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STS 145: Case Study

Nintendo 64 versus Sony PlayStation: The Cartridge/CD-ROM Battle

"By 1995, Nintendo would be the only major video game company that did not have a CD-based game system" (Kent 453). How did Nintendo, the company that headed the computer-game renaissance of the 1980s, later seem to fall behind the times when so many other companies, most importantly Sony Corporation, were capitalizing on the technological advances of CDs? This case study is an examination of two types of game data storage, Nintendo's cartridge format and Sony's CD-ROMs, and the factors that led to Nintendo's release of the cartridge-based Nintendo 64 when consoles of the same generation were becoming increasingly CD-based. The Nintendo 64's main competitor was the Sony PlayStation, a CD-ROM-based console that actually evolved out of a joint CD project between Nintendo and Sony. But after the project was dissolved, Nintendo reverted back to focusing on cartridge-based consoles. The company's decision was largely the result of a business strategy that was (and still is) so strongly focused on control that, unlike Sony, Nintendo was unable to embrace technological advances, while Sony was able to recognize CDs as the format of the future and capitalize on their advantages.

Nintendo Ltd., a Japanese gaming company that had originated as a non-computer-based toy company, released its third-generation console, the Nintendo 64, in 1996 for \$199 ("What's in the Box?," par. 1). The console used cartridges, rectangular storage devices with ROM chips (semi-conductor memory) and 64-bit processors (Asakura 93). The president of Nintendo at the time, Hiroshi Yamauchi, played a significant role in the Nintendo 64's development and the decision to stick with the cartridge format. Sony's first game console, of the same generation as

the Nintendo 64, was the CD-ROM-based PlayStation, released in 1995 for \$299 (Kent 532). In contrast to cartridges, CD-ROMs are a type of optical media that uses lasers to store and retrieve information. They can therefore contain up to 650 megabytes of data (Rojas 139) compared to the 64 megabytes on a Nintendo 64 cartridge. CDs were invented as early as the mid-1970s but were prone to reading errors; audio CDs did not become prevalent until Sony and a European company called Philips N.V. independently pioneered their versions in 1982 (Rojas 140). The chairman of Sony during the development of the PlayStation was Norio Ohga, but the man who was truly responsible for the console was a young engineer named Ken Kutaragi.

The origin of the interchangeable cartridge system is disputed but it marked a break from the earlier forms of video game consoles, called hardwired machines, which could play only one game each. Author Steven Kent cites Fairchild Camera and Instrument, which released the Channel F video game console in 1976, as the first company to utilize interchangeable cartridges called "Videocarts." Instead of having to buy a new console for every game, consumers could purchase one console and then insert different Videocarts that contained information for separate games. Kent argues that although "the Channel F never developed a large following, it changed the consumer market forever. Consumers no longer wanted single-game consoles" but rather one console that could play many games (98). Fairchild's console was revolutionary in that it changed the standard format of home consoles entirely.

Arnie Katz and Laurie Yates, on the other hand, recognize an older console, the Magnavox Odyssey, as the first to have truly individual game cartridges. Released in 1972, the Odyssey is considered by some to be the very first video game console (Shaun). But, "like almost every game console since," Katz and Yates assert, "the Odyssey was an underpowered machine without many features. ... [It] was ... saddled with very limited capabilities that

circumscribed cartridge design throughout the system's several-year lifespan;" for example, it had such limited memory that the cartridge could not even store data for a playing field, so "every Odyssey game included a plastic overlay that adhered to the TV screen during play" (11). But despite the restricted state of cartridge technology at the time, cartridges were obviously superior to hardwired units, providing much more flexibility at a lower retail price than hardwired machines (Katz and Yates 12). Although other companies, recognizing cartridges' advantages, attempted to make use of them as well, only Magnavox and later another company called Atari managed to produce successful consoles with interchangeable units in the 1970s. Eventually the effects of third-party companies led to the dominance of the Atari console over the Odyssey, and Atari took the lead of the industry (Katz and Yates 19).

Then in 1984 the United States console industry crashed. Major companies, most notably Atari, had lost control over the games that were being produced for their consoles, and as a result the market was flooded with low-quality games that destroyed the companies' respectability. Most of the cartridge companies went bankrupt, and since the home computer industry did not experience a similarly devastating crash, the computer game industry shifted to focus on PC games. Consoles were considered a dead market, and the disk (either floppy or compact) overtook the cartridge as the primary game storage medium (Katz and Yates 37-8).

