SCORING VIDEO GAMES' standard CONTRIBUTIONS

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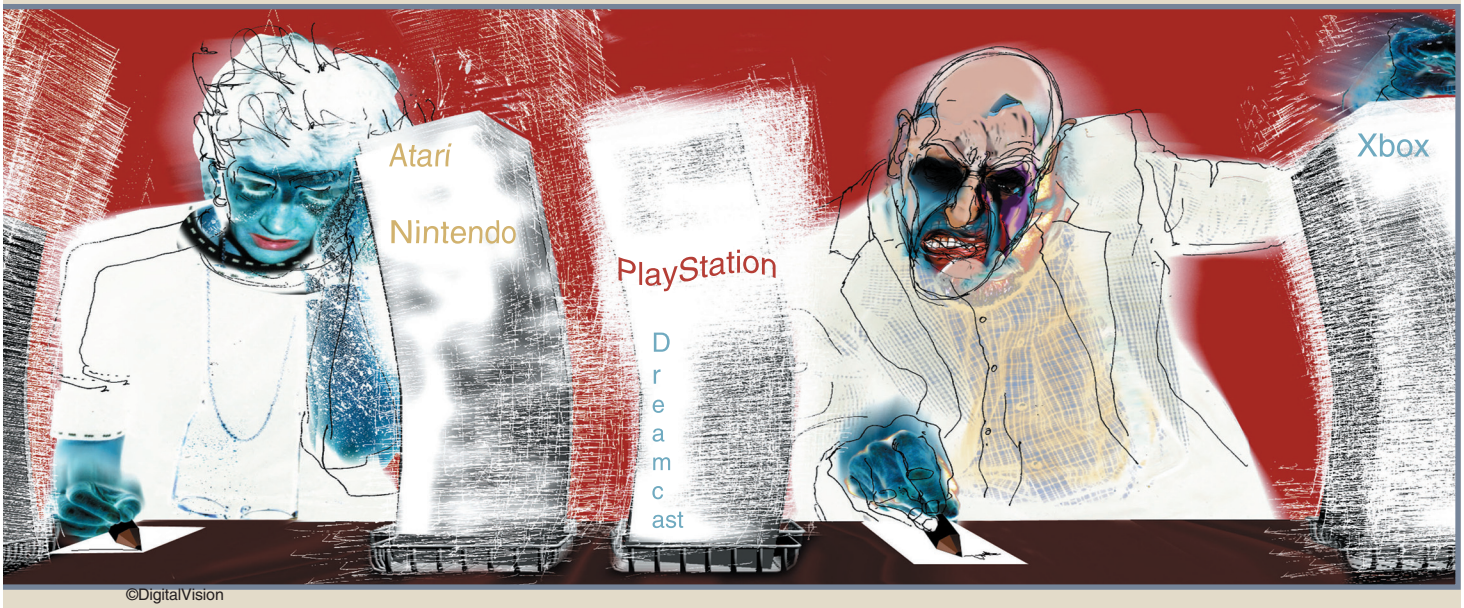


In many markets the decisions of some consumers can affect the utility other consumers receive from a product. These so-called network externalities are common in markets where products need to be connected together into a network (e.g., a telephone) or ancillary products are needed to fully benefit from a good (e.g., compact disks for a CD player). In these types of markets standards are needed to aid both consumers and producers. Interestingly, in these markets where network externalities are present the basis for competition between firms changes. Based on early work by economists J. Farrell and G. Saloner, this is because—with network externalities—market share itself becomes a potentially valuable resource for firms.

Traditional strategic frameworks explain discrepancies in levels of firm performance as an interaction between the external environment (e.g., industrial forces) and the resources and capabilities that are developed and deployed by firms. Competition in standard based industries does not overturn existing frameworks. However, since the existing installed base of products is a potential competitive advantage, firms now have greater motivation to compete for market share. (Note: Generally, firms should compete for profits rather than market share.) Therefore, strategy concepts that center around developing market share and mass acceptance of products, such as economies of scale, first mover advantage, and technological innovation, feature greater prominence in the analysis of these industries than they do for others.

The study presents a historical analysis of the US home video game industry to explore what roles these strategic issues play in a standard-based industry. Also, we try to understand how they might be different from competing in traditional manufacturing industries. In particular, we focus on technological innovations, switching costs, installed base, and complementary products as determinants of *de facto* standards and firm success in the US home video game industry. We then attempt to draw a comprehensive conceptual model that explains firm success in a network-based industry.

The US home video game market is an important example of a standard based industry because customers purchase or rent software to use with their console. The need to interface between software and hardware in this industry thus creates a need for an

industry standard to lower transaction costs and avoid confusion for consumers. The home video game market is a significant sector of the home electronics industry with 2002 sales of $10.3 billion in the US according to data from the NPD group. In addition, this industry is also of potential interest to scholars because it presents a dynamic and intensely competitive environment for firms. Since the first emergence of a dominant design based on a cartridge system in 1976 there have been at least five stages of technological innovations based on video graphics capability. A sixth round of innovation is presently underway pitting industry heavyweight Sony's PlayStation 2 against U.S. software giant Microsoft's Xbox, and long time industry stalwart Nintendo's GameCube. Even more remarkable is that there have been dramatic changes of market leadership along with these waves of technological innovation.

This frequent change of market leadership stands in stark contrast to changes in other recently emergent industries, such as the personal computer industry. For example, the personal computer industry saw the rapid imposition of standards upon IBM's entry in 1981 and has strong backward compatibility; the introduction of Pentium chips or Windows 95 did not preclude the use of software that had been written for DOS on the new machines. In contrast, backward compatibility has been rare in the home video game industry. Each generation has effectively "reset the clock" of competition between firms. Therefore, firms in the home video game industry fought what could be viewed as a full-blown standards war about every five years.

key STANDARD STRATEGIES

When competing in standard-based industries, managers cannot check all the extant precepts of strategic management at the door such as core competencies, aligning on a business level strategy, and competing in attractive industries. While the full array of relevant variables for competition in these industries remain open for discussion, this study focuses on three issues directly related to standards and innovation:

1) The role of the dominant design, a single architecture that embodies all of the key features and elements of a product;

2) The role of customer switching costs, which are the costs incurred by customers and rival suppliers for moving between standards;

3) The important role of installed base, the current number of adherents to a standard.

As we focus on these aspects specific to standard-based industries, we'll attempt to address three important theoretical issues. First, what are the roles of standards versus traditional sources of competitive advantage to establish market leadership in network-based industries? Second, what are the economic and competitive processes in traditional versus standards competition? Finally, what are the direct sources of success in establishing an industry standard in a network-based industry, i.e., superior technology, switching costs, installed base, backward compatibility, or complementary products?

1) *Dominant designs*: While definitions vary slightly, there is considerable consensus in the innovation literature that product designs (or production processes) in markets enter periods of punctuated equilibrium referred to as dominant designs. Henderson and Clark have offered one of the best definitions of a dominant design as the product architecture that embodies all the primary characteristics of later products. For example, a typewriter that allows the typing of upper and lower case letters that can be seen as they are typed is a dominant design. All typewriters that followed, even if from different makers, had those features. The emergence of the initial dominant design is usually what allows a well-defined market to take shape. A study of the US personal computer industry showed that adopting the dominant design was important once it had emerged, but there was little performance difference between firms that developed the dominant design and those that quickly adopted it. We will define a dominant design as the aspects of the video game consoles that are technically distinguishable to consumers, such as storage media and interface.

However, even after a dominant design emerges, technical improvement of products and/or production processes continues. Early views were that it is generally difficult for incumbents to survive shifts in the underlying technologies of their industry. Later models recognized that these innovative processes could be either competence enhancing or competence destroying for firms. It is generally assumed that the emergence of a dominant design depends on the nature and extent of technological innovation in an industry.

2) *Switching costs*: Switching costs are costs customers incur moving from one product to another. Once a dominant design emerges creating switching costs becomes a central feature of competition in standard based industries according to C. Shapiro and H.R. Varian. Switching costs are facilitated and mutually reinforced by two things: complementary products and network effects. Complementary products are simply those products that are needed to maximize the utility of the core product. Complementary products can be physical, e.g., razor blades for razors, or intangible, e.g., touch typing skills for QWERTY keyboard layouts. Since investments by consumers in either kind raises their switching costs, the provision of these complements is critical for firms competing in standard based industries.

Switching costs can also arise out of the need for interconnectedness (i.e., network effects, for example the telephone network) where customers become relatively more "locked in" to a standard as more customers are likely to spend on these complements. Therefore, in order to enter a standard based industry, a competitor must offer a product that is significantly more technologically advanced than existing products.

3) *Installed base*: Once customers start to incur switching costs, then (and only then) the installed base

of existing users starts to become a valuable resource for firms. Installed base is the existing number of users of a product. Therefore, the most direct way to build a firm's installed base is to be an early seller in a market. Early entry into a market often provides a lasting source of competitive advantage if the entrant can preempt assets, control technological leadership, or create customer-switching costs. The preemption of assets refers to the benefits a firm gains by accessing valuable resources before their value is known, e.g., a corner location on a highway that is about to be expanded. Technological leadership could result from legal protections like patents or learning based cost advantages. Empirical findings, however, have been mixed about first mover advantage, with many cases of first mover failures. However, this may not be as true for standard based industries. Contrary to many other markets, in a standard-based industry market share, i.e. installed base, is in and of itself a preempted asset. This suggests that there are strategic opportunities, such as penetration pricing and investing in complements, along with entry order that determine a firm's installed base, and in turn, offer it a competitive advantage. In standard based industries, the management of expectations of future installed base, such as pre-announcement of new product development, is also described as a useful strategy for firms.

