31

Sony Corporation: Car Navigation Systems

In April 1996, Masao Morita, president of the Sony Personal and Mobile Communication Company, a division of the Sony Corporation, pondered how to recover Sony's initial leadership in car navigation systems in Japan. As the first company to launch a reasonably priced (around $2,000) after-market model in 1993, Sony could claim to have created the world's largest car navigation systems market in Japan. Since the late 1980s, Sony led a group of 40 companies in establishing an industry standard (called NaviKen) which enabled consumers to benefit from mutually compatible digital map software while manufacturers reduced their risk by sharing development costs. Sony's efforts grew the Japanese market from 58,000 units in 1992 to 160,000 in 1993. Sony held a 60 percent market share in 1993. **Exhibit 1** reports unit sales of car navigation systems in Japan through 1995 and forecasts from 1996 through 2005.

Market growth fueled intense competition in Japan, leading to many new product launches and lower prices. The average retail price per unit decreased from $4,000 in 1990 to $2,500 in 1995.[1] Ironically, competitors not in the NaviKen group were able to introduce new and improved products more often and more rapidly by developing or acquiring proprietary digital map technologies. Increasingly sophisticated consumers sought out differentiated products with the latest features. In contrast, NaviKen member companies, including Sony, lost time while trying to agree on standard software upgrades. Sony's unit sales increased, but at a slower growth rate than the market; Sony's market share fell from 60 percent in 1993 to 23 percent in 1994 and 17 percent in 1995, and was estimated to drop to 15 percent in 1996. **Exhibit 2** summarized the major competitors' market shares. **Exhibit 3** compares sales performance of NaviKen and non-NaviKen companies.

In Europe and the United States, Sony was also the first to launch car navigation systems in the automobile after-market. Fewer than 1,000 units sold in test markets to gather information in each region by the summer of 1996. In Europe, local manufacturers, such as Philips and Bosch, started to market competing products aggressively. Other Japanese competitors, such as Alpine, Matsushita, and Pioneer were expected to enter Europe and the United States by 1997. **Exhibit 4** summarizes market forecasts for car navigation systems by geographic region.

SONY CORPORATION: COMPANY BACKGROUND

The Sony Corporation was founded in 1946 in the remains of a bombed department store as the Tokyo Tsushin Kogyo (Tokyo Telecommunications Engineering) by Akio Morita (Masao's father), and Masaru lbuka. As a young company, Sony did not have a keiretsu of affiliated companies and lacked the strong domestic sales base and the distribution networks that supported the other companies.

With only $500 in capital, the founders realized they would have to differentiate themselves from

[1] $2,500 was the retail price with a monitor. A system retailed at around $1,500 in 1995 if a monitor was sold separately as shown in Exhibit 1.

EXHIBIT 1
Market Development and Forecasts in Japan

			Actual			*Estimate*		*Forecast*				
	1990	*1991*	*1992*	*1993*	*1994*	*1995*	*1996E*	*1997E*	*1998E*	*1999E*	*2000E*	*2005E*
Entire Market												
<1> Unit Sales	16,400	27,600	57,800	160,400	343,500	578,500	850,000	1,200,000	1,500,000	1,800,000	2,000,000	2,800,000
Growth Rate Year-on-Year (%)		168%	209%	278%	214%	168%	147%	141%	125%	120%	111%	107%
<2> Retail Sales (¥ millions)	6,430	10,290	15,470	25,020	51,530	83,880	114,080	150,000	170,000	190,000	200,000	230,000
Growth Rate Year-on-Year (%)		160%	150%	162%	206%	163%	136%	131%	113%	112%	105%	103%
<3> Retail Price/Unit (¥)	392,073	372,826	267,647	155,985	150,015	144,996	134,212	125,000	113,333	105,556	100,000	82,143
<4> % Penetration of New Cars	0.27%	0.46%	0.96%	2.67%	5.73%	9.64%	14.17%	20.00%	25.00%	30.00%	33.33%	46.67%
<5> Cumulative Number of Car Navigation System Installed	16,400	44,000	101,800	262,200	605,700	1,167,800	1,990,200	3,132,400	4,472,000	5,928,500	7,350,000	2,385,000
<6> % Penetration of All Cars	0.03%	0.07%	0.17%	0.44%	1.01%	1.95%	3.32%	5.22%	7.45%	9.88%	12.25%	20.64%
AFTER MARKET												
<7> Unit Sales			39,000	139,016	297,900	462,500	550,000	700,000	800,000	850,000	900,000	1,100,000
Growth Rate Year-on-Year (%)				356%	214%	155%	119%	127%	114%	106%	106%	104%
% of Entire Market (%)			67%	87%	87%	80%	65%	58%	53%	47%	45%	39%
OEM MARKET												
<8> Unit Sales			18,800	21,350	45,600	116,000	300,000	500,000	700,000	950,000	1,100,000	1,700,000
Growth Rate Year-on-Year (%)				114%	214%	254%	259%	167%	140%	136%	116%	109%
% of Entire Market (%)			33%	13%	13%	20%	35%	42%	47%	53%	55%	61%

Notes: <1> Manufacturer unit sales.
<2> Retail sales level does not include monitors, adapters, software, sold separately from the navigation systems.
<3> = <2>/<1>
<4> Assuming that annual new car sales in Japan were approximately 6 million (i.e., <4>=<1>/6 million).
<5> Assuming that the car navigation system will be renewed every five years (i.e., 1992 figure=90-92 total, 1997 figure = 93.97 total, etc.).
<6> Assuming that there were approximately 60 million cars in Japan (i.e., <6>=<5>/60 million).

Source: 1990–1995 figures are actuals drawn from Yano Keizai Kenyusho, 1996 Car Navigation Systems: Market Forecast and Corporate Strategy (Tokyo, Japan).
1996–2005 figures are forecasts of the case writers, based on research interviews.

EXHIBIT 2

Major Competitor's Unit Sales and Market Shares in Japan: 1994–1996E

	Unit Sales, Total Market (% market shares)							*1996E Unit Sales (% market shares)*		*1996E Unit Sales (% sales composition)*		
	1995		*1996E*		*Three Years*			*After-Market*	*OEM*	*After-Market*		*OEM*
Pioneer	(24%)	#####	(19%)	157,000	(19%)	351,000	(20%)	(21%)	17,000	(9%)	89%	11%
Sony	(23%)	98,000	(17%)	124,000	(15%)	302,000	(17%)	(19%)	3,000	(2%)	98%	2%
Matsushita	(15%)	90,000	(15%)	149,000	(18%)	289,000	(16%)	(18%)	30,000	(16%)	80%	20%
Alpine	(10%)	87,000	(15%)	127,000	(15%)	250,000	(14%)	(11%)	57,000	(30%)	55%	45%
Mitsubishi	(1%)	30,000	(5%)	41,000	(5%)	74,600	(4%)	(4%)	16,000	(8%)	61%	39%
Kenwood	(6%)	27,000	(5%)	38,000	(4%)	84,000	(5%)	(6%)	—	(0%)	100%	0%
Zanavi	(0%)	24,000	(4%)	45,000	(5%)	69,000	(4%)	(1%)	36,000	(19%)	20%	80%
Clarion	(5%)	24,000	(4%)	39,000	(5%)	80,000	(5%)	(5%)	7,000	(4%)	82%	18%
Fujitsus Ten	(5%)	20,000	(3%)	37,000	(4%)	75,000	(4%)	(6%)	—	(0%)	100%	0%
Nippon Denso	(2%)	15,000	(3%)	26,000	(3%)	47,500	(3%)	(1%)	22,000	(12%)	15%	85%
Sharp	(2%)	11,000	(2%)	13,000	(2%)	31,000	(2%)	(2%)	—	(0%)	100%	0%
Casio	(1%)	10,500	(2%)	11,000	(1%)	26,500	(1%)	(2%)	—	(0%)	100%	0%
Sumitomo Denko	(3%)	7,800	(1%)	10,000	(1%)	29,700	(2%)	(1%)	3,000	(2%)	70%	30%
Toshiba	(1%)	6,000	(1%)	8,000	(1%)	17,500	(1%)	(1%)	—	(0%)	100%	0%
Citizen	(0%)	6,000	(1%)	8,000	(1%)	14,000	(1%)	(1%)	—	(0%)	100%	0%
Caisonic	(0%)	2,800	(0%)	4,000	(0%)	7,300	(0%)	(1%)	—	(0%)	100%	0%
NEC	(0%)	2,000	(0%)	3,000	(0%)	6,500	(0%)	(0%)	—	(0%)	100%	0%
Chuo Jidosha	(0%)	2,000	(0%)	2,000	(0%)	4,000	(0%)	(0%)	—	(0%)	100%	0%
Maspro	(0%)	1,500	(0%)	1,000	(0%)	3,200	(0%)	(0%)	—	(0%)	100%	0%
Sanyo	(0%)	1,200	(0%)	2,000	(0%)	3,500	(0%)	(0%)	—	(0%)	100%	0%
Nakamichi	(0%)	700	(0%)	—	(0%)	700	(0%)	(0%)	—	(0%)	—	—
Total	(100%)	#####	(100%)	#####	(100%)	#####	(100%)	(155%)	#####	(100%)	77%	23%

Source: Adapted from Yano Keizai Kanigusho, op. Cl.

