demand-side differences). For example, in the early 1990s, PC gaming was predominantly about strategy and adventure games, compared to action and platformer games on consoles. This could be attributed both to inputs of each hardware type (PC inputs of mouse and keyboard being much more amenable to strategy and adventure games), as well as to the users of consoles at the time - primarily small kids and early teenagers who were much more receptive to platformers with a mascot character (such as Mario or Sonic). Due to the convergence across gaming devices, we currently see that

[13] Before late 1980s, there were handheld gaming devices like Nintendo's Game & Watch, but these were simple, single game dedicated devices.
[14] In that respect, one can also make a provocative that handheld gaming devices were inspirations for professional handheld devices (e.g., PDAs) and after that, smartphones.

(almost) all genres are represented in each hardware: PCs, consoles, and smartphones. The fact that each of these devices is now computationally strong enough to handle a vast majority of games allows developers to release the same game across these different devices (i.e., "multihoming"), making the games available on these devices more similar. However, it is essential to note that considerable differences still exist, especially between mobile and others (PCs and consoles).

Over time, as games become more advanced and deeper in content, their development has become more complex, as reflected in the growing size of game development teams for consoles and PCs. For example, in 1995, a console game commercially sold in the US had, on average, a core team size of ~27 developers, whereas the same number in 2005 was around ~108[15]. This tremendous increase equated to a rise in development costs since a substantial share of game development costs are borne out by the project staff. This, in turn, has started the first wave of consolidation in the industry, with publishers such as Activision and Electronic Arts having acquired many developers as they had the economies of scale and scope to sustain the growing development costs in the industry.

Revitalization of Entry by Developer Firms through Cheaper Development, Digital Distribution, the Rise of Mobile Games

Although there was increasing consolidation towards the end of the 2000s, the industry has observed the entry of new developer firms through a series of changes: Digital distribution, mobile games, and diffusion of game engines. Each of these factors allowed smaller players to develop and release games for a smaller cost, and in the case of mobile games, it created a whole new market segment that eventually dwarfed the PC and console

[15] Own analysis, with data from Mobygames.com.

segments. Digital distribution has reduced entry barriers significantly since videogames until then were sold in retailers, for which large publishers had great advantages in accessing them and distributing their games. In addition, the diffusion of licensed game engines has further reduced entry barriers since this technical core of games, usually requiring very large and long development efforts, can now be licensed for a percentage-based royalty payment and sometimes even for free (e.g., some engines are free, and some others are free until reaching a sales threshold reached with the game developed using the engine). The combination of digital distribution with the diffusion of (cheaply available) licensed game engines has allowed teams of one or a few independent developers to develop and release games (which are commonly called "indie developers" and "indie games"), allowing PC and console segments to be populated with innovative but not high budget games alongside the high budget "AAA games" (industry jargon for the high production value games that targets PC and consoles, such as the Call of Duty franchise, which is a series of military first-person shooter games, or the Assassin's Creed franchise, which is a series of action-adventure games[16]).

Mobile gaming, which started on the feature phones of Nokia and others, was limited to simple games due to the hardware constraints on the phones[17]. Mobile games, however, had another much larger start with the release of the iPhone's App Store in 2008, growing exponentially in a few years and eventually becoming the industry's largest segment. The proliferation of smartphones, combined with the touchscreen, hardware capabilities, and their application stores, has created a huge segment of users – many of whom do not play

[16] "An action-adventure game is a video game hybrid genre that combines core elements from both the action game and adventure game genres… require many of the same physical skills as action games, but also offer a storyline, numerous characters, an inventory system, dialogue, and other features of adventure games." https://en.wikipedia.org/wiki/Action-adventure_game, accessed 27 October 2023.

[17] In this period, Nokia released N-gage in 2003 as a more ambitious combination of a mobile phone and a handheld gaming device, which ended up as a failure. However, it played a pivotal role in the Helsinki hub's development, as will be mentioned later.

games on their PCs or own a gaming console. In addition, these mobile games were (and still mostly are) magnitudes of cheaper (and technically simpler) to develop compared to the average PC or console game. As such, the mobile game segment explosion has also come with the accompanying increase in the development firms.

Recent Non-technological Disruption and Current State of the Industry

Non-technological disruptions also occurred during the evolution of the industry. The most recent, and perhaps one of the most impactful, lockdown measures occurred during the COVID-19 pandemic and proved a boon for the gaming industry as the homebound world population spent more time playing video games. As lockdowns ended, some parts of the industry have seen a decrease from that peak. Still, many trends seemed to stay (such as GaaS in the console and PC markets). Global consolidation in the industry has sped up even more, perhaps due to practices like cloud gaming and cross-play, which includes highlights such as Activision Blizzard's acquisition by Microsoft or Tencent becoming the largest video game company globally by revenue[18] through ownership shares around the companies in the world. In addition, there are ongoing significant changes in the industry, such as Epic Games challenging major platform owners such as Apple and Valve (Steam), while Apple itself is forcing new rules challenging advertising and user acquisition means of mobile games, which pushed the developers of the latter to adapt to this new environment.

Properties of Videogame Industry as a Creative Industry

The videogame industry is a project-based creative industry[19], which imbues it with several properties regarding production, development, and innovation of its output that is

[18] https://newzoo.com/resources/rankings/top-25-companies-game-revenues, accessed 26 September 2023.
[19] A project-based industry is one in which a team is formed for the purposes of fulfilling a project. Many creative industries, such as performing arts, movies, and videogames, are project-based (creative) industries.

shared across creative industries, as they revolve around the creation, production, and distribution of content that is often protected by IP rights. First, the industry is characterized by the importance of an intermediary that acts as a gatekeeper (Caves, 2000), which, in this case, the videogame publisher decides on funding the game developer for a game idea/project and supports it throughout the development and marketing. Second, the products are high in up-front development costs and low in marginal costs. Third, the industry has a combination of very uncertain returns to products (nobody knows a priori whether a product will be successful or not) and a very hits-oriented nature in which a handful of games make most of the profits. Fourth, the industry has a short product lifecycle once it is on the market, which means the development of a new product starts right after the previous one is released[20]. Fifth, consumers expect novelty and some familiarity, creating a need for a balancing act between the two (Lampel et al., 2000). Finally, as a combination of all the factors above, the continual development and renewal of intellectual property (IP) is essential in the industry (Tschang, 2007), and the following subsection will discuss further its importance.

The evolution of the industry's traditional console and PC gaming segments in terms of the rising development costs has caused difficult tensions between publishers and developers. On the one hand, given the increasing costs and the uncertain returns to innovation, publishers focused on sequels and spin-offs of existing game IPs[21], together with a further focus on mainstream genres that are less risky and require developers to develop products in a more efficiency-oriented manner (Tschang, 2007). This, in turn, may create some

[20] Certainly, this short lifecycle aspect is now changing with the GaaS games that are aimed to be "living products" with continuous additions and enhancements to keep the user base entertained and growing.

[21] In the videogame industry (and also movie industry), IP is a shorthand for a franchise rather than the broader set of intellectual property (although still referring to intellectual property). Probably this usage can be attributed to the fact that a franchise (generally represented by a trademark) is the key intellectual property in this industry. "Game IP" will be used throughout the text in order to not confuse it with the broader intellectual property.

clash between development firms and publishers, in which the former generally aim for more artistic values or are willing to release more novel products. Some of this novelty may indeed be required since gamers may experience some franchise fatigue if the newer versions of the same franchises are developed repeatedly. These dynamics have been primarily attributed to the AAA game development, which means the rest of the industry partially balances this tendency of incremental innovation of the traditional high-budget industry segment. In contrast, indie developers are more explorative in their gaming ideas. They may develop novel games, mainly due to the fewer financial risks they have.

What is the Role of IP in the Videogame Industry?

It would also be important to speak about the role of intellectual property regarding innovation and competition in this industry. This is especially so since developers and publishers in this industry are intricately involved with the development, renewal, and re-use of franchises, which are game IPs, and other actors, such as platform owners, are additionally involved with the hardware and software that are protected by a variety of intellectual property tools. Gaming IPs can sometimes be multibillion businesses, such as the Mario Brothers by Nintendo. IP protection in video games includes multiple tools, including copyrights, trademarks, design rights, patents, and trade secrets[22]. Perhaps the most important IP protection among these in the gaming industry is copyright (Greenspan and Dimita, 2022), as although its exact workings show differences in different countries, it covers creative aspects of the work such as music, story, artwork, as well as the software code itself. Trademarks are also following copyrights in terms of importance in this industry (Greenspan and Dimita, 2022) since almost all types of firms– including developers, publishers,

[22] See https://www.wipo.int/sme/en/videogames.html, accessed 27 October 2023.

development tool providers, and platform owners – all rely on trademarks for their brands. Many important gaming IPs are generally protected by a trademark (or multiples of them). Patents are the key IP protection tool for console owners and other hardware developers. Still, it is also not rare to have patents for games regarding their technical in-game mechanisms, game development technologies, and software (although it shows differences across countries due to differences in requirements for software patenting).

All in all, considering game developers and publishers, the key intellectual property for them is their gaming IPs (i.e., franchises), which they – beyond the legal protection – also try to manage from a business perspective strategically. For example, in the console market, established IPs (e.g., sequels or licensed IPs of existing properties) are more likely to succeed better in the later stages of a given console generation than in the early stages. This happens because when a console generation is new, the early adopters of consoles are looking for fresh experiences and franchises. In contrast, towards the end of a generational cycle, the mass of the existing console users includes laggard adopters, who prefer to take less risk and spend their money on known IPs (Rietveld and Eggers, 2018).

