ELSEVIER

Research Policy 32 (2003) 423–444

research policy

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Hardware gimmick or cultural innovation? Technological, cultural, and social foundations of the Japanese video game industry

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Received 14 September 2001; received in revised form 4 December 2001; accepted 18 February 2002

Abstract

This paper examines the role of creative resources in the emergence of the Japanese video game industry. We argue that creative resources nurtured by popular cartoons and animation sector, combined with technological knowledge accumulated in the consumer electronics industry, facilitated the emergence of successful video game industry in Japan. First we trace the development of the industry from its origin to the rise of platform developers and software publishers. Then, knowledge and creative foundations that influenced the developmental trajectory of this industry are analyzed, with links to consumer electronics and in regards to cartoons and animation industry.
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Keywords: Video game industry; Creative resources; Japan

1. Introduction

Although video game industry may not generally be regarded as a sector offering forms of "haut culture" or refined art, it has become a sizeable industry with pervasive influences on popular culture. The current worldwide market for video games is estimated to be at US$ 18 billion. In 1999 alone, 215 million copies of games were purchased in the US, which amount to two for every American household (IDSA, 2001). Despite its ubiquity and its significant influence upon youth culture, however, relatively little is known about the industry, and particularly, the role of creative resources in industry formation and competitive strength. Research on video games so far has emphasized the moral issues and psychological impacts (Loftus and Loftus, 1983; Greenfield, 1984; Kinder, 1991; US Congress, 1994). The industry's developmental trajectory, which incorporated multiple aspects of emerging technologies in computers, multimedia and the Internet, represents a contemporary synergy of digital technologies, artistic creativity, and multimedia entertainment.

Broadly speaking, there is an increasing domination of US and English language-based exportable cultural products, under the influence of multinational firms of the US origin, in forms of Hollywood films, rap music, and in commodities such as Levi's Strauss jeans, Coca-Cola, and Nike shoes, forcing other national players into a niche market (Llewelyn-Davies, 1996). Japan's video games therefore represent an

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PII: S0048-7333(02)00016-1

exception to this trend in the western world. Although the industry was first established by Atari, an American firm, most industry insiders today agree that without Japanese firms such as Nintendo and Sony Computer Entertainment (SCE), it would not have amounted to more than just a passing fad. In fact, after the famous video game industry crash of 1983, which virtually wiped all demand in the US, Nintendo played a significant role in re-establishing the industry as a profitable business. More recently, Sony, armed with significant reputation in consumer electronics, successfully combined hardware and software resources to dominate the global market with PlayStation and PlayStation 2. How did the Japanese video game industry manage to penetrate the global market?

The paper explores the aforementioned question by addressing widespread misconceptions that surround Japan's video game industry. While we acknowledge numerous books that document industry trends available in the Japanese language, few scholarly studies exist that focus on the cross-sectoral use of creative resources and offer a systematic interpretation on the role of technical expertise developed in other industrial sectors.[1] Our aim is to analyze the relatively neglected aspect of the industry through examining its distinctive historical, institutional and cultural foundations.

We argue creative foundations in cartoons and animation films, as well as cross-industry links to consumer electronics, have functioned as important foundations for this industry to emerge in Japan. We begin this paper by first offering the significance and misconceptions of video games as an industry (Section 2). We analyze how its evolutionary trajectory was influenced by interplays between hardware manufacturers and software publishers (Section 3). We will then shift our discussion to the skills foundations of the industry, based on historical and contemporary evidence for inter-industry sharing of labor pool and drawing from interviews of industry insiders (Sections 4 and 5).

[1] The primary focus of academic research available in the Japanese language has been either on corporate strategies (Fujikawa, 1999; Fujita, 1999a,b; Sunagawa, 1998), or on the inter-firm relationships within the industry (Shintaku, 2000; Shintaku and Ikuine, 1999, 2001; Tanaka and Shintaku, 2001; Yanagawa and Kuwayama, 2000).

2. Video games as a creative industry: its significance and misconceptions

New technologies deeply influence art form of the period, as was recognized by Benjamin (1936) during the industrial revolution and was elaborated in his article, "The work of art in the age of mechanical reproduction". Advanced information and communication technologies now offer a new frontier through digitization and simulation, opening up a possibility for new forms of art in cyberspace. Unlike cinema and televisions, which involve passive audience, video games emerged out of older interactive entertainment such as toys and arcade games, and expanded interactivity to a new realm by allowing players to adopt a character, function as a protagonist, craft storylines, engage in role-playing, and even interact with those from opposite ends of the world (Jenkins, 2000; Wolf, 2000).

As a contemporary art form, video games occupy an important position in the already fledging creative industries in advanced economies. With the current world market of US$ 18 billion, markets in G-5 countries are projected to continue growing up to 2005 (see Fig. 1).[2] Surveys reported that video games were more ubiquitous in the US than home-based Internet access in 1997,[3] and 78% of all households own video games in Japan (CESA, 2000). Video games and all related industries generated 220,000 jobs and US$ 7.2 billion in wages in the US in 2000 (IDSA, 2001). The video game hardware and software alone generates 30,000 jobs in Japan and 27,000 jobs in the UK (METI, 2001a; Department for Culture Media and Sport, 1998).

Despite its ubiquity and its significant influence upon youth culture, however, relatively little is known about the industry's evolutionary path, inter-

[2] Creative (or cultural) industries are increasingly seen as an important element of economic development (Hall, 1998, 2000; Scott, 1997, 1998). For instance, in the UK, the arts and creative industries produce an output approaching £60 billion a year, which accounts for over 4% of the domestic economy, and employ around 1.4 million people (Department for Culture, Media and Sport, 1998). In the US, it is estimated that cultural-products industry employs over 3 million people (IDSA, 2001).

[3] Survey conducted by Hart and Teeter Research Companies, sponsored by NBV News and Wall Street Journal on 2007 national adults polled over the telephone between 19 and 23 June 1997.

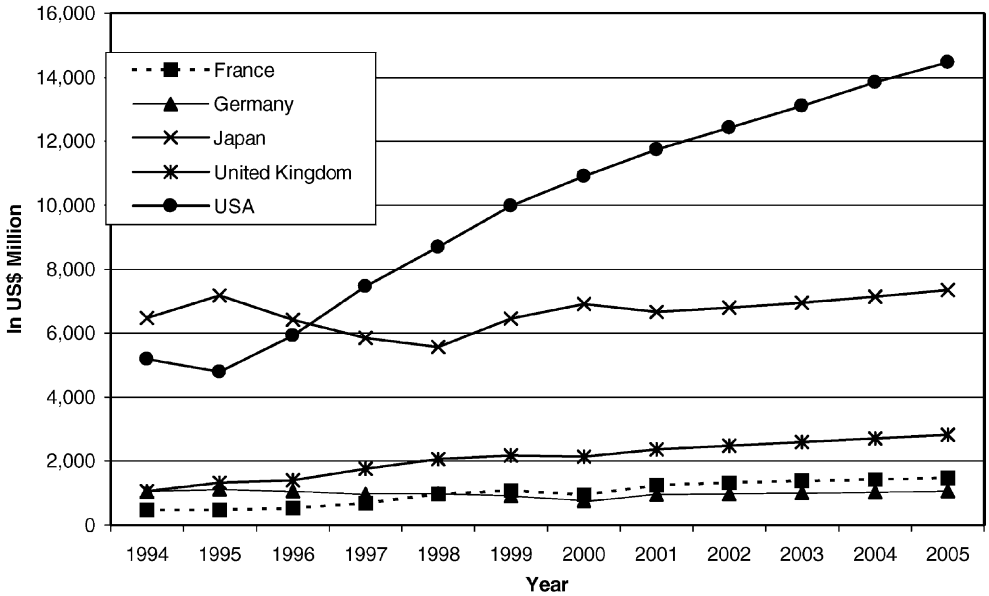

Fig. 1. International comparison of video game market trends (US$ million), 1994–2005 (projected). Source: Euromonitor International (2001).

nal dynamics, and the role of creative resources in innovation. Particularly little understood is the reason behind the dominance of Japanese firms. In addition to Nintendo and SCE, there is a plethora of Japanese software publishers. To better understand the competitive position of Japanese firms, we need to first address some widespread misconceptions surrounding Japan's video game industry.