EXHIBIT 3
Sales Comparison: NaviKen Group vs. Non-NaviKen Groups: 1994-1996E

Companies	*NaviKen Format Group*	*Proprietary Format (Can Read NaviKen)a*	*Proprietary Format (Cannot Read NaviKen)a*
	Sony	Matsushita	Pioneer
	Mitshubishi	Alpine	Clarion
	Zanavi	Kenwood	Nippon Denso
	Sharp	Fujitsu	Sumitomo Danko
	Casio		Nakamichi
	Toshiba		
	Citizen		
	Calsonic		
	NEC		
	Chuo Jidosha		
	Maspro		
	Sanyo		

Group Unit Sales (% share)	*NaviKen Format Group*		*Proprietary Format (Can Read NaviKen)a*		*Proprietary Format (Cannot Read NaviKen)a*	
1994	103,100	(30%)	123,000	(36%)	117,400	(34%)
1995	200,000	(35%)	216,000	(37%)	162,500	(28%)
1996E	262,000	(31%)	361,000	(43%)	222,000	(26%)

1996E Group Unit Sales (% Composition)	*NaviKen Format Group*		*Proprietary Format (Can Read NaviKen)a*		*Proprietary Format (Cannot Read NaviKen)a*	
After-market	246,000	(78%)	225,000	(73%)	173,000	(78%)
OEM	70,000	(22%)	82,000	(27%)	49,000	(22%)

Note: The second group's car navigation systems can read both proprietary and NaviKen software, while the first group's systems can only read NaviKen CD-ROMS. The third group's systems can only read their respective original software.

Source: Calculation of the case writers, based on the figures in Exhibit 2.

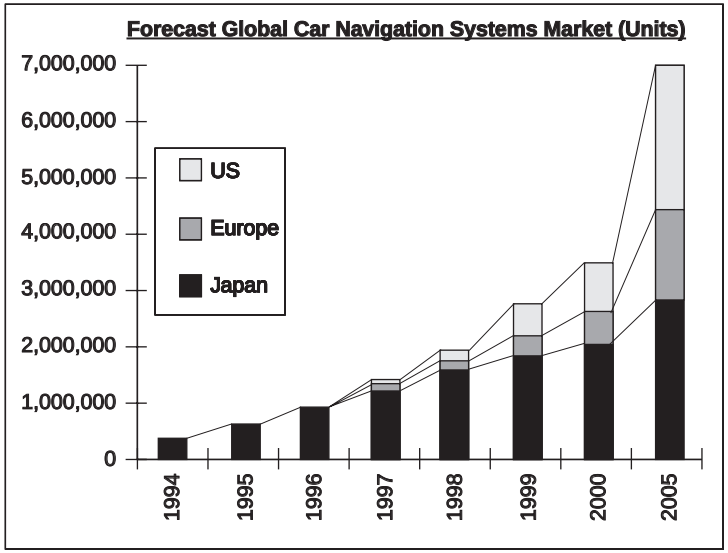
their larger competitors by developing more innovative products. From the failure of their first new product—a tape recorder that customers deemed expensive and flimsy—they learned the importance of paying close attention to consumer needs. Throughout its history, Sony pursued the innovation of commercially appealing products, maintaining a large research organization and vesting unusual decision-making authority in its engineers. The company's first breakthrough occurred after Ibuka acquired a patent license for transistors. Morita and Ibuka began mass production of transistor radios in 1954, and dubbed their new product Sony, after sonus, the Latin word for sound. Soon thereafter, the pair renamed the company.

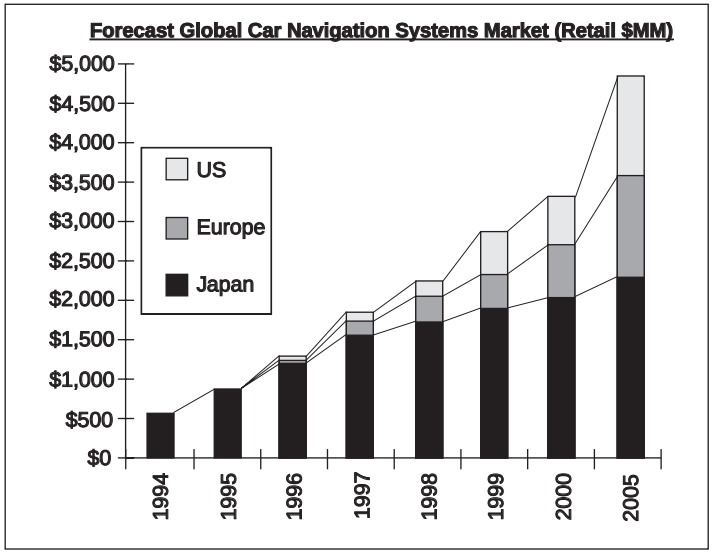
Internationally, as well as in Japan, Sony was often first to market with technological innovations that set industry standards. In 1968, Sony's sophisticated Trinitron technology expanded the color television market. In 1979, it launched the legendary Walkman, a lightweight portable tape player with headphones. In the mid 1980s, Sony developed a compact size camcorder video camera. Such innovations turned Sony into a leader in

EXHIBIT 4

	Estimate	*Forecast*				
	1996E	*1997E*	*1998E*	*1999E*	*2000E*	*2005E*
Japan						
<1>After Market (Unit)	550,000	700,000	800,000	850,000	900,000	1,100,000
<2>OEM Market (Unit)	300,000	500,000	700,000	950,000	1,100,000	1,700,000
<3>Entire Market (Unit)	850,000	1,200,000	1.500,000	1,800,000	2,000,000	2,800,000
<4>Entire Market (Retail % mil)	¥114,080	¥150,000	¥170,000	¥190,000	¥200,000	¥230,000
<5>Entire Market (Retail $ mil)	$1,141	$1,500	$1,700	$1,900	$2,000	$2,300
<6>Retail Price / Unit ($)	$1,342	$1,250	$1,133	$1,058	$1,000	$821
<7>% Penetration of New Cars	14.17%	20.00%	25.00%	30.00%	33.33%	48.67%
<8>Cumulative Number of Installed Units	1,990,200	3,132,400	4,472,000	5,928,500	7,350,000	12,385,000
<9>% Penetration of All Cars	3.32%	5.22%	7.45%	9.88%	12.25%	20.64%
Europe[a]						
<1>After Market (Unit)	10,000	50,000	100,000	200,000	400,000	900,000
<2>OEM Market (Unit)	20,000	50,000	100,000	150,000	200,000	900,000
<3>Entire Market (Unit)	30,000	100,000	200,000	350,000	600,000	1,800,000
<4>Entire Market (Retail % mil)	—	—	—	—	—	—
<5>Entire Market (Retail $ mil)	$60	$170	$300	$455	$600	$1,440
<6>Retail Price/Unit ($)	$2,000	$1,700	$1,500	$1,300	$1,000	$800
<7>% Penetration of New Cars	0.33%	1.11%	2.22%	3.89%	6.67%	20,00%
<8>Cumulative Number of Installed Units	30,000	130,000	330,000	680,000	1,280,000	3,752,000
<9>% Penetration of All Cars	0.02%	0.10%	0.25%	0.52%	0.98%	2.89%
US						
<1>After Market (Unit)	10,000	50,000	100,000	250,000	400,000	1,000,000
<2>OEM Market (Unit)	10,000	50,000	100,000	300,000	500,000	1,400,000
<3>Entire Market (Unit)	20,000	100,000	200,000	550,000	900000	2,400,000
<4>Entire Market (Retail % mil)	—	—	—	—	—	—
<5>Entire Market (Retail $ mil)	$34	$150	$260	$550	$720	$1,200
<6>Retail Price / Unit ($)	$1,700	$1,500	$1,300	$1,000	$800	$500
<7>% Penetration of New Cars	0.13%	0.67%	1.33%	3.67%	6.00%	16.00%
<8>Cumulative Number of Installed Units	20,000	120,000	320,000	870,000	1,770,000	4,720,000
<9>% Penetration of All Cars	0.01%	0.06%	0.16%	0.44%	0.89%	2.36%
TOTAL (Japan, Europe, US)						
<1>After Market (Unit)	570,000	800,000	1,000,000	1,300,000	1,700,000	3,000,000
<2>OEM Market (Unit)	330,000	600,000	900,000	1,400,000	1,800,000	4,000,000
<3>Entire Market (Unit)	900,00	1,400,000	1,900,000	2,700,000	3,500,000	7,000,000
<4>Entire Market (Retail % mil)	—	—	—	—	—	—
<5>Entire Market (Retail $ mil)	$1,235	$1,820	$2,260	$2,905	$3,320	$4,940
<6>Retail Price / Unit ($)	$1,372	$1,300	$1,189	$1,076	$949	$706

EXHIBIT 4
(continued)





Notes: [a] Europe figures include France, Germany, Italy, and United Kingdom.
<1>, <2>, <3> Manufacturer unit sales.
<3> = <1> + <2>.
<4> The figures are for the value of retail sales.
<5> Assuming an exchange rate = ¥100/$1 from 1996 throughout the year 2005.
<6> = <5>/<3>.
<7> Assuming that annual new car sales in Japan, Europe and the United States were approximately 6 million, 9 million, and 15 million, respectively (i.e., <7> = <3>/6 million.
<8> Assuming that the car navigation system will be renewed every five years (i.e., 1992 figure = 1990 – 1992 total, 200 figures = 1996 – 2000 total etc.)
<9> Assuming that there were approximately 60 million cars in Japan, 130 million in Europe, and 200 million in the United States (i.e., <9> = <8>/60 million.

Source: Forecasts of the case writers, based on research interviews.

consumer electronics with FY 1995 worldwide sales over $43 billion.

Sony's only significant failure came in the early 1980s, when its Betamax format VCR lost out to VHS. Sony developed the video cassette recorder as early as 1975, but motion picture studios protested that the new machine would encourage widespread copyright infringement of movies and television programs. Discussions of this matter gave Sony's competitors such as Matsushita and JVC time to develop a different VCR format, VHS, which permitted an additional three hours of playing time and was incompatible with Sony's Betamax. Although Betamax was generally considered technically superior, VHS soon became the industry standard, and Sony lost its early lead in the lucrative VCR market.

