

Enhancing Key Devices Such as LCDs Using the Spiral Strategy to Build a New Sharp

In 1992, the Sharp Makuhari Building was completed in Makuhari, Chiba Prefecture. As a monument commemorating the 80th anniversary of the company's founding, it became home to departments developing the multimedia technologies anticipated for the 21st century.

In the midst of an economic downturn following the collapse of Japan's bubble economy, Sharp formed alliances with leading companies in Japan and abroad; the company aimed at new development by promoting STAR 21, a creative enterprise concept. The advanced information age—in the form of the Internet—had arrived, and Sharp embarked on a full-fledged expansion of its TFT LCD business and information equipment business (which included PCs).

Improving and upgrading LCD application products made them into hit products—in particular, the LCD ViewCam—around the globe.

CAD screen showing the LCD ViewCam design

1 The 80th Anniversary of Sharp's Founding

Completion of the Sharp Makuhari Building

■ An Intelligent Building for the 21st Century

In 1992, Sharp celebrated the 80th anniversary of its founding. In July of that memorable year, the Sharp Makuhari Building was completed in Makuhari, Chiba, on Tokyo Bay. This building, intelligently designed for the 21st century, not only served as a new base for conducting R&D and for receiving and disseminating information to Japan and abroad; it also fulfilled some of the functions of the Tokyo Branch and became home to a number of sales departments. With a design incorporating feedback and suggestions from young employees, the building featured comfortable and functional office space as well as a smart, modern appearance.

At the opening ceremony and morning gathering held on July 8, 1992, President Tsuji expressed the hopes and expectations for this new strategic hub: "This building is a monument commemorating the 80th anniversary of our founding. It is a legacy reflecting the successes of those who came before us and who laid the foundations of our company. Our mission now is to leap forward into the 21st century."

At the same time the new building was opened, the Multimedia Systems Research and Development Center was



The Sharp Makuhari Building was completed in Mihama-ku, Chiba City, Chiba Prefecture

launched as a new organization under the umbrella of the Corporate Research and Development Group. It was tasked with expanding business through the further development and fusion of technologies in the video, information, and telecommunications sectors. Its aim was to become an engine for creating new products for the multimedia age.

The building was wired with a cabling system for



Ribbon-cutting ceremony held to celebrate completion of the Makuhari Building on October 27, 1992

SS-NET*, a proprietary information and communication network that Sharp had brought to market. SS phones—special multifunction digital telephones for use with SS-NET—made it possible to control building systems such as air conditioning.

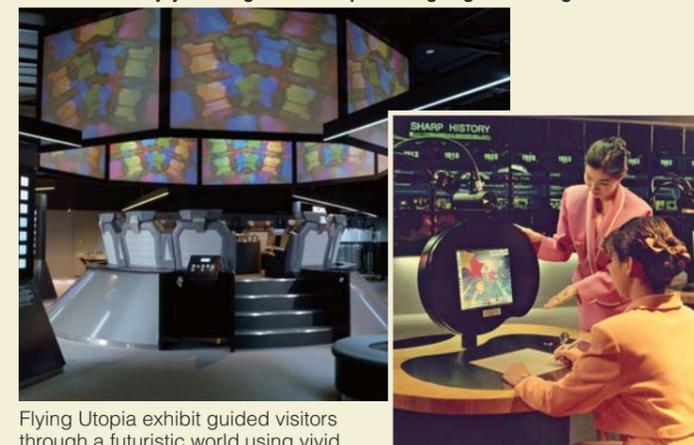
In conjunction with the completion of the new building, Sharp also established employee dormitories and company housing at 11 locations in the surrounding area. To reduce the cost of the investment, these buildings were sublet—an unusual step for Sharp.

One of the themes in the construction of the Makuhari Building was to move hand-in-hand with the local community. Consequently, the Sharp High Technology Hall was incorporated into the building as a facility open to the general public. Here, children and local residents could experience Sharp's state-of-the-art technologies. Visitors were able to enjoy vivid images on new LCD systems, such as a large 220-inch screen video projection system employing three high-definition LCD projectors.

■ Redesign of Uniforms and Choosing the Company Song

In Japan, Sharp took the opportunity of the 80th anniversary of its founding to redesign its uniforms and institute a company song aimed at raising employee morale and further enhancing the corporate image. The company held an in-house design contest, and new summer and winter uniforms were adopted based on the design chosen as the best from among the more than 3,000 works submitted.

