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Interfirm Relationship and Video Game Development in the Home Video Game Console Industry I: Japan in 1990s

Abstract

The development of the current home video game console industry began in the mid-1980s with the success of the Family Computer (Famicom), known outside Japan as the Nintendo Entertainment System (NES). The subsequent launch of the Super Famicom (also known as Super Nintendo Entertainment System, SNES) in 1990 and the introduction of the PlayStation by Sony Computer Entertainment (SCE) in 1994 heralded a new era of competition among video game consoles. This material briefly contrasts the measures taken by Nintendo and SCE in the latter half of the 1990s from the perspective excluding technical characteristics, summarizing the characteristics of video game development and the relationship between game console manufacturers and video game developers. Due to differences in market characteristics, distribution structures, and corporate organizations between Japan's video game console industry and its overseas counterparts, we limit our focus to events in Japan. In this way, we attempt to extract universal structures from the Japanese video game console industry that emerged rapidly in the 1990s that can also be used as a reference for corporate management in other industries.

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Questions

1. When the PlayStation was first launched, Sony Computer Entertainment (SCE) adopted a model whereby it purchased video games from software developers and stocked them for direct distribution to retailers. In doing so, SCE took on the inventory risk. What measures did SCE take to make this possible? On the other hand, SCE reduced the cost of outsourcing production of video games. Discuss the appropriateness of SCE's measures in terms of incentives and risk sharing.

2. In the mid-1990s, Nintendo opted for a strategy of backing only a select few software titles, narrowing down the number of video game developers and continuing to employ ROM cartridges as the video game delivery media. Examine the background behind Nintendo's decision to continue opting for these measures. (Might this be a case study of the "Innovator's Dilemma" mentioned in the Appendix?)

3. Compare the relationship between game console manufacturers and video game developers with the relationship between (traditional Japanese) assembly manufacturers and parts suppliers in the automobile industry from the 1980s to the mid-1990s, and discuss how the relationship differs in terms of providing incentives for video game developers to come up with new ideas.

4. Based on your practical experience, summarize the advantages and disadvantages of consensus decision-making and leader-based decision-making in organizations. Explain these advantages and disadvantages in so far as they can be seen in expected returns (1) and (2) noted in Section 3.

5. Derive a relation of magnitudes in expected returns (1) and (2) noted in Section 3 and describe the sort of situations in which leader-based decision-making produces greater expected returns for a company than decisions arising from consensus building. (It is enough to compare them in the cases of $r = 0$ or $r = 1$, if it is difficult to obtain a clear result.)

To date, many studies of competition among home video game consoles manufacturers have focused on the technical characteristics of the hardware. However, the development of various types of video games is deeply related to competition between hardware manufacturers, as evidenced by the emergence of popular series such as Dragon Quest/Dragon Warrior and Final Fantasy. This material focuses on the relationship between console manufacturers and software developers, and on leadership in video game development, shedding light on the microeconomic analysis of organizations and institutions. The resulting shadows throw the Japanese video game industry of the 1990s into clear relief. Sections 1 and 2 briefly summarize the subjects under consideration, first game consoles and then video game development, and then Section 3 discusses a mathematical model of leadership.

1 Game Console Development

The 1990s: The dawn of competition

The Family Computer (Famicom), known outside Japan as the Nintendo Entertainment System (NES), was released by Nintendo in July 1983. The console, which used 8-bit ROM cartridges as the video game software delivery media, was well received by users for its affordability and the high quality of its graphics and operability. While much was written through the 1990s, about technological development and decision-making on the part of console manufacturers in terms of the price and performance of the delivery media, as well as their competition with other companies, this paper focuses on how Nintendo and other console manufacturers made it possible for outside developers to supply video games. Here, together with some key concepts, we begin by briefly reviewing the early history of this situation with a focus on Nintendo. [1]

From 1984 onward, Nintendo released its console technology (under contract) to outside video game developers, a strategy that resulted in an abundant supply of video games and made it advantageous for users to own a Nintendo console. This policy enabled Nintendo to expand its domestic market share, but as is often pointed out, this policy also contributed to the development of the home video game industry as a whole. This is considered as cooperative behavior in the sense of creating a market and then expanding its scale (i.e., **creating and enlarging the pie**).

