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How Actors Establish Generative Platforms By Instituting Control Points: The U.S. Video Game Industry

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Abstract

In our paper we examine how the proliferation and growth of a sector can be contingent on the set up of control points in a multi-platform industry through an historical overview of the U.S. home video game industry between 1976 and 1989. We address the critical issue on how do actors establish generative platforms by instituting a set of control points acceptable to others, providing evidence that an increased control can also feed extensive generativity. To achieve such purpose, we present an inductive study that illustrates how the U.S. home video game industry crashed in 1983, after the removal of architectural control points in the video games market, and how Nintendo introduced new architectural control points after the crash, describing the role of the control points in the recovery of the sector.

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ABSTRACT

In our paper we examine how the proliferation and growth of a sector can be contingent on the set up of control points in a multi-platform industry through an historical overview of the U.S. home video game industry between 1976 and 1989. We address the critical issue on how do actors establish generative platforms by instituting a set of control points acceptable to others, providing evidence that an increased control can also feed extensive generativity. To achieve such purpose, we present an inductive study that illustrates how the U.S. home video game industry crashed in 1983, after the removal of architectural control points in the video games market, and how Nintendo introduced new architectural control points after the crash, describing the role of the control points in the recovery of the sector.

Keywords:

Platform architecture; generativity; control

1. INTRODUCTION

In September 2013 the revenue generated by mobile app stores totaled $26 billion, up from $18 billion in 2012 and more than 102 billion apps were downloaded worldwide (Gartner, 2013). Both, Apple and Google managed to quickly grow their installed base of devices to attract 3rd party developers and by July 2013, Google could offer more than 1 million apps through their app store (9to5Google, 2013), while Apple could do the same by October 2013 (The Verge, 2013). Such a huge proliferation in the number of mobile apps was enabled by redefinition that both Google and Apple made of the control points of the mobile operating systems platforms. A control point refers to a socio-technical element of a digital platform (e.g. an API, a standard) that largely determines the behaviors and constraints for other elements. The concept of control point captures two aspects of control: centralization / decentralization of certain rights and access to stipulate specific behaviors (Tilson, Lyytinen, & Sørensen, 2010). In that sense, the redefinition of control points stimulated 3rd party developers to create new apps for those platforms. In line with this empirical evidence in the context of mobile platforms, this paper aims to empirically study and shed light on the relationship between the growth of a sector and the setting up of control points.

The research gap we want to address is to build further understanding on how do actors establish generative platforms by instituting a set of control points acceptable to others (Tilson et al., 2010) to understand better platform ecosystem's dynamics. Existing literature on platform architecture has made progress in exploring the paradoxes of change and control for understanding the dynamic nature of digital platforms (Tilson et al., 2010; Yoo, Henfridsson, & Lyytinen, 2010). The architectural control points were studied as elements that can characterize architectural design decisions (Woodard, 2008), the generation of value (Trossen & Fine, 2005) or as elements that can migrate value from one layer to another in layered ecosystems (Woodard, Ramasubbu, Tschang, & Sambamurthy, 2013). While all these literatures contribute with valuable insights for firms in multi-platform ecosystems, they do not address the critical issue on how do actors establish generative platforms by instituting a set of control points acceptable to others (Tilson et al., 2010).

To address the research gap of how do actors establish generative platforms by instituting a set of control points acceptable to others (Tilson et al., 2010), in this paper we present an inductive study that illustrates how the U.S. home video game industry crashed in 1983, after the removal of architectural control points in the video games market, and how new architectural control points were introduced after the crash, describing the role of the control points in the recovery of the industry. In our research we provide evidence on how an increased control can also feed extensive generativity.

To ground our study we mainly use historical archival data. For the archival data we used multiple data sources, adopting Romano, Donovan, Chen, & Nunamaker's (2003) methodology for analyzing Internet-based qualitative data to develop a process perspective (Langley, 1999) with which to understand how the proliferation and growth of a sector can be contingent on the set up of control points.

We organized the remainder of this paper as follows: in the section 2 and 3 we outline our theoretical perspective and methodology; in section 4 we present an historical overview of the evolution of the U.S. home video game industry between 1976 and 1989 to contextualize our research; in section 5 we present our findings and in section 6 we discuss our findings and bring our conclusions.