The Betamax VCR experience in the early 1980s convinced Sony that technological innovation alone could not insure market dominance, and that the match between hardware and software was critical. Subsequently, Sony began to cooperate more with competitors to develop industry standards. In the 1980s, for example, Sony joined the Dutch electronic firm Philips to pioneer compact disc (CD) technology.

In the mid 1990s, Sony Corporation reorganized to keep the company market-driven and increase autonomy. Sony organized its businesses into 10 divisions, including Display, Home AV, Information Technology, Personal AV, Personal & Mobile Communications, Broadcast Products, Image & Sound Communication, Semiconductors, Components & Computer Peripherals, and Recording Media & Energy. To develop future top managers, Sony appointed promising young executives as presidents of each company with substantial autonomy. Masao Morita was appointed president of the Personal & Mobile Communication Company.

CAR NAVIGATION SYSTEMS

Evolving Products

A car navigation system plotted a driver's current location on a dashboard-mounted LCD monitor by calculating signals received from satellites and/or utilizing a dead reckoning system fed by speed and gyro sensors. The system also told the driver the best way to his or her destination by employing a digital map database stored on either a CD-ROM, a computer hard disk, or an IC-card. Unlike VCRs and personal computers, car navigation systems hardware and software were not standardized as of 1995, but a typical model consisted of hardware such as a satellite signal receiver, a CD-ROM player, an LCD monitor mounted on/in a car dashboard, and digital map software in the form of a CD-ROM. **Exhibit 5** summarizes the cost and margin structure of the system.

In the late 1980s, the earliest car navigation systems could only report where a driver was, his/her desired destination, and whether or not the car was headed in the right direction. By the mid 1990s, however, the systems had become more intelligent. Recent models could inform a driver of his/her current location at all times and deduce the best route to a destination automatically by taking into account current traffic conditions. Some systems could even communicate verbally with the driver and provide turn-by-turn instructions on the LCD map or through voice.

Enabling Hardware

Car navigation systems were facilitated by the Global Positioning Satellite (GPS) system, a constellation of 24 satellites operated by the U.S. Department of Defense. CPS was originally developed at a cost of $10 billion for military applications during the Cold War, but became available for civilian use at no charge in the late 1980s.

The central concept behind GPS was triangulation. If a car's exact distance from a satellite was known, the car's location had to lie somewhere on the sphere defined by that radius. If the driver's distance from a second satellite was also known, the car's position had to be along the circumference of the circle where the two spheres intersected. Knowing the distance from a third satellite would result in two points where all three spheres

EXHIBIT 5
Typical Cost and Margin Structure of Car Navigation Systems

a. Typical Cost and Margin Structure for Car Navigation Systems:

Retail Price	100%
Less Dealer Margin	35%
Manufacturer selling price	65%
Less Manufacturer Margin	5%
Manufacturer Total Cost	60%
Indirect Cost (SGA)	10%
Direct Cost	50%
(LCD Monitor	30%)
(CD-ROM Player	8%)
(CPU	7%)
(GPS Receiver	3%)
(Other Components	2%)

b. Japanese Model (e.g., Sony NVX-F16):

Retail selling price	$2,000
Less Dealer margin[a]	$700
Manufacturer selling price	$1,300
Less Manufacturer total costs	$1,200
Manufacturer margin	$100

c. Overseas Model (e.g., Sony NVX-F-160):

Overseas retail selling price	$3,000
Less Overseas dealer margin[a]	$1,000
Manufacturer selling price	$2,000
Less Manufacturer total costs[b]	$1,800
Manufacturer margin	$200

Notes: [a] Dealer charged separate fee for product installation. Japanese dealers charged around $200. US and European dealers charged around $30
[b] Manufacturer total costs of overseas model included applicable transportation costs and import duties.

Source: Estimation of the case writers, based on research interviews.

intersected. GPS in fact used four signals from four different satellites to locate the position of the antenna.

Triangulation on GPS could result in accuracy as close as thirty meters. Worrying that GPS could be used by an enemy to guide missiles or smart bombs, Department of Defense engineers intentionally built errors into the system for civilian use. The civilian signal could deliver 95 percent accuracy within 100 meters of the actual location. The GPS signal could also be blocked by tall buildings, trees, or overpasses, a common problem in large cities.

In order to improve the precision in identifying the car's location on the earth, the car navigation systems were equipped with a few supporting technologies. When GPS did not function accurately, a back-up dead-reckoning system of speed and gyro sensors typically installed in the car trunk could take over seamlessly and relay the car's speed and direction to the navigation system. Aided by the dead-reckoning system, map matching technologies enabled the car navigation system to pinpoint the car's position on the digital map.

In car navigation hardware, there was no dominant product standard. Some products utilized both GPS signals and dead-reckoning systems, but others employed only one of the two. Product interfaces were also diverse. Some displayed a colorful digital map on an LCD monitor. On a typical LCD screen, a small red circle sign, representing the car, moved along a highlighted street leading the driver to his/her desired destination. Some other models' monitors showed only right or left arrow signs and the street name to signal the next appropriate turn. Others did not have display devices but provided directions verbally.

Diverse Software Formats

The software database technology used in car navigation systems was the offspring of GIS, or Geographic Information Systems. GIS was originally developed by the U.S. Department of Defense for guiding missiles. In essence, GIS software turned a conventional map into a digital database.

For accurate navigation, a digital map had to contain correct details of every street. Every sign, every painted line, every relevant piece of information along the road had to be included. For example, the database had to note whether there was a concrete divider along a highway, whether two streets intersect or one was on an overpass, and so

forth. Consequently, each street corner required three to four dozen items of data.

As many data layers as desired could be added to the digitized map. Postal zip codes and phone numbers could be stored in the database so that a driver could find a destination by entering an address and/or phone number. Information on "points of interest," such as banks, restaurants and gas stations, could also be digitized on the map. One could analyze these data in hundreds of different ways and, in conjunction with a GPS receiver, could interact with the data on a real time basis. In real life, for instance, a stranger was not likely to know the ATM closest to any given spot. However, with a points of interest database, a car navigation system could sort through ATMs by distance, find the nearest one operated by the driver's preferred bank, and provide route guidance to this ATM.

Collecting and digitizing all the road-related information and the point of interest data were labor intensive. Government geological surveys and commercially published maps were often old and inaccurate. Hence, digital map companies had to send out research teams to take aerial and ground photos to fill in gaps and update the old information. Collecting, and digitizing the necessary information on the city of Boston, for example, required 20 engineers to work for one year. Given continuous change due to road construction and store openings and closings, digital map companies had to retain local staff to update the data.

The cost of digitizing the cartography of the United States was estimated at $1 billion with an additional $100 million a year for updating. A single company starting this task in 1995 could not achieve payback before 2005. There were two major digital map companies in the U.S. competing independently. As of early 1996, Etak, a Silicon Valley division of Rupert Murdoch's News Corporation, had covered cities representing 80 percent of the U.S. population. NavTech, another Silicon Valley startup, had covered 90 percent of the U.S. population.

There were three digital map companies working in Europe. Etak focused its European operation on the United Kingdom and had so far covered cities accounting for 80 percent of the population. EGT, NavTech's European subsidiary, covered 80 percent of Germany and 70 percent of France. A third company, TeleAtlas, was digitizing Italian maps. These companies had developed independently non-compatible digital map software.

In Japan, 40 companies, including car companies, electronic firms, and digital map developers, formed the Japan Navigation Research Association, known as NaviKen, in the early 1980s, and completed 100 percent digitization of the entire country by 1988. The NaviKen format was consistently applied in the navigation systems produced by the NaviKen member companies such as Sony and Mitsubishi. However, other incompatible formats had been developed independently by Pioneer and Matsushita respectively, which did not join NaviKen. **Exhibit 6** compares the number of CD-ROMs available for different competitors' car navigation systems.

The data storage media also varied. Some devices used the digital map stored on a CD-ROM, while others used maps stored on computer hard disk or IC card. CD-ROM based navigation systems were popular in Japan and Europe, but hard disk and IC card were believed equally acceptable in the United States, especially for low-end products.

Distribution Channels

Car navigation systems could be sold either on an OEM basis or through after-market retail channels. **Exhibit 7** summarizes the distribution alternatives.

In the OEM channel, car navigation system producers contracted with car assemblers to supply car navigation systems to the automaker's specifications. The systems were either pre-installed by the car manufacturers or installed later by dealers as a purchase option on new cars.

After-market models were usually designed and marketed by car navigation system makers and distributed through wholesalers to auto parts

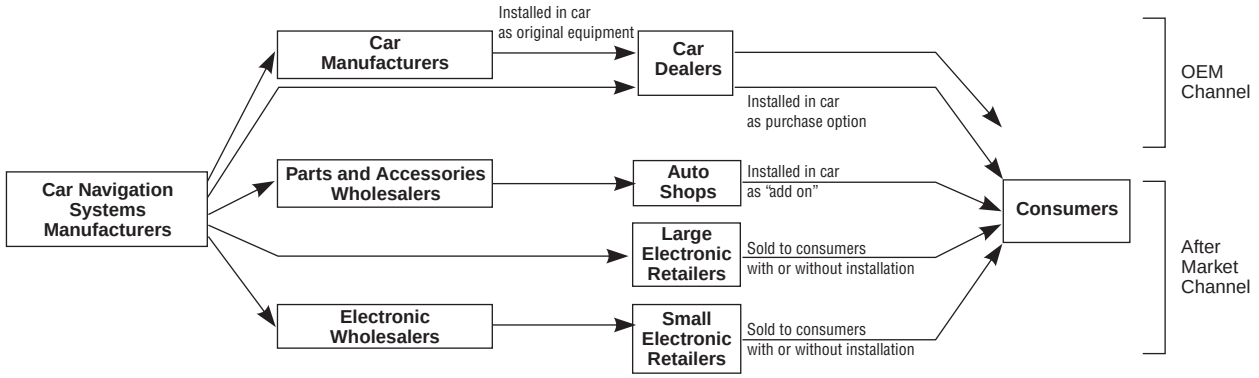
EXHIBIT 6
Number of CD-ROMs by Car Navigation System Producer: 1995

Company	*Sony*	*Alpine*		*Malsushita*		*Pioneer*
Software Format	*NaviKen*	*Proprietary & NaviKen*[a]		*Proprietary & NaviKen*[a]		*Proprietary*
General Road Maps	5	7	(2)	6	(1)	2
Sports (golf, ski, camping, etc.)	6	6	(0)	6	(0)	3
Travel (hotels, parks, etc.)	4	4	(0)	4	(0)	1
Shops/Restaurants	1	1	(0)	1	(0)	1
Radar Detection	0	0	(0)	0	(0)	1
Games/Quizzes	4	4	(0)	4	(0)	6
Karaoke	0	0	(0)	0	(0)	56
TOTAL	20	22	(2)	21	(1)	70

Note: [a] Numbers include both original and NaviKen CD-ROMs since Alphine and Matsushita's systems can read NaviKen software. Numbers in parentheses are proprietary CD-ROMs developed by Alpine and Matsushita.