First, there is a general consensus that Japan's competitive strengths in international trade lie in manufacturing industries (e.g. automotive, electronics, machinery) but not in creative, knowledge-based industries. The country's weakness in the latter is evident particularly in its uncompetitive software industry. It has been suggested that Japan's institutional arrangements in trade, finance, employment and education, with their emphasis upon conformity, loyalty and stability, suppress creativity and risk-taking entrepreneurship and thus constitute the source of its weakness in software (Anchordoguy, 2000; Cottrell, 1994). Given the institutional arrangements hindering the development of creative resources necessary for software design, how have Japanese video game firms succeeded in developing their products that fall in the category?

Anchordoguy (2000) argues that game software, which constitutes 27% of packaged software sales in Japan,[4] is distinctive from other software and therefore should be dealt with separately. While software is generally language-driven, hardware manufacturer-oriented, and targeted for personal and business communication, she argues that game software is part of a new industry with lower barriers to entry, does not suffer from language-based disadvantages, and escaped the negative aspects of state-led industrialization. Unlike Japan's other successful industries, the video game industry indeed did not receive governmental support, and it evolved solely out of private-sector initiatives. Yet, we find these explanations insufficient in understanding the rise of Japan's video game industry. For one, the argument for entry barriers may not work the same way for creative industries. A study by Bryman (1997) for example showed that late entrants had significant advantages over industry pioneers in case of the US animation industry. In addition, as we shall show, significant barriers to entry were observed for platform developers as well as for software publishers. Most importantly, however, the

[4] The figure used is for 2000 (METI, 2001b).

aforementioned explanations fail to identify creative resources for video games. What creative resources, if any, have Japanese video game firms made use of?

Second, creative industries have traditionally been regarded as craft-based, low-tech-oriented, and therefore labor-intensive (e.g. fashion, drama, arts). More recently, however, links to technology-intensive industries, particularly with the introduction of multimedia technologies have become an integral aspect of creative industries, and video games are the prime example. Evidence from the US indicates that the video game industry typically shows a higher R&D to sales ratio among entertainment industry (IDSA, 2000). Some even argue that the cutting-edge of technologies in graphical interfaces is in the video game industry, surpassing other sectors such as computer-aided manufacturing and design.[5]

Video games represent interactions between hardware manufacturing and software publishing, the significance of which remains ambiguous. It has been speculated that the co-location, or the lack of co-location, of creative/software industries and hardware industries matter to the development of the former (Pratt, 1997). Quite separately, von Hippel (1988) argued that users' knowledge about their tasks and needs is a source that gives rise to the formation of specialized complexes of software industry. Is the development of this high-tech creative industry in Japan linked to the country's resources in hardware technology in a particular manner?

Recent theoretical developments offer various insights into forms of industrial organization, with separate approaches such as that of transaction costs (Coase, 1937; Williamson, 1975), socio-institutional foundations (Piore and Sabel, 1984), and embeddedness (Granovetter, 1985). Nelson and Winter (1982) advocated an evolutionary approach, in which "path dependency" is observed through developmental trajectory of technologies. More recently, Osborn and Hagedoorn (1997) suggested a pluralistic approach that allows a better understanding of the complexity in organizational behavior. In our view, a pluralistic approach best accommodates distinctive characteristics of cultural industries. Our historical analysis of video games emphasizes the evolutionary process through cross-sectoral transfer that takes place concurrently with the evolution of technological knowledge and artistic creativity.

We argue that the industry is linked to socially and historically embedded foundation of creative imaginary based on vibrant cartoons (*manga*) and animation films, complemented by the availability of skilled engineers emerging from Japan's consumer electronics industry. The presence of competitive consumer electronics industry in Japan created a foundation of necessary technical labor pool, and social legitimacy drawn from pre-existing comic and animation industry has served as a foundation for game creators and designers. These foundations, combined by the timely entry of platform developers such as Nintendo and Sony, played an important catalytic role in the emergence of video games industry, and resulted in a vertically disintegrated industrial complex with hardware manufacturers as well as a plethora of small game software houses. In such context, cultural proximity facilitated the information exchange on next-generation hardware specifications, although formal exchanges of information are not as common between hardware and software manufacturers.

In the following sections, we will briefly trace the developmental trajectory of this industry to offer a background for readers unfamiliar with the industry's emergence and internal dynamics. It shows a process in which pre-existing sectors play a crucial role in the emergence of a new industry, by supplying creative and skills resources. Then we will discuss links to consumer electronics and comic art/animation industry in the subsequent sections.

3. Evolution of the video game industry

3.1. The birth of the video game industry and its early demise in the US

It is a well-known fact that the video game industry has its origin in the US in the form of arcade games. The first computer game, "Space War", was developed by Steve Russell at MIT lab in 1961, using DEC's new interactive mini-computer, PDP-10. Inspired by science fiction, the game featured two spaceships shooting beams to destroy each other. It quickly

[5] Interview by authors with Komei Harada, 3D middleware tool programmer at 3DO, 19 August 2001. Also see The Economist, 2000.

gained popularity at the MIT lab and was freely duplicated to specialized labs with computer equipment across the nation. The program was never intended to be for sale, however, as its development occurred 14 years before the US government's application of copyright laws to computer software. Nolan Bushnell was the first in successfully turning video games into a viable business. As the founder of Atari, he has been labeled as "the first of that generation of much-hyped super-successful high-tech entrepreneurs" (Sheff and Eddy, 1999, pp. 133–134). With keen interest in science fiction in his youth and experience of working at amusement parks, Bushnell was inspired to commercialize computer games after encountering Russell's "Space War" at University of Utah's computer laboratory. Bushnell moved to California and developed a simplified version of a computer game that did not require the computing power of a full-fledged computer and could be made cheaply in his home laboratory. Initial market reaction to the first computer-based arcade game was modest; only 1500 units were sold by a pinball company. A few years later he founded Atari and developed a new game "Pong" in the fall of 1972. This time it was an instantaneous hit: it generated revenue 10 times more than a typical pinball machine. Two years later Bushnell designed a cheaper machine for home-use, distributed by Sears Roebuck. By 1976, 20 firms were active in the industry, including such giants as National Semiconductor, Fairchild, General Instrument, Coleco, and Magnavox. The industry grew to a US$ 200 million business in 1978, and to US$ 1 billion in 1981. Atari, now owned by Warner, accounted for half of the total revenue.[6]

However, the rapidly growing, yet infant video game industry faced a sudden market crash in 1983–1984. Many analysts blame the over-supply and substandard game software, which caused the deadly downward spiral of prices and quality, eventually wiping out demand. Retailers and wholesalers with thousands of unsold game cartridges in their inventory suffered significant losses, and resulted in Mattel and Coleco to withdraw from business, while Atari was sold off in pieces. Bushnell was quoted, "very seldom do you have an industry in which the dominant player not only abandons leadership but abandons the *industry*." (Sheff and Eddy, 1999, p. 150). The fiasco has been subsequently cited by Nintendo as a reason to develop a strictly regulated, closed-system platform, in which game software is tested, approved, and given a secret code to avoid piracy and the insurgence of substandard software in the market.

3.2. The industry's resurrection by a Japanese toy firm Nintendo

Nintendo (founded in 1889), formerly a company that produced toys and playing-cards, began with experimenting with electronic toy products in the 1960s. Although widely ignored by the mainstream toy industry at the time, Nintendo took a particular interest in gaining knowledge of electronics, initially in order to respond to consumer demand generated by shooting games that used optical censors. As early as1964 Nintendo hired experienced electronics hardware engineers from well-known consumer electronics firms, and proceeded to conduct joint R&D with Sharp and Mitsubishi Electric. One of their experiments resulted in a license from Magnavox in 1975 to produce its video game system in Japan, which played a variation of "Pong". Initially hired to develop baseball pitching machines and toy transceivers, engineers were subsequently moved to developing arcade games that would lead to Nintendo's first home-use video game system, "Color TV Game 6" (Aida and Ohgaki, 1997; Sheff and Eddy, 1999).