High Technology Hall in the Makuhari Building allowed visitors to enjoy learning about Sharp's cutting-edge technologies



Flying Utopia exhibit guided visitors through a futuristic world using vivid images and powerful sound

Hyper Creator let visitors enjoy the experience of computer design

Also, the company song, *Beyond the Light*, was created by drawing on the results of an employee survey. Its pop style was different from that of conventional company songs.

Growth of In-House IT Systems

In the 1990s, an idea constantly addressed in the company's basic policies was how to improve production engineering—the capabilities regarded as the source of a manufacturer's competitiveness. To make sure that it had competency in production engineering commensurate with the increasing sophistication of its products, Sharp pushed forward to construct Sharp IMS (Intelligent Manufacturing System), a proprietary advanced design and production system. The system linked various types of information via computer, for example, development and design, production management, and production equipment. Sharp IMS was created based on the idea that having all production operations strengthened in a balanced manner would enable Sharp to establish a competitive advantage.

In 1989, Sharp embarked on the development of a global network linking all its business locations around the world using dedicated telecommunications lines. All company sites around the globe would be able to use the same line to send and receive different types of information—including voice, facsimile, and computer data—via the company's own infrastructure. This meant that required management information could be obtained whenever needed. Starting with a communications link opened between Japan and North America in December 1989, the network was subsequently deployed in Europe and Asia. By the end of April 1992, it covered 62 bases in 30 countries.

In addition, Sharp developed Integrated OA (Office Automation), a system employing computer networks to streamline office operations. Following a trial period of roughly one year beginning in the autumn of 1989, Integrated OA began service in November 1990 with e-mail. It was later expanded and upgraded to include electronic bulletin board services, followed by schedule management, business travel applications and expense reimbursements, and other office operations.

In May 1996, Sharp was among the first to establish an online presence in the early days of the commercial Internet. Sharp's website focused on presenting new technologies and

new products, and also contained a corporate profile and job availability information. An English-language version was posted at the same time. In 1997, Sharp launched a website specifically catering to material procurement.

* SS-NET (Sharp Super Network) was an integrated communications system that enabled high-speed two-way simultaneous communication of voice, data, and image information over ordinary (twisted pair) phone lines.

2 Putting Innovation into Action by Appreciating Customers' Point of View and through Creative Synergy

Innovation and Collaboration toward Becoming a Creative Company

NEWING Product Strategy

In 1991, President Tsuji issued a call to action: "At Sharp, we have a tradition of creating new products ahead of others. Now is the time to demonstrate the true value of this tradition." He called for each business group to create at least one SE (Super Excellent) product per year that proposed an innovative new lifestyle. Billed as the NEWING Product Strategy, it was deployed across the company.

President Tsuji also emphasized the importance of making products tailored to the user's point of view. In encouraging the company to properly meet users' needs, he repeatedly stated that, "To get information, it is important to place yourself in the thick of things." He encouraged employees to visit places where consumers actually live their lives and shop; to get a sense of how things are changing and gather information; and to take advantage of this in product development.

In 1991 when this strategy was launched, Sharp introduced the CJ-A30/31 pocket cordless phone with answering machine function, which featured an easily portable handset. In 1992, Sharp released the portable WV-S200 word processor with handwritten input via a pen-stylus, along with the 36C-SE1 HDTV (with built-in basic MUSE decoder).



The 36C-SE1 HDTV (with built-in basic MUSE decoder) created new demand by fulfilling users' needs, and became a hit product

STAR 21 Program

In 1991, to build a "new Sharp" oriented towards the 21st century, the company launched the STAR 21 program, a new concept in corporate creativity. All corporate business activities were undertaken with the intention of contributing to society and to the happiness of each employee; Sharp was striving to evolve and develop even further as a good corporate citizen. The STAR acronym, defined below, provided action guidelines for all employees.

Strategic & Creative Mind
Develop creatively rich, strategic initiatives

Total Customer Satisfaction
Ensure that customers feel highly satisfied

Advanced Technology
Use advanced technology to create demand

Rapid Action
Take quick action in response to changes in the environment

To achieve this corporate vision, in July 1992, Sharp instituted a program to put STAR into practice as a company-wide movement. Under this program, employees pursued the collective goal of making Sharp the company most trusted by customers. Small-group activities were vigorously developed throughout the company to work toward this goal. Beginning in April 1993, "hybrid" small-group activities that operated in a collaborative manner between departments were implemented under the theme of rebuilding business and management from the viewpoint of customers. The company also promoted rebuilding business and management based on a two-pronged strategy of offense and defense.