We can also consider the role of IP in the video game industry by pointing out how it relates to its properties as an industry, as discussed in the previous subsection. As an industry with very high investment and risk for games and the importance of publishers as the intermediary between the developer and platforms, IP allows licensing and transfer of intangibles between players. In addition, publishers take the risk of financing products not only in the hopes of securing a hit game but also in establishing a franchise – thanks to having

IP rights and protection – which is an important motivation[23]. Such an intellectual property (i.e., franchise) also permits capturing value with further sequels and other by-products, perhaps usually merchandising, but sometimes even moving from the game to neighboring industries such as movies. Finally, when considering developers and publishers, IP also plays an important role when externally owned material is licensed for games, such as games based on movies, brands, and sports associations. These points provide incentives for innovation through the availability of IP tools in this industry[24].

Moving beyond the developer and publishers, IP also protects the activities of many other industry actors. Platform owners can manage their business thanks to IP tools since their agreements with developers/publishers involve sharing proprietary information, software, and toolkits as parts of the licensing agreement to have the developer/publisher provide their games to their platforms. Users are bound by end-user licensing agreements (EULA), covering what they can and can't do with the software they have – for example, covering the issue of who owns the modifications or levels that the user generates for a game ("mods" as known in the industry). Development tool providers can provide their proprietary software to game developers thanks to licensing agreements between the parties. As such, multiple layers of actors can coordinate and work together to produce the final game for the users, thanks to IP protection tools.

[23] When an independent developer works with a publisher, it is not always the publisher owns the rights for the new intellectual property as it depends on the agreement between them, but it had been usually the case in the history of the industry.

[24] It is however important to note that patents given to certain mechanics at games are sometimes (informally) criticized. One such example could be the patent about an arrow that shows towards where the player must go in a driving game that was used as part of a broader infringement claim to sue another company developing a game with a similar mechanic.

CASE STUDY OF KEY HUBS IN 4 NATIONS: FINLAND, POLAND, JAPAN, AND THE UNITED STATES

In this section, a case study of key hubs in 4 nations will be presented. For each country, the historical evolution of the industry, institutional environment and support, current situation, and capabilities will be explained. The aim is to provide a historical perspective on the path-dependent development of the industry's capabilities in each nation's key hubs. These four nations were chosen to represent two dimensions: On one hand, it was essential to consider and compare countries that established the videogame industry earlier compared to those that established the industry later. On the other hand, it was important to consider countries representing different trajectories of capability development and eventual positioning of their industry (e.g., mobile vs. PC and console games).

Japan and the US are two main countries that historically represented the industry's beginnings. Naturally, Japan and the US also represented a very high share of the global gaming industry even well into the end of the 2000s. A study highlights these dynamics for the worldwide clusters between 1972-2009 (De Vaan et al., 2013): in 2000, the top 3 clusters were Tokyo (~200 developer or publisher firms), Los Angeles (~100 firms), and San Francisco (~70 firms), and among the top 10 clusters, only London, Paris, and Vancouver were neither Japanese nor American. Since then, although the US and Japan remain key countries for the global gaming industry, many other countries have grown massively since that study, with China already having passed Japan in revenues and competing with the US.

For the other two nations to study, Poland and Finland were chosen to represent the newer hubs of the videogame industry. Poland developed the gaming industry, mostly focusing on PC and console games, which is rare for a newer hub. On the other hand, Finland

has a long history of mobile games and is still a leading country in mobile games. In addition, these two nations had different developmental trajectories, showcasing different yet eventually successful pathways for industry development.

FINLAND

Historical Evolution of the Industry

The industry has its roots in the popularity and adoption of (gaming-oriented) personal computers from the late 1980s to early 1990s, such as Amiga and Atari ST, which also gave rise to many hobbyists who were usually teenagers. Due to Finland's winters being dark and cold, these hobbyists coded at home in winter. These people coding on the limited and mostly non-changing technology at that time have built the foundations of the "Demoscene" subculture[25], in which programmers and artists together try to do impressive computer audiovisual demos given the limited hardware. Although the gaming industry didn't bloom immediately at that time, the local pool of capable programmers and artists that flourished in the Demoscene at the time, together with the largest demoscene event, "Assembly", still play a role in the development and evolution of the Finnish Game Industry.

Even though many self-trained hobbyist programmers and digital artists were available through the Demoscene, it took a while for Finnish development studios to be established. In the early 1980s, some releases were published for Commodore 64 (through Amersoft), but these were mostly one-off individual-authored games. The first professional videogame developers (i.e., individual developers establishing together a firm) in the country had been established only by 1993, Bloodhouse and Terramarque, which merged in 1995 as

[25] As of April 2020, Finland added the Demoscene on its national UNESCO list of intangible cultural heritage of humanity.

Housemarque. In the summer of 1995, Remedy Entertainment was inspired by the Bloodhouse and Terramarque and was founded by members of various demoscene groups as a commercial videogame developer. Greater Helsinki Region, both at that time and currently, represents the main hub of game development.

In 2001, Remedy Entertainment scored the first big international success by a Finnish game developer, Max Payne, which also brought the foundation of other game development firms in Finland, with some of the key Finnish game development studios being founded around those years, such as RedLynx, Bugbear, Sulake, and Frozenbyte. Around the same period, Nokia was the globally leading company in mobile phones, with mobile phones relatively improving in terms of hardware capabilities compared to earlier mobile phones, which kicked off the first wave of mobile gaming companies in Finland. For example, Rovio Entertainment (known for Angry Birds) was founded in 2003 as Relude, after three founders (back then university students) competed with their game and won the award at the Assembly demoparty mobile game jam sponsored by Nokia and Hewlett-Packard, hence giving them resources and visibility (which eventually resulted in them having a publisher to work with) to start the company.

2003 was an important year for many mobile game developers in Finland since it was the year that the N-Gage by Nokia was launched. N-Gage was a hybrid of a handheld game console and a mobile phone, which was unique at the time. Around the launch of N-Gage, many mobile developers got funding from Nokia to start their mobile development firms, with many of their founders coming from the demoscene. Since mobile phones at the time – and even N-Gage – had limited hardware compared to PCs and consoles, the expertise of demoscene programmers and artists was a perfect fit to cram innovative and interesting

content into limited hardware. Although N-Gage ended up as a failure to be scrapped in early 2006, this push on mobile games by Nokia was key in the formation and support of the mobile gaming developer ecosystem, which became very successful when mobile gaming massively grew with modern iOS and Android smartphones.

The launch of the widely adopted iPhone 3GS in 2009 was a significant turning point, as in addition to widespread adoption, the iPhone as a hardware, together with its App Store, proved to be a very suitable gaming device, which initiated the big boom of mobile games. At that point, it became clear that iPhone/iOS adoption was quickly surpassing the incumbents such as Nokia and Blackberry (who were further squeezed by Android phones). It was also in that year that Rovio released Angry Birds, which became a big hit[26] worldwide and fueled not only in Finland but all around the world the founding of many mobile game development firms that were inspired by Rovio's success.

The mobile gaming market has increasingly moved towards social and connected games, so the free-to-play business model has become the real driver of success and revenues. Again, a Finnish mobile developer, Supercell, founded by two veterans coming from the demoscene with an earlier mobile development studio success (Sumea) during the Nokia era, has been one of the pioneers in the Western world being successful with free-to-play, in-game purchase ("microtransaction") based mobile games, particularly with its hit game Clash of Clans. The worldwide success of Supercell has created another big push to strengthen the videogame development hub in Helsinki and further strengthen the broader Finland.

[26] Please note that Angry Birds is Rovio's 52nd game release, and in the true fashion of a creative industry, shows that the success is quite uncertain and may need many attempts in such contexts.

Institutional Environment and Support

The video gaming industry in Finland, particularly the Helsinki hub, has a wide range of support from many institutional actors. Business Finland (formerly Tekes and Finpro), which is a government organization, funds R&D and game development and has helped the foundation of many game developers since 1995 (as Tekes), including key ones such as Supercell that also benefited from their funding (in addition to investments by the founders and venture capitalists). Early on, Tekes did not directly fund game development but instead funded technology related to game development, such as game engines (Sotamaa et al., 2020). It was in 2012 that it created its funding program specifically for games called "Skene – Games Refueled", which provided 28 million euros of money[27]. Currently, Business Finland (former Tekes) still provides funding for gaming companies up to 1.25 million euros[28]. It is, however, important to note that there is limited cultural fund support by government agencies, with the DigiDemo grant being the only one. Neogames, the non-profit, membership-based Finnish umbrella organization for the game industry, supports the whole ecosystem, including game developers, investors and publishers, educational institutions, media, and the people looking for a job in the industry, while cooperating with all other key associations as its members. The Finnish Game Developers' Association (Suomen Pelinkehittäjät Ry) is the primary association for game developer companies. It organizes events and represents the interests of game developer companies regarding policy and other decisions. In addition to these, although IGDA (International Game Developers Association) and EGDF (The European Games Developer Federation) are both organizations that are not

[27] 10 Years of Funding and Networks for the Finnish Game Industry, Tekes. http://www.neogames.fi/wp-content/uploads/2015/08/TEKES-SKENE_Info_Graafit_99x140_12-08.pdf, accessed 27 October 2023.
[28] Please see the funding scheme here: https://www.businessfinland.fi/en/for-finnish-customers/services/funding/tempo-funding/game-business-funding, accessed 28 March 2024.

unique to Finland – with the former active internationally and the latter in the broader European region, it is important to note that their chapters in Finland are very active (in terms of number of events and conferences organized) compared to those in other countries, which can be related to the knowledge sharing and more cooperative culture amongst game developers in Finland (please see below the section on “Capabilities”). In addition, the professionals in the industry have pushed for unionization early, with the Game Makers of Finland representing the world's first labor union for game workers and students.

In addition to the associations and organizations mentioned above, the Helsinki hub is directly supported by Helsinki City. It provides a wide range of activities and support to strengthen the hub further, ranging from support for external arrivals to start-up incubators and cultural events to promote the industry. For example, the City’s youth services organize game industry-related events, including game development camps, for young people. Overall, Helsinki City not only formally recognizes and supports the industry but also actively works with leading industry associations and organizations and organizes events.

