In 1979, executives in the Consumer Electronics Group at Philips N.V. of the Netherlands decided to investigate the market opportunities for the newly developed compact disc (CD), an optical disc product for reproducing prerecorded music for home entertainment. Although Philips’s managers recognized that the technical superiority of CDs in sound reproduction might appeal to consumers, they also realized that its commercial success would depend on resolving a number of competitive and marketing issues.

Experience in both the video and audio segments heightened the management team’s concern for standardization. Several firms in Europe and Japan had announced development of digitized audio products. If incompatible digital formats were introduced simultaneously, consumer acceptance might be permanently damaged. A second and related question concerned forecasts of profitability on the hardware (i.e., CD players) and software (i.e., discs) sides of the business. The team wanted to develop pricing policies that reflected the opportunity for differentiation as well as the advantages of a broad installed base. The timing of changes in prices would also be crucial. Influential, committed audiophiles would be willing to pay more for the system than casual users. Finally, the team was faced with difficult decisions regarding the timing of capital investments. If Philips were to commit relatively early to significant disc-pressing capacity, for example, it might attract other consumer electronics firms to its standard. On the other hand, too much pressing capacity might intimidate other firms and undermine standardization.

# Technology Development

Early research on digital reproduction methods using lasers was conducted at the Massachusetts Institute of Technology during the 1950s. Engineers in the Philips Research Laboratories began to explore potential applications in the late 1960s. By the early 1970s, the Consumer Electronics Group demonstrated its first video prototype based on optical scanning. LaserVision products used scanning over analog images engraved on discs. Despite their superior reproduction capability, the discs sold in limited quantities because of their playback-only capability. Consumers were unwilling to accept the product at a high price premium over the newly introduced videotape recorder.

Philips therefore began developing audio applications for optical scanning technology in an effort to partially recover eight years and several hundred million dollars of development expenditures. By 1979, it had developed a prototype audio CD player and a 4.5-inch disc that held 60 minutes of music. Although the optical engraving process for CDs was similar to the process for

LaserVision, the engraved information was digitized for the CD (as opposed to analog for LaserVision). Digital reproduction required conversion of sampled waves to binary codes which were then recorded by optical scanners as engraved pits on a specially treated disc. For playback, a high-speed laser read the pits off the surfaces of the discs and electronically reconverted the binary code to the original medium. If correctly performed, the process left little room for error in reproduction.

The CD would differ from conventional audio products in its accuracy and durability. Conventional mechanical scanning processes traced out an analog image of an entire sound wave onto a vinyl long-playing record (LP) or on electronically sensitive tape in a form readable, respectively, by phonograph or cassette players. Mechanical scanning for playback left room for error in the reading of the analog image and also tended to wear down the image, causing the quality of the recording to deteriorate over time. There would be no such deterioration with optical scanning.

# Standardization in Consumer Electronics

Battles to establish a standard in the video segment of the consumer electronics industry reached beyond the LaserVision/VCR issue. Within the VCR subsegment, vigorous competition had emerged between adherents to Beta and to VHS technology. Sony had been the innovator with its introduction of the Betamax videotape format in the mid-70s. Both RCA and Philips challenged sales of high-end videotape recorders with disc-based technologies. The Japan Victor Corporation’s (JVC’s) subsequent introduction of an incompatible format under the VHS label compounded a competitive situation that had proven costly for all firms. It appeared that the dominant standard would not emerge for several years.

The most recent standardization battle in audio dated back to the 1960s, when prerecorded tapes had first been offered in four incompatible styles. The 8-track cassette, a playback-only format that dominated all other types of prerecorded tapes, had lost share during the 1970s to Philips’ recordable audio cassette. (**Exhibit 1** tracks retail sales of prerecorded music in the United States by format for the years 1970 to 1978.) The slow penetration of the audio cassette had been particularly frustrating for Philips because it offered recording capability, a feature unavailable on the 8-track.

These precedents raised concern about the possibility there might be a competitive struggle to establish a standard audio disc format. Telefunken of West Germany and JVC of Japan had developed incompatible audio discs. Telefunken’s prototype used a groove-based mechanism to pick up digitized information engraved on the disc. This mechanism made the machine appear more like a conventional phonograph player than did the Philips prototype. JVC’s audio prototype was based on electronically-charged discs rather than optical scanning and therefore operated more like a digital cassette (without recording capability) than a CD. The Sony Corporation of Japan was developing a laser-based system similar to Philips’s but had not yet demonstrated a prototype. Sony was known to have an excellent error-correction system (although Philips was recognized as superior in basic design). Error-correction systems were crucial to maintaining a continuous stream of music when pits were improperly engraved, or “skips” occurred during playback.