Achieving Results through Creative Synergy

President Tsuji made extensive use of the phrase "creative synergy" to mean creating new value by working in close cooperation with one another. Individual workers were urged to manifest their creativity and originality to the maximum extent possible, as well as gather collective wisdom that would transcend the barriers of the workplace or business division. The President believed that creative synergy would enable working groups to achieve results that were greater than the sum of their inputs. The Sharp Taskforces were a perfect example of creative synergy within the company.

Against a backdrop of rapid technological innovation in the electronics industry—and faced with difficulties in providing all needed technologies in-house—Sharp collaborated with leading companies at home and abroad. Bringing together their signature technologies and specialized expertise, Sharp and its partners pursued creative synergies to tackle areas that were difficult to deal with alone. In the 1990s, Sharp extensively promoted partnerships with leading overseas companies.

In 1992, Sharp signed a long-term business partnership agreement with Intel Corporation of the US, with a major focus on R&D and the production of flash memory*¹. By merging the technologies of both companies, this partnership served to grow the flash memory business. Another aim of the partnership was to develop proprietary new application products that used the jointly developed technologies. Sharp also promoted a series of other partnerships, including one with Apple Computer, Inc. for development and production of personal information tools, and another with AT&T Corporation for joint development of next-generation videophone technology.

A Commitment to Quality Assurance and Environmental Protection

Acquiring ISO 9000 Series Certification

To improve product reliability and customer satisfaction, Sharp began the Customer Communication System (CCS) in 1992. CCS was a new customer information system that communicated the candid opinions of users and dealers to business divisions. This feedback was then faithfully reflected in product planning, design, and production, as well as in responses to the marketplace.

From February 1990, all production facilities in Japan and abroad began activities to acquire certification under the ISO 9000 series of international standards for quality assurance management. In April 1990, the microwave oven plant at SUKM, Sharp's production subsidiary in the UK, gained ISO 9002 certification—a first for a Japanese-affiliated company in the UK. In Japan, the Communication and Audio Systems Group acquired ISO 9002 certification in November 1991, making it the first Japanese domestic equipment manufacturer to do so. Since then, all business sites in Japan and abroad have obtained such certification.

Formulating a Basic Environmental Philosophy

To respond to environmental issues on a company-wide basis, Sharp instituted a system in April 1991 to oversee product quality and reliability and environmental issues. This way the company strengthened its systems for managing and providing guidance on product quality—from production of products to their final disposal—and environmental issues.

In 1992, Sharp formulated its Basic Environmental Philosophy (a strong commitment to creating an environmentally conscious company with Sincerity and Creativity) as well as a set of basic principles for environmental protection. In 1993, it announced a voluntary program consisting of four items—including promoting protection of the ozone layer and reducing industrial waste—and worked toward their achievement.

In addition, Sharp sought certification under ISO 14001, a set of international standards for evaluating and certifying a company's environmental management systems. In November 1995, SUKM gained certification under BS



Registration certificate issued by JACO for third-party certification under BS 7750, which the Communication and Audio Systems Group acquired

7750*², the UK's environmental management system standards. This aided the company in preparing for the enactment of ISO 14001 (in 1996). Earlier, in September 1995, the Communication and Audio Systems Group acquired third-party certification under the BS 7750 standards from the Japan Audit and Certification Organization for Environment and Quality (JACO); it was the first Sharp business unit to do so. Since then, the entire company has worked to acquire ISO 14001 certification.

Responding to the Great Hanshin-Awaji Earthquake

Early on the morning of January 17, 1995, a major earthquake struck the southern part of Hyogo Prefecture. It inflicted enormous damage to the northern part of Awaji Island and throughout the Osaka-Kobe area and claimed over 6,400 lives.



Devastation around the Sharp Kobe Building

Sharp lost one of its employees in the disaster, and Sharp employee housing, dealers, and material suppliers suffered serious damage. Meanwhile, company premises—such as the Head Office, production facilities, and the Sharp Kobe Building in Kobe's badly affected Higashinada-ku district—escaped serious structural damage.

In Kobe, the few employees who made it to work on the day of the earthquake moved quickly to confirm the safety status of employees and check the situation with dealers. Some employees worked to rescue victims from collapsed houses and helped in fire-fighting efforts to prevent the spread of blazes. The next day, some 250 crisis support team members were dispatched from the Head Office and Sharp factories to the disaster area to deliver relief supplies to affected dealers, suppliers, and employees, and to aid in recovery efforts.

In addition, Sharp responded to a request from Hyogo Prefecture to help victims among the general public, and delivered more than 100 million yen worth of Sharp products such as washing machines to the prefectural government. Donations totaling 34.56 million yen were received from Sharp executives—as well as from employees and business partners in Japan and abroad—and this was distributed as special disaster relief payments to affected citizens and employees.