However, the console market in Japan never really died out. Undaunted by gloomy forecasts of the industry's death, in 1984 Nintendo Ltd., formerly a distributor of card games and other toys, released the cartridge-based Family Computer System, or Famicom, in Japan. In 1985, only one year after the crash of the U.S. market, it released the Famicom as the Nintendo Entertainment System, or NES, in the United States. However, recognizing the generally pessimistic attitude towards game consoles, Nintendo marketed the NES as a robot-toy, not a

gaming unit, by inventing a robot-like peripheral that interacted with the console. The robot was only a gimmick, though, and soon faded from the market, while the NES and its games became immensely popular (Katz and Yates 53-4).

With the success of the NES Nintendo revived the market of video games and firmly established the cartridge as the primary medium for data storage of home-console games. The NES was successful where others had failed, however, because of several unique technological and business practices. First, the cartridges themselves were unique because they contained a new security chip that allowed the console to distinguish counterfeit cartridges from real ones. As David Sheff explains, "The AVS [or Advanced Video System, the original name for the console system itself] wouldn't work unless a chip in the cartridges unlocked, or shook hands with, a chip in the AVS. The key was a kind of song the two chips sang to one another. If a cartridge was inserted into the machine that didn't know the song, the system would freeze" (161). Nintendo hoped that the security chip would prevent counterfeiters from copying its games, since only Nintendo would have access to the security chip technology. Nintendo would thereby prevent illegal copies from flooding the market, avoiding the situation that had led to the 1984 crash and particularly to the failure of the Atari units, which had had no mechanism to prevent counterfeiting (Lowood). The security chip served a second purpose as well, though, that of quality control, which led to Nintendo's unique business strategy. Since only Nintendo had access to the security chip's code, no software company could manufacture games for the NES without Nintendo's approval, and Nintendo closely controlled which games it would license to be produced. The company would only license games that it deemed were of high enough quality. Nintendo's strict business practices allowed it to thereby become respected as having

high-quality games and, again, to avoid the situation that had engendered the 1984 crash (Sheff 161).

Nintendo's cartridge technology and licensing practices saved the home console market, but others in the industry were not pleased with the consequences. The security chip was known as the "lock-out chip" because it "also protected Nintendo's profit from every game sold that played on the NES--an estimated 700 yen, or \$5 per game developed by other companies" (Sheff 214), a fact that some considered to be indicative of monopolistic practices. Hiroshi Yamauchi, President of Nintendo, admitted that the chip was indeed intended both to prevent counterfeiting and to censor games, but he did not agree that it was monopolistic (Sheff 214, 247-50). Atari eventually took Nintendo to court over the issue, but the judge acquitted Nintendo, and Atari, deemed guilty of illegal procedures regarding the court case and already losing market dominance, was slowly absorbed into other companies (Lowood). The security chip became a basic element in all subsequent Nintendo cartridges and was at the foundation of the company's success.

Meanwhile, a man named Ken Kutaragi, who worked for Sony, was becoming more and more convinced that digital media, i.e. CD-ROMs, would soon overtake cartridges as the primary data storage units. However, at that time digital technology was rare in the consumer market, and the atmosphere at Sony was decidedly anti-digital. Kutaragi was remarkably far-sighted, though, as well as determined; Reiji Asakura quotes him as saying, "[t]he age of the computer is certain to come. To prepare for it, Sony must establish its own powerful digital technology and aim to move into the computer market" (qtd. in Asakura 15). Kutaragi recognized, though, that because of the anti-digital-media atmosphere of the company, the only way to convince Sony to embrace digital technology would be to use an outside force. An

admirer of the Famicom, Kutaragi decided to approach Nintendo about doing a joint project on a video game console that would combine Nintendo's second-generation console, the Super Famicom (the Super NES), with CD-ROMs, a proposal that Nintendo accepted. During negotiations between the two companies, "[t]he initial idea was to connect a CD player to the Super Famicom using an external digital interface, but the specifications were later changed to include a built-in CD-ROM drive" (Asakura 32) so that it would be more elegant and easier to use. The project, called the PlayStation, would have two ports, one for Super NES cartridges, the other for CD-ROMs. Eventually, the plans were changed again: Sony would produce the PlayStation, and Nintendo would design an adapter for a CD-ROM drive that would connect to the Super Famicom (Asakura 28-32).