Philips would have to disseminate information about the manufacturing process for players if other consumer electronics firms were to accept the Philips standard for CD hardware. The only unique component in CD players would be the laser assembly used to read digitized information from the disc. Although this assembly might cost over a hundred dollars to manufacture at the time of the introduction, its cost would decline significantly as production volumes mounted. One engineer projected that the cost of the laser assembly would eventually reach $16. The injection molding process for manufacturing the players would be similar to the one used to produce videotape, cassette, and receiver housings. Excess injection molding capacity designed for producing other components could be converted to CD player manufacture relatively easily. Necessary plastics

**2**

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and metals would be exactly the same as those used in other components. Furthermore, since digitally encoded sound waves would be reproduced from numerical representations of the music, and since optical scanning technologies were widely available among consumer electronics firms, CD players would almost surely sound similar. Nonetheless, those firms with a high-end image might attempt to differentiate hardware on appearance and special operating features (such as remote control and programming capability).

# The U.S. Audio Entertainment Industry

The U.S. record industry was dominated by five firms. The two largest, with about equal shares, were CBS Records and Warner/Elektra/Atlantic. The second-tier firms, EMI, Polygram, and RCA Records, were also about equal in size to each other. Philips and Siemens Electronics of Germany each owned 50% of Polygram. Besides Philips, Toshiba of Japan was the only consumer electronics firm giant with a close relationship to a record company with a strong share in the United States (EMI Records in its case). Sony was affiliated with CBS Records in Japan, but the relationship did not involve CBS Records in the United States. Hans Gout, director of marketing for Polygram Records, had approached EMI and Warner to introduce them to the CD format and to ask for their support in selecting the Philips disc as the industry standard. Toshiba/EMI had publicly announced its reluctance to pay a royalty to Philips.

The relationships of the record companies with other participants in the U.S. music industry are summarized in **Exhibit 2**. Record companies like Polygram typically contracted with performing artists for exclusive rights to distribute their titles in exchange for promotional backing and for royalties. Hans Gout described the music industry as cut-throat and emotional. While a few famous artists had considerable power in bargaining with recording companies, the overwhelming majority did not. If CDs were introduced in 1982 or 1983, for example, artists’ royalties would equal at most

$2.65 on each CD sold if they followed the current trend in LPs and cassettes. The record companies themselves bore the expense of promotion. These expenses plus a charge for profit (not including margins on pressing) would average $1.33 per LP or cassette by 1982. Traditionally, performers’ royalties and promotional expense had not varied by format. Polygram agents had negotiated with Abba and Dire Straits, two hit bands signed to the Polygram label, and had agreed to pay the same royalty on each CD sale as on an LP sale.

The record companies also manufactured and packaged records and cassettes. Some were partially integrated into capacity for pressing vinyl LPs and for making cassette tapes, while others purchased these services from independent firms. Partially integrated record companies commonly subcontracted LP pressing capacity from each other to meet fluctuations in demand. By 1979, some record companies were closing less efficient LP pressing plants. Prices of LPs, like those of prerecorded tapes, had declined slightly in 1979 (see **Exhibit 3**), and were forecasted to continue their decline. Some record executives blamed the increasing popularity of the cassette deck—and especially the blank audio cassette—for the decline.

Hans Gout of Polygram planned to lobby record companies to accept the same style of packaging for the CD. He planned to promote a plastic “jewel” box with a paper insert that would cost $1.18 per unit. Although more expensive to manufacture than a cardboard jacket, the jewel box would be more consistent with the quality image of the CD.

Packaged discs would pass from record companies to distributors and on to retailers. The largest distributor of prerecorded music in the United States held a 10% market share. Farther downstream, the retailing sector was highly fragmented. Total distributor and retailer markup on LPs and prerecorded cassettes was expected to be $3.00 for LPs, cassettes, or 8-tracks in 1982. After 1982, the nonproduction costs of delivering a CD to market—royalties, promotion, packaging and distribution—would probably increase with the overall price level.

**3**

One issue that Philips’s management team had to address concerned the royalty that it should demand for each disc pressed by a record company (or independent firm) that licensed the technology. Philips intended to insist that all software manufacturers adhere to high quality standards in their pressings. Managers from both the technical and marketing sides of the organization agreed that unless specified tolerances were sufficiently high, CDs pressed at different plants would sound different. On the other hand, if its technical requirements were judged to be too stringent and its royalty fee too great, Philips might meet resistance in securing acceptance of its standard.

The greatest challenge associated with the hardware introduction would be penetrating distribution channels. Distribution of consumer electronic equipment in the United States, the largest market in the world for consumer electronics, depended on a complex set of relationships between manufacturers representatives, wholesalers, and independent and chain retailers. Retailers typically carried a full line of audio and video products under three to seven brand names and received a 20%- 35% markup over their cost from the distributor.