Nintendo's first full-fledged home video game in 1983, Famicon, was in fact a latecomer in the home video game market behind Tommy and Bandai, both Japan's major toy companies. Nintendo's success over competitors is attributed to price competitiveness, initial alliances with hit arcade video games, as well as its ability to deliver original mega-hit software such as "Super Mario Brothers" (1985). Nintendo's position was solidified with the success of its portable console, GameBoy (1989), and the next-generation home video game console, Super Famicon (1990).

Nintendo's first success in the US market was accomplished with an arcade game, "Donkey Kong". To entice reluctant retailers that had suffered from the Atari fiasco, Nintendo offered non-risk packages, which included displays, windows, and risk-free inventory. Initially unable to gain support of the retailers, however, Nintendo turned to convince consumers

[6] Warner paid US$ 28 million in 1976 in return for a majority of Atari's shares and kept Bushnell as CEO but only for 2 years.

at toy stores city by city. Gradually responding to returning consumer demand, a number of retailers began signing up to do business with Nintendo, which included such major chains as Circuit City, K-Mart, Wal-Mart and finally, Sears. By 1990, Nintendo was a household name; one-third of American households had a Nintendo at home.

Unlike the otherwise troubled relationship between Japan's computer hardware and software industry, where hardware companies neglected innovation to such an extent that software was considered something of a "necessary evil" (Cottrell, 1994), Nintendo has been fully aware of the importance of software, and nurtured talent both in-house as well as through third-party publishers. In fact, President of Nintendo, Hiroshi Yamauchi, was once quoted as saying that *hardware* was the "necessary evil" of the industry (Morioka, 2000). The recognition for the importance of software in the video game industry prompted Nintendo to strictly regulate software. By retaining entire control over the production of ROM cartridges that stored game software, Nintendo made ultimate decisions on whether, when, and how many copies of game software would be produced. Until the mid-1990s, Nintendo successfully averted competition by: (1) monopolizing popular game titles, (2) having an in-depth knowledge of the toys and entertainment market, (3) upgrading technologies through alliances with hardware firms, such as Silicon Graphics and Philips, and (4) in case of the Japanese market, controlling the distribution channel, and in the US market, aggressively going after piracy in courts.

3.3. The battle over platform technologies and the changing logic of competition

Technological development has, however, altered the logic of competition in the video game industry in the 1990s, undermining the monopoly of Nintendo, and increasing the share for SCE's PlayStation that used CD-ROM (Yamashita, 1998). Nintendo's reluctance in aggressively pursuing CD-ROM technology was twofold: one was the potential loss of control over proprietary game software, and another was a perceived lack of understanding of apparent technological advantage in CD-ROM technology: ROM cartridge was more costly and held smaller amount of data than CD-ROM, but was faster in reading data. Yet, Nintendo disregarded the advantages of CD-ROM, which offered not only low production costs, but also the timely delivery made possible by its manufacturing process; while CD-ROMs can be produced in small batches and brought to the market within a week, ROM cartridges took 2–3 months for delivery, thereby making CD-ROM game software far more demand-responsive and adaptive to the rapidly changing market.

Since its launch in Japan in 1994 and in Europe and the US in 1995, SCE has sold 73 million units of PlayStation consoles and 600 million copies of game software (The Economist, 2000). By 1999, SCE had 55% market share in the US and 70% market share in Japan. Although Sony's international reputation, brand recognition and deep pockets have undoubtedly facilitated its emergence in video games, its success was neither assured nor anticipated. A number of other well-established consumer electronics firms have attempted and failed to enter the video game market. Matsushita's alliance with Electronics Arts (3DO REAL), as well as rumored alliance between Toshiba and Apple, both in the early 1990s, never had a chance in the face of overwhelming success of Nintendo's Super Famicon at the time (Yamashita, 1998). While Sony is known for its innovative product development, it is not without experiences of failure, the notable one being the ill-fated β-format for VCRs vis-à-vis Matsushita's VHS.

The major reason cited for the failure of most consumer electronics firms is the lack of market knowledge in video games. In comparison to consumer durables, demand for cultural products is often chaotic and unstable, yet simultaneously cumulative and addictive (Throsby, 1994). Akin to pop music recording, films, and trendy apparel, the market for video games is highly volatile. To sell video game platforms, firms need to devise a means to tame unstable demand with efficient production and distribution networks, and maintain a far greater volume to justify a tiny margin. Consumer electronics firms typically planned on selling thousands of consoles months after months when in reality, the video game business was sustained through selling millions of platforms. Both Sony and Matsushita had blundered in the early 1990s by planning platforms affordable in consumer electronics standards, but too costly as home video game consoles. Furthermore, they were unfamiliar

with Japan's intricate distribution networks for toys, for which Nintendo had a solid foundation and a century of experience.

SCE's success lies in ensuring that the firm capitalized on every aspect of its strengths, which centered on internal manufacturing facilities, new product development capability, and in-house accumulation of talent and expertise gathered through Sony's broad corporate appeal.[7] Having in-house manufacturing facilities ensured high degree of demand-responsiveness, although it went against the industry norm established by Nintendo. Further, SCE sell directly to retailers to discourage rampant risk-hedging behaviors observed among wholesalers, which disrupt the market and risk cooling the already unstable demand.[8]

However, the success of SCE ultimately depended upon their ability to forge alliances with major software publishers. The catalytic event that sent industry-wide signals took place when Namco, a major software publisher and a Nintendo partner with a history of troubled collaboration, agreed to produce software for PlayStation. When SCE was still a largely unproven entity, Namco's software made a significant contribution to SCE's credibility and facilitated its initial entry into the market, and helped showcase advantages of PlayStation in 3D graphics at various conventions. This strategy was effective in generating a reputation and heightened expectations months prior to the actual introduction of PlayStation in the Japanese market. The final decisive event took place in 1995 when Square, the publisher of mega-hit game series, "Final Fantasy", announced that it would produce a version for PlayStation. It was followed by Konami's announcement to begin selling their software directly to consumers without relying on Nintendo's distribution networks, and by Enix's, the publisher of another mega-hit game "Dragon Quest", to produce for PlayStation in 1997. Enix's president has been quoted as saying that it was strictly a sensible business decision for software publishers to seek expanded revenue through providing software to an increasingly popular platform. Nintendo counteracted with price cuts, but such tactic is generally considered as an ineffective long-term strategy, as the recent case of Sega's eventual withdrawal from the console business has shown. As a result, SCE achieved a 70% share in Japan. In the US, SCE's share has risen to 55% in 1999, while Nintendo trailed behind at 36%.

SCE solidified its position by introducing PlayStation 2 in 2000 (4 March in Japan and 26 October in the US), a carefully designed console to strategically retain customers. Unlike Sega's now defunct DreamCast, PlayStation 2 can play any games programmed for the previous console. It also functions as a DVD player; three quarters of Japanese consumers today use PlayStation 2 as both game platform and DVD player, while less than a quarter used it solely for games.[9] Added to it is the function of accessing the Internet, although it has not been widely adopted by consumers worldwide (13–30% depending on market). By 23 March 2001, over 10 million units of PlayStation 2 have been sold worldwide.[10]

The battle over delivery platforms is hardly over, however. Although Sony dominates the Japanese market, Nintendo still controls a good portion of the US market. Also, the future delivery platform is becoming increasingly uncertain, and firms are adopting separate strategies. While Nintendo has publicly announced that it will devote most of their energy and resources in developing the next-generation portable game device (their GameBoy series), SCE recently abandoned a plan to develop competing portable devises as they now expect that the future platform will move to cellular telephones (Kumar, 2001). In the meantime, Sega

[7] Also, Sony succeeded in part by attracting adult consumers far more than Nintendo. While Nintendo's customer base is concentrated in children aged 3–12 years, Sony has a much broader base and is particularly strong in the market for "young adults" aged between 21 and 29. According to a survey conducted in Japan in 1999, 45.0% of the surveyed adults of the age play PlayStation while only 5.9 and 11.4% of them play Nintendo 64 and GameBoy, respectively (Dentsu Soken, 2001).