2. CONCEPTUAL BACKGROUND

We understand **platforms** as the foundation technology or set of components used beyond a single firm and that brings multiple parties together for a common purpose or to solve a common problem (Gawer and Cusumano, 2002). The inherent scalability and flexibility of the digital platforms foster extraordinary growth in scale and scope developing new combinations of services and capabilities. Such trend of the digital platforms towards **generativity**, understood as the ability of any self-contained system to create, generate, or produce a new output, structure, or behavior without any input from the originator of the system (Tilson et al., 2010; Zittrain, 2006), forge new sociotechnical relationships and blur organizational boundaries, generating constant rivalries for creating new control points (Tilson et al., 2010). Previous research suggested that there is a need to understand better how the coevolution of the choices of the platform owners (endogenous to the ecosystem) and the environmental dynamics (exogenous to the ecosystem) influence the evolutionary dynamics of a platform-based ecosystem and their modules (Tiwana, Konsynski, & Bush, 2010).

2.1 Platform architecture

We use the definition of **platform architecture** as the conceptual blueprint that describes how an ecosystem is divided into relatively stable platform and a set of complementary modules that are encouraged to vary, and the design rules binding on both (Baldwin and Woodard, 2009; Katz and Shapiro, 1994; Sanchez and Mahoney, 1996; Tiwana et al., 2010; Ulrich, 1995). Therefore, a platform's architecture divides the ecosystem into the platform codebase that ideally exhibits low variety and high reusability and modules that exhibit high variety and low reusability within the ecosystem (Baldwin and Woodard, 2009).

2.2 Platform governance

We define **platform governance** as who makes what decisions about a platform, acknowledging that one of the main governance challenges is that a platform owner must retain enough control to ensure the integrity of the platform while relinquishing enough control to encourage innovation by the platform's module developers (Baldwin and Woodard, 2009; Tiwana et al., 2010).

One of the elements to implement such governance is to exert **control** over a platform, understood as the formal and informal mechanisms implemented by a platform owner to encourage desirable behaviors by module developers, and vice versa (Tiwana et al., 2010). This **control** can also be defined as the ability to say "no" to other stakeholders when they seek to introduce new modules to a platform (Herzhoff, 2011; Herzhoff, Elaluf-Calderwood, & Sørensen, 2010). Usually it is the platform owner that can directly or indirectly shape the **generativity** of the ecosystem and the antagonist can be a regulator, an intellectual property owner, or another platform owner (Eaton, Elaluf-Calderwood, Sørensen, & Yoo, 2011). One of the main challenges in a platform-based ecosystem is to continuously engage in balancing **control** and **generativity**, ensuring an appropriate balance between stability and change, and this paradox of change refers to the concurrent need of a stable and controlled foundation to enroll new artifacts, processes and actors in the development, and flexibility for unbounded growth of the ecosystem (Tilson et al., 2010).

In order to exert **control,** the platform owners can shape the architecture of platform through the **design rights** they hold, understanding them as those decisions rights that confer the right to create a new component or change the design of an existing one (Woodard, 2008). So we use the definition of an **architectural control point** as a system component whose decision rights confer

architectural control over other components (Woodard, 2008), which in turn is the capacity to enable or constrain the design of a system component, or set of components, without exercising **design rights** over it directly (Woodard, 2008).

The existing literature on digital platforms has made progress in exploring the paradoxes of change and control for understanding the dynamic nature of digital platforms (Tilson, Sørensen, & Lyytinen, 2012), while other scholars presented empirical evidence on how different approaches to open a system might influence the rate of innovation (Boudreau, 2010) and provided a conceptual framework for understanding how in multi-sided platforms the access and interactions are regulated through legal, technological or price setting mechanisms (Boudreau and Haigu, 2009). The architectural control points have been studied as elements that can characterize architectural design decisions (Woodard, 2008), the generation of value (Trossen & Fine, 2005) or as value migrators in layered ecosystems (Woodard, 2013) and other scholars has focused on a variety of aspects of platforms and platform innovation (Eaton et al., 2011; Gawer, 2009; Gawer and Cusumano, 2012; Ghazawneh and Henfridsson, 2010, 2013; Hanseth and Lyytinen, 2010; Herzhoff, 2011; Herzhoff et al., 2010; Monteiro, 1998; Zittrain, 2006, 2009) and shed light on the relationships between platforms and the systems in which they are embedded (Baldwin and Woodard, 2009). While all these literatures contribute valuable insights for firms in multi-platform ecosystems, they do not address the critical issue on how do actors establish generative platforms by instituting a set of control points acceptable to others (Tilson et al., 2010).