Source: Adapted from various product catalogues.

EXHIBIT 7
Channels for Car Navigation System



retailers and electronics outlets. Sales to end consumers were either made on a cash and carry basis or involved dealer installation and other after sales services.

All components of OEM models, including LCD monitors, were neatly installed together with audio equipment such as radio, cassette, and CD players in the car dashboard. In contrast, after-market systems usually had to be installed as "add ons" to the dashboard. Volume contracts with the car manufacturers meant that Japanese OEM products were technically one to two years behind and more expensive than after-market models.

In the Japanese market, 80 percent of the systems were sold through after-market channels while 20 percent were sold on an OEM basis. However, as the technological innovation diffused and products became more standardized, the percentages were forecast to be even by 2000 and to be reversed by 2005. The fledgling European markets mainly involved OEM sales in 1995, but the proportion of after-market sales was expected to increase. The U.S. market was still undeveloped, but OEM models were expected to exceed after-market sales, especially if the price decreased substantially.

In Japan, major auto parts chains, such as AUTOBACS and Yellow Hat, accounted for 60 percent of after-market unit sales. Hybrid models based on both GPS and dead-reckoning sensor were distributed through these auto parts retailers since they required professional installation and maintenance. These auto parts retailers carried, at most, five brands on their shelves. GPS-based systems which did not require complicated installation were channeled mainly through large electronics discount chains and were more subject to price competition.

MULTINATIONAL MARKETS

Advanced Japanese Market

The Japanese market for car navigation systems was the world's largest in 1995 with sales of 580,000 units and $840 million.[2] Car navigation systems were installed in 10 percent of new Japanese cars in 1995. The penetration rate for all cars registered in Japan was 2 percent. With competition among 30 companies, the average retail price per unit decreased dramatically from $4,000 in 1990 to $2,500 in 1995. As competitors vied to introduce new models with the latest technological features, market shares fluctuated wildly.

The popularity of car navigation systems reflected the uniqueness of the Japanese car driving environment. First, the Japanese road system was more complicated than its European and U.S. counterparts. Since not all the streets had names and road signs were few and far between, people relied heavily on maps and landmarks for finding their way. Caught on narrow roads without the benefit of a highly developed highway system, drivers were always looking for a way to bypass heavily congested arteries, especially in major metropolitan areas.

Given serious traffic jams and well-developed train systems, most Japanese used their cars for weekend joy-riding rather than daily commuting.[3] Many, therefore, welcomed car navigation systems as a means of finding their way around in unfamiliar cities and towns.

---

[2] The concept of the car navigation system had been around in Japan since the early 1980s. Honda claimed to be the first company to put a navigation system on the road. However, the dead-reckoning system, which required a driver to replace a slide-like map at each town boundary, did not attract consumers. The Japanese market remained small during the 1980s although electronic car component producers such as Alpine and Nippon Denso did supply car navigation systems on an OEM basis to the automobile assemblers. They offered the navigation systems as optional accessories on a limited number of their luxury models, such as the Honda Legend and the Toyota Crown. The navigation systems at that time were priced at around $6,000.

[3] If all the cars registered in Japan were to be on the road at the same time, the distance between each would be only four feet.

Japanese car drivers, especially young people, were willing, to spend heavily on cars and electronic accessories. Many drivers would readily invest over $2,000; few U.S. drivers would invest more than $1,000. Outside Japan, higher auto theft rates discouraged heavy investment in expensive electronic options. **Exhibit 8** summarizes results of Japanese consumer and dealer research.

The Japanese car navigation market was boosted further by Japanese government investment in improving the efficiency of the Japanese road system. A real-time traffic information system called

EXHIBIT 8
Results of Japanese Consumer and Dealer Surveys: 1992–1995

1992 Consumer Survey[a]

- Forty-five percent expressed their interest in buying a car navigation system in one or two years; two percent had already purchased one.
- Those who would buy a system were willing to spend $500–$1,000 (50 percent), $1,000–$2,000 (40 percent) and $2,000+ (10 percent).
- Seventy-five percent of those who would buy a system rated "accuracy of road map" as an important factor for their purchase decision, followed by "detailed traffic information" (56 percent), "number of CD-ROMs" (52 percent) and "up-to-date point-of-interest information" (43 percent):
- Benefits mentioned in order of frequency: can enjoy weekend drive better (90 percent), can drive in unfamiliar area (80 percent), can use landmarks for finding a route (75 percent).

1994 Dealer Survey[b]

- Eighty percent of respondents stated that the price of car navigation systems was too high. Among these, 80 percent believed $1,500 was appropriate and 20 percent said $1,000.
- The most frequently asked question by customers to retailers was: "Can I use NaviKen format CD-ROMs?"
- Ninety-two percent of dealer salespeople preferred selling systems with NaviKen compatible software.

1995 Customer Survey[c]

- Customer demographics were as follows:
  - 20–24 years (15 percent), 25–29 years (30 percent) 30–39 years (40 percent), and 40 years and older (15 percent)
  - married (44 percent) and not married (56 percent)
  - male (95 percent) and female (5 percent)
  - 75 percent owned new cars and 25 percent used cars
  - Average price of their cars was $33,000
- Respondents used car navigation systems: when driving in unfamiliar areas (95 percent); when enjoying weekend drives (85 percent); not during regular commute (70 percent); all the time (15 percent).
- Ninety percent stated that a map display was essential for route guidance while 10 percent said arrow signs and voice guidance were sufficient.
- Important factors influencing the purchase decision in order of frequency of mention: accuracy of map and map-matching; automatic route calculation; easy-to-set-up destination; speed of route calculation.
- Respondents wished to have the following information: "real time traffic jam" (100 percent), "one-ways" (85 percent), "real-time parking space" (80 percent), "alternative bypass route" (80 percent), and "expected arrival time to the destination" (75 percent).

Source: Compiled from the following surveys conducted by one of the car navigation systems producers:

[a] Survey of 550 high potential purchasers, sampled from car audio magazine readers in October 1992.

[b] Survey of dealer salespeople in 20 largest auto parts chain stores, conducted in May 1994.

[c] Survey of 600 owners of car navigation systems, sampled from car audio magazine readers in October 1995.

VICS (Vehicle Information and Communication System), would be launched in Tokyo and Osaka in 1996.[4] With VICS information, the next generation of navigation systems would be able to incorporate real-time traffic and weather alerts so that drivers could avoid gridlock, accidents, or washed out roads.

Emerging European Market

The European market lagged behind Japan by some five years. However, once major electronics manufacturers such as Bosch and Philips introduced products in Germany, the market began to develop. The market was expected to grow from annual sales of 30,000 units and $60 million in 1995 to 600,000 units and $600 million by 2000. (See Exhibit 4.)

European road systems were complex, especially in historic inner cities. However, most streets had names and road signage was good. As a result, opinions differed on whether a car navigation system needed to show a digital map on an LCD monitor or if right/left arrow signs and voice guidance were sufficient.

European drivers frequently drove across borders. Car navigation systems, therefore, needed to provide multi-lingual guidance. Digital map software also had to correspond to different traffic rules and road regulations from country to country.

European governments collaborated on efforts to improve the highway system. For example, the European Union's DRIVE program analyzed how the car should relate to the road infrastructure, while the PROMETHEUS project involving all major European manufacturers examined how cars could communicate with each other. The technologies developed through these projects contributed to Philips' and Bosch's development of navigation technologies such as route calculation and guidance.[5]

Untapped U.S. Market

The U.S. market lagged both Europe and Japan. Car navigation systems were not widely known. However, one forecast expects the U.S. market would surpass the European market by 2000, with annual sales of 900,000 units and $720 million, and approach the size of the Japanese market by 2005, with sales of 2.4 million units valued at $1.2 billion a year. (See Exhibit 4.)

The United States was well-organized with street names, traffic signs, and highly developed highway systems. The value of car navigation systems which pinpointed a car's current location was not so obvious to the U.S. driver. For car navigation systems to be attractive, they had to provide turn-by-turn route guidance and other more sophisticated functions.

As of 1995, few U.S. consumers were familiar with car navigation systems. A manager at one digital map maker explained:

> If it were described to you before you experienced it, you might not understand. But after testing the system, most drivers come around. All it takes, after all, is the admission that a map database knows more about the road than you do.[6]

Consumer research studies indicated rising interest among U.S. consumers. One study reported that 58 percent of car owners had heard about vehicle navigation systems, primarily through television (37 percent) or published material (36 percent). Among those aware, most could recall the system's purpose and basic features, but relatively few understood what "GPS" meant, knew about voice prompts, or about systems being available in rental cars.

[4] The ATIS (Advanced Traffic Information System) was launched earlier in 1995. The system allowed a driver to retrieve real-time traffic information by using a car cellular phone.