In the midst of a major disaster in which municipal functions were completely paralyzed, Sharp employees helped one another, and at the same time, provided support to the people around them. They were able to overcome this crisis by the entire company making a concerted effort.

*1 Flash memory is a type of non-volatile semiconductor memory that allows data to be freely stored or erased, but that retains data even when the device's power supply is turned off.

*2 BS 7750 was a standard related to environmental management systems published by the British Standards Institution in 1992. BS 7750 formed the template for the International Organization for Standardization's ISO 14001 certification (enacted in 1996), which became a common standard around the world.

3 Development and Production of LCDs and Solar Cells

The Evolving LCD Business

■ Expanding Production of TFT LCDs

In 1991, the year after the Liquid Crystal Display Group was established, a color TFT LCD plant (the NF-1 line) began operation at Tenri. This production facility harnessed technology that could use the full surface area of first-generation glass substrates (320 × 400 mm) to yield four 8.4-inch LCDs per substrate. The plant's supply capacity and cost competitiveness led to a leap in Sharp's market share.

With rival companies investing in plant and equipment and achieving per-substrate yields of four 9.4-inch LCD panels, Sharp began operation of a new production line (the NF-3 line) in August 1994—one capable of producing four 10.4-inch LCDs from a second-generation glass substrate (360 × 465 mm). The NF-3 line introduced single-substrate processing. Under this method, glass substrates were processed one at a time, making it possible to increase the size of the glass. This provided a solution to excessive equipment costs—which had been a problem in conventional simultaneous multi-substrate processing—and worked to boost the percentage of capacity utilized. By March 1995, production capacity at the two lines had grown to 240,000 units/month (in 10-inch-class panel equivalents).

Subsequently, the Mie Plant (Taki-cho, Mie Prefecture), which had become fully operational in October 1995, used 2.5-generation glass substrates (400 × 505 mm) to produce large-format color TFT LCDs sized 11.3 inches and larger. The introduction of CIM (computer-integrated manufacturing), along with a super-intelligent automated transport system that crisscrossed all processes, further increased production efficiency.



Microfabrication processing line for color TFT LCDs (Tenri Plant)

LCDs for laptops continued to grow larger in size, while replacement demand began to emerge as desktop PC monitors shifted away from large CRTs. Under these circumstances, Sharp adopted a strategy ahead of its competitors to constantly be introducing larger LCDs and achieving even lower production costs.

■ Evolution of TFT LCD Technology

Sharp developed a Super VA (Viewing Angle) LCD that enabled wide viewing angles by dividing each pixel in the LCD array into left and right domains and aligning the liquid crystal molecules at different angles.

Sharp also developed the Super HA (High Aperture Ratio) LCD. This yielded a bright display using an ingenious electrode structure inside each pixel that broadened the area through which light could pass (i.e., it offered a high aperture ratio). In 1996, Sharp announced the Super-V LCD, which merged these technologies to provide a display featuring both wide viewing angles and high brightness.

In 1997, Sharp announced success in the joint development*¹ of a 42-inch plasma-addressed liquid crystal (PALC) display that used plasma discharge instead of TFTs as the electronic switch driving the LCDs. Although commercialization of this LCD was shelved, this success proved that large screens were possible, and marked the dawn of the era of large-screen LCD TVs.

■ Development of New Mobile LCDs

In 1994, Sharp developed the industry's first reflective color TFT LCD that was easily viewable even outdoors and that did not require a backlight. It was intended for use in mobile devices such as Sharp's Zaurus, a then-new mobile information tool. Giving the TFT pixel electrodes high reflectivity and using a mixture of pigments in the liquid crystal material made it possible to have a bright, vivid color display. Sharp also started mass production of Advanced TFT displays that added the functionality of a backlit transmissive LCD for use in dark locations.

While burnishing its reputation as a pioneer in the field of LCDs, Sharp was able to offer a total lineup, ranging from large TFT LCDs to mobile LCDs and STN LCDs. The LCD business grew tremendously, with sales of LCDs going from 136 billion yen in fiscal 1992 to 226 billion yen in fiscal 1997—nearly doubling in just five years—and accounting for nearly 15% of total sales company-wide.