A consumer survey conducted by the Venture Development Corporation in 19781 indicated that manufacturer advertising was less of an influence on equipment selection than the recommendations of store selling staffs, especially for buyers of systems in the $400-799 range. Buyers of systems in this price range were most affected by demonstrations, budget limitations, test reports, friends’ recommendations, and the salesperson’s recommendation. Test reports, demonstrations, and past experience were most influential for consumers with systems costing over

$800. For consumers with systems costing less than $400, the greatest influences on equipment selection were space and budget limitations as well as recommendations from friends and demonstrations. Both in-store and manufacturer advertising were less influential than these factors for consumers in all categories. As part of its survey, Venture Development also obtained information on consumers’ willingness-to-pay for a digitized disc player. (The survey did not specify whether the player would incorporate laser-based optics, nor did it involve a demonstration of digital equipment.) The results are shown in **Exhibit 4**.

Venture Development also surveyed electronics retailers in that same year, and obtained the following ranking of manufacturers’ contribution to their total sales:2 Kenwood, Yamaha, Technics, Advent, Pioneer, Bang & Olufsen, JVC, McIntosh, Nakamichi, Dual and Sony. **Exhibits 5** through **8** show aggregate imports, exports, and sales of selected consumer electronics products in the United States. **Exhibit 9** shows the price points cited in a series of *Consumer Reports* articles between 1977 and 1979. *Consumer Reports*’ hi-fi selections for systems in various price ranges are given in **Exhibit 10**.

# Production

An efficiently scaled audio CD manufacturing line with the capacity to produce two million discs per year would cost $25 million and take a year-and-a-half to build. The principal activities in the production process were mastering, electroforming, molding, coating, sealing, labeling, centering and final testing, followed by packaging (see **Exhibit 11**). Efficient production presumed rough capacity balance for these activities. With the exception of the mastering equipment, which incorporated newly designed semiconductors and laser technology, virtually all the technology involved had been adapted from familiar consumer electronics applications. Nevertheless, the tolerances and cleanliness required of CD equipment made it prohibitively expensive to start up a production line in less than a year-and-a-half and ensured that it had little salvage value except as scrap.

**4**

Once a facility was established, managers would be able to identify the sources of contamination and curb them by adjusting procedures, modifying equipment, and automating linkages that proved to be bottlenecks. The historical data on the improvement of audio CD yields over time was limited. Video discs, which encoded rather different information using similar manufacturing activities, had not exhibited consistent progress even though they had been produced far longer: in 1979, the yields on some production lines were still stuck at about 50%. The smaller size of audio CDs would permit more consistency in heating, however, relaxing some of the constraints that had kept video disc yields low. It appeared that by the time 5 million audio CDs had been produced on a potentially efficient line, its average yield would reach 70%, and with experience levels of 10 million discs, as much as 90%. Based on these estimates, the ongoing cost (excluding all capital charges) of producing a useable disc would be $3.00 at start-up, $2.34 after producing 5 million discs, $1.77 after the production of 10 million discs, and very close to the lower limit, based on competitively priced inputs and 100% yields, of $0.69 after 50-60 million had been produced.

As time passed, start-up time would be reduced to a year and the capital equipment used in new pressing plants would also improve and become less expensive. According to a moderate estimate, the one-time cost of installing efficiently scaled new capacity would drop from its initial level of $12.50 per unit (of disc-pressing capacity per year) to $8.35 after one year, $5.58 after two years, $3.73 after three years, $2.49 after four years, and $1.67 subsequently. The time required to build a plant was also expected to decrease gradually so that after two years, new plants would require only a year for construction. While it would not be economical to refit old production capacity to take advantage of these improvements, independent equipment suppliers would allow established firms to capitalize on them when existing plants were made incrementally larger.

Experience in manufacturing CDs might also be useful later if the technology was successfully extended to solve data storage problems for businesses. Commercial applications were possible because the pits engraved on CDs could just as easily reflect binary representations of business data as music. A phone book for the entire United States, for example, could be stored on the equivalent of just seven CD audio discs. CD-ROMs (CD read-only memory disks) was the name attached to digital technology in business applications. Commercial acceptance for CD-ROM had been limited both because computer companies had blocked access to distribution channels and because businesses were reluctant to ship off organizational records to CD pressing plants.

# Demand

There were several reasons why compact discs were expected to be of particular appeal to buyers of prerecorded classical and jazz music. First, the greatest increment in the quality of sound would occur in these recordings because of their large dynamic range.3 Second, buyers in these segments had repeatedly demonstrated a willingness to upgrade components to improve the quality of their hardware systems. Finally, buyer acceptance for higher quality recordings had been tested in part with digitally mastered LPs.