[5] "Smart Cars," *TelecomWorld*, Aug. 1992, pp. 44–45

[6] *Wired*, Winter 1995.

The same research reported that 70 percent of respondents were interested in purchasing a car navigation system. Among those, 26 percent were interested in buying an OEM, pre-installed, in-dash model with display, 57 percent voted for an after-market, on-dash model with a monitor, while 17 percent, indicated preference for a lower-end, voice-navigation model with no display. Respondents were, willing to pay $700 to $1,000 for a pre-installed OEM model, $600 to $700 for the second type, and $500 to $600 for the third type. **Exhibit 9** summarizes the detailed research results.

Another survey conducted by J.D. Power and Associates focused on potential purchasers. The study involved 170 consumers taking two-day test drives of navigation system-equipped automobiles, and completing three questionnaires: prior to driving the system-equipped cars (to assess awareness and image of the navigation systems); following a 10-minute test drive (to simulate consumer impressions after a dealership test drive); and after driving the car for two days (to simulate impressions following an experience driving a system-equipped rental car). **Exhibit 10** summarizes the research results.

The survey revealed that both the 10-minute and the two-day test drives enhanced respondents' understanding of the system's features, benefits, and ease of use. After the initial test drive, participants noted several key advantages, including convenience, the ability to save time and money, the ability to replace maps, and less of a need to ask for directions. The extended two-day test led to lower stress and improved driving confidence. The longer test drive increased the likelihood of respondents recommending the system to family and friends.

In 1992, five years after Japan, the federal U.S. government began a six year program of investing in smart highway technologies, including sensors, television cameras, and radars to monitor city traffic and relay traffic conditions to central computers. From workstations at command headquarters, technicians would be able to alter freeway signals

EXHIBIT 9
Survey of California Car Renters: January 1996

- Drivers were willing to pay, on average, $5 more per day to rent a car with a navigation system.
- Drivers who would purchase or lease a car with a navigation system (70 percent of the sample) were willing to spend, on average, an extra $550. Eleven drivers were willing to spend over $1,000.
- Drivers who would buy navigation systems and install them in their current cars (35 percent of the sample) were willing to spend, on average, $1,100.
- Twenty percent said they would buy the navigation system if it cost $1,200.
- Twenty percent stated they used the system "all the time." Another 30 percent used it "a lot."
- Benefits mentioned in order of frequency: prevents you from getting lost in a new city; helps you find your destination; eliminates the need for maps; increases driving safety; you don't have to stop and ask directions; takes you via best route; and gives feeling of confidence when driving.
- Problems mentioned in order of frequency: took time to figure out how to use it; destination not in computer; not able to calibrate alternate route; out of range error; directions unclear and/or hard to hear; and monitor hard to read.
- Sixty percent found the navigation system worked better than they expected.
- Sixty percent used the system for guidance in getting to a destination. Twenty percent used it for finding points of interest, for experimenting with different routes, and for determining current location.
- Two-thirds of respondents stated the device was easier to use when the car was parked. Forty percent believed it was distracting to use while driving.

Source: Compiled from survey of 53 frequent Avis car renters in California, conducted by Center for Strategy Research, January 1996.

EXHIBIT 10
Results of J.D. Power Consumer Survey: August 1995

- Using a 10-point scale for satisfaction, where 10 is "extremely satisfied," eighty percent of respondents rated their overall satisfaction as a "nine" or "10," resulting in a mean of 8.43.
- Sixty percent were "very likely" to recommend the system to family and friends after the 10-minute test drive. The percentage increased to 70 percent after the two-day test drive.
- Respondents preferred an in-dash OEM system to an on-dash after-market model by a margin of four to one, due to perceived better quality and system reliability resulting from more professional installation and better integration with the vehicle's electrical system.
- Those who would buy an after-market system mentioned perceived transferability/portability and lower price as reasons for their preference. The average expected price for an after-market model was $900, versus $1,000 for an OEM system.
- Those preferring an after-market model expected to purchase it at "specialty store" (41 percent), "electronic store" (17 percent), "discount store" (13 percent) and "department store" (6 percent). "Specialty store" included outlets specializing in selling and installing alarms, audio systems, and vehicle cellular phones.
- Over eighty percent said that availability of a car navigation system would be an important factor in deciding which vehicle to purchase next time.
- Regarding the value of different point-of-interest information, "emergency assistance/hospital/police" was rated highest (9.03), followed by "auto care/gas" (8.23), "travel points" (8.13), "entertainment/tourist attractions" (8.04), "business facilities" (7.50) and "ATMs/banks" (7.39).
- Focus group discussions revealed high interest in point-of-interest listings of new and different entertainment and dining options, particularly in unfamiliar areas. Said one New York participant:

  > "We went to Connecticut to visit relatives and arrived early and decided to get something to eat. We just looked through point-of-interest listings and selected a restaurant."

  A participant from Los Angeles noted:

  > "The system opens up your world; it lists theaters and restaurants and places you haven't heard of."

Notes: Survey of 170 high potential purchasers by J.D. Power and Associates, July and August 1995.
Respondents participated in a two-day test drive of a vehicle equipped with an Avis car navigation system. They were screened for the following criteria:
- Household income of at least $50,000
- Cellular phone ownership and monthly cellular phone bill of $50 or more
- Average of 2 or more hours per day in vehicle on business travel (excluding normal commute)
- Ages 25 to 59

Source: Adapted from J.D. Power and Associates, *The Power Report*, November 1995.

and stoplights to reroute traffic, and relay advisories to cars equipped with more sophisticated navigation systems. On the other hand, safety regulations in 13 major states, including California and New York, prohibited any in-car visual devices, except for security purposes.

SONY IN INTERNATIONAL COMPETITION

Competition in Japan

In November 1990, the first GPS-based after-market car navigation system was introduced by Pioneer Electronic Corporation, a Japanese leader in car stereo and laser disc players. Since the GPS signal was not yet available around the clock and was easily interrupted by high-rise buildings in Tokyo, Pioneer defined the product as a "Satellite Cruising System," emphasizing the innovative and entertainment aspects of the product rather than its practical capabilities as a navigation device.[7] Pioneer had

[7] With only 12 satellites until 1992, GPS did not provide the signals necessary for 24 hour coverage. The system became complete with 24 satellites in 1993.

developed its own digital map software and stressed the variety of point-of-interest information its system could provide, ranging from hotels to restaurants. In addition, to distract drivers from Japan's endless traffic jams, Pioneer included entertainment software containing games, quizzes, horoscopes, and karaoke. Pioneer distributed the products through the same channels used for conventional car stereos, principally auto parts shops, since the product required professional installation. Despite a high retail price over $5,000, Pioneer sold 20,000 units annually in the early 1990s.

The market changed dramatically in June 1993, when Sony entered the after-market segment with the NVX-F1O, including a 4-inch LCD monitor at a low-price of $2,000. Six months later, Sony introduced NVX-15 with a larger 5-inch display at $2,500. Unlike Pioneer, Sony emphasized the product's practical benefits and named it "Digital Map Car Navigation System." Sony advertised the product as a problem-solving device for drivers, who did not want to face traffic jams, get lost in unfamiliar towns, or be late for appointments. These GPS-based products showed only the driver's current position on the digital map screen, but did not provide route guidance toward the destination. However, sharply lower prices attracted many consumers. Aiming at rapid market expansion, Sony distributed almost 50 percent of its units through consumer electronics channels. Sony sold some 10,000 units monthly through 1993, achieving a 60 percent market share.

To develop the market further, Sony set out to establish an industry standard for digital map software. Sony was the most active member of the Navigation Research Association to set the NaviKen format for CD-ROM based digital maps. The standard setting effort lowered entry barriers, resulting in 10 new entrants in 1994 and another five in 1995. Competition fueled market growth from 160,000 units in 1993, to 340,000 units in 1994, and to 580,000 units in 1995.

Market growth encouraged intense competition and faster new product development. **Exhibit 11** reports the timing of product introductions by different competitors. Once every six months during 1994 and 1995, competitors introduced progressively more advanced products. In April 1994, Matsushita, which had not joined NaviKen, was the first to develop a hybrid system employing both GPS and dead-reckoning sensor. The Matsushita model was also the first to be able to calculate and communicate the best route to a destination. In October 1994, Alpine, which was originally a NaviKen member but later became an independent developer, introduced the first hybrid model that could provide turn-by-turn route guidance. In early 1995, Pioneer introduced a new hybrid model with a flash memory chip in its CPU; this enabled the entire system to be upgraded by just installing a new CD-ROM. As shown in **Exhibit 12**, these more sophisticated hybrid models began to outsell the simpler GPS-based products by 1995.

NaviKen member companies, including Sony, did not respond quickly enough. It took the 40 NaviKen members more than a year to agree on a standardized software upgrade. In addition, NaviKen members saw little room to differentiate their products from each other. As shown in **Exhibit 13**, Sony introduced new products almost every six months, but all were modified versions of the original GPS-based products, which did not provide automatic route calculation or turn-by-turn route guidance. In May 1994, Sony introduced NVX-F16, an extended version of the NVX-F15, but sold only 15,000 units by April 1996. In October 1994, Sony introduced NVX-B50, which employed a CD-ROM changer in which a driver could place six different CD-ROMS. The product sold only 9,000 units by April 1996. Sony had perhaps introduced the product too early because the average navigation system owner had only 1.5 CD-ROMs as of 1995.