With the results from our research we would like to extend prior literature on platform architecture by showing how the proliferation and growth of a sector can also be contingent on the set up of control points.

3. METHOD

Our historical analysis attempts first to illustrate what happened to the U.S. home video game industry with the removal of architectural control points and the relation with the video game crash that happened in 1983. Second, we attempt to illustrate the positive effects on the home video game industry once new architectural control points were introduced by Nintendo after the video game crash of 1983 and the recovery of the industry in the following years.

Case site

Our study focuses on the home video game industry for several reasons. First, understanding the home video game industry as our unit of analysis, the main actors can be clearly identified and represented according to their platform governance roles, which allows us to systematically observe how their decisions affect the platform's architecture. Second, the design moves that affect the platform's architectural control points are observable, displayed through discrete changes and can be traced over time. Third, the amount of publicly available and accessible sources allowed capturing rich historical context information and objective data (e.g. annual reports, financial statements) allowing a deep understanding of the industry and the platform governance dynamics. Fourth, the crash of the U.S. home video game industry is an extreme case (Yin, 2009), which is suited for analyzing the introduction and removal of platform architectural control points. The case provides data manifesting enough the role of the architectural control points to enable grounded theorizing. In fact, the changes that happened in the industry over the studied period allowed us to isolate specific events where removal and introduction of new architectural control points can be observed, enabling the temporal decomposition, which is important to establish process variance in process studies (Langley, 1999).

Data collection & analysis

To face the methodological challenge of collecting historical data and allow for a limited amount of rigor to be applied, we attempted not to cherry picking the history of the market and neither boring the reader with a complete recitation of all the possible details. For that we first attempt to limit our discussion by including only the most significant events focusing on the issues concerning platform governance, design rights, architectural control points and platform generativity, measuring generativity in our case by the increase or decrease in size of the U.S. home video game industry and the growth of the Nintendo NES platform; second, limit our research to publicly available and accessible sources given we are addressing an historical study; third, we attempt to aid the reader in interpreting our analysis with tables and graphs to highlight and illustrate the key aspects and events we study.

To ground our study we mainly used historic archival data. In terms of archival data we refer to books reviewing the U.S. home video game industry, the press releases of relevant firms, official company blogs and industry-focused websites covering the home video game market. We analyzed events to create an overview of the key platform governance design moves that affected the platform architectural control points. The analysis was conducted iteratively and through different stages. First, we reviewed a set of books and collected a set of articles related to the home video games industry initiatives, including press releases and interviews. Second, the content was analyzed focusing on the actors involved in the event and the implications for the platform governance and design decisions that affected the platform's architectural control points. Third, the key events were analyzed in further detail becoming the main input for the empirical part of the research. As we iterated through our data set, we narrowed our focus to the analysis and understanding of the effects of architectural control point on platform's evolution following the elicitation, reduction, visualization approach (Romano, 2003). To narrow our focus we mainly referred to the U.S. home video game industry and the information that concerned the main actors of our study: Atari, Nintendo and Activision between years 1976 and 1989.

4. THE U.S. HOME VIDEO GAME INDUSTRY 1976-1989

4.1 The rise of Atari

In August 1976 the U.S. home video game industry saw the introduction of the Fairchild System F console by Fairchild. The Fairchild System F was the first video-console to use a microprocessor and the first to have its games on programmable ROM cartridges. Its 8-bit CPU, internally developed by Fairchild and running at 1,79 MHz, enabled for the first time to support enough artificial intelligence to offer player versus computer games, in contrast to all the previous video consoles that needed a human opponent.

New video game consoles appeared on the market following the release of the Fairchild System F, such as the Intellivision (Mattel), the Odyssey 2 (Magnavox) or the ColecoVision (Coleco). However, at the end of the 70's the dominant console was the Atari Video Computer System (VCS)[1], released by Atari in September 1977 and later renamed as the Atari 2600. This console was powered by a MOS Technology 6507 microprocessor, running at 1,19 MHz and could offer up to 16 different colors on screen, having 8 different levels of intensity for each of them[2], which allowed Atari 2600 to stand out from the rest by the superior quality of its graphics. Like the Fairchild System F, the Atari 2600 was also using programmable ROM cartridges for its games,

[1] http://www.videogameconsolelibrary.com/pg70-2600.htm#page=reviews
[2] http://www.old-computers.com/museum/computer.asp?st=2&c=878

providing a limitless capacity to grow its video games library. In order to ensure that they could produce enough Atari 2600 consoles to meet the expected demand of a growing market, Atari engaged in a partnership with Warner Communications, gaining access to significant financial resources. In 1976 Atari was bought by Warner Communications for $28 million[3], who infused Atari with enough capital to produce 400 000 Atari 2600's to meet the expected demand for Christmas in 1977[4]. However, the demand for home video games resulted to be weaker than expected and Atari got stuck with high levels of inventory[5].