At about the same time, Sega, a rival console company of Nintendo's, also began work on a console called Sega CD that would include a CD-ROM drive. CD-ROMs were not new to the computer industry, but they were just being introduced to the console industry, and many companies, Nintendo included, recognized their superiority over other formats. Their main advantage over cartridges was memory: CD-ROMs could hold about 320 times more memory than contemporary cartridges and could therefore contain digitized audio and video (Kent 451), elements that would make video games more realistic and more immersive.

Analysts were extremely enthusiastic about the potential impact of introducing CD-ROMs to the video game industry. Sheff recalls one analyst's words:

"CD-ROM's popularity will increase dramatically when Nintendo rolls out a CD-ROM-based game machine," the influential computer-industry columnist John C. Dvorak wrote in September 1991. The thinking was simple: Nintendo had in its clutches a huge number of savvy consumers, unafraid of technology, who could be expected to do whatever it took to get their hands on the hottest new games. Kids clamoring for a new super-powered Nintendo CD game would do much more for multimedia system sales than the most impressive multimedia encyclopedia. (377)

Dvorak also thought that Nintendo would help bring the prices of digital media down by creating an excited market. Nintendo was such a successful company that analysts expected it as a matter of course to take advantage of this new form of data storage and consequently to have a huge impact on the digital technology market.

But Nintendo started to realize the full implications of its 1989 contract with Sony to begin work on the PlayStation project. Nintendo had established its success on the basis of retaining every possible control over products and their licenses. Sheff candidly states that "By 1991 it [Nintendo's deal with Sony] was seen as a disaster, one that contradicted Nintendo's cardinal tenet of giving nothing away. Nintendo, which had predicated its business on complete control of its game software, had granted Sony the right to control (and profit from) all CD-based software that played on the Play Station" (379). So Nintendo signed a separate contract with the European company Philips N.V. to begin work on a different CD-ROM drive that would connect to the Super NES, which had been released earlier in 1991. Philips N.V. had pioneered its own CD format called CD-I (the "I" stands for "interactive"), and Philips was eager to popularize this new format as the format of all future Nintendo games. Under this new agreement, Nintendo would control all licensing rights to CD games, as it had with NES cartridge games (Sheff 378), unlike under the agreement with Sony. The deal, which was much more to Nintendo's advantage than its deal with Sony, effectively nullified the agreement with Sony without directly contradicting it.¹

¹ Nintendo was unwilling to openly break its agreement with Sony because Sony was the sole supplier of the sound chip for the Super NES, so Nintendo wanted to extract itself from the PlayStation deal without alienating Sony. Sony, for its part, decided not to use Nintendo's dependence on it as leverage because they recognized Nintendo's power to humiliate them in the market, as well as the huge advantage that having a Nintendo Super NES port on the PlayStation console would offer. Thus neither company wanted to risk an outright battle with the other (Sheff 380-2).

In 1991 Kutaragi, who was in charge of the PlayStation project on Sony's end and for whom the PlayStation was the realization of a longtime dream to see digital technology combine with home consoles, was on his way to Nintendo to discuss the project when he learned of Nintendo's new contract with Philips. He was stunned, but even more so when he found that some people at Sony had learned of the negotiations with Philips ahead of time yet had said nothing. These people were on Sony's CD-I team. Although Philips' CD-I team was their competitor, both companies' CD-I teams saw CD-ROM as the most pressing threat, and Kutaragi's joint project with Nintendo would bring the CD-ROM into consumer homes as the primary entertainment format, not CD-I. So Sony's CD-I team remained silent while Kutaragi's project became increasingly endangered, with Kutaragi unaware (Asakura 25, 27).

When, only a few days after Kutaragi became aware of Nintendo's actions, Nintendo announced at the 1991 Consumer Electronics Show in Chicago that it would be developing a CD-I drive with Philips, "[t]he shockwaves were felt throughout Japan, where the industry speculated about the implications of Hiroshi Yamauchi's stand, and the price Nintendo would pay for humiliating Sony" (Sheff 381). Everyone had expected an announcement to be made regarding the deal with Sony. Sony, for its part, had not learned of the Philips deal in time to do anything but accept the humiliation and make its announcement of the joint PlayStation project as planned. Nintendo's official statement said that it had aligned itself with Philips because of its superior CD technology, but Sony knew that control issues were at the heart of what they saw as Nintendo's betrayal. Nintendo's business practices were not the only causes of the industry's surprise, though: "[a]lso at issue was Nintendo's breach of the unwritten law of turning against a reigning Japanese company in favor of a foreign competitor" (Sheff 381). From a cultural position as well as a business one, Nintendo had made a huge affront to Sony.