In July 1995, Sony finally introduced NVX-S1, a hybrid system with a route guidance function. However, the market did not respond well to this late entry. According to a trade magazine, NVX-S1, which still employed the NaviKen standard in its digital map database, calculated a route too slowly and provided turn-by-turn guidance too

EXHIBIT 11
Number and Timing of New Product Introductions in Japan: After-Market Models

Company/Brand	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*TOTAL*	*1995 Product Line*[a]
Pioneer	2	0	1	4	4	3	14	7
Sony	0	0	1	3	5	5	14	8
Matsushita	0	0	0	1	3	3	7	4
Alpine	0	0	0	3	2	2	7	2
Mitsubishi	0	0	1	1	3	4	9	6
Kenwood	0	0	1	0	3	2	6	3
Zanavi	0	0	0	0	0	4	4	4
Clarion	0	0	0	2	1	2	5	3
Fujitsu Ten	0	0	0	0	1	3	4	3
Nippon Denso	0	0	0	0	0	2	2	2
Sharp	0	0	0	0	3	0	3	2
Casio	0	0	0	0	1	1	2	2
Sumitomo Denko	0	0	0	1	3	1	5	3
Toshiba	0	0	0	2	2	3	7	5
Citizen	0	0	0	0	0	3	3	3
Caisonic	0	0	0	0	2	3	5	4
NEC	0	0	0	0	1	1	2	1
Chuo Jidosha	0	0	0	0	1	1	2	1
Maspro	0	0	1	0	1	1	3	2
Sanyo	0	0	0	1	0	3	4	3
Nakamichi	0	0	0	0	1	0	1	1
TOTAL	2	0	5	18	37	47	109	69

Note: [a] After adjusting for discontinued products.

Source: Analysis of the case writers, based on research interviews.

infrequently, compared to competitive products. See **Exhibit 14** for a summary of the magazine's product comparison.

By 1995, competition focused on the richness of the digital map databases. In October 1995, Alpine introduced another new product with a database of 11 million phone numbers built into its digital map software which a driver could use to identify his/her destination. The product sold well, giving Alpine the market share leadership, as shown in **Exhibit 15**. Other competitors followed suit, building more advanced databases filled with large numbers of phone numbers, landmarks, and other point-of-interest information.

Fighting against heavy odds in the main models, Sony turned its product strategy back to the GPS-based model, by introducing portable navigation systems. In December 1995, Sony introduced Handy Navigation System GPX-5, the world's first detachable model. It could be used both inside and outside an automobile, targeting customers who wanted to use the system for outdoor camping, bike touring, and marine sports. The GPS-based device alone retailed for $2,000, with an option to purchase a gyroscopic sensor to convert the system into a hybrid for an additional $300. A customer could also add a home station kit for $200; this could connect a navigation system to

EXHIBIT 12
Unit Market Shares of Advanced Models in Japan: 1993–1995

Turn-by-Turn Route Guidance		
	No (GPS)	**Yes (Hybrid)**
1993	98%	2%
1994	56%	44%
1995	20%	80%

Automatic Route Calculation		
	No (Manual)	**Yes (Automatic)**
1993	97%	3%
1994	50%	50%
1995	30%	70%

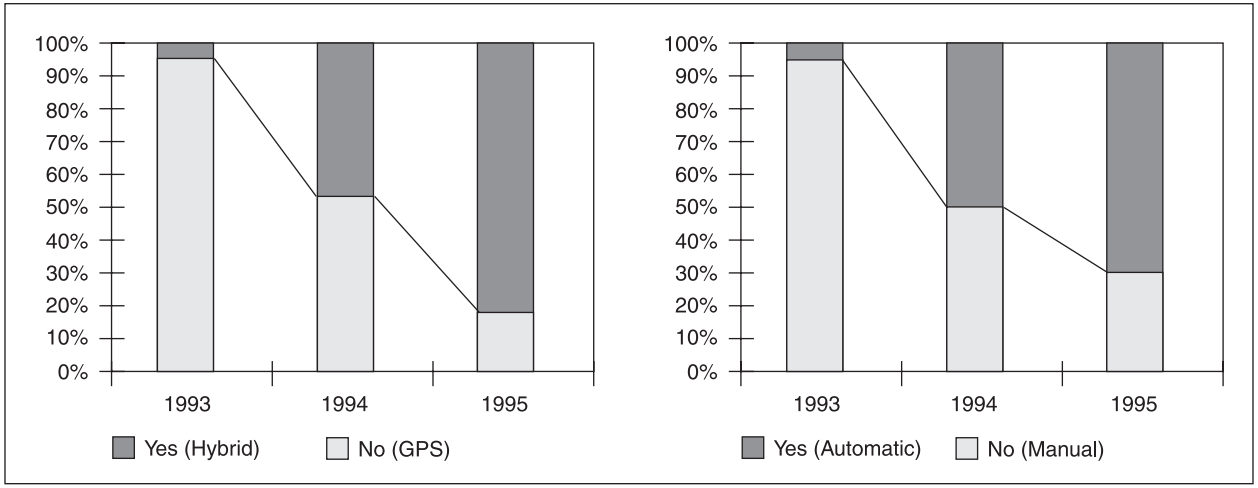


EXHIBIT 13
Sony Product Introduction Chronology: 1992–1995

General Information			*Cumulative*		*1995*		*Hardware*		*Functions*			
Product	*Retail Price*	*Launch Date*	*Unit Sales*[a]	*(%)*	*Unit Sales*[a]	*(%)*	*GPS or Hybrid*	*w/ or w/o Monitor*[b]	*Route Guidance*	*Route Cal.*	*Auto Route Re-Cal.*	*Voice Recognition*
NVX-1	$4,700	92/06	7,000	(3%)	-	(0%)	GPS	w/	No	No	No	No
NVX-F10	$2,100	93/06	100,000	(41%)	-	(0%)	GPS	w/	No	No	No	No
NVX-F15	$2,800	93/10	15,000	(6%)	-	(0%)	GPS	w/	No	No	No	No
NVX-F1	$1,600	93/10	4,000	(2%)	-	(0%)	GPS	w/	No	No	No	No
NVX-2	open price	94/02	3,000	(1%)	-	(0%)	GPS	w/o	No	No	No	No
NVX-F16	$2,500	94/06	15,000	(6%)	7,000	(7%)	GPS	w/	No	No	No	No
NVX-9	$1,400	94/06	4,000	(2%)	-	(0)%	GPS	w/o	No	No	No	No
NVX-B50	$1,800	94/10	9,000	(4%)	4,000	(4%)	Hybrid	w/o	No	No	No	No
NVX-4	$1,500	94/10	9,000	(4%)	4,000	(4%)	Hybrid	w/o	No	No	No	No
NVX-F18MK2	$2,500	95/02	10,000	(4%)	10,000	(10%)	GPS (w/ Hybrid Option)	w/	No	No	No	No
NVX-A1	$1,300	95/04	4,000	(2%)	10,000	(10%)	GPS	w/o	No	Yes	No	No
NVX-S1	$1,500	95/07	40,000	(16%)	40,000	(41%)	Hybrid	w/o	Yes	Yes	No	Optional
NVX-F30	$2,300	95/07	20,000	(8%)	20,000	(20%)	GPS	w/	Yes	Yes	No	Optional
GPX-5	$2,100	95/12	3,000	(1%)	3,000	(3%)	GPS (w/ Hybrid Option)	w/	Yes	Yes	No	Optional
		TOTAL	243,000	(100%)	98,000	(100%)						

Notes: [a] All sales were made in Japan in the after-market. All products used the NaviKen format.

[b] "w/o monitor" means that the product was sold without a monitor. A customer needed to buy a monitor (which cost $500–$1,000) to complete the system.

Source: Analysis of the case writers, based on research.

EXHIBIT 14
Top 10 Brand Product Comparisons: 1995

Company	Product	Retail Price	Launch Date	1995 Unit Sales	Hardware: GPS or Hybrid	Hardware: w/ or w/o Monitor	Software: Digital Map Format	Functions: Route Guidance	Functions: Route Cal.	Functions: Auto Route Re-Cal.	Functions: Voice Recognition
Pioneer	AVIC-XA1	$2,630	95/11	30,000	Hybrid	w/	Original Only	Yes	Yes	No	No
Sony	NVX-S1	$1,500	95/07	40,000	Hybrid	w/o	NaviKen Only	Yes	Yes	No	Optional
Matsushita	CN-V700	$1,570	95/07	50,000	Hybrid	w/o	Both	Yes	Yes	Yes	No
Alpine	NTV-W055V	$2,480	95/11	40,000	Hybrid	w/	Both	Yes	Yes	Yes	No
Mitsubishi	CU-9510	$1,490	95/05	15,000	Hybrid	w/o	NaviKen Only	Yes	Yes	No	No
Kenwood	GPR-03EX	$1,450	95/10	15,000	Hybrid	w/o	Both	Yes	Yes	No	Yes
Zanavl	XA-N1	$1,480	95/06	5,000	Hybrid	w/o	NaviKen Only	Yes	Yes	No	No
Clarion	NAX9100	$1,470	95/11	10,000	Hybrid	w/o	Original Only	Yes	Yes	No	No
Fujitsu Ten	E500NCU	$1,650	95/11	10,000	Hybrid	w/o	Both	Yes	Yes	Yes	No
Nippon Denso	MV-1000S	$2,580	95/01	3,000	Hybrid	w/	Original Only	Yes	Yes	No	No

		User Test Result (5=excellent, 1=poor)					
Company	Product	Easy To Use Command	Easy To Read Monitor	Easy To Find Destination	Speed of Route Calculation (Seconds)	Accuracy of Route Guidance	Total Score
Pioneer	AVIC-XA1	2	3	3	2 (141)	3	13
Sony	NVX-S1	2	3	3	2 (121)	2	12
Matsushita	CN-V700	5	5	4	3 (58)	5	22
Alpine	NTV-W055V	4	4	5	5 (16)	5	23
Mitsubishi	CU-9510	3	3	2	2 (110)	4	14
Kenwood	GPR-03EX	3	3	2	3 (57)	2	13
Zanavi	XA-N1	4	3	4	4 (43)	3	18
Clarion	NAX9100	3	5	3	4 (46)	4	19
Fujitsu Ten	E500NCU	3	4	2	2 (110)	3	14
Nippon Denso	NV-1000S	5	4	5	4 (42)	4	22
	Average	3.4	3.7	3.3	3.1 (74)	3.5	17