4) *de Facto standards/tipping*: If a firm selects the eventual dominant design, exploits network effects by building switching costs, and increases its installed base and complementary products, it has a good chance to set a standard in an industry. Standards can be either formal or *de facto*. Formal standards are usually set through negotiations between most, if not all, of the potential vendors of a technology. A good example of this is the U.S. color television broadcast standards. However, of more interest here are *de facto* standards that emerge through market competition. *De facto* standards arise simply as a result of consumer choice.

As described by M. A. Cusumano et al., the triumph of Matsushita's video home system (VHS) format over Sony's Betamax format is a classic example of a *de facto* standard. Matsushita's victory has been attributed to having complementary products, such as videotape rentals, and being able to ramp up production to build its installed base. This success led to the rapid disappearance of Sony's Betamax as the installed base of VHS format VCRs quickly expanded.

The tendency for markets to pick one standard over the other is referred to as tipping. Tipping often causes the "orphaning" of earlier standards as late adopters choose a dominant platform that becomes incompatible with the earlier one. As a result, vendors of complementary products stop supporting the earlier standard. Once a standard is adopted, competition between firms moves from between standards (e.g., Mac versus PC) to a battle within them (e.g., Compaq versus Dell). Continuing our VCR example, competition in this industry turned into a more conventional within standards rivalry as Sony began to produce VHS devices.

de Facto versus de Jure standards

Network effects exist in many industries. However, standards are often arrived at through negotiation rather than through competition in the market. Examples of these negotiated standards include color and high definition television broadcast standards and multi-media compression standards (e.g. MPEG-3). Generally most industry standards are arrived at this way.

However, what gets people excited are the potential returns for *de facto* standards that are set through the market. While this is a risky approach because competing standards make consumers reluctant to purchase any product, it can result in tremendous returns for a company. Bill Gates and Microsoft are often held up as the example of the wealth that can be harvested by setting a *de facto* standard. Unfortunately, as the history of video games shows, while setting a *de facto* standard is hard, profiting from it is even harder.—*SG*

METHOD

Our historical analysis of the US video game industry attempts to illustrate characteristics surrounding dominant designs, switching costs and installed base for each generation of technological change. As a result, we hope to identify the drivers of success. However, a historical analysis presents an important methodological challenge—how can the reader be assured that we are not cherry picking the history of the market while at the same time not being bored with a complete recitation of it? This is not a new problem and has been recognized most eloquently by Miles and Huberman, "We do not really see how the researcher got from 3600 pages of field notes to the final conclusions . . ."

Our approach for this difficult problem is as follows. First, we attempt to limit our discussion of the industry to only its most dramatic events focusing on the issues surrounding dominant designs, creation of switching costs and building an installed base. Second, since we are limiting ourselves to a historical study, our sources, books, newspaper articles, annual reports, etc., are publicly available and accessible. Third, we make every effort to aid the reader's interpretation of our analysis through the use of tables that highlight differences in the key aspects of this industry across generations. Finally, by examining this dynamic industry we are able to see if patterns repeat across generations or remain stable. This allows for a limited amount of rigor to be applied since we must be consistent in applying our constructs and expected patterns across generations.

industry OVERVIEW

The emergence of the home video game market is attributed to the introduction and reduction in cost of two technologies: the transistor and the microprocessor. Pioneers in these two fields, especially microprocessors, sought applications for their remarkable new products. Two companies, Magnavox (in the home) and Atari (in the video arcade), quickly adopt-

ed the promise of these new technologies to invent the electronic video game as a new form of entertainment. However, the first home systems could play only a limited number of games that were hardwired into consoles. In 1976, Fairchild introduced a central console with removable cartridges. This architecture, i.e., a console with software cartridges, coupled with the consumer's TV became the first dominant design. This is where our historical analysis of the video game industry begins.

There have been five distinct generations in the evolution of home video game consoles with a sixth generation underway as we write. Although each generation has unique aspects, there are a few general themes in the home video game market that are consistent across generations.

a) Profit margins on software, historically cartridges, but more recently CD-ROMs, have been higher than on the hardware, i.e., game consoles.

b) All hardware companies, with one exception (3DO), produced their own software titles. These inhouse titles were supplemented by varying numbers of third party software developers.

c) There has been a correlation between popular arcade hits, such as Pac-Man, Donkey Kong, and Mortal Kombat, and successful home versions of the same games, making both creating and licensing these games valuable. Some especially popular games, e.g. Asteroids, could be classified as what R.X. Cringely calls a "killer application," software so desirable that it motivated consumers to buy not only the game but a compatible hardware platform as well.

d) Starting with the third generation, most video game players were first introduced in Japan about a year earlier than in the US market. However, success in Japan does not appear to have influenced the outcome in the US market. For example, NEC had tremendous success in Japan with its Turbo Grafix-16 but it failed in the US.

e) Especially during the later generations, new systems were announced long before they became available in the market. For example, the Nintendo-64 was announced in August 1993 for shipment in the fourth quarter of 1995, but didn't appear on the market until the fourth quarter of 1996 (*Business Week*).

f) Since they are popular Christmas presents, most sales of home video games in the US occur in November and December. Accordingly, introduction of new products occurs mostly during the fourth quarter of the year.

Table 1 summarizes the six generations of video game technologies according to rival platforms and their respective manufacturers, introduction date, and graphics processing power (CPU, bits and ROM). The difference between generations of platforms in graphics capability is exponential (i.e., a minimum of 100% improvement between generations) and they are similar in magnitude to technological discontinuities that have been identified in other studies. The first platform (core hardware product and associated software) and manufacturer listed in each generation indicates the first mover of that generation. The platform in red indicates the most popular platform in each generation. However, the most popular platform did not always embody a new dominant design. These are indicated with a superscript (^{DD}).

Table 1 Technological evolution in the US home video game industry

Generation (time period)	Rival platforms (manufacturers)	Introduction date	Operating performance CPU	Bit	ROM
1st generation (1976-1982)	Channel F^{DD} (Fairchild)*	Aug. 1976	2 MHz	8	
	VCS**^{DD} (Atari)	Oct. 1977	1.19MHz	8	4K
	Studio II (RCA)	Jan. 1977		8	2K
	Odyssey2 (Magnavox	1978	1.78	8	
	Gamevision (Texas Instruments)	—	—	—	—
	Home Arcade (Bally)	Feb. 1978	3.58MHz	8	
2nd generation (1980-1984)	Intellivision (Mattel)*	1980	.87MHz	16	16K
	Atari 5200 (Atari)	1982	1.79MHz	8	
	Colecovision**(Coleco)	Sep. 1982	3.58MHz	8	8-32K
	Arcadia 2001 (Emerson)	1982	3.58MHz	8	8K
3rd generation (1986-1990)	NES**(Nintendo)*	Oct. 1985	1.79MHz	8	24-32K
	Master System (Sega)	Jun. 1986	3.6MHz	8	32-131K
	Atari 7800 (Atari)	Jun. 1986	1.79MHz	8	52K
4th generation (1989-1996)	Sega Genesis**(Sega)*	Aug. 1989	7.6MHz	16	64K
	Turbo Grafix 16 (NEC)	Sep. 1991	3.6MHz	8/16	250K
	Super NES (Nintendo)	Sep. 1991	3.58MHz	16	
5th generation (1995-present)	Interactive Multiplayer (3DO)*	Oct. 1993	12.5MHz	32	660Mb
	Jaguar (Atari)	Oct. 1993	26.6MHz	32	660Mb
	Saturn (Sega)	May 1995	28MHz	32	660Mb
	PlayStation**^{DD} (Sony)	Sep. 1995	33.9MHz	32	660Mb
	Nintendo 64 (Nintendo)	Oct. 1996	93.75MHz	64	100Mb
6th generation (1999-present)	Dreamcast (Sega)*	Sep. 1999	200MHz	128	1.1Gb
	PlayStation 2 (Sony)	Oct. 2000	294MHz	128	5.6Gb
	GameCube (Nintendo)	Nov. 2001	485MHz	128	1.5Gb
	Xbox (Microsoft)	Nov. 2001	733MHz	128	5.6Gb

* indicates the first mover
** indicates the most popular platform

^{DD} indicates early adapter and dominant design.