During 1978 Atari decided to leverage its supplier relationship with Sears to sell the Atari 2600[6] under the Sears name and focusing mainly on the coin-operated arcade side of its business. This strategy improved sales in the fourth quarter of 1978 and increased the expectations for the sales of the Atari 2600 in 1979.

At the same time, at the end of 1978, arrived the game Space Invaders, a major arcade game hit for which Atari purchased the license in 1979 for producing its home version. The success of Space Invaders and the game Asteroids, developed by Atari, rocket the sales of the Atari 2600, making it the dominant game platform between 1979 and 1981 with 80%-90% market share.

4.2 The opening of the video games cartridge market

By that time the production cost of a cartridge was about $5, while the selling price ranged from $20 to $30. The significantly higher margins of the game cartridges shifted market competition

[3] "1983 Annual Report", Warner Communications 1983
[4] S. Cohen "Zap! The Rise and Fall of Atari". New York: McGraw-Hill, 1984
[5] L. Herman "**Phoenix: The fall and rise of videogames**". Union, NJ: Rolenta, 1997
[6] L. Herman "**Phoenix: The fall and rise of videogames**". Union, NJ: Rolenta, 1997

towards the software business and Atari's dominance with the Atari 2600 began to slip as they started to face more competition. In 1980 four Atari programmers, feeling that their efforts were not enough neither compensated nor recognized left the company and founded a video game development company named Activision. Atari sued Activision, but that not prevented Activision from generating more than $50 million in revenue in 18 months, cutting Atari's profitability and attracting the interest of other companies for the Atari 2600 cartridge market.

Finally in early 1982 Activision arrived to a legal settlement with Atari that allowed 3rd party firms to produce cartridges for the Atari 2600 for a small licensing fee, opening the highly attractive cartridge market for other game developers and reducing Atari's control over the complementary products developed for their Atari 2600. Having the settlement between Activision and Atari removed the previous legal restrictment, 28 companies started to produce cartridges for the Atari 2600, increasing the sales of the Atari 2600 by growing dramatically its game library.

In early 1982 Coleco, another toy maker, entered the home video game industry by launching its Colecovision video console. Unlike other companies that adventured without significant success into the video console industry at that time, Coleco licensed "Donkey Kong", a hit arcade game from Nintendo, a Japanese video game company, and included a copy of that game with every Colecovision. To support the launch of the Colecovision and to take advantage of the large video games library for the Atari 2600, Coleco also released an adapter that allowed playing on the Colecovision the games developed for the Atari 2600. This move encouraged 3rd party developers to grow further the Atari 2600 games library as the combined installed base of Atari 2600 compatible video consoles increased.

4.3 U.S. home video games industry crash of 1983

Nevertheless, in 1983 the video games market finally imploded as video game makers were producing a great amount of games, just expecting to cash in on the boom. Most of the games were of poor quality and very similar, consistently missing customers' expectations, who were no longer able to differentiate which of the games were good or not. Despite of the decrease in sales, most of the companies, including Atari, kept producing millions of cartridges and building up inventory that finally led to a massive discount in prices. Cartridge prices dropped from $30 to $5 and many game developers went bankrupt. From a peak of $3 billion sales at the end of 1982, by 1985 the home video games industry only sold $100 million and most video game companies withdraw from the market. The U.S. video game industry was close to disappear.

4.4 Nintendo revamps the industry

By the end of 1985 Nintendo entered the U.S. market with its Nintendo Entertainment System (NES)[7]. NES was already a great success in the Japanese market, where it was introduced in 1983. Nintendo designed the NES in such a way that it could control practically all of its complementary products and introduced a whole set of measures for that, including the licensing agreements offered to 3rd party developers who wanted to run their games on the NES[8].