[8] To hedge risks, wholesalers and retailers habitually speculate on mega-hit games. They need to hold a sufficient yet minimum level of inventory to increase revenue (particularly for mega-hit games) and simultaneously reduce the risk of holding inventory of slow-selling games (some sellers illegally sell them to rental or second-hand game sellers when the value drops to zero). Nintendo distributes 97% of the products through *shoshinkai* (association of contract wholesalers) and also has franchise retailers (1,893 stores nation-wide) (Dentsu Soken, 1999). Sony initially decided to hold some inventory in-house, and to reduce licensing fees charged to software houses, although these strategies were later abandoned (Yamashita, 1998).

[9] Survey was conducted over Internet between 29 March and 1 April 2001 with 4381 valid responses. Nikkei Net: IT News, http://it.nikkei.co.jp/it/sp3/speCh.cfm?id=20000511p335b003_11.

[10] Data provided by Asahi.com, 2000.

Table 1
Video game consoles and specifications, 2001(excluding portable devises)

Console	Company	Launch in USA	Processor	Memory	CD-drive	Sound channels	Other features
PlayStation 2 (US$ 299.99)	Sony	26 October 2000	300 MHz (Sony, Toshiba); graphics chip by Sony	38MB (Rambus)	Sony	48 channels (developed in part with Sanyo)	Expansion port (co-developed by LSI Logic), networking technology (ImaginOn and Conexant), game pad (joystick) technology from Immersion
Xbox (US$ 299)	Microsoft	15 November 2001	733 MHz chip (Intel, Microsoft); graphics chip from nVidia	64MB	Thompson Multimedia	256 channels	8GB hard drive (supplied in part by Western Digital); networking technology (Coextant)
GameCube (price in US$)	Nintendo	18 November 2001	485 MHz Power PC "Gekko" chip (IBM); graphics chip from ATI Technologies	43MB	Matsushita	64 channels	Modem (Coexant)
Dreamcast (US$ 150), now defunct	Sega	9 September 1999	200 MHz chip (Hitachi); graphics chip by NEC	26MB (Microsoft operating system)	Sanyo	64 channels	Built-in modem (Conexant); online network (run in part by Genuity

Sources: Kranz (2000); New York Times (16 May 2001).

is transforming itself as a subcontractor to Microsoft's Xbox that entered the market in early November 2001 with a dozen games and at US$ 299 (see Table 1 for the list of major platforms).

4. Cross-sectoral links and sharing of resources for video game development in Japan

As the previous section showed, the evolution of the industry has been influenced by a variety of actors from broad sectoral backgrounds. The onset of the industry, which began with the application of computer programming for arcade games, was subsequently infused with technologies in consumer electronics to produce home-based video game consoles. Finally, the battle over platforms has been waged increasingly based on the access to hit game software. In Japan, the two major platform developers, Nintendo and SCE, forged an indirect link between manufacturing expertise in consumer electronics and software publishers. As hybrids of hardware manufactures and software developers, platform developers drew crucial resources indispensable for growth from consumer electronics, and facilitated fledgling software start-ups through financial assistance and early disclosure of platform specifications. In this section, we will elaborate on the sharing of technological knowledge and skills resources among consumer electronics manufacturers, platform developers, and software publishers.

4.1. Links between consumer electronics manufacturers and platform developers

Technical capability and expertise in consumer electronics have served as a critical foundation for the early development of platforms in Japan.[11] Nintendo's initial shift to technology-intensive video game business was made possible through collaborations with consumer electronics firms, and the sharing of engineering skills with them. Local presence of consumer electronics firms, and particularly IC chip manufacturers, such as Mitsubishi Electric, Ricoh and Sharp, enabled frequent communications and experiments at initial stages of new console design.[12] Nintendo's interest in video games in the mid-1970s coincided with that of Mitsubishi Electric, which was in search of a new partner after a joint large-scale integrated circuits (LSI) development for video games collapsed as a result of the partner's bankruptcy. The collaboration resulted in Nintendo's successful launch of the first color home-based video game console ("Color TV Game 6"), and provided an opportunity for Nintendo engineers to receive hands-on training in LSI design. Nintendo's subsequent alliance with Ricoh in their development of Famicon was in part motivated by an ex-Mitsubishi Electric engineer at Ricoh who had worked with Nintendo on LSI design for video games. Sharp had been a partner in previous electronic toy ventures, and the relationship nurtured during the previous project resulted in Sharp to provide liquid crystal display technology, and led to Nintendo's early success with hand-held video games ("Game & Watch"). Although Nintendo now deals with overseas manufacturers including Silicon Graphics, Philips and IBM, collaborations with domestic electronic firms were critical to functionality and affordability of Nintendo's early models.

In addition to supplying technological knowledge through sharing engineers, consumer electronics firms played a critical role for Nintendo's success by serving as contract manufacturers. Apart from its sales offices around the world, Nintendo, headquartered in Kyoto, only has a warehouse with product-checking functions near Kyoto, and maintains no in-house plant. Nintendo outsources most manufacturing activities, including production of parts and assembly of platforms and cartridges. At a time when sophisticated international supply chain was still underdeveloped, the use of domestic consumer electronics firms as

[11] Links between the video game and electronics industry were also found in the US, in its early stages. Atari hired a college-drop-out, a 17-year-old Steve Jobs as a technician for US$ 5 per hour as the fortieth employee. Jobs' friend, Steve Wozniak, an engineer at Hewlett-Packard at the time, was addicted to Atari's computer game, "Gran Trak", and was allegedly let into Atari laboratory by Jobs in evenings to play the game free. While Wozniak helped Jobs develop "Breakout", another "Pong"-based game, they were also developing the first personal computer in the garage of Jobs, prototype of Apple I. Aside from Apple, Atari alumni are also found in other computer software firms, including Microsoft, Electronic Arts, Lucasfilm, and LucasArts.

[12] See Takano, 1994/1995 for an extensive discussion on the involvement of Mitsubishi Electric in platform development by Nintendo.

contractors helped Nintendo concentrate its resources in the design and development of platforms.[13]

SCE's successful entry into the market with CD-ROM technologies represents a different relationship between the consumer electronics industry and platform developers. As a reputable consumer electronics firm itself, SCE uses Sony's in-house plants known for quality in design and performance. Direct control over production of consoles, coupled with shortened lead-time with CD-ROMs, allowed SCE to remain responsive to fluctuating market demand while maintaining quality standards. Yet another model is that of Sega; although now defunct, Sega exploited close links to resources possessed by an agglomeration of small engineering firms in Tokyo's Ota-Ward known for swift and flexible production of parts and components for prototypes.

In sum, Japan's video game industry benefited from technical knowledge and engineering skills nurtured by its globally competitive consumer electronics industry. In addition, a variety of other industries also provided skills resources, including, such as programming from automobile, computers, and telecommunications, multimedia technology from broadcasting, and system design from electronics industry, as well as CAD engineering even from the construction industry (Sunagawa, 1998).

4.2. Links between platform developers and software publishers

Both Nintendo and SCE today have extensive in-house resources for software publishing as well. The co-existence of hardware and software businesses creates a degree of synergy that is deemed critical in the success of the two firms. For instance, at Nintendo's software development division, all staff members, including designers and artists as well as software programmers, are given training in hardware architecture. Shigeru Miyamoto, Director of the division, argues that a combination of knowledge about hardware and software allows systematic development of games at all levels within his teams (Takeda, 1999, pp. 100–101). Yet, the Japanese video game industry consists of a plethora of independent software publishers as well as the two platform developers, forming a web of links that transfer expertise. A key to understanding the industrial structure is its market characteristics.

In the market for video game software, software publishers can expect revenues at negligible marginal costs after a certain threshold: mega-hits can bring in a high percentage profit vis-à-vis production cost (mostly labor), while with all the up-front labor cost, flops can quickly turn into a major financial disaster. It has been estimated that 14% of the games titles generate 70% of the total sales volume (Shintaku and Ikuine, 1999). Mega-hits can be further exploited by turning them into a series, raising the status of the publisher to a three-, four-, and five-title empire. At the same time, consumers expect a greater degree of excitement in the new versions, therefore raising stakes on its success, prompting a push toward a greater degree of technological complexity as well as more labor-intensive production. A case in point is a popular series "Dragon Quest" developed by Enix. The first version was developed in 3 months with five staff members, while "Dragon Quest IV" took 5 years and over 30 people to develop, and involved 16,000 pages of elaborate scenario and scripts (Oshita, 2001).