Negotiations between Sony and Nintendo continued until 1992, when both agreed that although they would make separate systems, they would make their systems mutually compatible. But the delay allowed a number of other companies to enter the market as competition. In 1992 Sega released its Sega CD, but the console was very expensive (around \$300). Nevertheless, they beat Nintendo and Sony to the market for CD-ROM consoles, as did a number of smaller companies, such as SNK and NEC, that released units with various types of CD players. None of these smaller companies were very successful, though (Sheff 384, 386).

But even as the negotiations were concluded, many inside Sony were convinced that the company should never have entered the console industry and blamed Kutaragi for the failure of the deal. Kutaragi, for his part, became increasingly convinced that Sony should divorce itself entirely from Nintendo and begin work on a completely unique console, especially after learning that the deal with Philips had been a ploy anyway—Nintendo eventually stopped production of the Super NES CD-ROM drive entirely (Asakura 34-35). At a June 1992 meeting with Sony chairman Norio Ohga, Kutaragi convinced Sony's leaders that it would be possible to invent a gaming machine that would outstrip Nintendo's 16-bit system (the Super NES) if it detached itself from the idea of making a Nintendo-compatible machine (Asakura 37). Ohga was duly impressed; he remembers thinking, "This was no mere game machine, but a graphics computer. It is on a totally different level from Nintendo's game machines" (qtd. in Asakura 40). So Sony decided to continue with the PlayStation project entirely on its own, with Kutaragi in charge.

Even though Sony would not be the first company with a CD-ROM-based gaming console, none of the other consoles were very popular or influential. Kutaragi wanted Sony's system to revolutionize the video game industry and make the CD-ROM the primary data storage format for console games. Accordingly, his team made the sole presence of a CD-ROM drive

the focus and differentiating aspect of the console, which they decided to continue to call the PlayStation. In developing the physical appearance of the PlayStation, for example, designer Teiyu Gotoh wanted the main theme of his design "to reflect ... the CD-ROM format. He decided to model the game's primary shape on the CD-ROM idea. So he combined a square and a circle: he gave the machine a linear, square body and a round disk lid" (Asakura 173) (see Fig. 1).

The CD-ROM format gives a number of significant advantages over cartridges that Sony took advantage of in ways that its competitors did not, allowing the PlayStation to eventually become the most successful CD-ROM-based console. The most significant advantage is increased storage space: CDs can hold more than half a gigabyte, while cartridges at that time could only hold 8 or 10 megabytes. This increased storage space meant that CD-ROM games could contain digitized full-motion videos (FMVs), symphonic music, and real human voices, all of which would contribute to a more immersive game (Sheff 368-9). But early PlayStation games held an additional advantage over other CD-ROM-based games, especially PC ones:

the PlayStation required much smaller volumes of data than other CD-ROM formats like PC engines ... The data volume of Ridge Racer, Namco's first PlayStation game, is two megabytes. The total capacity of a CD-ROM is 650 megabytes ... Once the PlayStation has read the Ridge Racer program from the CD-ROM, it has no further use for the CD. Because there was so much excess storage capacity, the creators filled it up with music data. They even added a minigame that ran while Ridge Racer was loading so users did not notice how long the process took. The ability to enjoy the game while playing music became an unexpected selling point of Ridge Racer. ... Later on, game fanatics discovered that once the data were loaded they could continue playing the game after replacing the game CD with a music CD. (Asakura 79)

So CD-ROM games offer more storage in general, but the nature of the early PlayStation games themselves gave the CDs even more "extra" space than PC games—and certainly more than cartridge games.