This generation summary shows the technological change that reoccurs every four to five years, creating a constantly evolving and dynamic industry. Time period indicates the period from the first introduction of a system to its final phase-out in a generation. Therefore, the periods are not consecutive and sometimes overlap across generations; for example, the second-generation Intellivision was introduced when the sales of the first generation VCS were booming. In addition, there are also gaps, e.g., 1985, due to negligible industry activity.

the ATARI YEARS

1st & 2nd generations

Table 2 Market shares for hardware and VCS software in 1982*

Company	Hardware share	VCS cartridge share
Atari	2600 System (VCS) - 58 % 5200 System - 6%	58%
Coleco	Colecovision - 17%	9%
Mattel	Intellivision - 8 %	N/A
Imagic	N/A	5 %
Activision	N/A	20%
Others	11 %	8%

*Market shares are in units.
Sources: S. Cohen, *Zap! The Rise and Fall of Atari.* New York: McGraw-Hill, 1984; B. Marich, "Cartridge share plummets; can Atari recover?," *Advert. Age*, p.3, Feb 7, '83

Table 3
Changes in retail prices of video game systems and home computers

Manufacturer	Model	Price (USD) 1 Jan. 1983	Price (USD) 31 May 1983	Price change
Video Games				
Atari	VCS/2600	$139.00	$99.00	29%
Coleco	ColecoVision	$199.00	$139.95	30%
Mattel	Intellivision	$199.00	$139.95	30%
Home computers				
Atari	Model 400	$299.00	$79.95	73%
Commodore	VIC-20	$199.95	$99.00	50%
Commodore	Commodore 64	$595.00	$289.00	51%
Tandy	TRS-80 Color	$299.00	$199.00	33%
Texas Inst.	TI 99 4A	$350.00	$99.00	72%
Timex	TS-1000-Sinclair	$69.95	$45.00	36%

Sources: Anonymous, "Keeping home computer owners turned on," *Business Week,* pp. 109-110, June 13, 1983; J. P, Forkan, "Licensing bounty awaits arcade game winners," *Advertising Age*, p. 36, Apr. 11, 1983.

The first generation of cartridge-based home video games was an outgrowth of the first commercially successful coin-operated video game, Pong introduced by Atari in 1972. Pong was based on Magnavox's home table tennis video game. Pong became wildly popular and widely copied by hosts of other small companies. Atari had trouble meeting demand for Pong and is credited by author S. Cohen with only producing 10% of the 100,000 "Pong-type" games produced in the industry. Magnavox's home version of "Pong" also became very popular and encouraged many companies to introduce similar products.

However, consumers soon got tired of these simplistic games and desired more variety. In late 1976, Fairchild Instrument and Camera introduced the Channel F game system to meet this market opportunity. This system used replaceable cartridges, which offered consumers a theoretically inexhaustible variety of games.

Atari quickly followed with a cartridge-based system of its own, called the Video Computer System (VCS, later renamed the 2600). Learning from its Pong experience, Atari wanted to make sure that it could produce enough VCSs to meet demand. Therefore, it sought a partner with significant financial resources and found one in Warner Communications. Warner bought Atari for $28 million in 1976. With a capital infusion from Warner, Atari built 400,000 VCSs to fully meet the *expected* demand for Christmas in 1977. However, the expected Christmas orders for home video games did not occur, and Atari was stuck with its inventory. Fairchild, also reeling from a tremendous drop in digital watch prices, exited the market.

The transition year in home video game market was 1978. Atari built on an earlier supplier relationship of its "Home Pong" game with Sears to sell its VCS under the Sears name, "Telegames," while focusing primarily on the coin-operated arcade side of its business. This resulted in better sales in the fourth quarter of 1978 and, along with increased marketing, considerable hope for its VCS in 1979. Magnavox also adopted the dominant design when it introduced its own cartridge-based Odessy 2 (called Odyssey Two) system.

Licensed by Midway from Tatio, Space Invaders arrived from Japan in late 1978 as the first major arcade game hit since Pong. Space Invaders is credited with starting the video game craze in the US. In 1979, Atari purchased a license for a home version of Space Invaders and developed a home version of its own popular Asteroids arcade game. On the strength of these titles, Atari's VCS sales exploded. It easily became the most popular home video game platform and historian L. Herman credits it with an 80% - 90% market share between 1979 and 1981.

Since Atari produced both arcade and home video games, its economies of scope allowed it

to preempt rivals, such as Magnavox, from obtaining successful game designs that had been proven in the video arcades. Atari's influence over these key complementary products allowed it to dominate in the hardware market.

Atari's dominance with VCS began to slip as the market competition shifted to the software business. In 1980, Activision was started by four former Atari programmers to make VCS compatible cartridges wrote Herman. Making a cartridge cost about $5 (USD) while its retail price ranged from $20 to $30 (USD)(*Business Week*). Given these economics, it is no surprise that Activision, with start-up capital of less than $1 million, was able to generate over $50 million in revenue within 18 months. While Atari sued Activision, other companies started to monitor the VCS cartridge market carefully. While the provision of these additional complementary products did add to Atari's VCS appeal, they cut into Atari's much more profitable cartridge sales.

The entry of the first second-generation system, Mattel's Intellivision, also came in 1980. Coming from a well-known toy company, the Intellivision's sound and graphics were clearly superior to the VCS. However, without the power of any big name arcade hit cartridges, such as Space Invaders or Asteroids, sales of the Intellivision never approached those of Atari's VCS.

The next two years show how rapidly things could change in this market. The pinnacle year for Atari was 1981. In fact, its main problem was keeping up with the demand for its VCS and related games. However, 1982 was the beginning of the end for Atari in the home video game industry for two reasons. First, another toy maker, Coleco, entered the market in early 1982 with its own second-generation system called the Colecovision. Unlike Mattel, Coleco had licensed a hit arcade game called Donkey Kong from a Japanese playing card, toy and video game company named Nintendo. A copy of Donkey Kong was included with every Colecovision.

(Note: This was standard practice. The included game was referred to as a "pack-in." Atari bundled Combat! with the VCS and Pac-Man with the 2600 and its own second-generation 5200 system.)

Coleco also marketed an adapter that allowed the Colecovision to play Atari's VCS games. While adapter sales were never brisk, its availability helped nullify the VCS' advantage of having a larger software library. By buying a Colecovision, consumers could theoretically have the best of both worlds. In addition, Coleco was very serious about winning the license deals that Atari had historically had to itself. Arnold Greenberg, president of Coleco, was quoted saying, "we will pay whatever we have to pay." This focus on complementary products paid off. Colecovision was an instant hit, grabbing 17% of the hardware market, compared to only 8% for the Intellivision introduced in 1980, or 6% for the more recently introduced Atari 5200. Table 2 gives market shares in unit volume for competing hardware systems in 1982.

Atari's second problem is also shown in Table 2. By 1982, serious competition had emerged in VCS software. Having set the *de facto* standard, Atari was now facing within-standard competition in the lucrative software market. Bensen and Farrell refer this type of challenge to a *de facto* standard holder as "pesky little brother."

Atari opened the floodgates for this type of competition when it settled its suit against Activision in early 1982 and allowed firms to produce VCS cartridges in exchange for small licensing fees. With the legal threat gone, Herman counts 28 companies who eventually entered the market for Atari's VCS cartridges. The strongest of these new entrants was another company of ex-Atari programmers called Imagic, whose colorful and action oriented games grabbed 5% of the VCS compatible market. Adding software injury to hardware insult, Coleco's Donkey Kong grabbed 9% of the software VCS software market. All this emerging competition cut into sales of Atari's products and caused distributors to renege on their earlier orders, leading to an inventory crisis for Atari.

1983 was a bust year for the video game industry. Of special concern to Atari was its large inventory after significant portions of the 1982 orders were returned. However, of considerable concern to all participants was the meltdown in the home computer industry. Texas Instruments precipitated this meltdown when it dumped its entire inventory, equivalent to 9% of the market, of the ill-fated 99/4A home computer. Massive price-cutting ensued, which erased the $100-$200 price premium for home computers over home video game systems. As a result, consumers did not trade up from a 2600 to a 5200 or a Colecovision as expected; instead, they bought a home computer. Table 3 shows the price change between 1 January and 31 May 1983.

This combination of new entry and substitutes in the video game industry led to tremendous industry-wide losses and the exit of several major competitors. While unit sales in 1983 remained flat, Atari suffered a 50% reduction in revenue and an operating loss of $539 million due to the intense price-cutting. By 1984, industry losses had totaled up to $3 billion (USD) according to E. Wojahn and firms were rapidly exiting the market. Mattel, whose losses over six

The real first Video Game

While Pong is credited with being the first commercially successful video game, it was not even the first video game introduced by Nolan Bushnell. As Herman recounts in his book, *Phoenix: The Fall and Rise of Video Games*, the first arcade video game was called Computer Space and was based on a mainframe computer game called Spacewar. (A different game *Space Wars* was a later arcade title.) Spacewar was a shootout game where two players flew spaceships around a sun and shot missiles at each other. Bushnell took Spacewar, tweaked it, renamed it Computer Space and sold it to a company called Nutting Associates. The game was set in a very futuristic looking cabinet that was itself a work of art that can be glimpsed in the background of movies such as *Jaws* and *Soylent Green*. Unfortunately, the game with its rotate, thrust, and fire buttons was too complicated for game players who were used to pinball games. It was the desire for a simpler game that motivated Bushnell to introduce Pong. Ironically, today's games feature complex controller layouts and often "secret moves" that must be discovered by the players.—*SG*

months had eliminated the entire net worth of the company, exited the market in July 1983. In May 1984, Atari was split into two parts and sold by Warner to Jack Tramiel (Atari Corporation) and Namco (Atari Games), a Japanese coin-op video game maker.

This closes out the first two generations of the home video game market in the US. Despite its early successes, Atari Corporation was now a minor player. Coleco, which had sold a majority of the second-generation type systems, had exited the market by the end of 1984, along with most of the smaller software companies.