In part because of the market volatility and complex creative environment, the industry cannot be systematically and hierarchically integrated in the same manner as *keitetsu*. Platform developers, while interested in retaining the core of software development, simultaneously seek flexibility and diversity of creative resources by encouraging the development of third-party publishers. Nintendo, whose strong in-house software section published such mega-hit titles as "Mario Brothers" series and "Pokémon" series, deals with 355 third-party software publishers, while SCE does business with 540 software publishers worldwide (Dentsu Soken, 1999).

As shown in Table 2, software publishers vary in origin, size and corporate organization. There are broadly categorized into three groups: (1) in-house publishers of platform developers (i.e. Nintendo, SCE), (2) comprehensive software publishers with

[13] While outsourcing manufacturing brought certain advantages to Nintendo, it may have brought disadvantages, namely, the lost opportunity in accumulating manufacturing knowledge. This may have contributed Nintendo's decision to decline the shift to CD-ROM technologies, and prioritize market advantages (control over software) offered by ROM cartridges over production advantages of CD-ROM.

Table 2
Major software publishers in Japan

Company	Year established	Origins	HQ location	Employees	Sales[a] (FY2000; ¥ millions)	Major titles
Bandai	1950	Toys	Tokyo (Taito)	960	217010	Dragon Ball
Capcom	1979	Arcade games	Osaka	1009	49082	Resident Evil, Biohazards, Onimusha
Enix	1975	Publishing	Tokyo (Shibuya)	130	45265	Dragon Quest
Koei	1978	PC sales, office software	Ashikaga → Yokohama	435	20077	Dynasty Warriors, Winbank
Konami	1973	Jukebox rental/repair	Tokyo (Minato)	522	171481	Metal Gear Solid, Silent Hill
Namco	1955	Arcade games	Tokyo (Ohta)	2097	146554	PacMan, Tekken
Nintendo	1889	Toys	Kyoto	1150	462502	Mario Brothers, Pokémon
SCE	1993	Consumer electronics/recording	Tokyo (Minato)	1700	N/A	Gran Turismo, Spyro, Cool Boarders
Sega	1951	Jukebox mfg	Tokyo (Ohta)	1007	242913	Virtual Racing, Virtua Fighter
Square	1986	Game software	Tokyo (Meguro)	774	72923	Final Fantasy

[a] Total corporation-wide sales.
Source: compiled by authors from company websites.

in-house capability in most aspects of software development from scenario writing to score writing and sound design (e.g. Square), and (3) publishers that act as producer/coordinator and outsource most functions (e.g. Enix).[14] It has been hypothesized that technology-driven games are better produced by comprehensive publishers, as in-house accumulation of technological knowledge can serve as a competitive advantage, while scenario-driven games are better produced through coordination of various new and creative ideas, thereby encouraging a structure of active outsourcing (Shintaku and Ikuine, 1999).

Platform developers facilitate the entry and growth of new, independent software publishers by taking the lead in information exchange with them. This normally takes place in the following three stages: (1) initial guidance on software formats, quality and ethics standards, purchase of development tools, etc., (2) provision of new versions of operating systems during the development of game titles at software publishers, and (3) final quality inspection on software and documentation. In contrast, the opposite flows of information are rarely observed: third-party software publishers do not share with platform developers much information on their game titles under development. Further, platform developers seldom become involved in joint development of game titles with third-party publishers. Hence, unlike supplier–customer relationships in the Japanese automobile and electronics industries, Nintendo and SCE do not contribute to their third-party software publishers in forms of technology transfer. When assistance is offered for start-ups, it normally takes the form of contests and competition aimed at cultivating new talent, and financial assistance may ensue thereafter.[15]

4.3. The issue of cultural proximity between hardware and software

Evidence shows a presence of cultural proximity between platform developers and third-party software publishers, as it has been observed in other industries.[16] Japan's software publishers have been in a unique position to access, almost exclusively, dominant platform developers particularly at the early stages of the industry's development. There are multiple ways in which cultural proximity matters, yet in all cases it functions to reduce barriers of communications and facilitates flows of information.

The first aspect of cultural proximity refers to the ease of communications, represented by the presence of face-to-face personal networks that allow for informal, word-of-mouth information transfer through the use of common language (with high barriers to outsiders). This ensures speedy access to new disclosure of formerly proprietary information. Platform developers normally disclose new platform specifications to third-party software publishers at mid- to late-stages of development. By doing so, platform publishers can incorporate feedbacks from software publishers before the final completion. It also helps software publishers to resolve any compatibility problems. Through such interactions, platform developers aim at the timely delivery of new titles as well as successful adaptation of existing hit titles to the new platform. Occasionally, platform developers distribute a small number of prototype consoles to a selected few software publishers with close business relationships, 2–4 years in advance of the planned release.[17] Such practices create favorable conditions for Japanese software publishers to make a head start at the release of new platforms.

[14] The same tendency is observed in the US. According to the survey conducted by Shintaku and Ikuine (2001) among 32 US software publishers, 40% of the firms conducted development "mostly in-house", 28% did so "mostly through outsourcing", 31% mixed both strategies.

[15] SCE's scheme of supporting start-ups ("Let's play games") provides financial assistance for individuals and groups who win an audition. Nintendo and Recruit Co., Ltd. also jointly established a venture capital firm that provides similar financial assistance (Yanagawa and Kuwayama, 2000, p. 12).

[16] Gertler and DiGiovanna (1997) demonstrate that proximity in training regime and language among other things between manufacturers and users of machine tools have a significant influence upon the use of tools and hence their contribution to the innovative performance of users.

[17] To take an example of SCE's PlayStation, the actual development began in 1987–1988, with informal disclosure of its specifications and the distribution of prototypes to major software publishers in 1989–1990, 4 years before PlayStation was released to the Japanese market (interview by authors with Jun-ichi Kawamura, Chief Producer, Namco, 12 April 2001). According to Yanagawa and Kuwayama (2000), Nintendo did not undertake an early disclosure of specifications for their 32-bit and 64-bit consoles, however.

The second aspect of cultural proximity refers to the presence of common operational procedures. For example, comparing software publishers in the UK and US as a partner for joint development, Shigeru Miyamoto, the creator of Nintendo's "Donkey Kong" and "Mario Brothers", finds it far easier to work with UK software publishers due to their proximity in their approaches to product development. In Miyamoto's view, UK software publishers pay attention to the structure of games at all stages of the development process so that the games can be programmable. Their approach is based on a solid understanding of hardware architecture, widely shared by Japanese software publishers, but seldom found among US publishers.

Finally, the third form of cultural proximity may be observed between software publishers and the market in terms of demand-responsiveness. As a content-driven commodity, local game publishers enjoy the advantage of knowing the preferences and tastes of the domestic market in detail. Popular genres of games significantly vary between countries (Monopolies and Mergers Commission, 1995, p. 48); while two-thirds of games sold in the US in 1999 were either actions or sports games, only one-third of the games sold in Japan that year fall in the same categories (Shintaku and Ikuine, 2001). The "Army Men" series developed by American publisher, 3DO, successfully cater to boys who also play with plastic toy figures, but overseas markets presumably will not respond in the same manner. In Japan, role-playing games enjoy huge popularity, some being specifically targeted only for the Japanese market.[18] As it will be shown in the following section, interaction between video games and cartoons/animation films has created in Japanese game software a unique style that elaborates characters and stories.

5. Sources of creativity in Japan's software publishing: cartoons and animation films

Today, software publishers command a decisive power in Japan's video game market. While the history of the industry is dominated by competing platforms, an increasing proportion of profits is being made in game software. Platform developers sell their consoles at a razor-thin margin and make a greater part of their profits from in-house software publishing or licensing fees from third-party software publishers. The ratio between hardware and software market in Japan shifted from 1 to 2.4 in 1990 to 1 to 3.2 in 1998. Further, platforms are being made obsolete as software distribution will increasingly take place over the Internet in the future.[19] This trend, while still limited at this time, will further push software publishers to the center stage of the industry.