The funding from private sources is also highly active in the Helsinki hub. Numerous VC firms are highly (or entirely) focused on funding gaming companies, such as Sisu and Play Ventures. These VC firms have old veterans from the industry, therefore allowing funding to benefit from the expertise of the investors. In line with this VC funding, the overall start-up scene in Helsinki is active in terms of the events for the start-ups seeking funding. For example, Slush, a startup and tech event held annually in Helsinki, regularly has gaming (and gaming-related) start-ups showcasing their firms for funding.

Higher education related to the gaming industry is one of Finland's highest per capita globally. It undoubtedly supports the industry with a fresh talent pool as it grows. Thirty-seven

higher education institutions offer formal education targeted at the gaming industry, resulting in 6.7 institutions per million citizens, far above the average in Europe (Marszałkowski et al., 2023).

Current Situation

According to Neogames, there are 232 active studios in 2022 (48% of them being in the Helsinki metropolitan area/the Capital Region) while employing 4100 employees (share of women: 20%) and a total turnover of €3.2 billion, which is precisely ten times of the turnover in 2012 (Hiltunen et al., 2023). To put the size and growth of the industry into context, one can observe the significant increase in the number of active studios right around Rovio's success in early 2010: There were 70 active studios in 2010 and 180 studios just two years later in 2012 (Hiltunen et al., 2023).

It is also important to note that Finland has a relatively developed esports scene, in which its strength mainly lies in having top-tier players in many games, such as "Serral", who was the first non-Korean Starcraft II World Championship Series (WCS) champion in 2018, or having 2 of the top 5 most successful (and earning) players ("JerAx" and "Topson") as of 2023 for the game with the highest prize pool in tournaments currently: DOTA 2. The esports in Finland have gotten a boost also from institutional developments, including the official recognition of the esports players as athletes in 2017, which gives tax benefits at the end of the career for players (which happens quite early as esports players generally retire or move to manage teams themselves in their 30s), therefore incentivizing more esports talent to pick it up as a professional job. In addition, in 2019, the Finnish Esports Federation (SEUL) became a full member of the Finnish Olympic Committee. Finally, esports growth in Finland also created a curious, yet equally fast, growth in esports betting.

As a country with a highly developed gaming industry, Finnish development studios have attracted international acquirers as the consolidation trend has increased. Major acquisitions involving 80% of Supercell were acquired by Tencent in 2016 and the Housemarque by Sony Interactive Entertainment in 2021. Seven acquisitions occurred between 2021 and 2022 (Hiltunen et al., 2023).

The importance of IPs (i.e., franchises and brands) for Finnish mobile game developers has increased dramatically in the last two years due to Apple's App Tracking Transparency (ATT), which has given users the choice to give or not give consent for the use of their data with the app owner while using an app. This data is vital for mobile game developers as they heavily rely on it for user acquisition and advertising-based monetization. Since ATT has disrupted these dynamics by letting users not share their data, mobile game developers now have much more of a need to rely on known IPs to build a user base for their new mobile games.

It is also important to note that the Finnish game industry reflects the recent convergence between mobile and other platforms due to the similar business models (GaaS, free-to-play) getting adopted in PC and console gaming – according to Neogames in 2019-2020, 65% of developer developed at least a game for mobile devices while 46% of them developed at least a game for PCs[29], whereas this number was 66% for mobile and 64% for PC in 2021-2022 (Hiltunen et al., 2023). Despite declining after the initial hype, AR/VR and Web 3.0 games still represented 20% of developers working on them (Hiltunen et al., 2023), which can be considered quite active for this emerging segment.

[29] Please note that percentages sum up more than 100% since developers are developing games for multiple platforms, especially through multihoming (i.e., same game having developed for different platforms)

Capabilities

If we consider the development of the capabilities of the Helsinki hub, it is easy to single out two main origins that provided its foundations and evolutionary path: Demoscene and the Nokia ecosystem in the early to mid-2000s. Demoscene provided the industry with an early pool of hardcore programmers and artists who were not immediately involved in founding commercial development studios but gave the Finnish industry an edge when most technologies were in-house (e.g., no game engines to license). In particular, the availability of this human capital had even more complementary value when it came to early mobile gaming in the Nokia era since these individuals were experts in working with limited hardware and under constraints. Nokia's investments in fostering a mobile gaming ecosystem, therefore, were able to take hold and determine the future of the Helsinki hub despite Nokia's demise in the mobile industry.

Another key determinant of successful new game developer firms and the ability of the hub to catch up with the constant changes in the industry have been the very high spin-off activity that spawned successful new firms out of the existing (successful) ones. This spin-off activity is also partly enabled by the substantial public and private investment and support infrastructure (including the City of Helsinki's support) available, together with the fresh pool of human capital educated in Finnish higher education institutions with their many offerings targeted at the industry. In addition, Helsinki is quite competitive in attracting foreign worker talent to meet the human capital needs of this still highly-growing industry hub, with the overall share of non-Finns in the gaming industry being 30% (Hiltunen et al., 2023).

In addition, the open knowledge sharing culture between the industry participants provides a unique capability for learning and adapting to the hub. The literature has well

documented the value of such openness in innovation and value creation on open innovation (Chesbrough and Appleyard, 2007), which is attributed to a few factors: shared Demoscene roots of the many CEOs in the currently prominent companies (Lehtonen et al., 2020); high trust and openness of the Nordic culture (Andreasson, 2017), which is ranked amongst highest in the world[30]; and a small local market to compete, but a large outside market as the main focus to cooperate.

A combination of the above capabilities allows the Helsinki hub to innovate and grow even in the turbulent and disrupted segments of the industry, such as the changing business models and privacy changes (i.e., Apple's ATT) while innovating themselves. One can also observe that development firms are also "in the know" about their need to adapt, and their awareness of the need for different capabilities allows them to understand the changing dynamics. For example, Metacore (developers of Merge Mansion) already realizes that gaming is now much different for the masses than it was in the past. As such, the industry must compete with other industries to employ specialists with various backgrounds beyond gaming[31].

POLAND

Historical Evolution of the Industry

In the early 1990s, Poland transitioned to an open market economy from communism. At that period, there were low purchasing power, lax (or not much functional) IP laws, rampant unlicensed consumption, and few (old) PCs. The first notable developers in Warsaw appeared

[30] https://ourworldindata.org/trust, accessed 28 March 2024.
[31] See https://www.computerweekly.com/feature/From-Nokia-to-Merge-Mansion-Helsinkis-tech-expertise-is-sparking-a-new-era-for-global-gaming, accessed 19 Aug 2023.

during this period (or just before), with mostly national, and sometimes European, successes, such as Mirage Media (founded as Mirage Software in 1989) and Metropolis Software (founded in 1992), which nevertheless were key for the future successes in the industry – with the co-founders of the latter being founders of the current day prominent Polish Game developers People Can Fly and 11 bit studios.

CD Projekt Sp. z o.o., a global player and the key firm in current Polish game development, was established in 1994 to import CD-ROM games for Polish consumers. Due to rampant unlicensed consumption, the incentive for buying a genuine copy of a game rested mainly on the additional value provided by what the genuine copy of the game provided. Initially, this was in the form of the translation of the printed game manual (in those years, game manuals of 100+ pages were not uncommon), which was important due to the limited English skills of the population back in the time[32]. The value of localization grew as its scope grew by moving beyond translating only the game manual. The first big success of CD Projekt came from its fully localized release of Baldur's Gate – a text-heavy Role-Playing Game of 1999 by Bioware in the U.S., which was also a global hit – for which CD Projekt translated not only hundreds of pages of in-game text and dialogue but also hired famous Polish actors to voiceover and localize in-game speeches by the characters in the game. The game became the biggest success for the firm at that time[33], creating enough funds (and vital connections[34])

[32] This was an important point in success through localization since text-heavy games were also popular due to the weak PCs that the consumers had. Particularly genres like RPGs (at the time much more text heavy compared to visual heavy 3D action or shooter games), and turn-based strategy (e.g., Heroes of Might and Magic series, not so demanding on the computing side and have one of the largest fan bases of the game in the world in Poland) were so popular that it also shaped the gaming tastes of the local population as well as – perhaps – still the games produced by some Polish developers nowadays – such as the CD Projekt being specialized in developing RPGs.
[33] The game sold 18,000 units in its day of release in Poland, compared to earlier numbers of 1,000 to 2,000 for past releases of CD Projekt (see http://www.polygon.com/features/2014/7/16/5884227/cd-projekt-the-witcher-3).
[34] In particular, Witcher's development had troubles, and thanks to CD Projekt's earlier good relations with Bioware – the developer of the Baldur's Gate series –, the latter provided with a license to Bioware's Aurora 3D game engine which allowed Witcher to be developed using their engine and gave them a space at the E3 convention in US, which helped CD Projekt to secure a global publisher for the game.

to start developing the first game of the Witcher series, which transitioned the Polish gaming industry into one of the key global players and a key financial and cultural export for the country.

The initial success of The Witcher, released in 2007, started the internal growth of the industry in Poland, as many employees of CD Projekt spun off with their studios in the Warsaw hub and Poland broadly in the following years. However, it was the global hit Witcher 3, released in 2015, that created a central shifting point for the industry in terms of both the institutional support and the size of the industry, making it one of the key export industries for Poland (see “Current Situation” on the growth of the industry).

Polish gaming industry success was wider than CD Projekt. In recent years, Polish developers have succeeded in multiple different platforms and arenas, including other AAA console/PC developers such as Techland, mobile developer and publisher Boombit, and VR developer SUPERHOT, to give an example.