At first blush the story of the first two generations of this market may appear to be a classic Porter's five forces case of entry and substitutes. (Note: Porter's five forces framework is based on industrial organization economics and models the profitability of an industry based on the relative threats of buyers, suppliers, substitutes, entry and rivalry.) However, there are several other competitive issues present. Consistent with innovation theory, Atari was a successful early adopter of the dominant design. Due to the capital infusion from Warner, Atari was able to remain in the industry and exploit traditional first mover advantages. It could preempt assets, such as programmers and game ideas, and had little competition for arcade licenses (e.g., Space Invaders, Pac-Man) that were critical for success in the home video game market. However, new entrants eroded this advantage by bidding up these costs. Atari had legally protected technological leadership until its settlement with Activision opened up its profitable cartridge market. This reduced its control over complementary products. Atari's VCS set the standard for third-party complementary products and had an installed base of over 65% of all consoles sold by the end of this period. Therefore, Atari's experience illustrates that setting the standard and building an installed base alone does not always result in a sustained competitive advantage for firms.

the 3rd generation RISE of NINTENDO

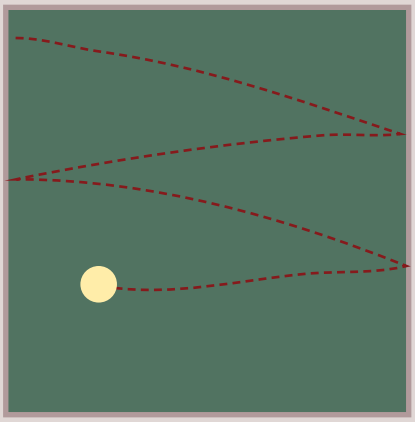
Despite the collapse of the US market, 1986 saw the nationwide rollout of the Nintendo Entertainment System (NES). The NES had more realistic graphics than the earlier systems and had been a great success in Japan. More importantly, Nintendo took a much more rationalized approach to the market than the earlier US firms had taken.

Unlike Atari's VCS, the NES was designed from the outset to ensure Nintendo could control its complementary products. First, Nintendo produced cartridges for the NES that contained a “lock out” chip which prevented unauthorized licensees from making NES compatible cartridges writes L. Herman.

Second, Nintendo limited the number of licensees that could create games for its system to 16 firms, of which four were US-based. In addition, although it had licensees, Nintendo maintained its own inhouse programming ability and routinely obtained licensing rights to the most current arcade coin-operated titles. For example, Nintendo bundled Super Mario Broth-

PONG

Around 1951, while fairly new at Loral Electronics, Ralph H. Baer, an engineer suggested the idea of a TV on which a viewer could also play games. His bosses turned down the concept. But in 1966, while now working for a military contractor, Sanders Associates, he wrote a proposal entitled, “Conceptual, TV Gaming Display.” Baer pictured a gaming system that would work on any TV. Using simple controllers, the viewer could play action games, board games, sports games chase games and such.



According to Ralph Baer, after an unofficial effort, he decided to demonstrate the concept to the company’s Corporate Director of Research. The Director liked the idea enough (even though Baer’s division worked on complex military electronic systems) to provide some official R&D funding. Baer states, “By the 11th of November of 1967, we had a functional Ping-Pong game. It was far more interesting than the old chase games....That hardware development job eventually grew into the “Brown Box, the prototype for Magnavox’s 1972 Odyssey game.”

Nolan Bushnell, later President of Atari, attended a demonstration at the Airport Marine in Burlingame, California. Bushnell “put Alan Alcorn to work on a coin-operated ping-pong game: PONG,” writes Baer.

“As everyone knows, PONG became a great hit in bars and arcades starting in the summer of 1972. Nolan Bushnell can clearly be credited with starting the Arcade Video Game Industry. There is also no doubt that Magnavox’s Odyssey game sales profited from the Public’s exposure to PONG. Many people bought an Odyssey game just so that they could have something resembling the “PONG experience” at home....And so, both home TV games and Arcade video games were off-and-running!” concludes Baer. <www.ralphbaer.com/how

ers, a game based on characters from its earlier arcade hit Donkey Kong, with the NES.

Third, Nintendo insisted on exclusive deals from the software makers; anyone who received a Nintendo license for a game would be prohibited from making the game available on any other competing systems for two years. This discouraged the emergence of rival networks and allowed Nintendo a limited form of monopoly power. Additionally, a licensee was limited to producing only five game titles per year, which prevented companies from flooding the market with "copy-cat" games and insured they released only what they thought were their best games. These actions stood in stark contrast to Atari in late 1983, which allowed an unlimited number of licensees to produce an unlimited number of titles in exchange for a small fee.

Finally, while Nintendo manufactured all the cartridges for the NES, it was incumbent on the licensee to sell them. This reduced Nintendo's risk of a game being a flop and being returned by retailers as had happened to Atari. These restrictions allowed Nintendo to strongly ration and control what had been a wide open market. Licensees were agreeable to these terms because, at that moment, they had no other outlet for their games. Therefore, this highly restrictive licensing system made it possible for Nintendo to preempt programming resources and tightly control complementary products.

Nintendo's plan worked flawlessly and the NES became wildly popular. US sales increased from 1.5 million units in 1986 to 9 million units in 1989. In addition, intentional or not, popular cartridges were often in short supply. These shortages further added to the "craze" nature of the business. It is unclear if the shortages actually increased demand and sales of Nintendo cartridges, but it certainly increased awareness of the NES and frustrated its distributors and retailers. In addition, Nintendo broadened its name awareness using a wide range of marketing channels. These venues included a breakfast cereal, Saturday morning Mario cartoons, a feature length movie called *The Wizard*, and *Nintendo Power*, which became the largest circulation teenage magazine in the US.

Nintendo's two main competitors during this time were the Atari Company and Sega. The now independent and weakened Atari Company attempted to cash in on the new craze with its 7800 system introduced in May 1986. However, the 7800 never really caught on despite Atari's purchase of Federated Superstores, an electronics chain, to carry Atari's products. The Atari 7800, unlike most other consoles before or since, was also backward compatible with the earlier VCS games. However, since they were so dated and offered relatively poor graphics quality, this was not as strong a selling point as it would have been for a second-generation machine.

Sega had a system, similar to the NES, called the Master System. Unfortunately, Sega suffered from two main problems. First, like Atari's 7800, most of the best potential home video game titles were now in exclusive deals with Nintendo. Second, Sega had trouble accessing the distribution network; even a distribution contract with the Tonka Company could not fully overcome this problem. Relative sales figures show the discrepancy in the market: in 1986, while Atari and Sega sold 100,000 7800s and 125,000 Master Systems, respectively; Nintendo sold over one million NES consoles.

The third generation illustrates the potential for a first mover with a well-structured network to harness the benefits of setting a market standard. Nintendo successfully preempted the game design, licensed assets and held onto its technological leadership. Unlike the first two generations, programmers could not leave to set up a rival company because they would not have been allowed a NES license, lock out chips, or NES cartridge production facilities. In addition, software was no longer as profitable for companies because Nintendo controlled the manufacturing process and received large royalties on any game title released for the NES. Nintendo had fully exploited the conceptual advantages of being the first mover by establishing the standard (over 80% market share), preempting scarce assets (e.g., programmers) and being synonymous with home video game technology in consumers' minds.

new CHALLENGES

4th generation

Just like Atari's competitors, Nintendo's competitors looked to technological innovation to help them gain inroads on this market leader. In late 1989, Sega introduced its Genesis system and NEC brought its Turbo Grafix-16 system to the US market. These two new entrants hoped to leapfrog Nintendo's 8-bit NES with their 16-bit graphic processors that provided much better colors, 512 versus 52 colors of the NES, and digital sound (9 Jan. 1990, *Wall Street Journal*).

However, just like Intellivision in 1980, these two new platforms suffered from the lack of any proven software. During the Christmas season of 1989, there were 265 NES titles available against about 20 Sega Genesis games and a dozen Turbo Grafix-16 games. Accordingly, in 1989 sales of these competitor systems, 600,000 for Genesis and 200,000 for Turbo Grafix-16, did not approach the nine million unit sales of Nintendo's NES system. A. M. Brandenburger puts Nintendo's profit at a record $725 million in 1990.

During 1990 and 1991 however, Sega was able to substantially increase its sales based on aggressive advertising, a strong sports game lineup and the popular game character, Sonic the Hedgehog. Sega harnessed the few software firms that had not already signed on with Nintendo into its own licensing network. In addition, as Sega emerged as a serious contender, Nintendo licensees created Genesis games; although, they could not offer the exact same titles as they did for Nintendo. Sega's sales momentum built up and carried over into the critical Christmas season in 1991. Nintendo waited until September 1991 to introduce its 16-bit system, the Super NES (SNES), but was unable to match the strength of the Genesis, either in number of software titles available or unit sales. For the first time in five years a Nintendo platform was

outsold: 1.4 million Genesis machines to 1.2 million SNES machines for the fourth quarter of 1991.