In response to the expansion of Nintendo's market share, Hudson and NEC Home Electronics released the PC Engine in October 1987, which used CD-ROMs (albeit 8-bit) as the delivery media, and in October 1988, Sega released the Mega Drive (known as the Sega Genesis in North America), which used 16-bit media (although it retained the ROM cartridge format). In response to these trends, Nintendo released the Super Famicom (also known as Super Nintendo Entertainment System, SNES) in November 1990, which employed a 16-bit ROM cartridge format. While it was not backwards compatible with the NES, its superior performance and Nintendo's existing distribution network

[1] See Yanagawa and Kuwayama (2000) for a detailed description of the home video game industry as a whole up to the 1990s

helped Nintendo secure a large domestic market share for the SNES. This is a competitive behavior in the sense of securing market share and revenue (i.e., **dividing the pie**).

The Appearance of the PlayStation

Consoles with 32-bit delivery media appeared on the market in 1994. In March of that year, Matsushita Electric Industrial (now Panasonic) released the 3DO Real (also known as 3DO Interactive Multiplayer), which was commercialized according to the U.S. 3DO standard. This was followed with the subsequent releases of the Sega Saturn in November and the SCE's PlayStation and NEC Home Electronics' PC-FX in December of that year. The eventual winner in this competition was SCE's PlayStation. The measures taken by SCE and Nintendo, its biggest rival, may be summarized as follows.

Measures adopted by SCE

- With the PlayStation, SCE made active use of outside software developers while reducing the cost of outsourcing production. As a result, it was able to offer a wide variety of video games to users.
  - SCE purchased video games from software developers and stocked them for direct distribution to retailers. In doing so, SCE assumed the software developers' inventory risk.

- Exploiting the fact that CD-ROMs could be manufactured quickly (in addition to their low price), SCE built a supply system to deliver video games to retailers rapidly, even when additional orders were placed. This enabled SCE to control its inventory and offer a flexible supply of video games.

Measures adopted by Nintendo

- Nintendo opted for a strategy of backing only a select few software titles and narrowing down the number of video game developers. In North America around Christmas 1982 and later, many low-quality game softwares were distributed, and consumers refrained from purchasing new game softwares.[2] As a result, the home video game market collapsed due to adverse selection. Nintendo thus required software developers to receive its approval when they created video game softwares for Nintendo's game console.

- Rather than adopting the CD-ROM media, it continued to employ ROM cartridges.

[2] This is called Atari shock in Japan.

PlayStation sales steadily increased in Japan and by 1996 had outstripped other video game console manufacturers in terms of units sold and revenue. In response, as a successor to the SNES, Nintendo released the NINTENDO64 in June 1996, a console that supported 3D game play. Nevertheless, it failed to explode in popularity. Meanwhile, Sega threw its hat into the ring of next-generation game console competition with the launch of the Dreamcast in November 1998. The Dreamcast was equipped with Internet connectivity as standard functionality and sought to differentiate itself with greatly enhanced 3D computer graphics and sound. However, video game development failed to progress smoothly and sales of game consoles were sluggish.

Despite attempts to stimulate demand by lowering prices, Sega faced the prospect of "losing 10,000 yen per unit sold," a situation that continued to put pressure on the company's performance, with the result that Sega decided to discontinue production of Dreamcast in February 2001. In March 2000, SCE released the PlayStation 2 (PS2), which doubled as a DVD player, as its next-generation game console.

Ensuring the quality of game softwares

For any console manufacturers, it is necessary to ensure the quality of game softwares.

- Sony evaluated the quality of game software and ranked game softwares, set production commissions and limits on the number of shipments in accordance with the rank of those game softwares in order to provide software developers with an incentive to produce game softwares with better quality.[3]

2 Video Game Development

Considerable Independence on the Part of Software Developers

Compared to the automobile industry, the home video game industry frequently involves development by outside software developers independently of game console manufacturers. This point is a major characteristic of the home video game industry and may be said to have resulted in a diverse stream of software developers entering the industry in response to the market environment, bringing in a succession of new ideas. The background factors or this characteristic can be summarized as follows:

- *Most video games are sold separately from the console.* This factor makes it less necessary for hardware manufacturers and software developers to maintain long-term business or capital

[3] This information was obtained through interviews with relevant parties.

relationships, which is also the case between manufacturers and suppliers in the automotive industry. Accordingly, software developers have a relatively large amount of discretion in deciding which consoles to develop video games for.

- *Fixed Specifications for Game Consoles.* Because hardware is not modified or adjusted in response to software, there is no need for a detailed exchange of information between hardware manufacturers and software developers.[4] In contrast, in the automobile industry, assembly manufacturers and parts suppliers develop new models by repeatedly exchanging and fine-tuning their information.