Despite the recent decade's favored mobile games with their lower entry barrier and higher profitability, it can be said that Polish game developers are still relatively highly active in the traditional AAA industry segment with console and PC games, competing with their counterparts in more established hubs in US, Japan, and others. This is also reflected in the choices of platforms for development: According to the European Game Developer Federation’s report in 2021, amongst the games under development by Polish developers, 71.8% of games targeted PC, whereas only 11.8% targeted a mobile device, lowest amongst the surveyed countries[35]. Competing in the AAA market is highly prestigious, which is also why Poland became a global player (of course, which happened in the first place through the

[35] European Game Developers Federation. (2022). 2021 European Video Games Industry Insight Report.

highly successful game releases by leading Polish developers) and enjoys this reputation. Multiple factors likely contributed to why Poland competed in the AAA market, which is a mix of education, culture, and heritage, as well as the economic conditions allowing relatively cheaper development of games compared to the US.

Institutional Environment and Support

As the industry has become strategic for the country, it has strong governmental support at multiple levels, especially the cultural and financial export aspects being deeply embraced and supported. Cultural state aid in the form of grants for video game developer firms is provided by the Ministry of Culture & National Heritage's Development of Creative Industries program. For R&D, the GAMEINN program first launched in 2016 and implemented by the National Center for Research and Development, is the most known and used subsidy (Krampus-Sepielak et al., 2021)[36]. In addition, the Polish Agency for Enterprise Development, the Creative Industries Development Center (founded recently in 2022), and the Polish Investment & Trade Agency all support game developers in different aspects of business with the main aim of helping developers create games and grow and succeed globally. There are two main developer-side institutions. The first is the Polish Game Association, formed by major Polish developers. It represents the industry in coordinating with governmental bodies, representing it at EGDF, and supporting developers in competing globally. The second one is the Indie Games Poland Foundation. This non-profit, grassroots organization promotes the

[36] Official page and details for the GameINN program can be found here (in Polish): https://archiwum.ncbr.gov.pl/programy/fundusze-europejskie/poir/konkursy/konkurs5122017gameinn/ accessed 27 March, 2024. An English summary can be found here: https://www.pwc.pl/pl/pdf/alerty-innowacje/13-PwC-Alert-GAMEINN-v1-ENG.pdf, accessed 27 March 2024.

Polish game industry abroad (through trade missions, exhibitions, and international cooperation) and supports all important developer events.

Warsaw hub, the largest in the country, mainly benefits from the excellent pool of specialized human capital needed for the industry and the easy connections for travels from/to abroad (Sliwinski et al., 2021). On the other hand, Krakow is a hub greatly benefiting from the Krakow Technology Park, which is also very active in supporting the industry through the Digital Dragons hub that serves as a startup accelerator and incubator, housing many developers, and through the Digital Dragons Conference, which is one of the two major conferences for developers in Poland. In addition, Krakow Technology Park offers workshops and undertakes research regarding the game industry in Poland. On the other hand, Katowice has events regarding esports, hosting the international esports competition Intel Extreme Masters and the Esports Association. Finally, the Game Industry Conference (GIC), together with the Poznan Game Arena Expo, both held in Poznan simultaneously (the former is B2B and for developers, and the latter is for consumers), serves as the other major conference for developers.

On the investment side, Polish game developer firms tend to become public companies to get investments. This has been achieved through the growth of the Polish gaming industry, which has become one of the key local industries competing at the global level. These companies needed further capital to boost their growth, which going public enabled. Warsaw Stock Exchange's moves have further complemented this increase in public offerings by Polish gaming companies, such as the founding of the WIG Gaming Index in 2019. Before the bear market of 2022, in the combined main exchange and New Connect Exchange (for smaller firms with easier listing requirements), nearly 90 gaming companies were listed,

with a total value of gaming companies comparable to those listed on the Japanese Stock Exchange.

Thanks to its education system, the industry heavily benefits from a good pool of programmers. In OECD's Programme for International Student Assessment (PISA) for high school students, Poland is in the top 5 in all three categories in 2022: Reading performance, maths performance, and science performance[37]. Also, Polish programmers rank amongst the top in coding challenges[38]. Regarding the higher education, it was reported that in 2022 there were 65 degree courses in 52 universities formal education targeted at the gaming industry, with most courses were for programming (26 courses) and art (23 courses) (Marszałkowski et al., 2023). The number of universities offering programs targeted at the gaming industry ranks in the top 4 in Europe. In terms of per million citizens, the number is 1.4 institutions, above Germany (1.2 institutions) but below France (2.2 institutions). In addition, the gaming industry is also embraced culturally in the overall education system, with This War of Mine (a unique game that makes players experience civilians' lives in a war) being added to the official reading list for children in schools in 2020.

The country became increasingly foreign worker friendly, allowing a good inflow of international talent and industry internationalization through diversity in development teams. In particular, the country had a massive inflow of highly skilled developers from Ukraine and Belarus, starting from 2014 – way before the invasion of Ukraine in 2020, which only increased this inflow further (Marszałkowski et al., 2023). Overall, the workforce of the Polish gaming industry has become more diverse over time, with the workforce's 14.5% being

[37] https://data.oecd.org/pisa/science-performance-pisa.htm#indicator-chart, accessed 21 Aug 2023.
[38] HackerRank, 2016, Poland is 3rd country amongst 50 (https://www.hackerrank.com/blog/which-country-would-win-in-the-programming-olympics/).

foreigners and 24% (a number very slightly above the EU average of 23.7%[39]) being women as of 2022 (Marszałkowski et al., 2023).

Finally, numerous prominent Polish developers have a no digital rights management (DRM) approach, such as GOG.com (CD Projekt's digital distribution platform) and Flying Wild Hog Studios. This choice risks more unlicensed consumption but gives users more freedom and autonomy (e.g., if they have a limited or unreliable internet connection, that doesn't pose a problem, whereas many modern DRM systems may require an online connection). This choice is perhaps due to the backdrop of the earlier Polish industry days when the competition against unlicensed consumption relied on the added value provided to consumers, as there is a focal group of players that argues DRM causes more trouble than benefits, therefore, reducing the value of licensed consumption (Ahn and Shin, 2010).

Current Situation

According to Polish Agency for Enterprise Development's 2023 report, there are 494 development studios (including publishers) in Poland, while employing 15290 employees (share of women employees: 24%) and a total revenue of €1.2 billion, which is 2.5 times of the revenue in 2018 (Marszałkowski et al., 2023). There are three key hubs: Warsaw (Masovia province), leading in number, representing 30% of the firms in Poland as a province, with two southern cities close to each other: Krakow (Lesser Poland province), representing 19% of firms in Poland as a province, and Katowice (Silesia province) representing 14% of firms in Poland as a province (in all three provinces, these cities represent almost all or a very high number of the firms). The growth of the game studios can be traced back to 2008 for the first increasing trend. Another jump starting from 2014 onwards, which shows some relation to

[39] European Game Developers Federation. (2022). 2021 European Video Games Industry Insight Report.

the releases of big Polish successes of Witcher (2007), This War of Mine (2014), Dying Light (2015), and Witcher III (2015) (Marszałkowski et al., 2023). Given the relative weight of AAA PC and console development in the Polish game industry, the average team size in 2023 is 31.3 (which increased more than 40% compared to 2020), a number that is 52% higher compared to Finland (in 2022) (Marszałkowski et al., 2023).

Since the Polish industry has become so prominent in the international scene, it has also attracted international acquirers with a lot of readily available money looking for high-potential firms to acquire. Just in July 2023, the key AAA developer Techland was acquired by Tencent for an undisclosed amount (although the valuation estimate of Techland was around 2 billion euros), with also other acquisitions or investments by Tencent in Poland in the last few years: 1C Entertainment (acquired and renamed as Fulqrum Entertainment), Bloober Team (majority ownership), and investments in Gruby Entertainment, Exit Plan Games and The Parasight.

As Polish developers have a relatively higher representation in AAA gaming, it is no wonder they have a good reliance on their IPs since most of these games are developed with very high budgets, and having the right IP plays a big role in major successes (e.g., Witcher III, with the whole Witcher game series being based on the same named books by Andrzej Sapkowski's fantasy saga based on Polish folklore). This likewise shows the importance of the literary works leveraged by the Polish gaming industry, as 11bit Studios (developers of This War of Mine) is now developing The Invincible, based on the same named novel by Stanislaw Lem.

However, it is important to note reliance on big-budget titles can be risky, as these titles are generally still sold as premium games (typically a large payment is made for the

whole game, with potentially some separate minor additions sold in the form of downloadable content, abbreviated as DLC), with 69% of Polish developers using premium business model (compared to 12% free-to-play) as their primary model (Marszałkowski et al., 2023). For example, CD Projekt, when its highly expected blockbuster title Cyperpunk 2077 had underdelivered upon release, had suffered financially and is still trying to adapt itself to the current market to have a leaner and more agile approach - with its latest downsizing of 9% of the workforce just announced in July 2023[40].

Still, to balance these issues, Polish Indie game development is quite sizeable and growing, as reflected in the 160+ game releases on Steam by Polish developers in 2022 (Marszałkowski et al., 2023). Even more, local consumption of games is relatively high – which benefits many developers, since although it could be a slice of the overall demand globally for many big productions (especially considering 96% of revenues from the games industry in Poland comes from exports[41]), it can be still valuable for indie developers, and also is an important source of new developers for the industry.

In line with this high local consumption of games and the popularity of PC gaming, Poland has a large and very active esports scene. One of the key global esports events, Intel Extreme Masters (IEM), has its yearly finals held in Katowice since 2013. In line with these, institutional support has also developed over time, with the Polish Government recognizing esports as a sport after an update on the Polish Act on Sport in 2017. In 2023, the Polish Esports Federation was accepted as a member of the Polish Olympic Committee. Finally, as a sign of Poland as an important European esports center, the European Games Esports Championships in 2023 is also held in Katowice.

[40] https://polskigamedev.pl/cd-projekt-red-zwalnia-100-ludzi-9-zalogi/ (in Polish), accessed 21 Aug 2023.
[41] Polish Investment & Trade Agency. (2022). The Gaming & Game Development Sector.

All in all, the Polish gaming ecosystem is a successful and still growing ecosystem, with large studios, smaller indie developers, mobile-first developers of different sizes, and successful VR game companies all represented in this flourishing and growing trio of hubs (and the whole of Poland, in general).