The rise of Sega was only one of the many problems facing Nintendo during this period. Nintendo came under increasing pressure from its licensees, which had grown to 65 companies, to loosen its restrictions. As a result, Nintendo started to allow its licensees to manufacture their own cartridges. In addition, under threat of antitrust investigation, Nintendo also removed the prohibition on licensees of making their games available on competing platforms. This freed current Nintendo licensees to release games for the Genesis that had a higher installed base than the SNES. Naturally, Sega benefited greatly from these changes.

On the other hand, NEC's Turbo Grafix-16 exited the market in 1992. This platform had sales of about one million units, but failed to attract strong software support. NEC later attempted to return to the market with a multimedia platform, which was also unsuccessful.

After NEC's departure, the duel between Sega and Nintendo continued with considerable intensity. Sega upped the ante in November 1992 when it introduced the Sega CD. Compact disks (CDs) were heralded as a boon to the game industry because they could store tremendous amount of data (i.e., 500 times the capacity of a cartridge). This ability would enable realistic game play and movie type games. (CDs' primary advantage over cartridges were in lower production costs and higher memory capacity, but at the expense of longer game loading times. This disadvantage has been reduced through the use of multi-spin drives.)

However, the Sega CD did not have any immediate impact on Genesis sales because of the steep price of the CD add-on, about $300 (USD). Also, game play was still constrained by the Genesis' video processors. Sales in 1992 were similar to those in 1991, with Sega and Nintendo in a dead heat.

Little change was seen in 1993 as the two Japanese giants continued the battle with more games and add-ons. By the end of 1993, Sega and Nintendo had sold worldwide over 40 million fourth-generation consoles, with Sega leading in the US market. Considering its past dominance in this industry, this was a disappointing result for Nintendo. The fourth generation was marked by Sega's successful challenge to Nintendo's dominance.

This was the first generation that had two major rivals who both had well-developed networks for complementary products. Third-party games were often released simultaneously for both platforms. Not surprisingly, the legacy of Nintendo's strength coupled with Sega's successful innovation resulted in a draw.

On the other hand, NEC was unable to marshal a good field of complementary products for the Turbo-Grafix-16 and was compelled to exit the market. Also, neither the SNES nor the Sega Genesis was backward compatible with earlier devices. Thus, it was critical for them to build franchises around game characters, such as NEC's Mario Brothers and Sega's Sonic, to translate past success into future advantage.

Killer Applications

The term "killer application"came into use in the late 1980s to refer to a software "application" for a hardware product that was so compelling that it motivated the consumer to purchase both the software and the hardware.Killer apps are important because they initiate wide consumer acceptance of a product. Lotus's 1-2-3 spreadsheet was the killer application for the IBM PC, while desktop publishing was for Apple's Macintosh. Prerecorded videotapes wound up being the killer application for VCRs. Electronic mail is generally credited with being the Internet's killer application.

Arcade game hits such as *Pac Man* were killer apps for early video game systems. One game, *Mortal Kombat,* stands out as an important game for fourth generation systems. While it was released for both the SNES and the Genesis the Genesis version was purported to have much more realistic fighting action. However, by that time, there were so many competing characters and game franchises (e.g. Mario Bros., Sonic) it did not have a dramatic effect.

Speculation about killer apps for today's video game platforms abounds. With sales in the tens of billions, video games have clearly entered the mainstream of the U.S. entertainment industry. So while a killer app is not needed for video games to become accepted, one could be critical for people choosing a Xbox or GameCube over the PlayStation 2. For example, *Grand Theft Auto* is available only on PlayStation while Halo is only available for Xbox. Some have suggested that online play will be a killer application. —*SG*

LEARNING from OTHERS

5th generation

A startup company, 3DO, initiated the fifth generation of home video games by introducing a 32-bit system, called the Interactive Multiplayer (IM), in March 1994. 3DO, taking note of Nintendo's approach, assembled a huge network of licensees for its platform. This network included a whopping 302 software companies along with three hardware vendors (June '93, *Computerworld*). This network was critical because 3DO planned to profit by licensing the right to use its video game technology, not producing the game players or cartridges.

Investors found this approach attractive and before a single Interactive Multiplayer had been sold, 3DO had raised $48 million from its initial public offering (IPO). However, in the stores, the shoppers' enthusiasm was more muted. Unlike other early entrants in prior generations, 3DO's game player was produced by a licensee, Panasonic. Because Panasonic could not expect to offset losses on the sales of the console with profitable game sales the 3DO player was expensive, $699 (USD), compared to $150-$200 for the Genesis or the Super NES systems. This led to slow initial sales, only 50,000 units by November 1994.

Recalling its early mover success in the fourth gen-

eration, in May 1995, Sega introduced a 32-bit fifth-generation machine, called the Sega Saturn. Sega also introduced the Sega Channel and an Internet add-on for the Saturn to pursue opportunities in online game play. However, like the Interactive Multiplayer, the Saturn was priced at the high end of the market-$399. Sega's interest in other businesses, such as video theme parks, might also have hampered the Saturn by distracting Sega management.

While Sega was considering theme parks, Sony entered the industry in late 1995 with its own video game player, called the PlayStation. We believe that the PlayStation was the second dominant design to appear in the industry. Like the Interactive Multiplayer and Saturn, it utilized CDs for its games. However, Sony went beyond these platforms by offering optional memory cards that let players save their games in progress. (Earlier versions of console games had used different codes to allow players an approximate save capability.) We believe these two features: 1) CDs that allowed a dramatic increase in the complexity of games, and 2) the new memory capability, distinguished the PlayStation sufficiently to label it a dominant design.

Priced at $299, the Playstation outsold the Saturn 60,000 to 25,000 units during the 1995 Christmas season. On the strength of a strong marketing campaign and a plethora of action game titles, Sony sold over one million PlayStations in six months.

Despite the entry of fifth-generation platforms, however, 16-bit machines continued to be popular. While Sega was focusing on the Saturn, Nintendo continued to turn out popular software titles for the SNES by incorporating additional graphics ability into the game cartridges themselves rather than the console. As a result, the SNES was outselling the more advanced fifth-generation machines as late as Christmas, 1996. As a whole, 16-bit machines and related software accounted for 63% of home video game sales in 1995.

However, in 1996, Sony was able to gain tremendous ground in the market by cutting the PlayStation's price from $299 to $199. Sega's advantage in the US market in early 1996— a 38% share versus 30% for Nintendo and 24% for Sony—began to slip as the Saturn sales lagged far behind Sony's PlayStation and Nintendo's just-arrived Nintendo 64. Although Sega matched Sony's price cuts, Sony continued to dominate the 32-bit segment, outselling Sega two to one in 1996, while 16-bit sales began to dry up.

However, the big winner in 1996 was latecomer, Nintendo. Nintendo introduced its Nintendo 64 in October 1996 with great success. Unlike other fifth-generation machines, the Nintendo 64 was introduced at the currently prevailing price for hardware, $199. Based on the strength of this low price and the appeal of its bundled Super Mario game, the Nintendo 64 matched the sales of Sony's PlayStation over the crucial 1996 Christmas season, i.e., 1.3 versus 1.4 million units, respectively. Nintendo also gained ground on Sony's installed base of 2.8 million units with 1.7 million for the Nintendo 64. The success of the Nintendo 64 was achieved despite the traditional bane of new systems, limited software; it had only six titles. Furthermore, it did not fully conform to the new dominant design. It had memory cards but still utilized cartridges for its games.

Table 4 Distribution of top 20 software titles per platform between 1999-2001

Month	PlayStation	Nintendo 64	Dream Cast	PlayStation 2	Xbox	GameCube
Aug. '99	14	6	0	0	0	0
Sept. '99	13	3	4	0	0	0
Oct. '99	13	5	2	0	0	0
Nov. '99	15	4	1	0	0	0
Dec. '99	14	6	0	0	0	0
Jan. '00	17	3	0	0	0	0
Feb. '00	14	4	2	0	0	0
Mar. '00	12	5	3	0	0	0
Apr. '00	15	4	1	0	0	0
May '00	15	4	1	0	0	0
June '00	15	4	1	0	0	0
July '00	13	5	2	0	0	0
Aug. '00	15	4	1	0	0	0
Sept. '00	14	4	2	0	0	0
Oct. '00	14	2	1	3	0	0
Nov. '00	10	6	3	1	0	0
Dec. '00	12	6	1	1	0	0
Jan. '01	11	5	1	3	0	0
Feb. '01	9	4	2	5	0	0
Mar. '01	4	5	0	11	0	0
Apr. '01	7	4	0	9	0	0
May '01 *	4	2	0	8	0	0
June '01	3	1	1	4	0	0
July '01	3	1	1	7	0	0
Aug. '01	5	1	2	6	0	0
Sept. '01	5	1	2	8	0	0
Oct. '01	3	1	2	11	0	0
Nov. '01	3	0	0	7	4	2
Dec. '01	4	0	0	10	1	2

Source: *TRSTS Video Game Top Sellers*, Aug. 19–Dec. 2001, *In May 2001, NPD group started including portable software titles, e.g. Gameboy, in with this report. This is why rows no longer sum to 20.