5.1. Production and the division of labor in software publishing

The production of game software requires a variety of technical skills and artistic creativity. Individuals work as part of a multi-disciplinary team and are required to interact with others from a variety of backgrounds. Table 3 shows some of the major occupational categories represented in the industry, with skills varying from design, music, modeling to programming.

Since its infancy in the US, the video game industry offered employment opportunities for artists and programmers who prefer to work in the alternative-to-the-mainstream environment. It attracted engineers and programmers, many of whom were nurtured in close association with the country's defense interests under the cold-war regime. Bushnell was quoted as saying, "... we provided a place for creative people to be part of something completely new. These were people who wanted to create something intellectually stimulating and fun. They wanted to put their talent into making games, not bombs." (Sheff and Eddy, 1999, p. 140). Japan's software publishers today also showcase their work environment as being casual and

[18] This form of cultural proximity, however, explains the strength of locally-based software publishers, and questions still remain as to why Japanese-made software can hold a significant market-share in the US market.

[19] The forefront of technology today is online games (or otherwise known as massively multi-player games—MMPGs) in which the Internet is the medium of delivery. The most popular of all, EverQuest by Sony, a 3D multi-player dungeons game, have 300,000 subscribers with US$ 119 annual fee, and as many as 60,000 players have played at one time. Currently, information is delivered on a CD-ROM, and games rely on the online bandwidth only for the current state, with occasional updates. SCE also announced its alliance with AOL recently to ensure its position on online games.

Table 3
Occupational categories in the video game industry

Occupational category	Summary of major tasks	Skills/training required
Game designers	Write the blueprint of the game; decide the mission, theme, and rules of play; lead game designer determines overall concept, level designers work on smaller sections of the game, and writer designers write text and dialogue	Writing and communication skills; management skills; technical skills including computer programming and software design; most designers earn a college degree in English, art, or computer science
Artists	Create graphics; in a 2D game, artists draw images on paper and then scan them into the computer, in a 3D game, artists create most of their images within the computer; character artists design and build creatures, animators make them move; background artists create video game settings; texture artists add detail to the surfaces of 3D art	Visual imagination; ability to apply basic math concepts; ability to use modelling and animating software; most video game artists have formal training in fine arts or art-related subjects, bachelor's degrees are an advantage
Sound designers	Compose music and sound in a game; research appropriate music options for particular games; choose creative sound effects with the correct balance of realism and entertainment value of exaggeration	Musical creativity; training in audio engineering; knowledge of the basics of computer hardware and software; many sound designers have a bachelor's degree in music and some have education in film scoring
Programmers	Plan and write video game software; translate ideas into mathematical equations the computer understands; specialists include engine programmers who write software that makes video games run, artificial intelligence programmers who write code to make computer-controlled characters act realistically, graphics programmers, sound programmers, and tool programmers who write software for artists and designers	Strong math skills; knowledge of computer programming (C and C++); most programmers have a bachelor's in computer science
Game testers	Play games to find errors in software, graphic glitches, computer crashes and other bugs; write reports describing the problems they find	Ability to communicate clearly; familiarity with technology and expert game playing skills; does not require formal education but testers are encouraged to earn computer technician certificates

Source: Crosby (2000).

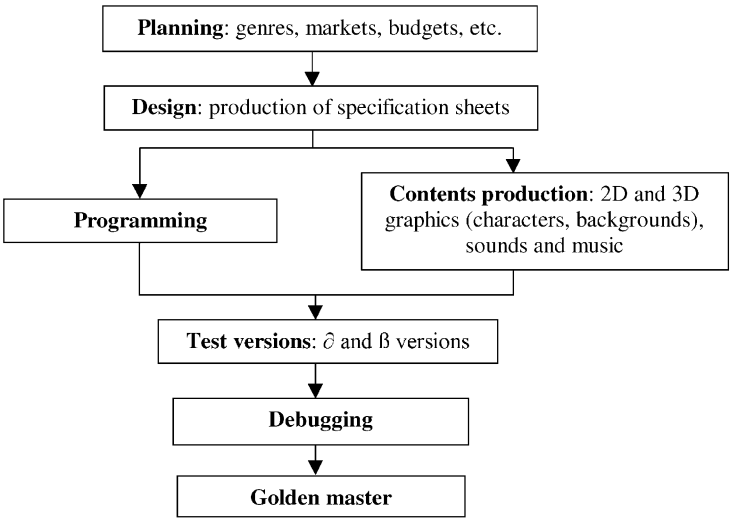

Fig. 2. Production process of game software. Sources: Ueda (1998); Dai-X Shuppan (2000); Yanagawa and Kuwayama (2000).

informal, creativity-oriented and divorced from the strict hierarchy of firms in traditional industries.

Today, the production of game software consists of a number of stages (see Fig. 2). The production starts with planning of game titles, including missions, themes, key characters, target platforms, market, and the budget. Game blueprints are either made in-house or brought to publishers by freelance game designers. Upon being approved by the producer, who is responsible for the overall management of the project, production moves onto the specifics that include scenario writing, designing of character details and accessory items, and developing plans for backgrounds settings. This stage is followed by two concurrent tasks; production of graphic materials including characters and backgrounds, and programming. For graphic material production, characters are normally hand-drawn first by artists and then scanned into the computer with 2D or 3D software specially designed for graphics and animation. Sound and music are generated by sound designers. Computer programmers work on programming to define movements and backgrounds. Programmers then import graphic and sound materials and complete what is known as an "α version". At the next stage, debugging, game testers play the programmes and identify bugs, glitches and errors. At some point of the debugging stage, a β version is often issued and made available to critics and mass media for pre-release evaluation and marketing. The production is complete when a "golden master" is issued and sent to mass production.[20]

Over the course of its history, skills requirements in software publishing have witnessed two fundamental changes. The first took place when Nintendo introduced characters and story lines, a significant development from the previously dominant "war game" and "ball game" types in which speedy reflexes determined the winner. Early video games, such as Russell's "Space War" (1961), Bushnell's "Pong" (1973), and Taito's "Space Invader" (1978), all fall into this category. Nintendo's hit titles such as "Donkey Kong" and "Mario Brothers" introduced identifiable human/animal characters with scenarios and story lines. These developments made skills for creating absorbing stories and appealing characters a necessity in video game software publishing. Consequently, game design, which was largely within the realm of engineers until then, henceforth became the task of specialized designers with artistic talent.[21] Engineers with high level of mathematics increasingly specialize

[20] For a detailed description of the production process, see Ueda, 1998, also Dai-X Shuppan, 2000.

[21] In an interview, Masayuki Uemura, Nintendo's chief engineer, stated that electronics engineers used to design characters in arcade games before the 1980s (Aida and Ohgaki, 1997, pp. 286–287).

in middleware, e.g. proprietary programming software that transfers graphic data from industry-standard 2D/3D tools, such as Avid Technology's Soft Image, and optimizes them to a specific platform.[22]

The second change took place with the shift from ROM cartridges to CD-ROM as the primary storage media. This development accelerated the already on-going shift in emphasis toward talented artists with superior graphics capability. Also, CD-ROM's large memory capacity allowed some game software to begin including pre-rendered movies to be shown during the game, increasing the need for a more realistic movement by associated game characters. These two trends increased the importance of graphic design skills further.

To respond to these changing skills requirements, Japan's video game industry drew artistic creativity from its already well-developed cartoons and animation film industry. Cartoons and animation films have pervasive influence upon Japan's culture and society, far greater in comparison to American and European counterparts. As we shall show, a variety of indicators illuminate *manga*'s position and significance in the Japanese society.