Entry and Exit by Software Developers

The considerable degree of independence on the part of software developers has encouraged many such firms to enter the industry, providing the video game industry with the opportunity to realize a wide variety of ideas. In particular, many such firms made their industry debut with the introduction of a new generation of game consoles. Video game development takes many forms, with some software developers having more than a hundred developers (creators), while others, known as publishers, have no in-house developers of their own, but instead release video games developed by other firms.

On the other hand, it is worth noting that many companies also end up exiting the market because they are unable to develop or sell profitable video games, which indicates the intense competition among software developers. In the 1990s, the number of firms entering the market was approximately 10% to 20% of the total number in the industry, but the number of firms exiting the market also rose to around the same proportion, implying that the game industry was undergoing a major change during this period compared to other industries. From 1983, when the Famicom was launched, until 1999, just before the launch of PlayStation 2, at any given time, nearly 40% of all the software developers had been active for less than one year, and the proportion that had been active for three years or less was in excess of 60%

Leadership

Something that many video game developers could be seen to have in common is the fact that strong leadership in the context of video game development was demonstrated not only by management but also by development managers, who have high levels of expertise. This strong leadership has been a

[4] It has been noted that this factor has aspects in common with the production process known as *modularization*, which has been defined as "building a complex product or process from smaller subsystems that can be designed independently yet function together as a whole" (Clark and Baldwin, 1997) and attracted attention in the 1990s as a production process that promotes innovation.

major driving force in the development of the game industry.

The development of video games is heavily reliant on the ideas and skills of individual developers. Naturally, developers do not have complete freedom when creating video games, as they are subject to budget and deadline constraints. Management and user evaluations can lead to changes in game content, and sometimes even to the cancellation of the project. This requires a high level of expertise on the part of the development manager, who carries out management tasks as a liaison with the developers. Accordingly, the discretion of the individual supervising the developers becomes important, which seems to make it easier for the person in charge to exercise leadership.

3 A Mathematical Model of Leadership

In this section, we provide a simple mathematical model to express the advantages and disadvantages of exercising strong leadership, comparing it with decision-making by consensus-building.

Basic Setup of the Model

In a certain company, Development Manager A is responsible for the development of Project A, and Development Manager B is responsible for the development of Project B. They choose between the status quo or implementing new Project A or B. The probability of the status quo being optimal is $1-p$, the probability that Project A should be chosen is $p/2$, and the probability of choosing Project B being optimal is also $p/2$. The firm earns $M(>0)$ if it is able to choose the new project properly. The gain if the firm properly chooses to maintain the status quo is normalized to zero. The firm suffers a loss of $m(>0)$ if it makes a choice that it should not have made. When Project A is desirable, Development Manager A, as the leading expert, is certain to recognize the situation as such. However, Development Manager B, who more often than not will be unfamiliar with Project A, will obtain information to the effect that Project B is desirable with probability q. Likewise, when Project B is desirable, Development Manager B is certain to recognize the situation as such, but Development Manager A will obtain information to the effect that Project A is desirable with probability q. In the case that the status quo is optimal, both managers will consider the implementation of their respective projects to be optimal with probability q. Assume that each development manager can recognize whether it is optimal to maintain the status quo when he or she cannot obtain information that it is desirable to carry out his or her own project.

Here, we do not incorporate the monetary rewards that might be paid to development managers into the model, but only consider the expected payoff that the firm will obtain. Thus, there is no conflict of interest between the two managers, which allows us to dispense with the problem of any strategic misrepresentation of the information they obtained. We then address the case in which corporate decisions are made through consensus building and the case wherein one of the development managers takes the lead in decision-making.

Decision-Making by Consensus Building

First, as a benchmark, we calculate the expected payoff for a firm that opts for the status quo in the event of a disagreement between the two development managers. If the situation of the status quo being optimal arises with probability of $1-p$ and the two development managers correctly recognized that event, then the status quo will be maintained. Even if one or both of the development managers receive incorrect information to the effect that their own project is preferable to the other options, the fact that they will not agree on the project means that the firm will opt to maintain the status quo. In all of these cases, the company's payoff will be zero. Otherwise, the situation of either Project A or B being desirable occurs with probability p. In that situation, the development manager for the undesirable project will receive incorrect information with probability q, in which case the status quo will be maintained, incurring a loss of m. On the other hand, with probability $1-q$, the other development manager will not receive incorrect information, and then the new project will be chosen properly, and in that case, the firm will gain a payoff of M. Thus, when a decision is made with consensus, the expected payoff for the entire firm will be as follows.

$$-pqm + p(1-q)M. \quad (1)$$

Decision-Making by Leaders

Next, without loss of generality, let us calculate the expected payoff for a firm in which the decision-making authority is granted to Development Manager A. This decision-making authority is defined here as leadership. However, in the case that Development Manager A is unable to obtain information to the effect that Project A should be implemented, then he or she will confirm the information received with Development Manager B. As described in the basic setup of the model, there is no incentive for strategic misrepresentation on the part of Development Manager B when being asked for his or her opinion. Accordingly, he or she will honestly convey the information he or she has received to Development Manager A, who will also know that this information is truthful. Upon receiving information from Development Manager B that Project B should be implemented, Development Manager A will delegate authority to Development Manager B with probability r (not necessarily $r = 1$ probably due to psychological resistance) and allow the implementation of Project B. The above rule is defined as leader-based decision-making in this firm.