Not only do CDs provide more storage, they do so at a much cheaper price. Cartridges cost \$12 to \$16 to manufacture, but CD-ROMs cost only \$1 to \$2—so cheap that a new PlayStation game could be sold for less than a used Nintendo cartridge. And again, this discrepancy had additional effects, since Sony could risk licensing small-audience games that would be financially impossible to market as cartridge games: "[w]hile no company would risk an investment in a Nintendo game about stamp collecting or an electronic version of canasta, many of them would if the cost of manufacturing were much lower. ... A new market would result: people who had never considered playing video games before" (Sheff 369). Of course, by licensing such games, Sony would be taking the risk that Nintendo strove so hard to avoid, that of flooding the market with mediocre games. But it was a risk Sony was willing to take (and that in retrospect proved highly successful). Sony thereby hoped to beat out its main competitor in a price war which Nintendo could not hope to dominate.

A third advantage of CD-ROMs that would play a larger role in second-generation consoles is backwards compatibility. Nintendo's cartridges were not backwards compatible, so games that the consumer had bought for the NES would not work on the Super NES. However, the PlayStation 2, Sony's current second generation console, runs on DVDs, which are more advanced forms of CD-ROMs and are therefore able to play the original PlayStation games. Andrew Rollings and Dave Morris recognize that "[t]he PlayStation 2 wouldn't be taken up so quickly if it weren't backwardly compatible with the old PlayStation" (Rollings and Morris 439), so backwards compatibility plays a large role in the success of a console. Also, the PlayStation could play audio CDs, just as the PlayStation 2 can play DVDs, another incentive for consumers.

But what allowed Sony to revolutionize the console industry and differentiate itself from companies like Sega was its unique manipulation of the marketing strategy for CD-ROM games.

Cartridges are extremely time-consuming to produce; while a batch of CDs can be pressed within a few days, cartridge manufacturers must be given about three months to allow for production.

As a result, repeat production, the manufacturing of more product according to demand, is effectively impossible for cartridge games. As the Senior Managing Director of Namco, Masaya Nakamura, said, "To ensure that mask ROM products [i.e. cartridges] would be on store shelves on the release date, we had to deliver the master copy to Nintendo three months in advance.

Taking end-of-year demand into account, production had to start in August. But how can you predict end-of-year demand accurately in August?" (qtd. in Asakura 94-5). So cartridge games were an extremely high-risk industry for game manufacturers and retailers; if they overestimated the number of games to produce or to buy as inventory, they would end up with excess that they could not sell, but if they underestimated the demand, they would not be able to manufacture more while demand was still high.

All CD-ROMs enable repeat production, of course, but Sony was the first to use this feature to revolutionize business strategies. First, they eliminated the \$5 risk fee that software houses had to pay to produce cartridge games, since they risked not being able to sell excess stock. Second, and more importantly, Sony was able to eliminate dealing with wholesalers and implemented a "purchase-for-resale" strategy: Sony itself would act as the distributor for the games, buying inventory from the software developers as demand required and selling directly to retailers. As the platform developer and now the "middleman," Sony could more accurately monitor supply-and-demand statistics than could ordinary distributors. All other companies were still basing their marketing strategies on Nintendo's model for cartridges, which involved overstocking wholesalers who then flooded the retailers with inventory or dumped unsold cartridges into the used-game market. Sony, on the other hand, took full advantage of repeat

production, devising a strategy that was more advantageous for both retailers and the software houses Sony needed to attract (Asakura 110-114). And, of course, eliminating the extensive manufacturing time for games meant the added bonus that software developers had more time to perfect their games (Asakura 103).

Kutaragi and his team had to deal with only two major worries that software companies had about the CD-ROM format. The first complaint was about load times: "CD-ROM games were already in existence for Sega's Megadrive and NEC's PC Engine, but they had extremely slow access speeds and were difficult to operate, and conventional wisdom had it that CD-ROM was unsuitable for video games" (Asakura 78). But, Kutaragi responded, these problems did not apply to the PlayStation because it was "an image-generation system, not a data-replay system. Once the data has been read from the CD, the image-generation engine works at full speed, quickly generating and synthesizing images one after another. This is where it's totally different from other game machines" (Asakura 78-9). So Kutaragi was able to quiet fears about the load times because the PlayStation, unlike other consoles, loaded sections of the game all at once, instead of continuously loading from the CD. The second concern was about durability, since CDs, as optical disks, expose the data side and can be rendered unreadable by dirty fingers, scratches, etc. Ohga wanted Kutaragi to put a plastic caddy as a cover on all of the disks, but Kutaragi argued that to do so would increase manufacturing cost and time, two areas where CDs held an advantage over cartridges. In the end, Kutaragi won, and as it turned out Sony did not receive a significant number of complaints about the PlayStation being unable to read disks (Asakura 166-9).