Space-saving CE-LT14M color display using a 13.8-inch Super-V LCD (1997)

Expanding Solar Power Systems to Residential Uses

■ Introduction of Residential Solar Power Systems

In April 1994, the Agency for Natural Resources and Energy under the Ministry of International Trade and Industry (now METI) created a subsidized program for residential PV systems that marked the start of the residential solar power market in Japan. In addition, the fact that the industry had established grid interconnect technologies to enable home-generated electricity to be combined with commercial (utility-supplied) power also served as a boost to the start of residential PV applications.

In 1994, Sharp introduced a new residential solar power system consisting of monocrystalline solar cells with high conversion efficiency and a compact power conditioner (inverter) to handle the grid interconnection. Sharp's Sunvista residential solar power system—along with other examples of advanced PV systems, such as houses with pre-installed solar power systems—won awards in the New Energy Foundation's Commendation for 21st Century New Energy Equipment/System program (New Energy Awards) for six years in a row, beginning the first year the awards were instituted (fiscal 1996).



Example of a residential solar power system (1994)

■ Improving the Conversion Efficiency of Polycrystalline Solar Cells

Sharp set out to achieve higher conversion efficiencies in polycrystalline solar cells. In 1996, the company developed UDS (unidirectional solidification) polycrystalline solar cells with a crystal size of approximately 70 cm²—about 30 times larger in area than conventional cells. This was achieved by developing a method to cool molten silicon so that the crystal orientation remained constant. Even though polycrystalline silicon was used, the module conversion efficiency was near that of monocrystalline cells and, at 15%, the best in the industry.

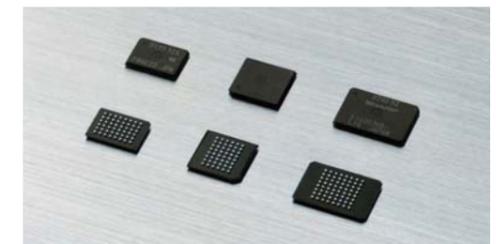
■ Expanding Solar Cell Production Capacity

In 1998, Sharp constructed Shinjo Plant No. 3, a solar cell plant in Shinjo-cho (now Katsuragi City), Nara Prefecture. It was one of the world's largest dedicated solar cell production facilities, with a production capacity that expanded from an initial base of 20 MW of polycrystalline solar cells to 150 MW per year.

Toward Increased Production of Electronic Devices

■ Entering the Flash Memory Business

In February 1992, Sharp entered into a business partnership with Intel Corporation, the largest semiconductor maker in the US, for research and development, production, and mutual supply of flash memory. Flash memory enables data to be written and reprogrammed at will, yet it retains data even when power is switched off. With sales of 46.5 billion yen in fiscal 1996, production value showed remarkable growth, and flash memory became a mainstay of Sharp's semiconductor business. At the Fukuyama Plant, where flash memory devices were produced, Plant No. 3 became operational in 1993 with new equipment using 0.6 μm process design rules*²; this was followed by Plant No. 4 in 1999, which used 0.25 μm rules.



Flash memory contributed to the creation of unique products

■ Developing Semiconductors to Contribute to Greater Functionality in Equipment

To respond to the ever-shrinking size of equipment, Sharp developed SST (Super Slim TCP [tape carrier package]) technology that enabled the industry's narrowest tape-based package (with a width of 8 mm). In addition, the company created a chip-scale package (CSP) with external dimensions very close to those of the silicon die itself. The LZ2353, a high-resolution (410,000-pixel) 1/3-inch (about 8.5 mm) CCD image sensor, was developed in 1992 for use in camera-integrated video tape recorders.

Sharp also successfully developed a red laser diode, which was integrated into hologram laser pick-ups used in DVD players. The company also developed data transmission devices that worked by transmitting and receiving infrared light. These were embedded in numerous products, such as word processors and mobile information tools.

Feature-rich optoelectronic devices created by Sharp boasted the world's top market share for 20 consecutive years*³ beginning in 1986.

*¹ A joint development of Philips Electronics N.V. and Sony Corporation.

*² Process design rules define the minimum width and spacing of transistor elements in an IC device.

*³ Source: Gartner (March 2011).

Note Optical Semiconductor (including Photovoltaic Solar Cells) is based on Gartner's "old" definition and that Gartner now excludes solar cell devices in their new definition set, which can be found in Gartner's publication "Market Definitions and Methodology: Semiconductor Devices and Applications" January 18, 2011 (ID: G00209322).

4 A Blossoming Spiral Strategy

Aiming for Personal Informatization

■ Pursuing a Spiral Strategy

During this period, Sharp laid out a spiral strategy as a new approach to product engineering. The idea was to develop key devices with key technologies at their core and then put them to practical use in creating uniquely featured products not made by any other company. Those products, in turn, would promote the further evolution of key technologies and key devices. Repeating this process for both products and devices gave rise to a virtuous synergistic spiral.