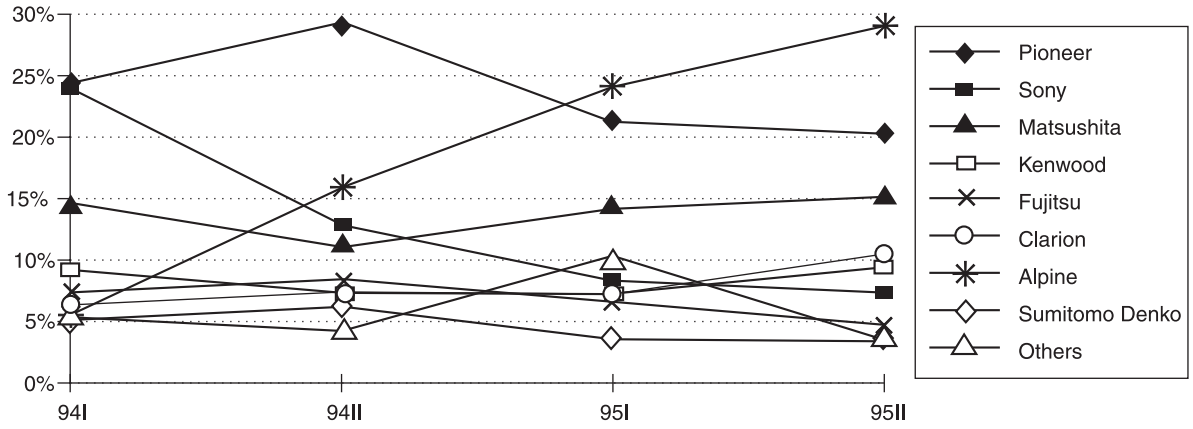
Notes: For each brand, this exhibit reports sales of the best selling after-market in 1995.

"w/o monitor" means that the product sold without a monitor. A customer needed to buy a monitor (which cost $500–$1,000) to complete the system.

Source: Adapted from *1996 New and Improved Car Navigation Systems*, Naigal Shuppan Publishing, 1995.

EXHIBIT 15
Unit Market Share Changes in After-Market/Auto Parts Store Channel in Japan: 1994–1995

1994 January–June		*1994 July–December*		*1995 January–June*		*1995 July–December*	
Pioneer	24%	Pioneer	29%	Alpine	24%	Alpine	29%
Sony	24%	Alpine	16%	Pioneer	21%	Pioneer	20%
Matsushita	15%	Sony	13%	Matsushita	14%	Matsushita	15%
Kenwood	9%	Matsushita	11%	Sony	8%	Clarion	10%
Fujitsu	7%	Fujitsu	8%	Clarion	7%	Kenwood	9%
Clarion	6%	Kenwood	7%	Kenwood	6%	Sony	7%
Alpine	5%	Clarion	6%	Fujitsu	6%	Fujitsu	4%
Sumitomo Denko	4%	Sumitomo Denko	6%	Sumitomo Denko	3%	Sumitomo Denko	3%
Others	4%	Others	4%	Others	10%	Others	3%



a home television and enable a consumer to plan a route before going out to drive.

European Competition

In Europe, car navigation systems were first installed on an OEM basis in luxury automobiles in late 1994. Philips developed its first system as an optional accessory to BMW's 7- and 5- Series models in October 1994. Philips' model employed a hybrid system with GPS and dead-reckoning sensors, provided route guidance by either map, arrows, or voice, and used the CD-ROM based digital map software developed by EGT, a subsidiary of NavTech of the United States. Retailing for DM6,900 ($4,600), the first model sold 10,000 units in 1995. In September 1995, Philips started marketing the same product at the same price through after-market channels in Germany and France, but sold only 400 units in the last three months of 1995.

In October 1994, Bosch began supplying car navigation systems for Mercedes S-Class models. Bosch's product was similar to Philips' except that it provided route guidance only with arrow signs and, voice direction, with no map on the display. Bosch employed the CD-ROM based map database developed by Etak. Retailing for DM 4,000 ($2,700), the product sold 8,000 units in 1995. Bosch also developed a model with a map on the monitor for the after-market segment in Germany and France, introducing it in June 1995, three months earlier than Philips. Retailing for DM6,500 ($4,300), the after-market model sold 1,800 units by December 1995.

Besides the two European companies, only Sony competed in the after-market segment. Sony started test marketing its GPS-based model in France in late 1995, but sold only 300 units by April 1996. The product specification was similar to Sony's NVX-Fl6 and used Etak software. The GPS system pinpointed the car's current position on an LCD monitor, but did not give route guidance to the destination. It showed a driver where the destination was located, but the driver had to plan the route. It was unclear whether Sony would continue marketing the tested model in Europe.

Some other companies including Alpine, Matsushita, and Pioneer, were said to be planning to enter the European market in 1997–98. Luxury car manufacturers, such as Jaguar and Volvo, were reportedly considering OEM installation of car navigation systems. Volkswagen, Audi, and Opel were rumored to be seeking OEM suppliers of low-end models offering voice navigation with no monitor for around DM600 ($400). **Exhibit 16** summarizes current and prospective competitors in Europe and the characteristics of their products.

U.S. Competition

As shown in Exhibit 4, sales of one million units per year were expected in the United States by 2000. On the other hand, none of the models introduced to date had sold more than a few thousand units as of 1995. Car navigation systems were not yet widely known among U.S. consumers.

Industry observers believed price reductions would be critical before demand for car navigation systems would take off in the United States. Market research revealed that few U.S. consumers would pay over $1,000 for car navigation systems. Auto manufacturers had told the car navigation makers that they needed prices to drop as low as $500, which was not expected until 2005 after further investments in mapping, data storage, and route guidance were completed.

Zexel, a Japanese auto parts supplier, was the first to bring car navigation systems to the United States.[8] As an OEM, Zexel began supplying systems for GM's Oldsmobile Eighty Eight in summer 1994. Zexel's navigation products employed hybrid systems with GPS and dead reckoning sensors and provided route guidance by either map, arrows, or voice. The digital map database was stored in a 170MB hard disk drive located in a car trunk. With the price tag of $1,995, however, the product was

[8] Zexel did not sell car navigation systems either on an OEM basis or through after-market channels in Japan as of 1996.

EXHIBIT 16
Current and Prospective Competitors in Europe

Current Competitors

OEM	General Information				Cumulative	Hardware		Software	
	Company	*Auto Maker*	*Retail Price*	*Launch Date*	*Unit Sales*	*GPS or Hybrid*	*Interface: map, arrow, voice*	*Digital Map Format*	*Software Media*
	Bosch	Mercedes	DM 4,025	10/94	8,000	Hybrid	arrow, voice	Etak	CD-ROM
	Philips	BMW	DM 6,900	10/94	10,000	Hybrid	map, arrow, voice	NavTech	CD-ROM

After-Market	General Information				Cumulative	Hardware		Software	
	Company	*Product*	*Retail Price*	*Launch Date*	*Unit Sales*	*GPS or Hybrid*	*Interface: map, arrow, voice*	*Digital Map Format*	*Software Media*
	Bosch	Travel Pilot	DM 6,500	06/95	1,800	Hybrid	map, arrow, voice	Etak	CD-ROM
	Philips	Carin	DM 6,900	09/95	400	Hybrid	map, arrow, voice	NavTech	CD-ROM
	Sony	NVX-160	DM 5,500	10/95	300	GPS	map	Etak	CD-ROM

Prospective Competitors

OEM	General Information				Expected	Hardware		Software	
	Company	*Auto Maker*	*Retail Price*	*Launch Date*	*Unit Sales*	*GPS or Hybrid*	*Interface: map, arrow, voice*	*Digital Map Format*	*Software Media*
	Mitsubishi	Volvo	—	Early 97	—	Hybrid	map, arrow, voice	TeleAtlas	CD-ROM
	Bosch	VW	DM 600	Early 97	—	GPS	voice	Etak	CD-ROM
	Bosch	Audi	DM 600	Early 97	—	GPS	voice	Etak	CD-ROM

After-Market	General Information				Expected	Hardware		Software	
	Company	*Product*	*Retail Price*	*Launch Date*	*Unit Sales*	*GPS or Hybrid*	*Interface: map, arrow, voice*	*Digital Map Format*	*Software Media*
	Alpine	NTV-W055V	DM 6,000	Mid 96	—	Hybrid	map, arrow, voice	NavTech	CD-ROM
	Matsushita	—	—	Early 97	—	Hybrid	map, arrow, voice	—	—
	Pioneer	—	—	Early 97	—	Hybrid	map, arrow, voice	—	—

Source: Analysis of the case writers, based on research interviews.

expensive. In 1994, the most expensive car accessory in the United States was a European branded premium hi-fi speaker system for $1,200. Due to a lack of marketing expertise at Zexel and Oldsmobile and due to the fact that digital maps were only available for a few major cities, only 2,500 units were sold by the end of 1995.

Zexel licensed its product technology to Rockwell for after-market sales. Rockwell sold the product to rental car companies such as Avis and Hertz. The rental car companies purchased a few thousand units in total and rented the systems for a $5 to $7 daily upcharge. However, neither Rockwell nor the rental car companies had aggressively marketed the product.

Sony began marketing the NVX-F160, the U.S. version of the Japanese model NVX-F16, in California and Florida in late 1994. Despite its lack of route guidance capability, Sony launched the NVX-160, the most advanced model in Sony's product line as of 1994, in order to be the first to market an after-market model. At a price of $2,995, only 800 units were sold by the end of 1995.