So for reasons of storage capacity, cost, compatibility, and marketing strategy, the advantages of CD-ROMs far surpass those of cartridges. They were obviously the medium of

the future, and Sony correctly guessed their potential: the PlayStation sold out on its first day, and continued to steal the market from both Sega and Nintendo. Imagine the industry's shock when Nintendo announced that its third-generation console, the Nintendo 64, would not run on CD-ROMs but on cartridges.

"The battle for dominance in the video games market took a new twist this month when Nintendo, one of the major Japanese players, said that it will continue to distribute games for its home players on cartridges because it has a secret weapon which will help it resist pressure to switch over to compact discs," wrote columnist Barry Fox in his July 16, 1994, article in *New Scientist*. By this time, most consoles used CDs and not cartridges. But, as Fox noted,

Howard Lincoln, chairman of Nintendo in the US, says that although CDs are a good way of storing lots of data cheaply, they suffer from slow access times which can spoil the game. This is because data on a CD is recorded as a continuous stream. The laser reading device must therefore first find where the required section is stored, then move over it and wait for the spinning disc to bring the start of the data block to the correct position. (Fox 22)

Cartridges, with their built-in ROM chips, have no such access times. Kathleen Morris gave the following analysis in her article "Nightmare in the Fun House," which appeared in the February 21, 1995 issue of *Financial Week*:

What makes Nintendo's platform so much cheaper than competing machines is the lack of a CD-ROM drive. Critics claim this is a great weakness. Everyone thinks the transition to CD-ROMs is inevitable because they can be manufactured much more quickly and inexpensively than cartridges. They also have much more memory, which allows developers to throw in movie and music clips. There is a problem, however. There is a difference in data-access speed of 1,000 times. To get around this, companies have had to build in lots of internal memory in the machines. But that is expensive. For software houses, it is cheaper to make CD games, but Nintendo says its cartridges will be priced the same as CDs and that for hot titles there will be plenty of margin for profit. (qtd. in Kent 510-511)

Nintendo also claimed that it had a new form of compression that would allow it to increase the storage capacity of cartridges, as well as several other noteworthy

technological advances. First, the Nintendo 64, with a "64-bit reduced instruction set computing processor running at 80 megahertz" (Fox 22) was as fast as the best contemporary desktop computers; it could transfer data from the cartridge to the console at a rate of 400 Mb/sec. And second, the Silicon graphics chip set in the new console

will enable Nintendo to store only key graphics images on the cartridge and rely on the Silicon Graphics processor to manipulate the images [in contrast to] existing cartridges that store a library of images of the game's characters, which the console processor selects one after another, blending them into jerky, crude animation ... The Nintendo 64 cartridge stores three-dimensional images of objects such as planes. These models are then loaded from the cartridge onto the console and the processors in the console then work on the models, to move and turn them in whatever way the game play requires. So the characters move more smoothly and realistically on screen. (Fox 22).

Nintendo's new cartridges were therefore more technologically advanced than those of previous generations, and Nintendo was confident that the cartridges could successfully compete with CD-ROMs in the market.

But cartridges had other advantages that Nintendo was no doubt aware of as well. First, cartridges had the flexibility to contain chips that performed functions other than game data storage. The original Zelda game for the NES was the first game to contain an internal battery, allowing the player to save games onto the cartridge (Kent 354). The battery in the cartridge revolutionized game play: games could be more complicated because they did not have to be beatable in one sitting. The PlayStation, to compensate, had to have memory cards, additional devices that saved a player's games, but these had to be bought separately from the CD-ROM game itself.² And several Super NES games, most notably Star Fox, contained chips such as the FX chip that added to the console's graphics capability; compare the pseudo-three-dimensional

² The Nintendo 64 also made use of memory cards, but they were never as popular or as widely used as the PlayStation equivalents; PlayStation depended on them as the only way to store saved games.

graphics of Star Fox with those of the more cartoon-like, two-dimensional Super Mario World (Fig. 2). However, these features were not very influential because the PlayStation offered equally effective alternatives.