■ Debut of the Zaurus, a New Mobile Information Tool

In April 1992, Sharp announced its Pi²T (personal information and intelligent tool) concept to support “personal informatization.” In essence, this tool would support smart, information-intensive lifestyles and personal communications, and it would be easy to use for anyone, anytime, anywhere.

The precursor to Pi²T was the PV-F1 electronic management organizer, introduced in July 1992. Although it offered features such as handwritten input and schedule management, it was bulky, heavy, and carried a high price tag. Sales duly flagged.

Evolving from the PV-F1 was a new personal information tool, the PI-3000 LCD Pencom Zaurus, which made its debut in October 1993. It featured a compact size small enough to fit in a suit pocket, weighed only 250 g, and had a low price of 65,000 yen. Its advertising catch phrase promised that, “With one of these, you won’t need anything else.” It sold well as an advanced information tool sought after by companies and individuals aiming to improve work efficiency.

Following this, Sharp incorporated new features into the Zaurus that were slightly ahead of the times—for example, facsimile transmission, PC communication, and Internet access—and it became a popular product with businesspeople. In October 1996, sales of the Zaurus in Japan topped one million units. Sharp also developed Zaurus models for corporate users and overseas markets.



The PI-3000 could exchange data with a PC via infrared communication (top); A hands-on Zaurus event at Haneda Airport, Tokyo (March 1994)

■ Debut of the Mebius Notebook PC

In 1995, Sharp launched the AV1/590CD (PC-A330) Mebius notebook PC as a core Pi²T product. Armed with big, bright, and beautiful LCD screens, subsequent Sharp notebook PCs gained immense popularity.



The AV1/590CD notebook PC used an 11.3-inch SVGA (800 × 600-dot) color TFT LCD that was 40% brighter than previous Sharp LCDs

■ Evolution of Word Processors

Sharp was a leader in the word processor industry, maintaining the top market share for more than 10 years beginning in fiscal 1987 (according to a survey by Nikkei Inc.). With the rise of the personal computer, stand-alone word processor shipments peaked in 1989 and began to decline, but by offering useful new features, Sharp models continued to enjoy strong support.

In 1992, Sharp introduced the WV-S200, the first model to offer input via a stylus, and the WD-A751, which allowed handwritten editing using the stylus. In 1996, Sharp introduced the MR-1, which boasted functions such as Internet access and PC communication.

■ Debut of Digital Copiers

In 1994, Sharp introduced the AR-5040 digital copier, which made physical copies after first storing digital images of the originals on a built-in hard drive. The AR-5030FR, which added facsimile functions to the copier, was introduced the following year, marking the dawn of Sharp’s MFPs (multifunction printers).



The AR-5130 digital copier could also be used as a computer printer (1996)

■ Evolution of System Products

On POS terminals, CRTs were gradually being replaced by LCD screens. The RZ-A765, introduced in 1992 and equipped with a duty (passive-matrix) color LCD, and the RZ-A505, introduced in 1995 with an 8-inch color TFT LCD, were two such examples.

Proprietary AV Products Taking Full Advantage of the Evolution of LCDs

■ Debut of the “Shoot, Watch, and Enjoy” LCD ViewCam

The LCD ViewCam video camera was born from the idea that a mother should be able to record videos of her children easily, without having to strain by looking through a tiny viewfinder. This was made possible by replacing the viewfinder with an LCD monitor. During development of the device, two technical challenges had to be overcome. The first was making the LCD monitor easily viewable even in bright outdoor light. This was achieved by applying a five-layer anti-reflection film to the LCD panel. The second challenge concerned broken electrical connections between the rotating parts (where the LCD viewfinder and deck section joined the camera unit). This problem was overcome by developing a special structure with non-breaking wire.

The VL-HL1 LCD ViewCam eventually made its debut in October 1992, under a promotional concept of “shoot, watch, and enjoy.” New ways of using the product emerged naturally—for example, using it to record wedding guests’ messages—and it became a huge hit. In September 1994, less than two years after its introduction, cumulative production reached one million units. Overseas exports accounted for 480,000 units of the total, and the VL-HL1 had grown into a global product.



Many visitors to Electronics Show '92 picked up the VL-HL1 LCD ViewCam and couldn't take their eyes off the LCD monitor

■ Development of the LCD TV

Up to this point, the LCD TV market had been dominated by small-screen models. But in 1995, Sharp introduced the Window series of LCD TVs, which included the 10.4-inch LC-104TV1 model. Featuring a thin-profile design with a full-color TFT LCD, these models were promoted as personal TVs that could be set up almost anywhere.