Capabilities

Poland's success can be traced back to its capabilities developed over time, starting with the initial localization activities by the early publishers. Particularly the CD Projekt, which succeeded with its (for the time) big localization investment for Baldur's Gate, which became a local success despite unlicensed consumption, and allowed the firm to start developing its first hit game, The Witcher, which is also undoubtedly the major boost that allowed the industry to grow over time.

This aspect of localization still plays an important role in Poland – however, in a different way. Since Poland is currently ranked highly in English skills among the population, the localization efforts are now more about making Polish games localized for other countries. More than 65% of games developed by Polish developers are translated into more than two languages; this figure is 29% for the rest of the world (Marszałkowski et al., 2023), highlighting the export capabilities of Polish game developers.

Another important aspect of the capabilities in Poland lies in its highly ranking (in PISA) high school education, combined with the many universities offering game-related education and, overall, a country that is good at training a highly-skilled, large pool of programmers. Also, the recognition of the gaming industry in the education system is further highlighted by actions such as incorporating a game into the official school reading list.

Government support is undoubtedly a very important part of the Polish game development hubs since the government has been quick in starting to support the industry, realizing its fast growth after The Witcher's success. As written above, the GameINN program, established in 2016 (the year after Witcher 3's release and global acclaim), has been a key support. In addition to this R&D support, there is also strong cultural support, in which the country recognizes it as its soft power. For example, one can also see that the game mentioned above, War of Mine, is being added to the official school reading lists as a recognition of this general cultural emphasis on video games.

Poland's game development hubs also greatly benefit from being an attractive country for foreign workers to move to. The high number of foreign workers can support the booming industry and its need for highly skilled talent. Polish game developers certainly benefited from being a welcoming haven for developers who moved from Belarus and Ukraine in the last decade.

Finally, Poland has been able to build on its cultural and literary heritage (Pantalony, 2009; Mergos and Patsavos, 2017), hence complementing the government's cultural efforts in building innovative games and experiences such as This War of Mine and many others—especially indie ones—that counterbalance the country's heavyweight AAA studios to create an innovative ecosystem.

JAPAN

Historical Evolution of the Industry

Japan has been one of the pioneers in the formation of the video game industry, even starting back in the 1960s with the development of the electromechanical games in which electronics and mechanics are fused (such as the Periscope, initially developed by Namco, and

then an adaptation of it a year later by Sega). The two important early major successes in the industry happened with the releases of Space Invaders by Taito (1978) and Pac-Man by Namco (1980), ushering in the Golden Age of the Arcades (Kent, 2001) and providing a boon for many Japanese arcade game developers for the next 3-4 years. Fueled by this, home video game consoles also started to get popular in the United States, where the Atari (with Atari 2600) became a household name (with its most popular game being the Atari 2600 version of Pac-Man) in US until the videogame crash of 1983 (known as "Atari Crash" in Japan), which happened due to the oversaturation of the market with dubious quality games and the lack of quality control. This led many in the US to consider video games as a fad. Also, in 1983, Nintendo released its Family Computer (Famicom) in Japan and then brought it to the US (in 1985) and Europe (starting in 1986) under the name of Nintendo Entertainment System (NES). NES turned out to be a massive success, partly also because of the ability of Nintendo to have strict control over which games to be released on the hardware through the combination of its security chip access[42]. As the NES succeeded greatly worldwide, it proved a boon for many Japanese developers who released games for the NES. Tokyo (Kantō region) has been the central hub of the industry by far since those early days. However, it is still important to consider Kyoto and Osaka (Kansai region) since the latter region has key companies like Nintendo (Kyoto) and Capcom (Osaka), again active since the early years of the industry in Japan.

[42] This also allowed Nintendo to have very tough business terms, which was later examined by the FTC and settled for 25 million USD equivalent of discounts and payments and changed its business terms, but overall, the requirement of having high upfront fixed costs to release games on a console motivated developers to develop high-quality games to recoup their costs (see Hagiu, A. (2014). Strategic decisions for multisided platforms. MIT Sloan management review, 55(2), 71-80), hence building the foundation of the modern console gaming industry structure.

In the early 1990s, the slowing arcade market got another boost with the massive success of Street Fighter II by Capcom. The late 80s to early 90s also had two other important console producers competing with Nintendo – NEC with its PC Engine (TurboGrafx-16 in the US) and Sega with its Mega Drive (Genesis in the US). Sega became globally successful in its competition against Nintendo, sharing the console market half and half around 1993-1994. This competition kept innovation alive – on the arcade front, SEGA produced its first specialized 3D gaming arcade board as early as 1992 (Model 1). In contrast, different platform owners competed on the console front by releasing new consoles. Sony's release of PlayStation in 1994 in Japan (and in 1995 in the US and Europe) had a massive impact on the console market by bringing 3D gaming and CD-ROMs to mainstream gaming, with the CD-ROM technology directly building on Sony's R&D and knowledge[43]. This period saw Sony becoming the global market leader ahead of Nintendo, Sega, and others, and despite being an entrant, it solidified the dominance of Japanese consoles globally until the Xbox entered the market in 2001.

The period after Sony's entry represents Japan's peak power in the industry, with the combined dominance of console hardware and the peak of its developers' power in the late 90s. In addition, these games released in the 90s by Japanese developers were either pioneers of some genres or were major catalyzers that defined it, such as Street Fighter II in 1991. However, on the PC side, Western games were developing fast, and so was the market. During the 2000s, the large publishers in the West (particularly in the US with the likes of EA and Activision, but also in Europe, such as Ubisoft) benefited from the massively increasing size of

[43] Compact Disc (CD) technology is co-developed by Sony and Philips.

the market. In contrast, the Japanese market was already mature and was not showing much growth (Koyama, 2023).

This created a turning point in the latter half of the 2000s with the release of PlayStation 3 and Xbox 360. The increasing team sizes for developing games (see also section "Determinants of Innovation and the Role of IP in the Videogame Industry") has again tremendously risen with the move to this new generation, and it was relatively more difficult to develop games for PlayStation 3 due to its complex architecture (Cennamo et al., 2018). This proved problematic for Japanese developers since they had to consider developing for PlayStation 3 first if they wanted to develop games for a console due to the weak presence of Xbox locally. It was in this period that the handheld game consoles had their second golden moment (the first was 1996-1998 with the release of Pokémon for Gameboy), particularly in Japan, with Nintendo DS and PlayStation Portable (PSP) having a high number of game releases since mid-sized developers that find PlayStation 3 too costly to develop for has moved their efforts to these handheld consoles (Koyama, 2023).

The combination of these developments – the continuously increasing market size in the West with massive publishers being able to fund ever larger games and the disappearance of the most mid and smaller-sized Japanese developers from the PlayStation 3 and Xbox, put the industry into a period of decline in the global competition since also the gap between Western and Japanese developers widened through the focus on different game genres and art styles (something that became clearer as the graphic fidelity increased greatly in 10-11 years between the release of PlayStation 1 in 1994 (Japan)/1995 (US) and PlayStation 3 in 2006). It was not uncommon to have this discussed in the mainstream media[44], with some

[44] Cieslak (2010). "Is the Japanese gaming industry in crisis?", BBC Click. Accessed 10 August 2023, http://news.bbc.co.uk/2/hi/programmes/click_online/9159905.stm.

industry veterans highlighting the issue. They wished that Japanese developer firms would adapt to the market and make the industry globally leading again.

In parallel, the period towards the end of feature phones and the rise of smartphones has also affected the market structure and the dominant business models. In the early 2000s, simple games that could be played on the feature phones were developed, like the Finland case. However, towards 2010, when smartphone adoption started and feature phones began to recede, social gaming boomed on feature phones based on social gaming platforms by GREE and DeNA. These platforms were necessary due to the limited hardware functionality of the feature phones; hence, the games were mostly browser-based with the gaming server/infrastructure provided by these social platforms (thus, developers had to pay them for these infrastructure costs) (Koyama 2023). In addition, the increasingly dominant business model in these games has leaned towards "pay-to-win," where players with better items/characters had a better chance to win the game, with which items to win upon payment being managed by the lootbox (gacha) mechanic. The social game platforms have later added an additional layer of even stronger and rarer items, for which you had to collect several rare items from the 1st level of lootboxes to unlock *the chance* to win the 2nd level grand prize (consider it as a pyramid of rewards; hence a multi-level lootbox, kompu gacha), which was banned in 2012 by Japan's Consumer Affairs Agency, sending a shock to the social gaming platforms' massive profits[45]. It was also around that time that smartphones became dominant in the population, and mobile games taking advantage of this hardware started to replace some of the older social games. Particularly, Puzzle & Dragons by GungHo Online Entertainment has become a massive hit with its free-to-play model, which sent a message to

[45] https://www.gamedeveloper.com/business/why-quot-kompu-gacha-quot-was-banned, accessed 10 August 2023.

other developers in the market and started the move towards a free-to-play model (Koyama, 2023).