Innovation, via increasingly better graphics capabilities, continued to provide a gateway for new challengers in the industry. Yet, early mover advantages were not routinely decisive; NEC and 3DO both entered the market earlier than the prior incumbents but failed. However, the success of challengers, such as Sega against Nintendo and Sony against 3DO and Sega, illustrates the importance of complementary products and installed base. Sega succeeded through its provision of complementary products, especially games centered on its popular Sonic character. Sony's winning strategy was to expand installed base by lowering the price of the core product. Since 3DO's hardware partners could profit only from the hardware product side, they were not willing to cut prices for the Interactive Multiplayer, and their product failed.

THE RECENT PAST & current EVENTS

6th generation

A sixth generation of consoles was initiated by Sega's introduction of its 128-bit Dreamcast system on 9 September 1999. With the support of a $100 million promotional budget, the Dreamcast easily exceeded its early sales targets. On the strength of Dreamcast's sales, Sega surged from less than 1% of the market to about 15% in the fourth calendar quarter of 1999 and all of 2000. Sega did not ignore complementary products offering 16 Dreamcast software titles at its introduction.

Nintendo and Sony offered the standard responses to Sega's newest threat: they cut prices on their fifth-generation systems to $129 and $99, respectively. They also promised new sixth-generation systems of their own for Fall 2000. Sony previewed its own sixth-generation system, the PlayStation 2, one week after the Dreamcast's debut.

Consistent with past practice, the Dreamcast was a significant technological advance over the systems already on the market (see Table 1). It also conformed to the dominant design parameters of Sony's PlayStation featuring a high capacity CD drive, memory cards and similar controllers. One area where the Dreamcast differed significantly from earlier products, however, was that it included a modem designed to facilitate games over Sega's network and to use a variant Windows CE from Microsoft as its operating systems.

The sixth-generation competition for the Dreamcast picked up slowly. Sony got its highly anticipated PlayStation 2 into stores on 26 October 2000, over a year after the Dreamcast's debut. The PlayStation 2 was a formidable competitor selling 1.4 million units by year-end. While technically similar to the Dreamcast, it offered two significant advantages. First, it was capable of playing consumer digital video disks (DVDs) making it a substitute for a DVD player. This was cited as a factor in making the machine so successful in Japan. Second, and more importantly from the perspective of standard based industries, it was backward compatible with several hundred existing PlayStation games. This backwards compatibility solved the problem of limited software at introduction and allowed the PlayStation 2 to inherit some of the network benefits of the original PlayStation.

In the battle for complements, despite its late and limited introduction, the PlayStation 2 quickly overcame the Dreamcast. This is highlighted by the success PlayStation 2 titles had breaking into the top 20 sales lists for software. Table 4 shows the distribution of the top 20 software titles per platform between 1999-2001. Sony's success was also mirrored in sales figures of each firm's in-house titles, with 14.1% accounted by for Sony, 3.5% by Sega, 20.7% by Nintendo, and the remaining 61.7% shared by third party developers. However, the PlayStation 2 does appear to have one issue that also plagued the Atari Jaguar and Sega Saturn; it is very hard to program games for it.

At present, the most interesting aspect of the sixth generation is the entry of US software giant Microsoft into the market. Microsoft's Xbox is based on technology from the personal computer industry. For the Xbox, Microsoft has undertaken aggressive efforts to encourage developers by seeding development tools and offering a nonpreferential licensing scheme as well as developing software titles in-house. Microsoft also received a possible assist from Sony, who kept the PlayStation 2 priced at $299, the same as the newer Xbox, when the Xbox was introduced. However, despite these actions and technical advantages such as including a hard disk drive most industry reports have the Xbox getting outsold by the PlayStation 2 in the U.S. during 2002. However, the Xbox has outsold Nintendo's sixth generation GameCube.

While it is unclear if tipping will occur in this generation, it is clear that being an early mover did not confer benefits to Sega. In January 2001, after continuous losses generated through aggressive price-cutting and numerous failed promotions including free Dreamcasts, Sega announced it would cease manufacturing the Dreamcast.

and now
we will pause for
a brief interlude
(with really BIG pictures)

... the conclusion to
this study of the video game
industry by Gallagher and Park
begins on page 22

WHO won, WHO lost & WHY

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What distinguishes competition in standard-based industries from other industries is the presence of potential network effects. With different software and hardware competing for market dominance, network effects were present in the home video game industry. So what was the role of complementary products and installed base in this market?

At first, most software was produced in-house for each platform by the parent company. By licensing Hangman and Yahtzee from Milton Bradley, Texas Instruments was the first to use non-video game licensing for programs. However, during the first two generations, the competitive focus was specifically on obtaining popular arcade hits for a company's own platform.

Based on its in-house arcade unit and first mover status, Atari had an early advantage here. As other firms entered the VCS software market, however, Atari began to lose cartridge sales. Atari acted unconcerned claiming (correctly) that the increase in software for the VCS resulted in higher demand for the VCS. Unfortunately, Atari was harmed because it was in the practice of selling platforms at cost in order to profit from cartridge sales. Atari's weakness accelerated when it agreed to a small license fee for VCS compatible cartridges. Unlike Atari, Nintendo and other followers handled this problem by continuing to sell platforms at near cost while strictly licensing who could make games for them, imposing higher licensing fees and actively enforcing their contracts.

Table 5 maps out platforms, early mover status, complementary products and outcome (by platform) of the major competitors across generations. From Table 5, Atari's VCS had a lot of uncontrolled support that resulted in a large number of complements for its platform. Nintendo had unusually strong network support in the third generation. Table 5 also indicates that there is a tight correlation between complements and firm performance. The firms and platforms with strong complementary support, such as Atari's VCS, Coleco's Colecovision, Nintendo's NES and SNES, Sega's Genesis and Sony's PlayStation, emerged as winners in their own generations. The outcome also seems to be more closely tied with complements than early mover status; that is, many of the early movers did not become winners, but every platform with strong complementary support did.

3DO's MISTAKE IN RELYING too much ON THE NETWORK

In Table 5, a second glance should be given to 3DO in the fifth generation. 3DO entered the market with what appeared to be a powerful network of three hardware licensees and 302 software licensees. 3DO's technically superior system with a strong network behind it was theoretically a formidable challenge to Nintendo and Sega. However, 3DO never met with much success. 3DO's failure can be partially attributed to a high price, $699 (USD), that was twice as much as 16-bit systems and far beyond the mass market price for consumer electronics of about $200-$300 (USD). Combined with the customary lack of software for new hardware platforms, this was enough to keep 3DO's system from reaching a critical mass to incur further support in the industry.

However, we believe that the primary source of 3DO's failure was more than its high price. 3DO had a broad base of support but it was not deep. 3DO's 302 software licensees only produced about 35 games for the Interactive Multiplayer (IM), and only one hardware licensee, Panasonic, actually built the IM.

Although it is critical to develop a broad network of suppliers and users to succeed in standard-based industries, this also carries a danger of becoming too dependent on outsiders for critical resources. Powell, Koput and Smith-Doer emphasize the importance of retaining a hand in the research process and in-house capabilities in managing alliance strategy. 3DO demonstrated the perils of relying too much on the network for a firm's strategic success and key resources.

3DO attempted to profit by licensing the rights to make hardware or software, which required broad market penetration to further encourage software

development. However, unlike other companies in this industry, 3DO also relied on a licensee to make the hardware platform. Therefore, the platform could not be sold at cost or a loss because the hardware licensee, i.e., Panasonic, had no incentive to subsidize the software licensees. The software licensees, in turn, had no incentive to write for the Interactive Multiplayer and pay royalties to 3DO until it gained wide acceptance. Other firms had overcome this problem by selling their consoles at low prices, which helped sell more systems and gain more external support for their platform. A variation of this theory can also explain Atari's fall. While its network helped entrench its platform as a standard, the network itself came at the expense of Atari's own programming staff who left to form new game companies. In other words, Atari's critical internal resources were traded for platform support.

WHERE'S the LOCK OUT?

Overall, the firms with strong emphasis on the provision of complementary products, i.e., Atari, Nintendo, Sega/Nintendo and Sony/Nintendo, did well in four of the five generations of the home video game industry. Three of these four winners were also first movers (Atari, Nintendo and Sega) suggesting a potential interaction effect between these two factors, i.e., early movers are successful if they develop a strong network of complementary products, rather than just focusing on installed base. However, Coleco, the second-generation winner, was an exception. While it was able to overcome an early mover, Mattel's Intellivision, its complementary network was clearly not better than Atari's.

Although securing complementary products is critical, even having a successful platform and "setting the standard" is no guarantee of firm success in this industry. Much like IBM in the PC industry, Atari was able to set the standard in the first generation, but the potential gains from it went to other firms. Clearly, there is more to gaining sustainable competitive advantage than simply setting the standard. Despite large installed bases for Atari and Nintendo in the first and third generations, respectively, competitors in later generations were successful in challenging their dominance. This also appears to reduce the chances for "lock out." Lock out is an idea developed by W.B. Arthur that an extant standard precludes later, and intrinsically better, products from entering the market.

We believe there were three main reasons for the lack of lock out in this industry:

a) no backward compatibility between core products;

b) subsidized costs of core products, and

c) very low intangible customer switching costs.

Few systems in this industry had backward compatibility with the earlier ones. The lack of backward compatibility limited the value of earlier dominant designs in the market. It is notable that the only "new" system with backward compatibility, i.e., Atari's 7800, was successful primarily on the grounds of this feature. If Nintendo's fourth- or fifth-generation systems had been backward compatible, video game's history probably would have been written very differently since 1991. The recent success of PlayStation 2 is also attributed to its backwards compatibility.