5.2. Manga and animation films industry in Japan

Japanese cartoons, known as *manga* comprise over one-third of all books/magazines sold in 1999 (Dentsu Soken, 2001). There were 2192 titles of new *manga* books published that year, in addition to 280 titles of *manga* magazines with an annual circulation of 1.1 billion copies. Approximately two-thirds of boys and more than one-sixth of girls aged between 5 and 18 read *manga*, and most read weekly, biweekly or monthly comic magazines averaging 400 pages with 15 serialized stories (Schrodt, 1983; Grigsby, 1998). *Manga* are for adults, too; out of 280 comic magazines in circulation in 1999, 215 were magazines targeting adults with an annual total of 727 million copies printed comprising 53% of all comic magazines (Dentsu Soken, 2001). The subjects range from romantic to educational, humor, sports, adventure, sex and violence. There are even how-to *manga* (e.g. cooking, finance), *manga*-fied classics, and socio-political satires.[23]

Manga has a distinctive style, which is owed to the famous cartoonist known as the "god of *manga*", late Osamu Tezuka (1926–1989) (Bendazzi, 1994; The Economist, 1995). Influenced by Hollywood films at a young age, Tezuka revolutionized *manga* by incorporating techniques used in films, such as close-ups, fadeouts, and varying camera angles. He has been influential in introducing new formats as well as contents, making *manga* develop from previously dominant short strip humor to that involving long and complex stories. He also succeeded in weaving in serious issues, such as religion, race, war and social justice without leaving the boundaries of entertainment. Throughout his over 40-year career, Tezuka drew over 150,000 pages, with a record 250 million copies of sales by the mid-1980s. Tezuka was also the pioneer in producing an animation TV series in 1963, with his hit *manga* "Astro Boy". When Tezuka died in 1989, Japan's influential daily *Asahi Shimbun* carried an editorial that stated among many reasons for the popularity of *manga* in the country, the most important factor was that "Japan had Osamu Tezuka". Almost all professional cartoonists today are under his influence in one form or another. With the quality of his works as well as his credentials as a medical doctor, Tezuka was most influential in raising the status of *manga* in Japan to the level of literary works.

The importance of *manga* in Japan's popular culture meant high social status for cartoonists, who are regarded as celebrities with recognition that at least equals popular novelists.[24] Japan's comic artists typically possess copyrights of their own series, and therefore enjoy a greater control over their products than American serial comic book artists (Reinmoeller,

[22] Interview by authors, Jun-ichi Kawamura, Chief Producer, Namco, 12 April 2001.

[23] An example well known outside Japan includes "The Manga Introduction to the Japanese Economy" or otherwise known in the US as "Japan.Inc" by Shotaro Ishinomori (The Economist, 1995).

[24] Despite its phenomenal popularity and its profound influence on popular culture, cartoons and animation films have long been considered societal vice viewed by Japan's parents and educational establishments for years. A dramatic shift in their views has been observed only recently. Asahi.com reported on 28 September 2000 that the Education White Paper produced by the Ministry of Education focuses on the role of culture in education, which includes cartoons and animation as an artistic sub-field, and for the first time recognized their role as art form and a form of expression that illuminate contemporary social trends.

1999). Regarded as artist-entrepreneurs, the high social status associated with Japan's cartoonists is in part a reflection of their economic status. In 1997, there are 3500–4000 publishing cartoonists in Japan, in addition to 20,000 assistants.[25] Almost every educational institution from elementary schools to universities has student-run cartoonist clubs as part of extra-curricular activities. Ask Japan's third graders about their future career aspirations, a significant number aspires to become cartoonists. As a result, more than 10,000 individuals regularly attempt to become professional cartoonists in Japan (Lent, 1995). Comic books gave rise to animation films and TV series, further reinforcing the strength of *manga* as an integral part of popular culture in Japan. Most of the early TV animation programs in the 1960s and 1970s were based on characters and stories out of comic books. In the late 1970s and the 1980s, animation films emerged as blockbusters in the Japanese cinema, with such hits as "Cosmic Warship Yamato" which features a spaceship transformed from a World War II battleship, "Galaxy Express 999", an adventure story of a boy travelling on a space train, and "Mobile Suit Gundam", hard science fiction chronicling a war between people living in the earth and space colonies. Animation films and TV programs today account for a significant portion of Japan's market for films and broadcasting. For instance, of the revenues grossed by the top 10 films released in 1997, 40% were accounted for by animation films.[26]

Skills transfer from *manga* to animation films was clearly one of the consequences. Reiji Matsumoto, who produced such animation films as "Yamato" and "999", was trained as a cartoonist with a strong influence from Tezuka. Another producer of the science fiction animation series "Gundam", Yoshiyuki Tomino started his career at Tezuka's firm, and Hayao Miyazaki, who produced "Princess Mononoke",[27] the second best selling film in all of Japan's film industry, also produces *manga* and does not hesitate to acknowledge Tezuka's strong influence in his work.

5.3. Transfer of creative resources to video games

Cartoons and animation films provided an important foundation for the emergence of Japan's video game industry. The core of game software production involves scenario writing and drawing, and cartoons and animation films provided the necessary skills and expertise for character production and graphic design. A higher income offered by the video game industry encouraged migration of skilled designers and illustrators from cartoons and animation industry. In the animation industry, the hierarchical structure with a series of small subcontractors tends to suppress wages, and project-based fees often reduce hourly wages.[28] The video game industry, which enjoyed a rapid market growth in the 1990s, managed to employ workers at higher wages, and even caused labor shortage in the animation industry (Nikkei BP, 1999).

While no data exist on the actual transfer of employment among cartoons, animation and video games, the presence of interactions between these sectors are clear from various literature on the video game industry, and was also supported by our interviews with industry insiders.[29] The overlap in required skills between cartoons/animation films and video games can also be observed through programs in vocational schools. There are 300 vocational programs that offer training specifically designed for video game-related occupations, and additional 170 vocational programs offer training for those who aspire to become cartoonists, animators and illustrators.[30] These vocational

[25] Estimates provided by Dentsu Soken, 1999.

[26] A great majority of animation TV series broadcasted are domestically produced. In 1999, only 296 out of 2553 animation programs broadcasted in Japan were foreign programs (Dentsu Soken, 2001). Japan is a large exporter of TV animation programs as well; in 1992, 58.3% of TV programs exported were animations (Kawatake and Hara, 1994).

[27] A popular animation film, "Princess Mononoke" (1997) earned ¥11.3 billion, second only to James Cameron's "Titanic" that earned ¥16 billion in Japan (Dentsu Soken, 2001).

[28] While game software publishers are dominated by small firms, firms in the cartoons and animation film industry are generally even smaller. In 1999, there were 235 firms in business, employing 3720 persons (Dentsu Soken, 2001).

[29] Interviews by authors, Jun-ichi Kawamura, Chief Producer, Namco, 12 April 2001 and Komei Harada, middleware programmer at 3DO, 18 August 2001.

[30] According to the search conducted on the database provided by JS Corporation, which include over 3000 vocational schools in their database (http://www.js-corp.co.jp/index.html). Video game-related occupations selected for the survey include computer graphic designers, game creators, game programmers, game designers, game planners, multimedia creators, digital processors/editors, computer graphics artists, and multimedia technicians/engineers.

schools are typically classified into two categories: fashion/art/design schools, and electronics/computer programming schools (see Table 4). Among the 12 vocational schools surveyed for this research in Tokyo, the majority fell into these two categories, with the exception of two that were specialized schools devoted to developing a variety of skills for video game production. In all arts and design schools surveyed, programs on animated films and cartoons are run in conjunction with ones on video games, often sharing curricula (e.g. computer graphics, 3D animations) between them.

The video game industry maintains close ties to these vocational schools. Practitioners in the industry often serve as instructors, and occasionally students are hired part-time workers, an entry-way for full-time employment later. Some firms go as far as setting up their own vocational schools; platform developers as well as major software publishers jointly established "Digital Entertainment Academy" in Tokyo, and Konami runs its own, "Konami Computer Entertainment School" in Tokyo and Osaka. These schools are popular among aspiring game designers for they open doors to employment in a highly competitive job market in the video game industry (Mikuriya, 1999).