■ Portable MD Player Created through Concurrent Development

In 1993, the debut of the MD-S10, the world’s smallest and lightest portable MD (MiniDisc) player, rocked the

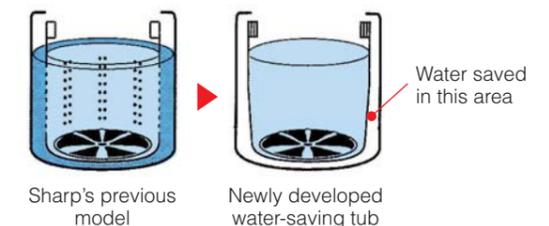
industry. A concurrent development system was used to conduct R&D and design at the same time. With production beginning the instant development was completed, the unit enjoyed a successful early introduction. Sharp developed a miniature hologram laser and an OPIC photodetector element for use in the optical pickup that read data from the MiniDisc, enabling the creation of a small, lightweight unit. The MD-S10 exemplifies well Sharp’s spiral strategy, in which products and devices evolve together.



The MD-S10 MD player came with a remote control equipped with an LCD

Home Appliances Destined to Become New Necessities

In 1992, Sharp introduced the ES-BE65 fully automatic washing machine. Conventional washing machines in Japan had a dual-layer tub construction, with a spin tub placed inside a washing tub. Sharp developed a water-saving tub with a single-layer structure that eliminated the holes in the spin tub. This design saved about 30% on water and detergent usage. It also prevented mold from forming due to detergent residue—a frequent problem with the dual-layer construction.



In 1993, Sharp introduced the SJ-V45K refrigerator, which used a newly developed CFC-free vacuum insulation material. Compared to conventional urethane foam, its heat-insulating properties were about 2.5 times higher. The SJ-V45K had the same exterior dimensions as conventional models but a larger interior capacity. In addition, eliminating the use of CFCs in urethane foam formation improved the environmental performance of the refrigerator. Building on this foundation, Sharp devised a new compressor control system and developed the SJ-SE40R refrigerator, which was No. 1 in the industry for energy savings.

Beginning in the spring of 1996, the Appliance Systems Group launched a New Necessities strategy proposing new lifestyles. Representative of this was the AY-H28FX air conditioner, introduced in October 1996. In addition to conventional dehumidifying, heating, and cooling functions, it also featured—for the first time in the industry—a ventilation function and a humidifying function that did not require a water supply. By capturing water from the air, the unit could provide heating humidification without the inconvenience of dealing with a water supply. Further, users could enjoy constant ventilation without having to open windows.

5 The Sharp Brand Spreads around the World

Strengthening Systems Overseas

■ Expanding Product Offerings for Overseas Markets

During this period, Sharp introduced to the world LCD application products that created new markets. The company's efforts not only helped greatly to increase sales, but also to improve the Sharp brand image. The popular LCD ViewCam, introduced in Japan in 1992, was released in the US the following year and subsequently launched around the world. An overseas version of the Zaurus, the ZR-5000, was introduced in the US in January 1995. In this fashion, Sharp would tailor a number of its existing products to respond to the different needs of specific markets.

In the 1990s, personal incomes in Asian countries were on the rise, increasing the area's attractiveness as a target for sales. At the hub of this region was Sharp Electronics (Malaysia) Sdn. Bhd. (SEM), established in 1995. SEM undertook design and development of TVs, VCRs, and audio equipment for Sharp's Asian production bases. It also supplied components for manufacture and repair to Sharp's production sites around the world.



Q Beat series color TVs for the Asian market were designed and developed by SEM (1998). They were made and sold in countries such as Thailand, Indonesia, India, and Malaysia.

■ Expansion of Overseas Bases

To expand production in consuming areas in Asia, Sharp established Sharp Thebnakorn Manufacturing Thailand (STTM^{*1}) in 1992. As the manufacturing division of STCL—Sharp's sales subsidiary in Thailand—STTM was tasked with the production of color TVs. In 1994 in Indonesia, Sharp established P.T. Sharp Yasonta Indonesia (SYI^{*2}) for the production of color TVs and refrigerators and P.T. Sharp Yasonta Antarnusa (SYA^{*2}) for sales.