When the situation arises, with probability $1-p$, that the status quo is optimal, then if Development Manager A correctly recognizes the situation, the status quo will be chosen. However, if Development Manager A has obtained, with probability q, the incorrect information that Project A should be implemented, then the firm will suffer a loss of m. In the event that Development Manager A has obtained, with probability $p/2$, (correct) information that Project A should be implemented, then Project A will be implemented, earning the firm a payoff of M. On the other hand, if Project B is actually preferable, then with probability q, Development Manager A will still end up implementing Project A on the basis of incorrect information. In such a case, the firm suffers a loss of m.

However, if Development Manager A does not receive incorrect information, with probability $1-q$, then Development Manager A will confirm the information received with Development Manager B. Thus, with probability r, authority will be delegated, and Project B will be implemented by Development Manager B. In such a case, the firm earns a payoff of M. The expected payoff of the entire firm for leader-based decisions is as follows.

$$-(1-p)qm + \frac{pM}{2} - \frac{pqm}{2} + \frac{p(1-q)rM}{2} - \frac{p(1-q)(1-r)m}{2}.. \qquad (2)$$

Appendix: Innovator's Dilemma [5]

- Creative destruction: A historical pattern in which companies and industries undergo generational change in tandem with "technological generational change."
  - Mobile phones and smart phones
  - Online shopping and bookstores or department stores

Why is it that the champions of previous eras are unable to adapt to new technologies? How are we to interpret or predict the emergence of such historical patterns? (And how should we respond to them?)

- Christensen (1997): Generational change in the context of hard disk drives (HDD): an interview-based survey
  - A weakness of a good company is its large and influential customer base.
  - Many corporate executives come from the main divisions of a company and products and services other than those demanded by major customers are "sidelined" within the company.

    ⇒ If those executives are attracted by "proven successes," then they will be slow to respond to new types of products and services as they gain traction in the world.

  - Christensen identified "authority in the organization" and "psychological bias" as the main causes of creative destruction.

[5] This Appendix is a note on Igami (2018).

Why does it occur?

- There are three factors to consider:
    1. Profits from an old product are simply displaced by profits from a new product. "Cannibalization" by old and new products means that there may be no significant increase in profits for existing firms. For new entrants, the new technology has the potential to generate profits. If not, they will exit the market.
    2. Existing firms can also buy up new technologies through mergers and acquisitions. This can prevent the emergence of new rivals through "preemptive strikes" (e.g., Facebook and Instagram).
    3. Pure R&D capability (as opposed to organizational capability).

An analytical perspective: Existing firms are in a state of "cannibalization" while also making "preemptive strikes" on future rivals. Under these conditions, the balance between cannibalism and preemptive strikes changes depending on which of the existing firms and new entrants possesses superior R&D capabilities.

- Causal inference is not valid for "chicken-and-egg"-style arguments, and it is not even meaningful to discuss correlation. Extending the results of (small-scale) laboratory experiments to verify historical patterns is not feasible, and (large-scale) field experiments would require funds in the hundreds of millions dollars. Accordingly, the most realistic method of demonstration is to build a mathematical model (a cluster of logic), extrapolate observable data to it, and then conduct computer experiments (i.e., simulations).

- A simulation using data from the HDD industry showed that existing firms 'R&D capabilities were higher than those of new entrants (Igami 2017).

⇒ The innovator's dilemma in the HDD industry was not caused by differences in R&D capabilities but by differences in incentives. In other words, even if R&D capability is high and rational decisions are being made by good managers, as long as old and new products are cannibalizing each other, an existing firm will not be willing (though such unwillingness may be unintentional) to develop new technologies that will bring about major changes (i.e., innovate), and this in turn leads to creative destruction.

- If this is true, then encouraging cannibalization among existing firms and speeding up the demise of older products may increase the likelihood that new products will find success, which could potentially lead to the prolongation of the life of existing firms.

- The question is how to predict and recognize when innovation is occurring.

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