The sharing of creative resources in Japan was in part possible due to the contemporaneous and overlapping development of cartoons, animation films, and video game industries. Unlike the case of the US, where influences of comic books and animation films in popular culture peaked in the immediate post-war period and had already waned by the time video games emerged, Japan's comic book publishing peaked as recently as in the mid-1990s.[31] Animation films in Japan today occupy the major share of the otherwise seriously declining domestic film industry. Skills resources in these industries were concurrently developed and far more effectively shared in Japan, thereby increasing cross-influences of contents among these creative industries.

The sharing of artistic talent between cartoon/animation films and video games in Japan has led to a number of common features that can be observed between the two forms of art. For example, many in the video game industry refer to their interest in cartoon/animation films as being the primary motivating factor for pursuing current occupation. In fact, Nintendo's innovation of incorporating human and animal characters and stories in its video games, as noted earlier, was attributed to an individual designer with a strong influence of Tezuka as well. Shigeru Miyamoto, Nintendo's chief game developer and the creator of "Donkey Kong" and "Mario Brothers", began his interest in *manga* in junior high school, and led the cartoonist club at school. He later attended Kanazawa College of Art and was hired by Nintendo as its first staff artist in 1977. When he was assigned to develop an arcade game for the US market in 1980, he studied the then popular "Space Invader" and "Packman". Upon realizing that the objective of these games was simply to erase objects from the screen, he decided to create a game with a story just as in cartoons/animation films.

In the case of "Donkey Kong", the simple game is built upon a detailed *manga*-like character with an elaborate story that resembles those from animation films, "in which the lead character overcomes a variety of barriers and wins back his princess from a mischievous gorilla".[32] Miyamoto spent time on character development, to such an extent that the lead character is made as specified as a blue-collar, construction worker who keeps a gorilla as a pet and has a pretty girlfriend. The gorilla ventures on to kidnap the girlfriend one day and flees to a construction site, which prompts the lead character to go after the gorilla to rescue his girlfriend.[33] The gorilla counteracts by dropping a series of wooden barrels as obstacles to deter the lead character. The same lead character was employed again, appearing as "Mario" in "Super Mario Brothers". Video games have since become far more complex and elaborate. As an extension of such early games as "Donkey Kong", role-playing games,

[31] For a detailed analysis of the American comic culture and animation films, see Bendazzi, 1994; Wright, 2001.

[32] An interview with Miyamamo (Aida and Ohgaki, 1997, p. 178).

[33] In the mid-1980s Nintendo was sued by Warner, which claimed that "Donkey Kong" violated copyright laws for its similarities to "King Kong". The lawsuit ended in Nintendo's favor, when it became clear that Warner never officially copyrighted "King Kong" (Sheff and Eddy, 1999). On another unrelated incident, the similarity in character between Disney's animation film "Lion King" and Tezuka's cartoon "Jungle Emperor" (1950–1954) has been suggested.

Table 4
Examples of vocational schools in Tokyo offering courses on video games

Types	Courses on video games	Program duration: enrolment	Other courses
Specialized video game training schools	(1) Game programming, planning, graphics, sound design	2 years: 230, 3 years: 50	None
	(2) Game programming, CG, sound design, planning, scenario writing	3 levels (1 level per year): total of 250	None
Art/design schools	(3) Game programming, game design, character design	2 years: 120	Cartoons (2 years: admissions 80), animation films (2 years: 80), broadcasting, IT, architecture
	(4) Game design, CG design	2 years: 200	Cartoons (2 years: 150), animation films (2 years: 250), voice acting, illustration
	(5) Game graphics (as part of CG design)	2 years: approximately 40	Cartoons (2 years: approximately 40), graphic design, interior design
	(6) Game design, character design, game sound, game production	2 years: approximately 200	Cartoons and animation films (2 years: approximately 200), graphic design, fashion design, interior design, architecture, industrial design
	(7) Game programming, game graphics, mobile game programming	2 years: 120	Cartoons (2 years: 50), animation films (2 years: 40), 3D movies, Web design, voice acting
Electronic/computer programming schools	(8) Game design and programming	2 years: 40	Information processing, IT, architecture
	(9) Game programming, game CG	2 years: 80	Information processing, architecture, biotechnology, environmental technology
	(10) Game design and programming	2 years: 30	Computer graphics, architecture, information processing
	(11) Game programming, game CG (as part of CG course)	3 years: 70	System engineering, computer programming, computer music
	(12) Game design and programming	2 years: 40	3D computer graphics, Web design, digital movies, information processing, networks management

Source: Authors' survey.

in which players can pick and assume a character and typically go on an adventure or treasure hunt, enjoy broad popularity in Japan. Some of the role-playing games feature characters out of *manga* and animation films, or with features resembling them, suggesting that drawing techniques and character design are directly transferred from *manga* or animation film industries.

The three media, video games, cartoons and animation films are increasingly linked with one another in their marketing to boost sales of one another. For example, a few good classics in animation films have been adapted for video games.[34] These games include video clips from the originals and use the same voice actors to capture those grown-ups who used to watch the originals. Yet the most well-known example of the three media's integration is the success of Pokémon (Hatayama and Kubo, 2000). Pokémon was first developed as a video game for Nintendo's Game Boy. Shortly after its oblivious debut in 1996, the character began appearing in monthly *manga* magazines for children. This ignited its popularity, resulting in a TV animation program series in 1997, followed by a couple of blockbuster films. The appearance of Pokémon in a variety of media reinforced one another, facilitating the growth of the market for video games.

6. Conclusion

The developmental trajectory of the video games industry revealed a complex interplay between hardware and software technologies from its origin, and more recent trends represent a transition from hardware, engineering-driven to increasingly software-centered industry supported by artistic creativity drawn from cartoon and animation film industries. To signify this shift, the battle over platforms today to a large extent hinges upon the coordination with software publishers that provide hit game titles. In the video game industry, in the past platform hardware has functioned much like an operating system. Yet the monopolistic control over hardware has shown not impossible to break, as the case of Sony indicates.

Several issues remain unresolved for the future of Japan's video game industry. One is the issue of globalization, both in terms of markets as well as production. The entry of Microsoft with Xbox may undermine the exclusive advantages on cultural proximity Japanese software publishers enjoyed over the last two decades. Major US publishers, such as Activision, THQ, and Electronic Arts are already seen to benefit from the new battle over platforms in the fall 2001 (Clifford, 2001). Also, some Japanese firms have already begun to offshore selected functions to low-cost areas such as Shanghai. We may also observe a rise of localized video game publishers as potential competitors in hitherto underdeveloped markets, as already seen in South Korea. Finally, some Japanese software publishers have become involved in expanding online game markets to Asia, to take advantage of the rapid proliferation of Internet access and simultaneously to counteract rampant piracy in Asian markets. Online games can theoretically be accessed across borders, yet at the moment it does not accommodate participants using different languages. Currently, regional codes prevent the use of software across borders (i.e. Japanese software cannot be played by US-purchased consoles). The issue of control over contents across borders is likely to generate concerns with the increasing popularity of online games.

Another area of concern for the Japanese video game industry is its reliance upon upstream development tools developed by US firms. Today, almost all developmental environment, including 3D animation tools (e.g. Avid Technology's Soft Image, Alias|Wavefront's Maya, Newtek's Lightwave) and operating systems (e.g. Silicon Graphics' IRIX, Microsoft's Windows) are made by North American software publishers. These publishers, some with multiple expertise in TV advertising and motion picture as well as industrial design, reign graphic tools for a variety of sectors. This, combined by the changing delivery medium, may provide a further push for the Japanese video game industry to specialize in game contents production in the future, with continuous inter-relationships in artistic creativity brewed by *manga*/animation industry.

[34] Examples include "Space Warship Yamato", released for PlayStation in 1999 and "Mobile Suit Gundam" for PlayStation 2 in 2000. The import of classic animation films, such as "Yamato" and "Gundam", is also found in typing training programs on the PC format.

Acknowledgements

We would like to thank those who granted interviews for the research, as well as two anonymous reviewers for their constructive comments. Financial support of Clark University with Faculty Development Grant along with excellent research assistantship provided by Kathryn Michaud, Clark University are also gratefully acknowledged. An early version was presented at the Management of Creativity and Creative Industries Stream, Critical Management Studies Conference, Manchester School of Management, Manchester, 11–13 July 2001.

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