Digitally mastered LPs had first been offered by classical and jazz labels in the early 1970s at a significantly higher price than conventional LPs. The masters for such recordings were prepared using digital techniques, although the final LP was pressed in vinyl, which could only be manufactured using standard mechanical methods. Consumer acceptance was so great that by 1982, they accounted for a majority of unit sales of classical music at a 30% price premium. Although they did not offer the same improvement in quality over conventional LPs as would the compact disc, they did provide a benchmark for assessing the value attached to extra quality by buyers in these segments.

The classical and jazz segment accounted for approximately 7.6% of the sales of prerecorded music. Within this segment, buyers of prerecorded tapes were unlikely to switch to CDs because they apparently attached a lower value to quality relative to other characteristics such as portability, convenience, or recording capability. The relevant benchmark for forecasting unit sales therefore seemed to be the total market for classical and jazz LPs. Penetration by CDs into the classical and jazz segment would take several years. If acceptance of CD hardware in this segment followed a classical S-curve, penetration rates would be 0.1% in the year of introduction, and 1%, 5%, 15%, 29%, 50%, 75%, and 100% in subsequent years.

Buyers in the popular, rock, country, soul and other segments (hereafter called the popular segment) bought 92.3% of prerecorded music (by volume) in the United States. The rate of acceptance of the CD in the popular segment was more difficult to forecast for several reasons. First, the improvement in sound quality would not be as large because dynamic range on popular music was not as wide. Second, the CD technology required a change in recording style: artists would have to curtail the use of engineered splices and dubbing because these would be audible in digital reproduction; this, in turn, would make their music sound inherently different. Third, although portable CD players would be available if buyer acceptance were high, it was unclear that consumers would view the new format as comparable to cassette tapes in portability. Fourth, buyers in the popular segment might not be willing to make their collections of LPs and cassettes obsolete. Finally, the playback-only capability of the CD might also limit its appeal.

Market researchers had studied the likely extent of switching using several different methodologies, and had come to rather different conclusions. Philips and Polygram executives were convinced that additional testing would not yield more satisfying results until after the product was introduced to the mass market and consumers were more familiar with the product. They did know that in the United States, legal restrictions would force pressing companies to charge the same per- disc price for their classical/jazz and popular labels and therefore left no opportunity to tailor prices to the valuations of buyers in different segments.

In the best case scenario, popular segment buyers would convert from LPs to CDs at the same rate as classical and jazz buyers. Gout and other Polygram executives assigned a higher probability to this outcome than their counterparts at Philips headquarters, but even the record company’s managers conceded that the chances of this happening were 15% at most. Their second, more likely scenario put the rate of conversion in the popular segment at 1/3 the rate in the classical and jazz segments.

The value of investment in CD pressing plants was also contingent on the timing of the next generation in audio formats. Digital cassette tapes would offer the same durability and quality in reproduction as a CD, together with recording capability and greater portability. Sony already had a prototype in development (although its cost of production was rumored to be prohibitive). The technology required imprinting tape with electronic blips comparable to the engraved pits on compact discs. Several other firms, including Tandy in the United States, were developing a competing technology that would allow recording on compact discs. The digital cassette introduction was forecasted to be 10 to 15 years away partly because of resistance among performance artists. The recording industry, stung by the sales of blank cassette tapes, had lobbied the U.S. Congress for legislation banning DAT until development of a mechanism insuring collection of royalties on home recording.

**6**

**Exhibit 1** U.S. Retail Sales of Prerecorded Music on Tape by Format (millions of dollars)



Sources: “Inside the Recording Industry: A Statistical Overview 1986 Update”; *Billboard International Buyer’s Guide*, 1979-80, 1980-81; *Electronics Industry of America Yearbook*.

**7**

**Exhibit 2** The U.S. Audio Entertainment Industry

Performing Artists

LP/Disc

Presser

**or**

Tape

Manufacturer

Packaging

Record Co.