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Of course, maintaining backward compatibility is expensive, and it is critical to keep the hardware's cost low to compete in this industry. On the other hand, intentionally depressing the cost of core products also serves to lower switching costs and, therefore, the chances for lock out.

A potential reason for the weak backward compatibility in this industry can be found in the customer profile, which includes mostly children. Unlike adult customers in other industries, such as the Microsoft Windows / Intel system in the PC industry, children may play video games at a particular developmental stage and then go onto other things when they lose interest in video games. Given the discontinuity in the customer group, there is little incentive for platform manufacturers to stick to the old standard as they attempt to leapfrog the current competition with a new design. However, video game demographics seem to be shifting to more adult audiences that would further increase the importance of backward compatibility.

Lock out would also be less likely if it costs only a small marginal amount to buy an alternate platform compared to a piece of software. For example, current

Table 5
Major platforms and complementary products in the home video game industry

Generation	Competitor	Platform	Early mover	Complements	Outcome
1st	Atari	VCS/2600	yes	strong	winner
2nd	Atari Mattel Coleco	5200 Intellivision Colecovision	no yes no	avg. weak strong	also ran also ran winner
3rd	Atari Nintendo	7800 NES	no yes	weak strong	also ran big winner
4th	Nintendo Sega NEC	Super NES Genesis TGrafix-16	no yes yes	strong strong weak	tie with Genesis tie with SNES also ran
5th	Atari Nintendo Sega 3DO Sony	Jaguar Nintendo 64 Saturn Interactive Multiplayer PlayStation	no no yes yes no	weak average average average strong	also ran tie with Sony also ran also ran winner

sixth-generation players cost $149 to $199 but software for them costs about $50. This is a much lower core to complement product ratio than other typical standard-based industries, such as a VCR compared to tape rentals or a PC compared to software.

Finally, compared to other standard-based industries, e.g., typewriters, intangible switching costs are minimal for home video games. The consoles are easy to handle; they generally consist of a power switch and a slot to insert a cartridge. The challenge lies in playing the individual games. While they can be quite demanding on eye-hand coordination, the objectives of the games are usually simple, e.g., shoot the bad guys. Also, since video games are a youth-oriented industry, fads and fashion are much more salient in this industry, which helps overcome intangible switching costs.

BENEFITS OF setting THE STANDARD

In the video game industry, setting the standard is helpful only when a company is positioned to reap the advantage of it. This is because lock out alone cannot be counted on for long term dominance. As discussed, in the third generation, Nintendo tried to build dominance with exclusive licenses and lock out chips. However, Nintendo did not build trust within its network. In fact, its conduct bordered on being exploitative, such as limiting quantities of cartridges for licensees and always demanding payments in advance. Such enforcement enabled Nintendo to build further advantages for its current product but at the cost of undermining long-term support for its network. In short, Nintendo's success during the third generation was based on its closed system standard. However, this advantage came at the expense of tying the network to its third-generation platform, the NES, not to Nintendo. Later when the opportunity came, Nintendo's NES allies were happy to desert it for Sega's Genesis and Sony's PlayStation.

Atari and Nintendo applied another strategy to reap the benefit of setting the standard, which was to build complementary resources in addition to products. These resources were helpful beyond simply establishing the standard. Based on its early success, Atari had a large library of popular software titles to draw upon. Atari released versions of Asteroids, Pac-Man and Space Invaders for all its platforms in all the generations.

Similarly, Nintendo used its early lead-time to build another strong resource, what we call its "Donkey Kong franchise." This set of related games, over 10 in all, are all based on the characters that first appeared in Donkey Kong 20 years ago. For Nintendo, this game character franchise has supplanted the importance of arcade game hits that were critical for Atari's early success. (Today, the ubiquitous Pokemon might be another example of this type of franchise for Nintendo.)

After all, the recent success of the Nintendo 64 is largely credited to the high game play value of the included cartridge, i.e., Super Mario 64, that is a direct descendant of Donkey Kong. The rapid technological change over generations has strengthened this advantage. Technological advances allow even more realistic and entertaining exploitation of this franchise, often providing a potential in-house "killer app." Nintendo used this strategy with its fourth- and fifth-generation entries. However, its sixth-generation GameCube seems to have not met with as much success as these earlier efforts.

SOME theoretical IMPLICATIONS

The video game industry offers insights on technological innovation and its role in competition in standard-based industries. Let's examine some of the relevant theoretical issues based on the historical information presented.

1) *Role of the dominant design*: The video game industry evolved as firms engaged in continuous technological innovation. Each innovation shifted the industry into a new generation resulting in new platforms, a new set of competitors and different competitive moves. Two clear dominant designs emerged; one based on cartridges (Channel F and VCS/2600) and the other based on CDs and memory cards (PlayStation).

How important is it to adopt the dominant design? The issue of a dominant design does not appear to have been as significant here as it has been in other industries. Most products in the first, second and third generations of the industry uniformly adopted the console, cartridge and consumer's TV design. (Note: There was only one exception to this, the Vetrix, which used vector graphics. Since TVs don't do well displaying vector graphics, the Vetrix's screen was built into the platform. It garnered little market share.)

Given this homogeneity, it is difficult to argue that adopting the dominant design offered an advantage. While an early adopter (Atari) of the dominant design was successful, it offered little lasting advantage. In the fifth generation, Sony did much better with the second dominant design of CD game media coupled with memory cards. The fact that Sony continued to do well against established video game rivals who did not initially adopt its design (e.g., Nintendo's Nintendo 64) offers some support for the idea that initiating the dominant design can be a source of competitive advantage.

Of course, dominant designs can only be recognized retrospectively as M. Tushman and P. Anderson point out. Therefore, we have to acknowledge that our labeling the PlayStation as a dominant design may be premature. However, we are encouraged that the recently announced specifications for sixth generation video games generally include CD or DVD as game media and some memory capability.

2) *Switching costs and technological innovation*: How important are switching costs and how are they overcome in the video game market? Prior to the emergence of a dominant player in a generation traditional competitive strategies, involving firm capabilities, channel management, brand awareness, pricing

and entry order, are effective. However, once the market is settled with a dominant player switching costs become a potentially important consideration. Switching costs in this industry primarily arise through two sources: 1) customer's sunk costs in a console player and its associated game library, and 2) the tacit knowledge of how to play the games. However, both of these sources were rather weak. Companies generally priced their consoles low, often at or below cost, in order to gain users. This penetration pricing lowered a customer's sunk costs. At the same time, while the games themselves were often complex, there was not much tacit knowledge lost in switching from one gaming console to another.

Therefore, it is no surprise that successful entry was possible. While some new entrants were more successful (Coleco, Sega and Sony) than others (Mattel, NEC and 3DO), they all were able to enter with a technologically superior platform. Therefore, we explain successful challengers as firms that not only brought to bear superior technology, but also duplicating the non-product advantages of the incumbent.

For example, Coleco entered with a proven arcade hit, Donkey Kong, tied to its second-generation system while Intellivision did not. Sega developed a character franchise around its Sonic, the hedgehog character, to match Nintendo's Mario Brothers. Superior technology was merely a necessary but not sufficient condition to challenge the leading firms in the industry. Also of interest, and consistent with innovation theory, is that no prior winner ever initiated a new generation.

Table 6
Early movers and market leadership in the video game industry

Early mover (entry year)	Platform	Generation	Lead within generation	Lead before new generation
Fairchild (1976)	Channel F	1st	0	withdrawn (1977)
Atari (1976)	VCS/2600	1st	0	4 years
Mattel (1980)	Intellivsion	2nd	2 years	6 years
Nintendo (1986)	NES	3rd	1 year	3 years
Sega (1989)	Genesis	4th	0	5 years
NEC 1989)	TG-16	4th	0	withdrawn (1991)
3DO (1994)	Interactive Multiplayer	5th	1 year	6 years

3) *Entry timing*: The history of this industry provides an ideal venue to examine first mover advantages for several reasons. First, it is an emerging industry that did not exist before 1976. Second, the history reveals a rapid turnover in leadership, which facilitates the examination of several cases of market leadership over a relatively short time period. This rapid turnover was primarily due to ongoing technological innovations. A company that was successful might see its dominance quickly threatened by technological advances. Finally, because of ongoing entry and exit of firms in each generation, we can examine firm performance simply using survival as an indicator of success.

Tables 1 (pg 7) and 6 show that first mover advantage alone was not enough to ensure success in the emerging market. While Nintendo and Sega succeed as first movers in the third and the fourth generations, Fairchild, Mattel and 3DO did not establish market leadership as first movers in the first, second and fifth generations. Table 6 presents for each generation 1) the early movers, 2) their platforms, 3) their leads until the next competing platform within the same generation, and 4) who lead until the beginning of the next generation. Again, it does not appear that having a head start in building an installed base was a decisive advantage. (It should be noted that the lead time for Atari is somewhat inflated because there was little or no market in 1976-1978 and 1984-1985 for it to exploit.)