A low-end product priced under $1,000 was introduced in December 1995 by Amerigon, a Silicon Valley startup known for its voice recognition technology. The system was bundled with car stereos and sold under car audio brand names by manufacturers such as Alpine, Clarion, and Kenwood. The price was about $600, although when the stereo and installation were included, the price was more like $1,000 to $1,500. This CD-ROM based system, named AudioNav, did not employ GPS, relying instead on a dead-reckoning sensor alone. There was no monitor; only a voice system that used a microphone similar to one used in a cellular phone. The driver had to spell out the destination for route calculation. It was hands free, but the driver had to find a street sign or local landmark if he/she became lost. Unit sales to date were unknown.

Within a year or two, Alpine and Nippon Denso were expected to supply OEM models to Honda and Toyota factories in the United States. Pioneer, Alpine, and Matsushita were expected to enter the U.S. after-market segment, introducing modified versions of their latest domestic market models. **Exhibit 17** lists current and prospective competitors in the United States and characteristics of their products.

SUMMER 1996: RECONSTRUCT THE GLOBAL STRATEGY

Masao Morita, the son of the legendary founder Akio Morita, contemplated how to formulate his multinational marketing strategy for the fast changing car navigation systems market for the next five years. Given the different market conditions from one region to another and Sony's unsatisfactory position in each market, Morita resolved to reevaluate the company's marketing strategy for car navigation systems and the benefits Sony could and should provide drivers around the world. Morita needed to resolve the conflicting views within his company regarding several key issues.

Geographical Focus Issue

Some managers believed it was time to focus much more effort on markets outside Japan. One international marketing manager said:

> Both the European and United States markets are expected to grow as large as the Japanese market within 10 years. We should preempt competitors with our own after-market models. We will be too late if we wait until these overseas markets take off. We should be the company that creates these markets as we did at home.

In contrast, a marketing manager in Tokyo insisted that Sony should focus on reestablishing its competitive position in Japan:

> Our share is down because we have lagged behind our competitors in developing more accurate hybrid models and more sophisticated route guidance technology. The fact is, in 1996, 98 percent of our car navigation sales come from Japan. The, growth forecasts for markets overseas are totally speculative.

The allocation of R&D resources depended in part on Sony's geographical priorities. In 1996,

EXHIBIT 17
Current and Prospective Competitors in Europe

Current Competitors

	General Information				Cumulative	Hardware		Software	
OEM	*Company*	*Auto Maker*	*Retail Price*	*Launch Date*	*Unit Sales*	*GPS or Hybrid*	*Interface: map, arrow, voice*	*Digital Map Format*	*Software Media*
	Zexel	GM/ Oldsmobile	$1,995	08/94	2,500	Hybrid	map, arrow, voice	NavTech	Hard Disk (170MB)

	General Information				Cumulative	Hardware		Software	
After-Market	*Company*	*Product*	*Retail Price*	*Launch Date*	*Unit Sales*	*GPS or Hybrid*	*Interface: map, arrow, voice*	*Digital Map Format*	*Software Media*
	Sony	NVX-160	$2,995	10/94	800	GPS	map	Etak	CD-ROM
	Rockwell	GuideStar	$1,995	01/95	7,000	Hybrid	map, arrow, voice	NavTech	HD (170MB)
	Amerigon	AudioNav	$600	12/95	—	Dead Reck No GPS	voice	NavTech	CD-ROM

Prospective Competitors

	General Information				Expected	Hardware		Software	
OEM	*Company*	*Auto Maker*	*Retail Price*	*Launch Date*	*Unit Sales*	*GPS or Hybrid*	*Interface: map, arrow, voice*	*Digital Map Format*	*Software Media*
	Alpine	Honda	$2,000	Mid 96	—	Hybrid	map, arrow, voice	NavTech	HD(170MB)
	Nippon Denso	Toyota	—	Late 96	—	Hybrid	map, arrow, voice	NavTech	HD (170MB)
	Bosch	Mercedes	—	Early 99	—	Hybrid	map, arrow, voice	Etak	CD-ROM

	General Information				Expected	Hardware		Software	
After-Market	*Company*	*Product*	*Retail Price*	*Launch Date*	*Unit Sales*	*GPS or Hybrid*	*Interface: map, arrow, voice*	*Digital Map Format*	*Software Media*
	Delco (US)	Telepath 100	$500	Mid 96	—	Dead Reck No GPS	voice	NavTech	CD-ROM
	Pioneer	—	—	Early 97	—	Hybrid	map, arrow, voice	NavTech	CD-ROM
	Matsushita	—	—	Early 97	—	Hybrid	map, arrow, voice	—	CD-ROM
	Clarion	—	—	Early 97	—	Hybrid	map, arrow, voice	NavTech	CD-ROM
	Kenwood	—	—	Early 97	—	Hybrid	map, arrow, voice	NavTech	CD-ROM

Source: Analysis of the case writers, based on research interviews.

Sony employed 200 highly skilled engineers dedicated to car navigation systems development, all of whom were stationed in Japan, except for only one each in Europe and the United States.

Product Choice

Given the poor performance of the current overseas model NVX-F160, it seemed that a simple GFS-based model at a price of $3,000 was unlikely to appeal to drivers in Europe and the United States. There were at least three product options for Sony: (1) launch the Handy Navigation System GPX-5, the portable GPS model most recently introduced in Japan, as a global product; (2) modify the hybrid NVX-S1 for Europe and/or the United States; and (3) develop a new low-priced model for overseas markets.

A marketing manager in Tokyo emphasized the advantage of the GPX-5 as a global product:

> The portable nature of the GPX-5 should appeal to a much broader population, including consumers interested in outdoor camping, bike touring and marine sports. Users can also use it to enjoy regular TV channels while traveling. Since the product is detachable, it is not strictly an automobile device, so auto safety regulation and product liability issues may not apply. Portability also reduces the risk of theft.

The U.S. country manager, however, questioned the product's potential:

> For the product to succeed in the United States, we need software with geocoded information specifically for camping sites, fishing locations, mountain skiing routes, and the like, all of which currently do not exist. It will cost at least $1 million and take nine months to develop software for each recreation activity. By the time we have a variety of CD-ROMS, competition could be on different basis. In addition, if the product is priced around $3,000 again, it will flop. Finally, modifying the GPX-5 for the United States would require five engineers working for six months.

Another manager in Tokyo proposed to modify the NVX-S1, the hybrid model with turn-by-turn route guidance capability, for overseas markets:

> In the countries where street names are clearly signed and road systems are straightforward, the current GPS-based model, which only shows the driver's position on the map, adds little value to drivers. We need a more sophisticated hybrid model, which can be upgraded to accommodate future advances such as a real-time traffic information service and a traffic emergency warning system.

However, there were also pessimistic views regarding this product modification:

> In turn-by-turn route guidance technology, Sony lags far behind its competitors overseas. The product modification option requires Sony to reinvent its digital map software for the U.S. and European markets. When competitors launch more sophisticated route guidance systems, the present system will quickly become obsolete. Moreover, this option will incur substantial time and cost. It will take two years for our software vendor Etak to digitize U.S. and European maps for turn-by-turn route guidance. This will cost $100 million in initial development costs and $30 million for annual maintenance and content upgrades. This option will require 50 engineers to work with Etak in the United States and Europe. NavTech, Etak's competitor, will have soon digitized 100 percent of the U.S. and European maps for turn-by-turn guidance. We can switch from Etak to NavTech, but we are not sure how much competitive advantage we will lose by using the same database as our main competitors.

Rejecting the above product modification options, some sales managers in the United States argued for developing low-end models from scratch, solely for the overseas market:

> As consumer research has shown, it is obvious nobody here will buy a $3,000 gadget for his/her car. If we want to create a market here, we need a product designed to meet local needs. European and U.S. drivers don't need a fancy digital map nor an expensive LCD monitor and will be happy with some simple arrow and voice guidance at a price of $1,000 or less.

The international marketing manager in Tokyo, however, strongly opposed this low-end product strategy:

> Even if a low-end stripped-down product stimulates the market in the short run, Sony will gain little in the

long run. It will precipitate price competition and may shrink the market, at least in value terms. The product will not be adaptable to future developments in road infrastructure. It will diminish Sony's leadership image in car navigation systems. Furthermore, this option will need 60 of our engineers to work for a year on developing this new product. Given the competition we face at home, we can not afford to divert them.

Standard Setting Issue

There was wide debate over continuation of the NaviKen consortium. Some managers contended that Sony should leave NaviKen or at least develop proprietary digital map technology in parallel in order to compete head-to-head with other companies. A young manager in charge of product development stated:

> The NaviKen format was helpful early on. However, product introductions are now so frequent that we need our own digital map technology to respond quickly to the market's evolving needs. Customers appreciate a differentiated database to standardized ones. As one survey says, an average consumer owns only 1.5 CD-ROMS, and most do not use CD-ROM maps across different hardware anyway. Car navigation systems are not the same as personal computers.

In contrast, several of the digital map engineers who were heavily involved in establishing NaviKen format in the 1980s opposed such a radical move. As one senior engineer stated:

> Such a myopic and opportunistic action may bring some market share in the short run, but hinder market development for the future. Standardized software will always benefit the consumer as well as the industry, as has been shown in the cases of CD players and VCRs. Our market research shows 80 percent of our customers care about software compatibility. As a market leader, Sony always tries to grow the market pie. Sony does not pursue a larger share of a shrinking market. After all we've put into establishing the NaviKen standard, why should we quit now? Now it is time for us to extend our effort overseas and to stimulate consumer demand as we have done in Japan.

Other managers took a compromise view. While supporting NaviKen in Japan, they proposed to establish different digital map formats for Europe and the United States. One manager explained:

> To boost the market overseas, especially early on, we need a variety of compatible software. However, the NaviKen standard was developed for the unique Japanese road system, and is not extendible to other markets. Since the traffic infrastructures are very different from country to country, we should try to establish new product standards region by region.