Distributors and Retailers

Classical/Jazz Buyers

Popular Buyers

**8**

## Exhibit 3

**Prices (U.S. Retail Sales of Prerecorded Music by Unit), 1973-1979**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **LPs** | **8-tracks** | **Cassettes** |
| 1973 | 4.45 | 5.37 | 5.07 |
| 1974 | 4.91 | 5.68 | 5.70 |
| 1975 | 5.78 | 6.16 | 6.10 |
| 1976 | 6.09 | 6.39 | 6.68 |
| 1977 | 6.38 | 6.37 | 6.76 |
| 1978 | 7.25 | 7.10 | 7.34 |
| 1979 | 6.71 | 6.39 | 7.30 |

**U.S. Unit Sales of Prerecorded Music (net after returns—in millions)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **LPs** | **8-tracks** | **Cassettes** |
| 1973 | 280 | 91 | 15 |
| 1974 | 276 | 97 | 15 |
| 1975 | 257 | 95 | 16 |
| 1976 | 273 | 106 | 22 |
| 1977 | 344 | 127 | 37 |
| 1978 | 341 | 134 | 61 |
| 1979 | 318 | 105 | 83 |
| Sources: | See **Exhibit 1** |  |  |

**9**

**Exhibit 4** Consumers Interested in Digital Disc Players in 1978—Results of Consumer Survey

Owners of Systems Costing

Under

$400

$400- 799

$800- 1399

$1400

and over

Would Pay $150 Premium Over Turntable

Would Pay $75 Premium Over Turntable

Not Interested

11.1%

25.9%

63.0%

14.3%

25.3%

60.4%

30.0%

33.1%

36.9%

21.7%

22.6%

55.7%

Source: *The Hi-Fi Components Market, 1979-1983* (Wellesley, Mass.: Venture Development Corporation, 1979), p. 47.

**10**

**Exhibit 5** U.S. Factory Sales of Selected Consumer Electronics Productsa (millions of dollars)

**Systems**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Black & White Televisions** | **Color Televisions** | **Phonographs/ Audio Systemsb** | **Tape Playersc** | **Tape Players/ Recordersc** | **Home Radios** | **CarAudio** |
| 1960 | $750 | $ 47 | $359 |  |  |  | $190 | $154 |
| 1961 | 758 | 56 | 304 |  | $ 54 |  | 190 | 134 |
| 1962 | 851 | 154 | 389 |  | 58 |  | 207 | 181 |
| 1963 | 841 | 258 | 421 |  | 79 |  | 179 | 206 |
| 1964 | 896 | 488 | 440 |  | 97 |  | 267 | 205 |
| 1965 | 910 | 959 | 505 |  | 122 |  | 328 | 248 |
| 1966 | 756 | 1,861 | 528 |  | 113 |  | 346 | 267 |
| 1967 | 555 | 2,015 | 480 |  | 129 |  | 333 | 259 |
| 1968 | 591 | 2,086 | 503 |  | 160 |  | 371 | 330 |
| 1969 | 554 | 2,031 | 490 |  | 198 |  | 422 | 316 |
| 1970 | 518 | 1,684 | 376 | $113 |  | $202 | 380 | 271 |
| 1971 | 621 | 2,355 | 425 | 145 |  | 213 | 487 | 315 |
| 1972 | 649 | 2,825 | 577 | 244 |  | 267 | 606 | 377 |
| 1973 | 560 | 2,971 | 502 | 236 |  | 319 | 562 | 391 |
| 1974 | 543 | 2,524 | 510 | 133 |  | 311 | 559 | 370 |
| 1975 | 416 | 2,268 | 474 | 78 |  | 273 | 373 | 355 |
| 1976 | 495 | 2,755 | 489 | 99 |  | 437 | 356 | 497 |
| 1977 | 530 | 3,289 | 606 | 107 |  | 520 | 522 | 534 |
| 1978 | 549 | 3,675 | 748 | 84 |  | 707 | 436 | 582 |

Sources: The U.S. Consumer Electronics Industry Annual Review, 1980-1989; *Electronic Market Data Book*, 1959-1988; *Billboard International Buyers’ Guide*, 1980-1; *Inside the Recording Industry: A Statistical Overview,* 1986 Update; *Electronic Market Data Book,* 1959-1988.

aIncludes imports

bIncludes console phone, component systems, compact systems, and portable and table units cNot separately available for 1961-1969