In the first generation, Atari was successful in obtaining typical first mover advantages with solid technological leadership, preemption of assets, while generating some level of customer switching costs. However, as discussed, it failed to hold on to these benefits. Atari's technological leadership was rapidly weakened as its programmers went off to start their own firms. Despite Atari's active use of the courts, it failed to prevent other companies from making cartridges for its VCS, adapters for rival hardware for VCS games, and close copies of popular VCS games. New entrants eroded Atari's preemption of assets by bidding up the price of arcade licenses, movie tie-ins and programming talent. Customer switching costs were not a large factor since Atari and its rivals purposely set console prices low to increase the sale of cartridges.

Other early movers, such as Fairchild, Mattel, NEC and 3DO, did not benefit from any of these drivers of early mover advantages. Fairchild did not persist in the market long enough to realize any benefits that it might have captured. Mattel's technological leadership was not inimitable and it did not benefit from the complements that Atari could offer (see Table 5). NEC was also a competent early mover but it did not develop sufficient complements to expand the basis of its platform. 3DO was not a successful early mover because its structure undermined its ability to conform to the industry norm of subsidizing hardware with software sales.

Nintendo's success as an early mover in the third generation was even more dramatic than Atari's in the first. Its effective lead is much greater than it appears within the third generation because it virtually shut out other competitors through network arrangement for complementary products. Given lock out chips and contractual safeguards, it became the only firm that was able to gain ironclad preemption of assets and cement technological leadership for an entire generation. Nintendo's tremendous success in the third generation reflected its ability to secure these advantages.

Sega was a first mover winner in the fourth generation. Although it never achieved the same level of market share that Nintendo garnered in the third generation (more than 80%), it did manage to break Nin-

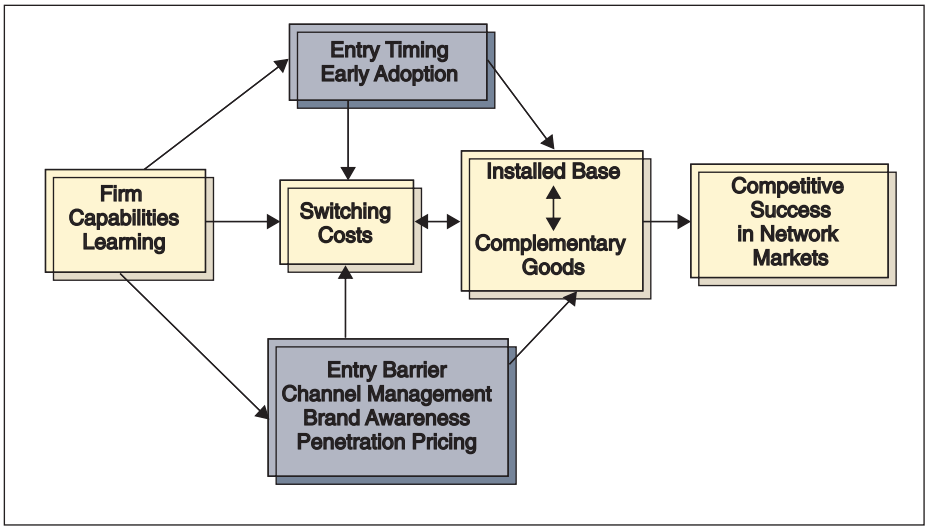

Fig. 1 A conceptual framework of competitive success in network-based industries

observations THEORIZED

Success in a standard-based industry requires new competitive rules in addition to the traditional tenets of strategic management. Working around industry standards and complementary networks requires much more than dealing with price and quality (the primary elements in traditional generic competitive strategies). Recently, there have been significant efforts to bridge this gap. However, it is a daunting task to study firm strategy in a standard-based industry because of limited empirical observations, i.e., the need for longitudinal data at the industry level.

tendo's stranglehold on the market.

Three of the early movers in the video game industry became the dominant players in their generation: Atari, Nintendo and Sega. Their success was possible based on the utilization of typical first mover advantages, such as the preemption of assets, technological leadership and switching costs. These findings offer some support for early movers emerging as dominant players in the market.

However, as illustrated by the failure of other early movers, early mover advantages are not sufficient to establish sustainable market leadership, especially in this type of standard-based industry. This is consistent with surveys of prior work on first mover advantages. However, we believe that unlike prior examples of first mover advantage, the potential rewards of success are greatly enhanced in standard based industries. For example, at its peak, Nintendo's profit was as large as Sony's on only a quarter of Sony's sales.

4) *Tipping*: Finally, "tipping" is a tendency to rapidly adopt a single dominant standard. Examples would include IBM compatible PC's and VHS format videocassette recorders. However, probably for reasons similar to why lock out did not occur, tipping was not common in this industry. Although the industry has been highly dynamic, there are some firms that persisted for some time. Atari (1976-1997) and Nintendo (1986 to present) were dominant players in their respective generations and actively competed in the market for several succeeding generations. However, several other companies that dominated in various generations, such as Coleco in the second and Sega in the fourth, did not persist. There were also a number of challengers present in each generation that obtained significant market shares with non-dominant designs. Thus, we can conclude that tipping was rare in this industry. Compared to the orphaning of CP/M by DOS in the PC industry, there is a much lower level of user-based network effects, i.e., intangible switching costs, in the video game industry, allowing multiple formats to exist at the same time.

The history of the US home video game industry reveals quite rapid changes of technologies, competitors and firm strategies over a relatively short time period. Furthermore, it operates in a nice juncture of the real and information economy. Video games are very real products that also embody many aspects of information goods.

We focused on three important strategic issues:

1) technological innovation and dominant designs;

2) early mover advantages (and switching costs), and

3) competition in standard-based industries, especially the role of complementary products and having an installed base.

The key finding is that success in a standard-based industry requires much more than just technological innovation or being a first-mover. Technological innovation was essential and being a first-mover helpful, but not sufficient, toward building a dominant position in the market. An effective strategy to become a winner in each generation appears to be building a network of complementary products and subsequently an installed base, which depend on each firm's competitive strategies toward building switching costs.

Although innovation did not guarantee eventual success in the market, it was a mandatory strategic weapon for challengers. The industry experienced several quantum changes because of technological innovations, leading to different competitive landscapes with a new set of competitors. Even the most successful firms in this industry, with strong complementary networks, were not able to sustain their dominance for more than one generation. The history of this industry presents a typical Schumpeterian "creative destruction" regime with incumbents being buffeted by technological change and new entrants.

Our findings also offer partial support to the traditional argument on first mover advantages: they were important only when first movers used their time to develop a network of complementary products. This study also validates that installed base alone is not

sufficient to develop sustained competitive advantages which is consistent with the recent work by C. Shapiro and H. R. Varian.

This study illustrates that building a network of complementary products and installed base should be the primary goal to compete in this type of industry. However, most traditional tenets—such as technological innovation, building entry barriers, protection of firm-specific key resources, building name brands, pricing, etc.—still play critical roles in a standards-based industry. For example, the history of the video game industry shows that attracting independent software vendors into the network of a platform required the following:

1) superior technology;
2) early entry through innovation;
3) proper pricing;
4) name brand;
5) channel management, and
6) entry barriers.

These competitive strategies provide higher switching costs and a broader network of complementary products, which further increases the installed base. Success in building complementary products and installed base then reinforces switching costs. We, thus, conclude that the new competitive rule in a network-based industry reflects the change of strategic goals, but not necessarily the change of competitive strategies.

According to these findings, we suggest a conceptual framework that explains firm success in network markets. The model emphasizes firm (innovation and managerial) capabilities as the founding and necessary block to sustain a firm's advantage within and across generations of standards. Strong capabilities and absorptive capacity allow early entry or adoption of a new design and effective competitive strategies, potentially creating a higher level of switching costs for the firm's platform. These are critical forces toward meeting the strategic goals of installed base and complementary products. Figure 1 summarizes these findings into a conceptual model for competitive success in network markets.

Due to the lack of tipping and lock out of competing standards, this study does not provide direct evidence to draw conclusions about between and within standard competition. However, since each generation of platforms reflects a distinctive set of technological combinations that is often incompatible with earlier generations, we believe comparing across and within generations allows implications similar to the within and between standards competition to be drawn. A clear pattern emerging from our historical observation about the generational shifts in industry standards is that it is a typical Schumpeterian competition with a new generation only arising through technological innovation.

Our study also shows that a generational shift requires far more than incremental changes in operating performance of the platform. Technological innovation, however, is limited to within generation competition as firms operate within a similar technological configuration. As a new generation starts, the strategic focus shifts from technological innovation into traditional competitive strategies to build a network of complementary products and installed base.

The ongoing confusion on how to compete in this new type of industry leaves many opportunities for future work. Strategy scholars should explore, in particular, the linkage between setting a standard and subsequent performance of the firm. Also it is critical to understand the unique natures and new competitive rules in this type of industry before attempting to develop new strategies for them. Firms with a good understanding of prior history, change, and market development performed well in this industry.

The Battle of the Sexes in video games

Considerably more males play video games than females. Part of this is easily attributable the content of video games, e.g. stealing cars in Grand Theft Auto, that is at odds with typical female play patterns. However, there have been games that did appeal to girls and women. Pac-Man was relatively popular with women and Ecco: The Dolphin was designed with female game players in mind. Today, The Sims has been popular with women on the PC and was recently released for home video game players. It will be interesting to see if video games' move into the entertainment mainstream results in more female gamers and female oriented games.—*SG*

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