The main feature of cartridges that Nintendo undoubtedly wanted to exploit was the same feature that had led to its success in the first place: its controllability. Nintendo was unwilling to give up the security chip that it included in each cartridge, which not only prevented counterfeiting but also allowed them to tightly control game licenses—and therefore revenues. In his article "Pirates Platform: Is the Cost of Computer Games Fueling a Criminal Counterculture," Fox notes, "Games software for the Nintendo 64, the main rival to the PlayStation, is more difficult to pirate because its games come on ROM chip cartridges" (Fox 16). CD-ROMs are easier to copy than cartridges in the first place, but the security chip made counterfeiting even more difficult. And, of course, only Nintendo had access to the cartridges' technology, so it was able to censor games just as before, not only to protect revenues but also to prevent the market from being flooded with poor-quality games. Nintendo was unable escape from this business mindset that had led to its success in the first place after the 1984 crash.

Reactions to the Nintendo 64 were mixed. Despite its arguably behind-the-times technology, it still sold well. However, Kent argues that "[d]ue to the cartridge format, there simply were not enough games for the new console, and many games that came out were expensive or small" (538). Others thought that the quality of Nintendo 64 games were far inferior to those of the PlayStation; according to *GameSpot VG* writer Jeff Gerstmann,

When played side-by-side, the PlayStation version [of *Mortal Kombat Trilogy*] makes the N64 version look like it's on a SNES. ... The music is typical of a non-CD game—that is to say, worthless. It's tinny and very electronic sounding. / *Mortal Kombat Trilogy* proves that the Nintendo 64 is merely mortal. While it surpasses the PlayStation version in regard to load time, it still suffers a three or

four second delay when loading a new character in multiplayer fighting.
(Gerstmann)

Perhaps most tellingly, an important game manufacturer, Square Soft, which had previously made games exclusively for Nintendo, left Nintendo for Sony in 1996. Hironobu Sakaguchi, creator of the immensely popular *Final Fantasy* series, said that Square Soft left because "Sony's CD-ROM format allowed for more artistic freedom" as well as cinematic cut scenes and symphonic music, essential elements of future *Final Fantasy* games (Kent 542). In fact, many developers resented Nintendo's decision to continue using cartridges because of their limitations and their cost (Kent 511).

Nintendo remains, however, one of the most respected console manufacturers in the industry today. Their decision to continue with cartridge-based games for the Nintendo 64 even though CD-ROMs possessed numerous obvious advantages reflects how the company became mired in a certain business strategy that prevented them from keeping abreast of technological developments. Sony, on the other hand, and particularly Kutaragi, revolutionized the industry by taking a risk and sacrificing a certain amount of control over its products that Nintendo was unwilling to give up. The PlayStation did not just revolutionize an industry, however; it also played a huge role in the spread of CD-ROMs and digital media as an acceptable format (Asakura 229). Cartridges were history.

Did Nintendo make a mistake in constructing the Nintendo 64 to run on cartridges? Perhaps, since it did lose much of its dominance in the video games market. But it did not lose all of it, and the success of a console depends heavily on a number of other factors, including the technical specifications of the console hardware and the quality of the games produced for the system. With its next-generation console, GameCube, Nintendo seems determined to maintain many of the same business ideals that it has always held. The GameCube's main rivals, the

PlayStation 2 and Microsoft's Xbox, both run on DVDs, the latest advancement in digital technology, which can store about 7 times as much information as CDs (Rojas 140). Like the original PlayStation, both of these consoles are not only gaming consoles, but they can play DVD movies as well. With the GameCube, Nintendo has finally abandoned cartridges and embraced DVD format as well. However, the GameCube uses 2.9-inch mini DVDs, not the standard DVDs of the PlayStation 2 and the Xbox; as physically smaller discs, they again cannot hold as much data as their competitors' full-sized ones. By not using a standard format, Nintendo could once again be attempting to control counterfeiting and game licenses. But they could also be making a statement about where *they* think the future of home entertainment lies, since they have made the decision that "[u]nlike Xbox and PlayStation 2, GameCube would be a dedicated game machine with no ambitions of playing DVD movies" (Kent 584). Nintendo apparently does not think that the future of home entertainment will revolve around a single, multi-purpose machine, and it wants to distinguish their system as solely devoted to games. Will Nintendo's prediction prove true? Or will the business strategy and ultimate control that led to its original success in the 1980s lead to its demise?



Fig. 1: Sony PlayStation, with its emphasis on the CD drive (*Sony PlayStation*)



Fig. 2: Screenshots of Star Fox, left, with the FX chip, and Super Mario World, right, without it (*Ndex* and *Super Mario 128 Central* respectively)

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