**11**

**Exhibit 6** Sales to U.S. dealers (thousands of units)

**Black & White Televisions**

**Color Televisions**

**Phonographs/ Audio Systemsb**

**Tape Playersc**

**Tape Players/ Recordersc**

**Home Radios**

**CarAudio Systems**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1960 | 5,651 | 120 | 4,523 |  | 295 |  | 18,031 | 6,432 |
| 1961 | 5,775 | 147 | 3,989 |  | 1,166 |  | 23,654 | 5,568 |
| 1962 | 6,301 | 438 | 4,955 |  | 1,675 |  | 24,781 | 7,249 |
| 1963 | 6,828 | 747 | 5,142 |  | 2,841 |  | 23,602 | 7,946 |
| 1964 | 7,685 | 1,404 | 5,159 |  | 3,561 |  | 23,558 | 8,313 |
| 1965 | 8,028 | 2,694 | 6,130 |  | 3,445 |  | 31,689 | 10,037 |
| 1966 | 6,950 | 5,012 | 6,303 |  | 3,675 |  | 34,779 | 9,394 |
| 1967 | 5,435 | 5,563 | 6,626 |  | 4,563 |  | 31,684 | 9,527 |
| 1968 | 5,551 | 6,215 | 6,495 |  | 5,573 |  | 34,322 | 12,510 |
| 1969 | 4,975 | 6,191 | 6,320 |  | 6,929 |  | 39,414 | 11,939 |
| 1970 | 4,546 | 5,320 | 5,620 | 3,655 |  | 8,078 | 34,049 | 10,378 |
| 1971 | 4,874 | 7,274 | 6,034 | 5,158 |  | 8,390 | 34,105 | 13,505 |
| 1972 | 8,145 | 8,845 | 7,207 | 8,263 |  | 9,873 | 42,149 | 13,162 |
| 1973 | 7,033 | 9,263 | 6,135 | 7,181 |  | 10,470 | 37,652 | 12,546 |
| 1974 | 5,941 | 7,830 | 5,195 | 4,488 |  | 9,087 | 22,706 | 10,762 |
| 1975 | 4,968 | 6,485 | 3,702 | 3,100 |  | 7,653 | 18,938 | 9,239 |
| 1976 | 5,561 | 7,894 | 3,831 | 4,143 |  | 12,664 | 20,091 | 12,445 |
| 1977 | 5,952 | 9,398 | 4,387 | 4,199 |  | 13,473 | 27,664 | 12,890 |
| 1978 | 6,733 | 10,674 | 4,434 | 3,305 |  | 15,996 | 24,739 | 12,668 |

Sources: The U.S. Consumer Electronics Industry Annual Review, 1980-1989; *Electronic Market Data Book*, 1959-1988; *Billboard International Buyers’ Guide*, 1980-1; *Inside the Recording Industry: A Statistical Overview*, 1986 Update; *Electronic Market Data Book*, 1959-1988.

aIncludes console phone, component systems, compact systems, and portable and table units bNot separately available for 1961-1969

**12**

**Exhibit 7** U.S. Imports of Selected Consumer Electronics Products by Typea (millions of dollars)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Black & White Televisions** | **Color Televisions** | **Phonographs** | **Tape Recorders and Playersb** | **Home Radios** | **Car Audio Systems** |
| 1964 | $ 39 |  | $ 9 |  | $ 92 |  |
| 1965 | 60 |  | 12 |  | 125 |  |
| 1966 | 115 |  | 25 |  | 142 | $ 3 |
| 1967 | 71 | $ 53 | 34 |  | 163 | 9 |
| 1968 | 97 | 106 | 37 | $137 | 225 | 58 |
| 1969 | 152 | 143 | 44 | 204 | 306 | 89 |
| 1970 | 174 | 142 | 52 | 315 | 305 | 99 |
| 1971 | 208 | 205 | 62 | 358 | 307 | 102 |
| 1972 | 262 | 235 | 93 | 511 | 404 | 123 |
| 1973 | 269 | 262 | 96 | 554 | 449 | 194 |
| 1974 | 278 | 242 | 93 | 444 | 475 | 258 |
| 1975 | 181 | 221 | 58 | 351 | 375 | 253 |
| 1976 | 255 | 522 | 104 | 536 | 498 | 435 |
| 1977 | 294 | 501 | 173 | 627 | 579 | 492 |
| 1978 | 351 | 577 | 232 | 790 | 628 | 656 |
| **Thousands of Units** |  |  |  |  |  |  |
| 1964 | 661 |  | 135 |  | 13,377 |  |
| 1965 | 1,048 |  | 275 |  | 19,350 |  |
| 1966 | 1,519 |  | 1,523 |  | 24,950 | 178 |
| 1967 | 1,290 | 318 | 1,964 |  | 23,579 | 621 |
| 1968 | 2,043 | 666 | 2,129 | 6,168 | 28,346 | 3,038 |
| 1969 | 3,121 | 912 | 2,063 | 8,759 | 34,677 | 4,318 |
| 1970 | 3,596 | 914 | 2,040 | 11,733 | 31,150 | 5,011 |
| 1971 | 4,166 | 1,281 | 1,926 | 13,548 | 30,988 | 5,889 |
| 1972 | 5,056 | 1,318 | 2,451 | 18,136 | 40,159 | 6,565 |
| 1973 | 4,989 | 1,399 | 2,423 | 17,651 | 40,907 | 9,146 |
| 1974 | 4,659 | 1,282 | 1,934 | 13,575 | 34,433 | 9,831 |
| 1975 | 2,975 | 1,215 | 1,299 | 10,753 | 27,945 | 8,899 |
| 1976 | 4,327 | 2,834 | 2,455 | 16,807 | 35,394 | 15,106 |
| 1977 | 4,908 | 2,539 | 3,309 | 17,672 | 37,782 | 13,672 |
| 1978 | 5,931 | 2,775 | 4,312 | 19,301 | 37,935 | 15,946 |