The latter half of the 2010s and onwards represented a comeback for the Japanese videogame industry in the global scene, for which a combination of factors could be counted. First, large Japanese game developer firms have adapted to the need for further globalization and better localization. This, together with the larger budgets (particularly for marketing) needed to compete with Western games, was required to succeed in the videogame console and PC segments. Perhaps also by leveraging the niches in which Japanese developers are successful, they created new global hits, perhaps the culmination of it being most visible in the global multiple award-winning hit game "Elden Ring". Second, the Nintendo Switch, the innovative hybrid stationary and mobile gaming console released in 2017, has become a massive success, which breathed life and gave space for many developers of different sizes, including those that used to develop for smaller audiences and lower budget titles, especially for handheld consoles (for which the Switch mostly absorbs the market), as well as those that do larger budget size games for consoles (and some, PCs)[46]. Third, Japanese mobile games are played widely in the country[47], due to many developers' embrace of mobile games – these include specialized mobile game developers and classic major developers such as Konami, Square Enix, and even Nintendo. Fourth, although hobbyist game development (doujin games) was historically preceded much longer than those in the West, modern indie game development has also gained strength, as can be seen in the 10th-anniversary edition of the BitSummit in Kyoto, which is Japan's key indie game development festival to introduce their

[46] Except those newest and most demanding games for latest generation consoles and newer PCs that were beyond the Nintendo Switch's hardware capabilities to run with an acceptable performance for gamers.
[47] https://newzoo.com/resources/blog/newzoo-and-gamma-data-report-female-mobile-gamers-in-japan-play-more-per-week-than-men, accessed 10 August 2023.

games to the rest of the world. Finally, one can also say that the developers have changed their attitude regarding outsourced technology use – in particular, the use of licensed game engines increased, something Japanese developers were lagging in adoption compared to their Western counterparts. This happened – apart from other reasons - because historically, Japanese developers worked on consoles, creating custom in-house game engines working with individual consoles. In contrast, US and European developers were more familiar with PC game development, which was exposed to licensed technology adoption much earlier.

Nowadays, the Japanese gaming industry is quite vibrant, with both advancing on the technology front such as AR/XR/VR (interestingly, Web 3.0 gaming in Japan shows no signs of decline despite the trend everywhere else with almost all major players being active in this emergent market[48]) and also being diverse in terms of the targeted hardware, with mobile being the most important segment. In addition, the most prominent hub, Tokyo, is benefiting from the booming start-up scene there, such as new gaming firms betting on new technologies, such as Web 3.0, for the industry's future. Finally, the convergence of the console market with the PC market has helped Japanese developers who traditionally focused on consoles since the PC is an important segment for selling games to global audiences. As such, sales of major Japanese developers have again become competitive globally, with many games becoming global hits.

Institutional Environment and Support

Historically, the gaming industry in Japan grew and evolved through private sector initiatives and did not receive governmental support (Aoyama and Izushi, 2003). However,

[48] Toto, S. (2023). Which major game companies in Japan are active in Web3 gaming? Almost all of them. https://www.serkantoto.com/2023/02/17/which-major-game-companies-in-japan-are-active-in-web3-gaming-almost-all-of-them/, accessed on 13 Aug 2023.

some indirect support has become available more recently. Visual Industry Promotion Organization (VIPO), a non-profit organization, cooperates with content organizations (anime, films, games) and also coordinates with the Creative Industries Promotion Office (founded in 2016) under the Ministry of Economy, Trade and Industry (METI). VIPO, in coordination with the promotion office, offers a Localization and Promotion Support grant (J-LOD), through which, for example, a Japanese Games Pavilion is set in a key international gaming industry trade fair (Gamescom in Germany). In addition, a Cool Japan Fund was established in 2013 by the Creative Industries Promotion Office, for which gaming companies are also eligible. It is also important to mention that, in 2020, METI announced its ambitious plans to grow the Japanese esports industry by cooperating with industry actors and organizations.

The main industry trade association is CESA, established in 1996 to promote and grow the industry. CESA has organized the Tokyo Game Show, a video game trade fair and convention that has been a key event globally since 1996. In addition, another event focusing exclusively on game developers, CEDEC (Computer Entertainment Developers Conference), has been organized since 1998. Japan Game Awards and CEDEC Awards are also related to these two main events, with the former being supported by the METI.

The gaming industry greatly benefitted, and still benefits, from the existing human resources in creative industries – particularly from manga (Japanese comic/cartoon) and animation industries- and the educational offers. Even two decades ago, there were 300 vocational schools offering training for video game-related occupations, with the art/design-oriented schools (in contrast to video gaming specialized or electronics-oriented schools) sharing part of the curricula for the animation and gaming industries (Aoyama and Izushi,

2003). In addition, many universities have programs focused on the gaming industry. Historically, Tokyo had a good presence of technical colleges and other relevant educational institutes, allowing this major hub to fulfill its human capital needs while growing (Hanzawa and Yamamoto, 2017). The educational offers in Japan have already advanced to a stage in which innovations are introduced – for example, in 2022, the first esports high school opened in Tokyo.

Current Situation

According to gamedevmap, there are 238 gaming companies in Japan that cover developers and publishers amongst all types of mediums (such as mobile, social, and XR), excluding associations, serious, and health-related games[49]. Almost 70% of these companies are in Tokyo (Kantō region) and 15% in Kyoto and Osaka (Kansai region), corresponding to the three main hubs in Japan (with Tokyo being the by far largest hub)[50]. The total employee numbers of the "Big Five" companies alone (Nintendo, Bandai Namco, Sega Sammy, Square Enix, and Konami) are close to 40,000 (at the corporate level, including subsidiaries, excluding temporary employees for Bandai Namco)[51]. The share of women employees in the gaming industry in Japan was 25.85% in 2017 (Carpentier et al., 2023).

It is easy to see that the current structure of the industry was heavily affected by mergers and acquisitions, with Bandai Namco, Square Enix, and Sega Sammy being all products of mergers from 2003 to 2005. Japanese developers/publishers have been acquiring

[49] https://www.gamedevmap.com/, accessed 29 Aug 2023.
[50] Ibid.
[51] See https://www.nintendo.co.jp/corporate/en/outline/index.html, https://www.hd.square-enix.com/eng/company/outline.html, https://www.konami.com/corporate/en/data/, https://www.bandainamco.co.jp/en/group/index.html, https://www.segasammy.co.jp/cms/wp-content/uploads/pdf/en/ir/ir_2022_web_all_e-1.pdf, accessed 29 August 2023.

overseas firms in the last two decades, with the more recent and larger one being the acquisition of Rovio Entertainment (Angry Birds) by Sega Sammy Holdings for €706 million, finalized in August 2023.

Intellectual property use by Japanese gaming companies is vibrant and diverse, including strategic use of IPs (i.e., franchises) – perhaps Nintendo having the most important global IP in gaming with the Mario Brothers, as well as patenting – both hardware and software (especially related to gaming mechanics that revolve around technical solutions to technical challenges). Patenting activity early on was likely highly related to hardware producers in the industry. Still, software-related patenting is now also quite active. For example, in a report that ranked Japanese gaming companies by the number of patents considered grounds for rejection by a competitor, Konami and Bandai Namco, both non-console owners, ranked above Sony and Nintendo, console owners[52]. On the IP side of things, there is a complementary relationship with the manga and animation industry: Cross-over properties are valuable on both sides, although one can still say that it is the gaming industry that licenses properties from the manga and animation industry more often (however, it goes both ways as exemplified by Pokémon, which started as a video game first).

Considering the current market segment sizes, mobile games are regularly growing in influence, but consoles still represent an important part of the industry. It is important to note that PC games, a historically niche market for Japanese developers and gaming users, are growing very fast on both demand and supply sides in Japan (the market size for PC games in Japan on Steam doubled between 2018 and 2021)[53]. This trend certainly benefits from the

[52] https://automaton-media.com/en/news/20230629-19839/, based on report https://www.patentresult.co.jp/news/2023/06/fcitgame.html, accessed 29 August 2023.
[53] Toto, S. (2022). Japan's PC gaming market doubles in size in 3 years. https://www.serkantoto.com/2022/11/06/japan-pc-gaming-market/, accessed on 13 Aug 2023.

convergence of the console segment with the PC one. However, it also shows that in a country where physical game sales are still very high for console (and PC games) (Koyama, 2023), digital sales are finally growing in importance and revitalizing, particularly the PC gaming market in the country.

Another recent important change in Japan relates to its esports activity. Esports in Japan have been relatively lagging until 2018 due to a specific law, the Act against Unjustifiable Premiums and Misleading Representations, mainly targeting gambling, which also meant a maximum of 100,000 Japanese yen (~665 US dollars) of prizes for a gaming tournament. However, with the change of the law to allow esports to flourish, big events with large prize pools for esports started to be held from 2018 and onwards, and esports since have been growing massively in a short time, beginning to close some of its gap with the globally leading countries in esports, such as the geographically close leaders, China and South Korea.

Capabilities

The unique capabilities that explain Japan's success can be traced back to the combination of two factors: First, the local presence of consumer electronics firms, as well as integrated circuit chip manufacturers, helped immensely for the initial arcade businesses, and then later, for the gaming consoles. Nintendo cooperated with electronics giants like Mitsubishi, Ricoh, and Sharp in its early history (Aoyama and Izushi, 2003) and outsourced its production to various producers. Sega relied on its close links with small engineering firms in Tokyo (Aoyama and Izushi, 2003). Sony, being a consumer electronics firm itself, was able to leverage its know-how, technology, and production capabilities (after all, the first PlayStation wouldn't have happened if Sony didn't co-invent the CD technology). This also meant that these firms commonly and actively used patenting as an intellectual property protection. Second, the

manga and animation industry provided strong foundations, human capital, and IPs to build on/license the gaming industry (Izushi and Aoyama, 2006). Notably, early in the gaming industry, artists and art styles from the manga and animation industry were indispensable. Many artists moved to the gaming industry due to better wages around the 90s (Izushi and Aoyama, 2006). Shigeru Miyamoto, perhaps the most renowned game designer in the world and the creator of Nintendo's "Donkey Kong" and "Mario Brothers" series, for example, studied at a college of art and was the first staff artist when hired in 1977 (Aoyama and Izushi, 2003). The links between the manga and animation industry and the gaming industry are also essential due to the IP cross-over with the gaming industry, with many hit games using IPs from the manga and animation industries (e.g., Dragon Ball Z). Again, a strong knowledge of protecting these franchises already available in the adjacent industries also built the foundations of the capability to use trademarks and other means of intellectual property by game developers.