Introducing the licensing agreements as a control point, Nintendo was limiting the number of licensees that could develop games to 16 firms (being four of them U.S based); second, for those software makers that received a license from Nintendo, Nintendo insisted on exclusive deals

[7] Sheff, D., 1993. **Game Over: How Nintendo zapped an American Industry, captured your dollars, and enslaved your children**.
[8] Kent, S.L, 2001. **From Pong to Pokemon and Beyond: The Ultimate History of Video Games**

ensuring that the licensed game would not be available on any other competing system for two years; third, Nintendo limited the licensees to produce only five games per year, preventing the developers from flooding the market and ensuring that only the best games were released.

Nintendo introduced additional control points through its cartridges as they kept the production of cartridges for the NES for the U.S. and Canadian market and included a "lock out" chip that avoided unauthorized developers from making NES compatible cartridges[9]. Nintendo was the only manufacturer for all the cartridges for the NES and was reselling them back to the 3rd party developers, leaving the distribution to the licensee. The result was that only those cartridges that had the "lock out" chip from Nintendo could run on NES. Apart from these measures, Nintendo kept producing their own in-house games and obtaining licensing rights of the most popular arcade coin-operated games and releasing the games themselves to the market.

Introducing all these elements of control, Nintendo managed to re-structure completely the U.S. home video game industry, which was on the verge of collapse. Such a re-structuring happened by means of increasing the control that an actor had over it. Despite the highly restrictive licensing system, licensees had to agree on Nintendo's terms as most of them had no other means to commercialize their games given the situation of the market, empowering Nintendo with a tight control over complementary products and the access to the best programming resources.

By 1986 Nintendo managed to sell 1.5 million units of the NES and gained brand awareness by exposing its brand in a broad range of marketing channels. In May 1986 Atari attempted to challenge Nintendo's supremacy by launching the Atari 7800 console and even purchasing an

[9] Zackariasson, P., & Wilson, T. (Eds.). 2012. **The Video Game Industry: Formation, Present State, and Future**

electronic chain of shops (Federated Superstores) to distribute Atari products. The Atari 7800 was backwards compatible for all the video games released for the Atari 2600, however those games were already outdated when compared to the games that were released for Nintendo and the best potential home video game titles were locked with Nintendo with exclusive deals. In 1986 Sega released the Master System video console, a similar device to the NES. However, Sega had to face the same problem as Atari, as video game developers had no incentives to develop games for neither of them because of their exclusive agreements with Nintendo and the large installed base of NES consoles that Nintendo already had by that time. In 1986 Atari sold only 100.000 units of the Atari 7800, Sega sold 125.000 units of the Master System, while Nintendo sold 1 million units of the NES.

Insert Figure 1 about here.

By 1989 Nintendo had $2.7 billion in sales and 80% of market share in U.S. home video game industry that since the entrance of Nintendo in 1985 grew from $100 million to $3.4 billion (Figure 1). The introduction of strong control points fostered the release of quality video games that pushed the sales of the NES. As the installed base of the NES kept growing, more and more developers were ready to sing the licensing agreements with Nintendo to start producing new games achieving extensive generativity within the sector.

5. FINDINGS AND ANALYSIS

To address the research gap of how do actors establish generative platforms by instituting a set of control points acceptable to others (Tilson et al., 2010), we conducted our inductive study on the

U.S. home video game industry between 1976 and 1989. During this period of time we first observed that the removal of architectural control points in the video games market by opening the video game cartridge market in 1982 increased the number of companies producing video games for the Atari 2600 console from 1 (not counting Activision) to 28 by the end of 1982. Given that by that time the production cost of a cartridge was about $5, while the cartridges were sold for $20 to $30, the significantly higher margins of the game cartridges made the new entrants to rush with the creation of new video games in an attempt to capture those margins. In 1983 the video games market imploded as video game makers flooded the market with poor quality games, what can be associated with extensive generativity without economic value. This spiral forced companies to get rid of their inventories that finally led to a massive discount in prices, with many companies disappearing and the industry going from a peak of $3 billion sales at the end of 1982 to $100 million by 1985.

Observing what happened when Nintendo entered the U.S. market with its Nintendo Entertainment System (NES) at the end of 1985, we see that the industry configuration changed as Nintendo introduced new architectural control points through licensing agreements and their "lock up" chip (Figure 2).

Insert Figure 2 about here.