Sources: *Electronic Market Data Book,* 1975,1980

aDollar value is defined generally as the market value in the foreign country (FOB) and excludes U.S. import duties, freight charges from the foreign country to the United States, and insurance (*Electronic Market Data Book*, 1980).

aIncludes both players and players/recorders

**13**

**Exhibit 8** U.S. Exports of Selected Consumer Electronics Products by Typea (millions of dollars)

**Radios**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Black & White Televisionb** |  | **Color Televisionb** | **Phonographs** | **Home Radios** | **Car** |
| 1964 |  | $23 |  | $ 3 | $ 5 | $ 2 |
| 1965 |  | 21 |  | 4 | 5 | 3 |
| 1966 |  | 26 |  | 5 | 4 | 4 |
| 1967 |  | 24 |  | 5 | 4 | 5 |
| 1968 |  | 28 |  | 6 | 5 | 7 |
| 1969 | $12 |  | $ 21 | 7 | 5 | 11 |
| 1970 | 8 |  | 18 | 5 | 4 | 9 |
| 1971 | 8 |  | 29 | 6 | 3 | 13 |
| 1972 | 8 |  | 51 | 8 | 4 | 16 |
| 1973 | 11 |  | 73 | 11 | 4 | 16 |
| 1974 | 13 |  | 66 | 17 | 6 | 15 |
| 1975 | 9 |  | 50 | 19 | 5 | 16 |
| 1976 | 20 |  | 61 | 29 | 5 | 25 |
| 1977 | 16 |  | 65 | 32 | 7 | 28 |
| 1978 | 24 |  | 144 | 55 | 22 | 56 |
| **Thousands of Units** |  |  |  |  |  |  |
| 1964 |  | 202 |  | 40 | 268 | 61 |
| 1965 |  | 182 |  | 46 | 243 | 109 |
| 1966 |  | 168 |  | 52 | 218 | 124 |
| 1967 |  | 139 |  | 51 | 255 | 183 |
| 1968 |  | 144 |  | 59 | 385 | 258 |
| 1969 | 99 |  | 58 | 73 | 329 | 441 |
| 1970 | 75 |  | 51 | 55 | 245 | 432 |
| 1971 | 74 |  | 88 | 75 | 224 | 495 |
| 1972 | 75 |  | 149 | 112 | 248 | 566 |
| 1973 | 99 |  | 215 | 134 | 307 | 447 |
| 1974 | 117 |  | 202 | 196 | 405 | 333 |
| 1975 | 91 |  | 141 | 221 | 351 | 303 |
| 1976 | 156 |  | 160 | 333 | 328 | 472 |
| 1977 | 153 |  | 186 | 450 | 421 | 452 |
| 1978 | 223 |  | 410 | 336 | 836 | 795 |

Sources: *Electronic Market Data Book*, 1975, 1980

aDollar value shown is defined generally as the value at the U.S. port of export, based on selling price, including inland freight, insurance, and other charges to the U.S. port of export (*Electronic Market Data Book*, 1980).