An interesting aspect of capability development for Japanese developers reflects other studies on how it is historically compared with US developers. An interesting historical anecdote is that the Japanese computer hardware and operating systems were more focused on application-specific uses and designs due to the slower diffusion of microcomputers and PCs in Japan compared to US ones, which focused on general-purpose software and operating systems on PCs as they get diffused (Bresnahan and Gambardella, 1998). In line with this, developers in Japan specialized in the hardware architecture of consoles. They were heavy in the use of proprietary technologies until the mid-2000s, compared to US developers that favored more platform-agnostic choices as it became easier with technological changes, such as adopting more middleware and game engines compared to their Japanese counterparts

or utilizing cross-platform game development practices to develop games for both PCs and different consoles. However, Japanese developers nowadays also converged on this matter as consoles and PCs have significantly converged in terms of the hardware; despite on the demand side, consoles are larger than PCs in Japan (although, as noted above, the latter is growing fast).

UNITED STATES

Historical Evolution of the Industry

There were two parallel developing markets in the US, reflecting its presence in both PC and console markets. The arcade side of developments represented the more commercial efforts, which boomed with Pong in 1972 and moved on with the Golden Age of Arcades as explained in Japan's history. The PC games, on the other side, had a different origin story (although they eventually converged with console games). The first computer games were developed for mainframes and minicomputers, the first being the "Spacewar!" developed at MIT in 1962. This period was also during which initial game innovations were observed, with the most prominent being the "Colossal Cave Adventure" in 1976. Since mainframes were available in universities and large corporations only, and minicomputers, despite being relatively smaller and cheaper, were still more suited for organizations than individual consumer adoption, it meant that video games for computers were a small niche (microcomputer users).

California – with Silicon Valley and perhaps to some degree Hollywood – and the Seattle[54] metropolitan area that includes Seattle, Redmond, and Bellevue had the

[54] All mentions of Seattle hereon refers to the Seattle metropolitan area.

concentration of capabilities and human capital in related fields, which made these two states the most important hubs for the videogame industry in the US (but it is nevertheless important to note that throughout in the history of the industry, some other hubs were also important – such as Texas).

Both markets developing in parallel can be seen in this main combined hub of California and Seattle – including Atari's foundation in California in 1972, kicking off the arcade and home console market, which by itself has members that have moved ahead and then founded Activision, which is the first third party publisher for a game console. On the other hand, Apple Computer is borne out of the Homebrew computer scene in Menlo Park, which housed the early beginnings of gaming and hardware development – with Apple's early founders can be traced back to there. This pattern of the links between human capital, venture capital, hardware, software, and spin-out/entrepreneurship has been the essence of this historic and highly successful video game hub.

The hub's growth has been almost linear until the mid-2000s (De Vaan et al., 2013). However, one should consider the important inflection points: Following the video game crash in 1983, many developers moved from console to personal computer development. Some developers founded in this period were some of the most influential and important, such as Electronic Arts (EA), founded in 1982, which first published software and games for the Commodore 64, and then IBM PCs and consoles. EA was a perfect representation of all these elements – it was founded through venture capital by a marketing director of Apple (Trip Hawkins). Its main idea was to give credit to developers of games like a star, like Hollywood movies, again representing the qualities of its geographical location.

The 90s and 2000s saw the growth of these hubs through innovation provided by the CPU and memory, GPUs, operating systems (particularly Windows), and optical media. For example, CD-ROM as a game format allowed innovation –the hit game of the 1993 (Mac)/1994 (Windows), "Myst" helped the further adoption of the CD-ROM drives amongst users. Similarly, the increasing adoption of 3D accelerators, initially as a separate add-on hardware (by 3dfx Interactive, which was in California before being bankrupt and acquired by Nvidia in 2002) and later as a GPU (Nvidia and AMD, with Nvidia is headquartered in California), which has driven innovation greatly in the industry. Windows 95's launch in 1995 (together with the DirectX API) made "Wintel" a popular gaming machine, and Microsoft's presence in Bellevue also boosted the number of new game developer firms in Washington. Nintendo is also in the region, albeit for historical reasons related to the more accessible transport of arcade machines from Japan to the US (initially, Nintendo of America was in New York), nevertheless strengthening the area in terms of the gaming industry. Other major Japanese gaming firms also acted similarly. They opened their US subsidiaries in the same hub, enabling the hub to benefit from the knowledge and human capital of the gaming industry's historically most important two countries.

A particularly important one amongst these developers, founded by ex-Microsoft employees, is Valve. Founded in 1996 in Kirkland (WA), it became famous for its debut title, Half-Life, a significant milestone in the first-person shooter genre. But it is the launch of Steam, the digital distribution platform of Valve (initially just an online patcher/launcher for Half-Life 2), that changed the industry fundamentally. Around the early to mid-2000s, PC gaming declined relative to the console market, and unlicensed consumption contributed to this decline. The latter happened because of increased peer-to-peer sharing platforms and

internet adoption, increasing unlicensed consumption. As such, it became increasingly difficult to justify the PC games' development budgets, which grew quickly due to more technological complexity. In comparison, consoles had less unlicensed consumption (although exceptions like Sega Dreamcast with more unlicensed consumption were observed). In addition, Xbox provided a good alternative for PC developers wishing to enter the console segment. Steam's launch, however, has reversed this declining PC games market pattern over time.

Digital distribution reduced the power of retailers, opened a new avenue for indie developers, and, together with the availability of free or cheaply licensed game engines, reduced entry barriers dramatically, allowing thousands of developers (individuals or small teams) to develop games with much fewer resources and budgets. Indie gaming has grown consistently since its emergence in the early 2000s as a balancing act to the increasingly consolidating AAA gaming segment. Its position in the gaming ecosystem had been solidified with many other complementary developments helping the indie game developers, such as crowdfunding, which funded hits like Undertale and also proved a constant source of hits overall (for example, Minecraft started as an indie gaming project before it grew tremendously and finally acquired by Microsoft). It is also important to note that indie gaming is not limited to PCs since console owners have actively supported and given them easier conditions to be on platforms, with programs such as Xbox Live Arcade being important early moves that allowed many indie games to be known and appreciated by console gamers.

The late 2000s also saw the industry's massive growth thanks to the swift growth of social and mobile gaming. Social gaming grew virally with Zynga's games on Facebook, such as Farmville, which launched on Facebook in 2009. Social gaming entered a period of decline

after a few years, whereas mobile gaming has continued to grow. Combined, these segments allowed a big pool of new demand for games and opportunities for many new and existing game developers.

The trends in the last years drive (and reflect) convergence and consolidation happening in the industry. On the one hand, many of the social and mobile gaming companies are acquired by large incumbents, such as Zynga, acquired by Take-Two software in 2022 (for 12.7 billion US dollars), King (Candy Crush) acquired in 2016 by Activision Blizzard (for 5.9 billion US dollars). Activision Blizzard itself is acquired by Microsoft (for 68.7 billion US dollars). In parallel, cloud gaming and cross-play have further accelerated the convergence across different hardware, with players such as Microsoft and Epic Games pushing the industry on this front.

Institutional Environment and Support

Gaming hubs in California and Seattle didn't have any direct tax benefits and subsidies throughout the industry's evolution, which motivated other states, such as Texas, to have such benefits to lure away game developer firms. However, video game developers in the US can benefit from R&D credits as a tax break, gaining reductions from their income tax up to 10% of their R&D costs (which applies to many steps of game development from concept generation to design and programming implementation)[55]. These tax breaks also generated some discussion on the topic, as some argued that these are essentially subsidies for an industry that already makes high profits[56].

[55] https://igda.org/resources-archive/rd-tax-credit-opportunities-for-video-game-developers/, accessed 28 March 2024.
[56] McCaffrey, M. 30 August 2016. No, Video Games Are Not Subsidized. https://www.gamedeveloper.com/business/no-video-games-are-not-subsidized, accessed 30 August 2023.

The Entertainment Software Association (ESA) is the main association, formed in April 1994 as the Interactive Digital Software Association (IDSA), which also organized the Electronic Entertainment Expo (E3), a globally major trade event for the game industry held for over 25 years until its discontinuation after the last edition in 2021. For game developers, an annual conference, the Game Developers Conference (GDC), has been held since 1988. Both represent(ed) the key gaming events with console launch announcements, major title teasers, and awards.

On the funding end, both hubs benefit deeply from Silicon Valley and its various funding opportunities. Although nowadays, VC funds and other investors have much more gaming-focused funds (such as A16Z Games by Andreessen Horowitz), the broader incubator, spin-off, and venture capital culture and the availability of different kinds of funding were major factors throughout the evolution of both major hubs in the US (Pilon and Tremblay, 2013).

The hubs not only benefitted from VC funding and entrepreneurial culture but also enjoyed significant support in terms of education. First, already existing programs for interactive arts and animation, which were in the region due to film and animation studios in Hollywood, provided an initial education path for those who wanted to join as artists in the industry. Second, the availability of many tech companies meant many programmers and technically oriented programs were already in the area. Finally, specialized educational programs for game design and the game industry started to open up in 1998 with the opening of the DigiPen Institute of Technology's Redmond campus, and universities themselves also began to offer programs which now many are considered the premier programs to study to enter the industry, such as University of Southern California's program offerings including

game design, interactive design, animation, and an interdisciplinary program of computer science games. There are 57 college programs in California and eight more in Washington (which includes the Seattle metropolitan area)[57].

Current Situation

According to ESA's 2020 Economic Impact Report, there were 444 publisher, developer, and (gaming) hardware companies in California and 121 in Washington, with California supporting (direct and indirect) 218,090 jobs and Washington supporting (direct and indirect) 48,808 jobs[58]. In addition, in the gaming industry in 2020, the US supported over 143,000 direct jobs[59]. Although there is no authoritative data on the share of women in the US gaming industry, the numbers in a few major gaming firms were around 24% in 2020[60].

The US Gaming Industry is both mature and still very active in all fronts and segments of the industry, with VCs already funding generative AI-based game development tools[61] and many major companies developing similar in-house tools for the same purpose[62]. Also, the industry has been quite active in the merger and acquisitions front historically (De Vaan et al., 2013), with the recent acquisition wave of the last decade being especially strong in the US with both local major players making massive acquisitions (such as Microsoft and Take Two's acquisitions) as well as international players, such as Tencent, acquiring players or investing in them.