We observe that by introducing the licensing agreements as a control point, Nintendo successfully manage to limit the number of licensees that could develop games and provide exclusive deals. Moreover, the technological dimension appears to be crucial to ensure the compliance of the 3rd party developers with the newly established control points as keeping the production of the video game cartridges and the inclusion of technological elements, such as the "lock out" chip, achieved to avoid unauthorized developers from making NES compatible cartridges. As only those cartridges that had the "lock out" chip from Nintendo could run on NES, a whole industry had to transform its set-up (Figure 2) if 3rd party developers expected to hit 80% of the U.S. home video game market that Nintendo controlled by 1989, representing $2,7 billion in sales.

6. DISCUSSION & CONCLUSIONS

With the results from our research we extend prior literature on platform architecture by showing how the proliferation and growth of a sector can also be contingent on the set up of control points. We extend the existing literature on digital platforms exploring in further detail the paradoxes of change and control (Tilson et al., 2012) from the architectural control point perspective. With our research we expect to provide a deeper understanding on how the architectural control points can affect the dynamic of digital platforms and show practitioners how technology can facilitate the introduction of new control points acceptable to others and what architectural design moves can be taken to foster the generativity of their platform.

We also found empirical evidence on how the set-up of control points can influence the rate of innovation in a digital platform extending the existing literature on platform strategies and their effect on innovation (Boudreau, 2010). In our research we found evidence that revoking 3rd party access to a platform through architectural control points can also foster innovation within the platform.

Finally, we extend the existing literature on how the multi-sided platforms can be regulated through legal and technological mechanisms (Boudreau and Haigu, 2009) observing how such mechanisms can be introduced to a digital platform. In our research we found evidence on how Nintendo achieved high generativity with its NES platform with the introduction of normative control points, such as licensing agreements, and the introduction of technological control points with the "lock up" chip. Our findings suggest that the new control points established by Nintendo were accepted by other actors and managed to consolidate as they accomplished to generate value for the end customer and other participants of the platform. In that sense, our observations suggest that control points can foster extensive generativity as long as they add value to the platform and the added value becomes evident not only to those actors who introduce the control points, but also to those actors that are expected to accept the control points. These findings are in line with what existing literature on value chain dynamics suggest (Trossen & Fine, 2005).

To conclude, from our research we observed that after the U.S. home video game industry crashed in 1983, the increased control over the NES platform by Nintendo led to extensive generativity of the platform. However, although our findings allow us to extend the existing literature on digital platforms by building further understanding about the paradoxes of change and control in the dynamic context of digital platforms (Tilson et al., 2012), further research should be done to evaluate the effect of the different architectural control points on the generativity of a digital platform and validate whether similar architectural control points apply across different industries. For the purpose of our research we considered the concept of generativity as the ability of any self-contained system to create, generate, or produce a new output, structure, or behavior without any input from the originator of the system (Tilson et al., 2010; Zittrain, 2006) and measured it through the growth of the U.S. home video game sector and the growth of the NES platform, but we are aware that this is just one of the possible ways to measure and study the generativity of a platform. We believe that there can be further opportunity to explore this concept and how to measure it to provide further valuable insights for firms in multi-platform ecosystems.