bNot separately available for 1964-1968

**14**

**Exhibit 9** *Consumer Reports’* Rankings of Selected Consumer Electronics Products (brands ranked in order of overall score)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Manual Turntables** | **Price** | **Cassette Tape Decks** | **Price** | **Open-reel Tape Decks** | **Price** |
| Garrard DD75 | $230 | Onkyo TA630D | $350 | Akai GX650D | $1,295 |
| Technics by |  | Aiwa AD6350 | 320 | Teac A3300SX | 1,000 |
| Panasonic SL1700 | 230 | B.I.C. T2 | 350 | Revox B77 | 1,499 |
| JVC JLA40 | 180 | Sharp RT3388A | 390 | Teac A2300SX | 750 |
| Hitachi PS48 | 240 | Hitachi D720 | 270 | Akai GX270D | 775 |
| Sony PS3300 | 200 | JVC KD55 | 320 | Sony TC765 | 1,125 |
| Lafayette T600 | 230 | Technics RS631 | 300 | Uher SG631 | 1,800 |
| Marantz 6300 | 270 | Sony TCK5 | 320 | Pioneer RT701 | 595 |
| Acoustic Research ARXB91 | 160 | Sanyo STD2000 | 310 | Pioneer RT707 | 695 |
| Teac Micro Seiki DD20 | 200 | Sansui SC1100G | 280 | Teac A2300SR | 850 |
| Dual CS 502 | 170 | Akai GXC706D | 250 | Philips N4504 | 480 |
| Thorens TD 166 MK11 | 215 | Yamaha TC520 | 320 | Akai 4000DS MK11 | 385 |
| Harman Karden ST-6 | 350 | Kenwood KX830 | 325 |  |  |
| Pioneer PL510A | 200 | Marantz 5025B | 350 |  |  |
| Realistic Lab 300 | 160 | Realistic SCT16 | 260 |  |  |
| Philips GA312 | 180 | Teac A105 | 275 |  |  |
|  |  | Fisher CR5115 | 300 |  |  |
|  |  | Dual C809 | 300 |  |  |
|  |  | Pioneer CTF6262 | 300 |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Low-priced Stereo Receivers** |  | **Price** | **Mid-priced Stereo Receivers** | **Price** |
| Toshiba SA725 |  | $250 | Fisher R51040 | $400 |
| Sherwood S7250CP |  | 290 | Harman/Kardon 730 | 420 |
| Technics SA200 |  | 240 | Sony STR4800SD | 400 |
| Sansui G3500 |  | 270 | Onkyo TX4500 | 450 |
| Yamaha CR420 |  | 310 | Marantz 2252 | 460 |
| Marantz 2218 | appro | 250 | Sherwood S8910 | 475 |
| Pioneer SX580 |  | 250 | Akai AA 1030 | 350 |
| Fisher RS1022 |  | 250 | Sherwood S7310A | 400 |
| Hitachi SR504 |  | 280 | Technics SA 5460 | 400 |
| Scott 330R |  | 280 | Pioneer SX750 | 400 |
| Akai AA 1125 |  | 260 | Kenwood KR4600 | 300 |
| Philips AH784 |  | 220 | Pioneer SX650 | 300 |
| Sears Catalog No. 92582 |  | 220 | Nikko 7075 | 360 |
| Onkyo TX 1500 MK11 |  | 235 | Lafayette LR3030 | 300 |
| Sanyo SRC2020 |  | 230 | Sansui 5050 | 320 |
| Kenwood KR3090 |  | 285 | Kenwood KR6600 | 450 |
| Sony STRV2 |  | 260 | Yamaha CR450 | 390 |
| Sanyo JCX 2300 KR |  | 260 | Scott R336 | 400 |
| Rotel RX403 |  | 260 | Realistic STA90 | 380 |
| Realistic STA64B |  | 260 | JVC JR5300 | 400 |
| Harmon-Kardon HK340 |  | 219 | Sansui 6060 | 420 |

Lafayette Criterion MK111 260

Source: *Consumer Reports* magazine, various issues, 1977-1979

Note: Matsushita distributed under the Technics and Panasonic brand names. Philips supplied equipment under its own name and under the Marantz label.

**15**

**Exhibit 10** *Consumer Reports’* Selection of Hi-Fi Systems by Price of System (November 1978)

**Low-priced Systems**

**List Price**

**Lowest Available**

**Price Low-priced Systems**

**List Price**

**Lowest Available Price**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Receiver: | Harmon Kardon 330C | $240 | $165 | Rotel RX403 | $250 | $175 |
| Loudspeakers: | EPI 70 | 150 | 105 | Advent 2W | 162 | 125 |
| Record player: | AR 77XB | 150 | 98 | Dual CS 1237 | 180 | 130 |
| Phono cartridge: | Shure MP5ED |  78 |  29 | Shure M95ED |  78 |  29 |
|  |  | $618 | $397 |  | $670 | $459 |

**Medium-priced Systems**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Receiver: | Kenwood KR4070 | $315 | $225 | Pioneer SX780 | $350 | $235 |
| Loudspeakers: | EPI 100 | 218 | 150 | Avid 102A | 300 | 270 |
| Record player: | Dual CS1242 | 225 | 160 | Garrard DD75 | 230 | 130 |
| Phono cartridge: | Shure V15 Type III |  95 |  63 | Pickering XSV3000 |  100 |  65 |
|  |  | $835 | $598 |  | $980 | $700 |

**High-priced Systems**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Receiver: | Onkyo TX4500 MKII | $460 | $340 | Onkyo TX4500 MKII | $460 | $340 |
| Loudspeakers: | Marantz HD880 | 760 | 475 | ESSAMT 1B | 976 | 750 |
| Record player: | Dual CS1242 | 225 | 160 | Carrard DD75 | 230 | 130 |
| Phono cartridge: | Shure V15 Type IV |  150 |  90 | Shure V15 Type IV |  150 |  90 |
|  |  | $1,595 | $1,065 |  | $1,816 | $1,310 |

Note: Differences in model years account for absence of some listed components from **Exhibit 9**.

**16**