[57] https://www.theesa.com/video-game-impact-map/, accessed 30 August 2023.
[58] Ibid.
[59] https://www.theesa.com/industries/economic-impact/, accessed 30 August 2023.
[60] https://www.protocol.com/workplace/gaming-industry-diversity-reports, accessed 29 September 2023.
[61] https://www.gamesindustry.biz/scenario-raises-6m-ahead-of-ai-powered-art-engine-early-access, accessed 30 August.
[62] https://www.nytimes.com/2023/05/22/arts/blizzard-diffusion-ai-video-games.html, accessed 30 August 2023.

The United States is the second largest country in esports revenues, following China,[63], according to Statista. This is also true when the combined esports (pro)player prize earnings are combined[64]. The US has a lively and developed esports scene, with numerous teams that are essentially companies (and some even publicly listed, such as FaZe Holdings), well-developed leagues (across multiple games and genres), and esports organizers and organizations. As an aspect of further development, it has been highlighted that despite the advanced state of the esports industry in the US, it lags in the number of top prize-winning players[65].

A unique feature of the two largest hubs in the US is the fact that they are also home to the most important digital marketplaces of games: Steam, App Store, and Play Store[66]. This additionally strengthens these hubs. For example, beyond the apparent gaming industry-related high levels of income made by these stores, one can also point out that global data on games gained by these marketplaces allow the owners to have a knowledge advantage of the market compared to other firms and other hubs.

Capabilities

The success of the California and Seattle clusters can be traced back to various regional inter-related capabilities. On the one hand, Silicon Valley, with its venture capitalistic, high-risk-high return, and entrepreneurial culture, had been directly relevant in the birth of the industry. For example, one can trace the links between Apple and its early employees opening up their own companies (such as Electronic Arts by Trip Hawkins, funded by venture capital)

[63] https://www.statista.com/forecasts/1130696/esports-revenue-share-country, accessed 29 September 2023.
[64] https://www.esportsearnings.com/countries, accessed 29 September 2023.
[65] https://globalsportmatters.com/culture/2021/08/18/united-states-lags-world-esports-why-culture-infrastructure-finances/, accessed 29 September 2023.
[66] Apart from these, another large marketplace is owned by Epic Games (Epic Games Store, competitor to Steam), which is headquartered in North Carolina.

and the early PC gaming foundations laid in the homebrew computer club before that. On the other hand, the cross-fertilization with Hollywood has brought great success to the industry, particularly in the 2000s when the convergence between the two entertainment industries sped up. It is also important to note that there were also some failures in this endeavor as it sometimes resulted in short-lived fads that ended up being flops, such as FMV (full motion video) games. However, the local pool of animation and CGI talent that supported Hollywood and the licensed IPs from movies helped shape the industry greatly. Finally, the region's key hardware and operating system suppliers (such as Nvidia and Microsoft) were crucial in supplying a large local talent pool and enabling innovation through the new hardware and software.

An essential capability for these hubs in the US relates to their close relationship with intellectual property since they are one of the most active regions in the world in terms of patenting and technology (Silicon Valley) and entertainment franchises (Hollywood). This means an active knowledge of leveraging intellectual property and managing IPs in the gaming industry, which many major players have been doing for decades (e.g., Microsoft or Electronic Arts).

All in all, California and Seattle hubs in the US benefit from cross-fertilization between the hardware and gaming industries, as well as the entertainment (i.e., Hollywood) and gaming industries. This, combined with the entrepreneurial opportunities given by Silicon Valley, allows the US to continuously adapt, innovate, and lead as the industry changes over time.

DISCUSSION AND CONCLUSION

This case study provided the history, evolution, and capabilities of the key hubs in four countries for their videogame industry. It aimed to analyze the historical evolution of these different hubs to build an understanding of how to cultivate successful videogame hubs. The qualitative study of key hubs in Finland, Poland, Japan, and the United States has resulted in four main findings.

First, it was shown that each video game industry hub has its own heterogeneous and path-dependent evolution based on the locally available existing capabilities. Thus, each country's cultural, technological, and industrial background contributed to and fundamentally affected the evolution and growth path of the local gaming industry. In the traditional hubs of Japan and the United States, this has taken the form of a cross-over of capabilities from the other established and related industries. Japan pioneered the gaming industry by leveraging its electro-mechanical industry assets, knowledge, and human capital, and then able to lead on to the consoles era by also leveraging its animation industry. The United States also co-pioneered the industry and led it over the years by building over technological talent and entrepreneurship in Silicon Valley combined with Hollywood's cultural and entertainment talent. On the other hand, new hubs show more unique patterns based on local developments. Finland could leverage its hobbyist coders, especially as the telecommunications industry became more established and Nokia pushed the boundary for mobile games at the time. On the other hand, Poland started by localizing games and moved on to create their original titles by leveraging their cultural heritage and programming human capital.

It is also important to highlight two important points regarding heterogeneous, local development paths across all four hubs. One point comes from thinking of video games as a combination of technology and arts (or creativity). When considering each hub, each hub had different, local elements contributing to the technology and art elements of their video games. Japan had electronics technology and anime/manga industries; the United States had the early computer industry and Hollywood; Finland had hobbyist demoscene coders doing programming and art, and telecommunications talent; and Poland had good programming talent and cultural heritage. So, it is crucial for an emerging hub to consider its local sources of relative strength in building technology and art (or creativity) elements in growing the video game industry. The other point relates to these local hubs' industry and market choices. It is interesting to observe that each of our four hubs has a different market specialization. Between traditional hubs, Japan specialized in console gaming. In contrast, the United States was balanced between PC and console gaming, with both choices directly drawing from their path-dependent evolution. On the other hand, Finland specialized in mobile gaming, whereas Poland specialized (and somewhat unusual for a new hub) in PC gaming. Although the industry convergence, driven by developments such as cloud gaming, decreases these hardware specializations as a trend, this still highlights the important market specialization choices emerging hubs need to make to grow their local industry successfully.

If the first takeaway pertains more to the local developmental paths, the second takeaway relates to the global evolution and influence of the industry and, in particular, relates to the increasing democratization of game development and publishing over time. The widespread availability of game engines, digital distribution channels, the arrival of new hardware with less complex games (i.e., mobile gaming and even more recently games developed within

other games such as Fortnite and Roblox), and many open communities around gaming has made it much easier for many hobbyist coders to turn into professional game developers and have reduced entry barriers to the industry, fostering entrepreneurship. Although these changes are not without their flaws – e.g., high commissions that are taken by the platform or digital distribution platform owners or very high competition due to thousands of other competing games – they create a much more favorable environment for many emerging hubs to be able to have a competitive chance. This is a critical change since this was an important barrier even in the relatively recent times of the industry. For example, the very first Witcher series game was able to be completed thanks to a licensing agreement between CD Projekt and Bioware (the developer of the Baldur's Gate game, which CD Projekt had localized in Polish) in which the latter licensed its game engine to CD Projekt since the latter had difficulties in developing their own within their budget and timeline. The increasing democratization of the gaming industry may even challenge traditional or established hubs in combination with the upcoming new technologies such as AR/VR, blockchain, and most recently, generative AI, since these may fundamentally change the playfield and, as such, may allow even more new videogame industry hubs to rise to prominence.

Third, direct and indirect government support and institutional infrastructure have been fundamental to the growth and success of these four hubs. Yet, when we consider the differences between traditional and emerging hubs. Direct and targeted government support has played a key role in the growth of emerging hubs. Interestingly, these direct government support's prominence and size correlated with the major successes in these industries. The Skene program in Finland, which directly targeted game development, started in 2012 (which followed Angry Birds' release by three years and coincided with the release year of Clash of

Clans), and the GameINN program in Poland started a year after the release of Witcher 3. This is likely not a coincidence as major successes in new hubs play a critical role: On one hand, entrepreneurial activities radically increase after major successes, partly by those who establish their gaming firms by leaving their jobs in the firm that made the major hit (e.g., people leaving CD Projekt after the Witcher to create their gaming firm), and partly by other entrepreneurs that are drawn to the industry observing the success of the major hit developed by the local firm. In such an environment, it perhaps becomes more visible and more certain for local governments that there will be clear long-term returns to such direct and targeted support activities. Nevertheless, governments and local institutions in newer hubs should foster local industry with direct and targeted support early on. Even if large funds are risky when the hub is fledgling, seed funds may enable a firm to hit a major success, which then accumulates other successes more likely and faster.

Finally, all hubs in this study have made long-term investments in education related to video game development, ranging from strong high school education to targeted higher education programs, and even recently, focusing on esports in specialized schools and academies. However, considering emerging hubs, it is important to note that more specialized and targeted programs for the video game industry have been crucial to developing the required talent. Partially, this is also co-related to the size and success of the industry to motivate younger people to join the industry, but this also could be reversed such that a strong relationship between the gaming industry and education can be established to develop the required talent to grow the industry to build a virtuous cycle.

In conclusion, this study showed that in the video game industry, in which (increasingly more) complex innovations are happening and required for success, the local capabilities and

knowledge may create a unique path of development and success to cultivate and grow an emerging hub to join the established players in this industry. Moreover, the general diffusion and democratization of knowledge, technologies, and means of reaching the market helps these emerging and new hubs in combination with further upcoming new technologies. Therefore, blending local capabilities and know-how with global technologies and connectivity opens opportunities for many emerging hubs to contribute more to this massive industry and allow traditional hubs to renew and adapt themselves to be on the frontier of new developments.

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Suggested citation: Özalp, H. (2024). Heterogeneous development paths to growth and innovation: The evolution of the video game industry across four hubs. WIPO Economic Research Working Paper No. 84. World Intellectual Property Organization.

Cover: WIPO Design