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FIGURE 1

Nintendo's NES sales and US home video games market size

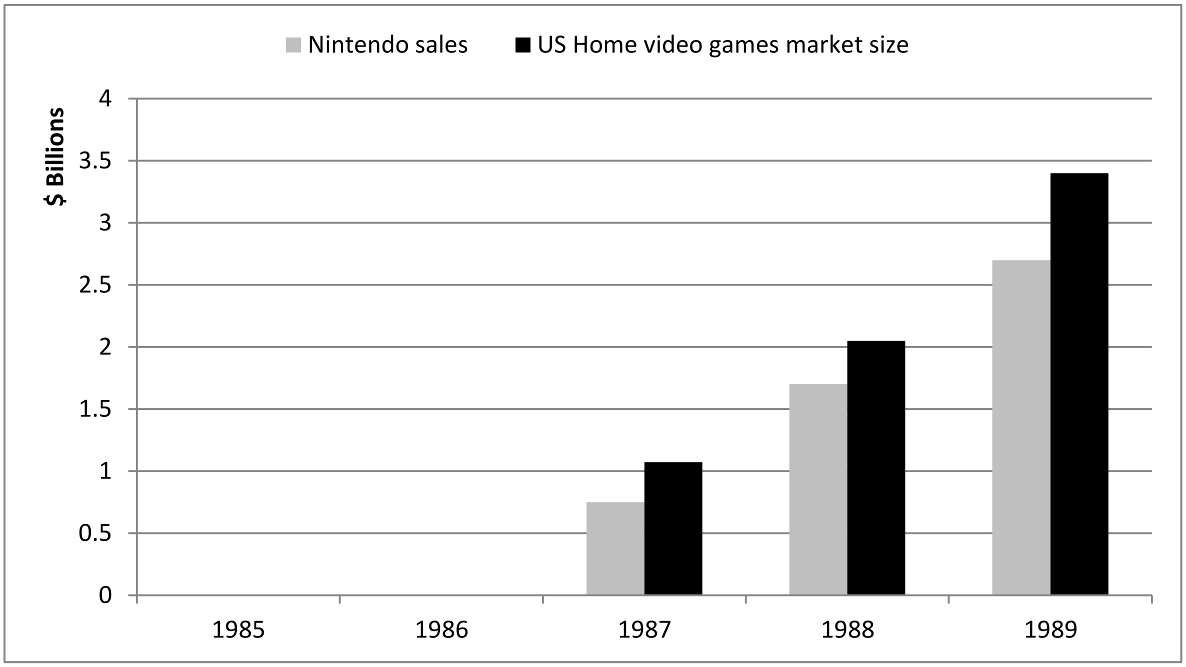
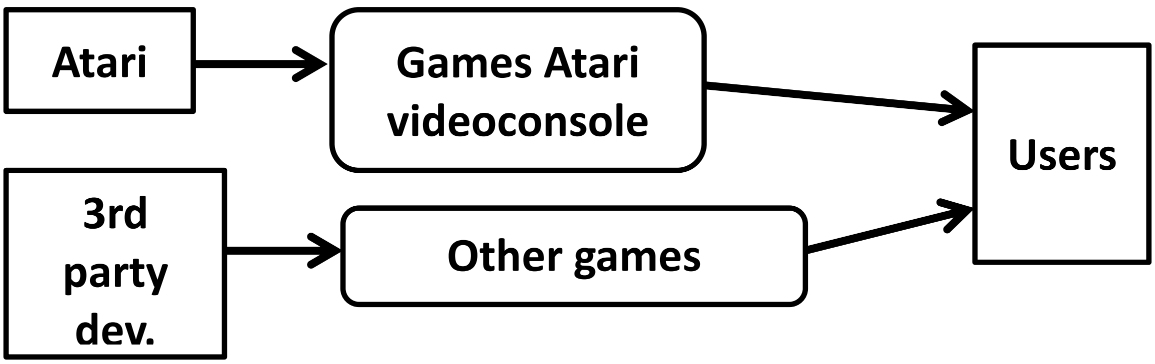


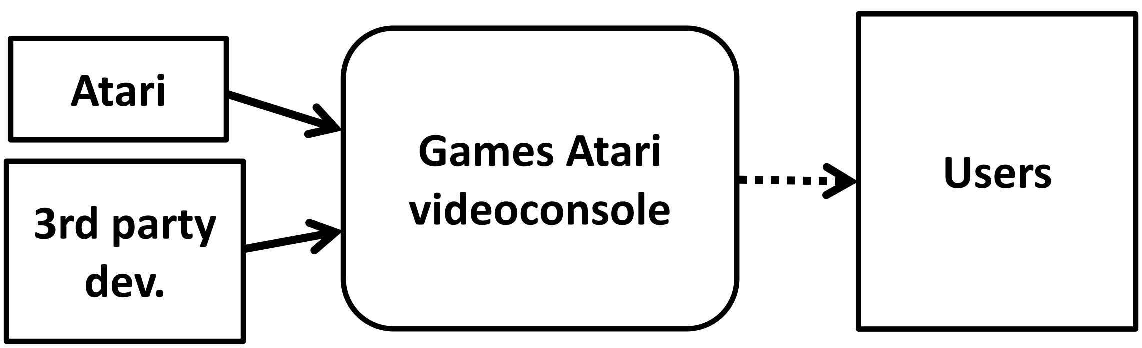
FIGURE 2

Evolution of the U.S. home video game industry set-up

BEFORE OPENING VIDEO GAME CARTRIDGE MARKET



INDUSTRY CRASH AFTER OPENING VIDEO GAME CARTRIDGE MARKET



INCREASE OF CONTROL BY NINTENDO