Asia was experiencing rapid growth as a production base for the electronics industry, and expanding and upgrading the production and sales system for electronic devices in the region became an urgent task. Sharp Electronics

Components (Taiwan) Corporation (SECT) was established in Taiwan in 1992 as a sales subsidiary for electronic components. Then, in 1995 in Indonesia, P.T. Sharp Semiconductor Indonesia (SSI) was established as a manufacturing company for ICs and optoelectronic devices. Sharp's objective was to expand business in the field of electronic components.

In the US, the North American Free Trade Agreement (NAFTA) came into effect in 1994, and US investment in Mexico increased. A number of manufacturers began setting up *maquiladoras* (manufacturing operations in a free trade zone) in Mexico. In 1997, Sharp established Sharp Electrónica Mexico S.A. de C.V. (SEMEX), and in addition to manufacturing TVs and vacuum cleaners mainly for the US market, it also shipped products within Mexico as well as to Central and South America.

In addition, in 1997, Sharp established Sharp Middle East Free Zone Establishment (SMEF), a sales company based in Dubai, United Arab Emirates. SMEF managed the Middle East, Africa, and Central Asia markets, and worked to expand sales throughout the region.

Expanding Business in China, Focusing on the Coastal Region

Sharp embarked on an aggressive business expansion in China, where remarkable economic growth had been continuing under the country's reforms and open-door policies.

Sharp worked aggressively to expand business by keeping in step with development policies along the Changjiang (Yangtze River) coast of China—an area that had been strongly promoted by the Chinese government—and by moving to form strategic partnerships (joint ventures) to harness the mutually complementary strengths of Sharp and local companies. In addition, Sharp developed two basic policies for expanding business in China: 1) focus on the Changjiang (Yangtze River) area to locate bases of operation, and 2) manufacture multiple products at each plant. In China, the government generally instructed each plant to produce only a single item. Yet Sharp took the bold step of manufacturing multiple items at a single plant, explaining to the government that it was possible to both maintain stable operations and boost the plants' efficiency.

First, in 1992, Sharp established Shanghai Sharp Air-Conditioning Systems Co., Ltd. (SSAC) for the production of air conditioners. In 1994, the name was changed to Shanghai Sharp Electronics Co., Ltd. (SSEC), and in 1996, the company added production of refrigerators and washing machines. This plant was set up in the Pudong New Area, an area of Shanghai earmarked for development. Sharp was one of the first Japanese companies to establish a presence there. In 1993, the company established Sharp Office Equipments (Changshu) Co., Ltd. (SOCC) in Changshu as a manufacturing base for copiers. With the goal of exporting its products to the world, SOCC was established as a fully owned subsidiary of Sharp. When asked by the Chinese government to set up an LCD production base as part of a national project, Sharp

established Wuxi Sharp Electronic Components Co., Ltd. (WSEC) in 1994. WSEC was tasked with the manufacture and sales of STN LCDs. Sharp also established Nanjing Sharp Electronics Co., Ltd. (NSEC) in 1996 as a production and sales company for AV products, and Shanghai Sharp Mold and Manufacturing Systems Co., Ltd. (SSMC) in 1997 for the manufacture and sales of molds and other production tooling.



Sharp bases in China (as of 1997)

Mindful of the Three Golden Projects—a series of policy measures announced by the Chinese government in 1993 related to the development of the information superhighway in China—Sharp also pushed forward to strengthen its image as a technology leader. In July 1995, the Sharp Multimedia Technology Exchange and Exhibition was held in Beijing to communicate the attractiveness and technological capabilities of Sharp products.

Since the 1980s, Sharp had built a strong relationship of trust with the Chinese government—in particular, with former President Jiang Zemin (then Minister of Electronic Industries) and former Vice Premier Wu Bangguo (then CPC Shanghai Committee Secretary), who were among the many government officials who visited Sharp bases in Japan. Meanwhile, each base in China contributed to the prosperity of its local region, while laying a foundation for Sharp's business in China.

Establishing a Three-Node R&D System in Japan, the US, and Europe

In 1990, Sharp established Sharp Laboratories of Europe, Ltd. (SLE) in Oxford, UK. It became fully operational in 1992 and conducted research in a number of fields: optoelectronics, in particular new light-emitting devices and blue laser diodes; imaging technologies, including 3D image display systems and ultra-high resolution printing; and information technologies, such as systems for machine translation between European languages.

In 1995, at a time when the US had taken the lead in the field of multimedia technology, Sharp established Sharp Laboratories of America, Inc. (SLA) in Washington State. SLA conducted research related to core technologies for the new information society, such as digital video signal processing technologies.



SLE completed construction of a new building in 1992 and began full-scale operations

Together with facilities in Japan, Sharp established a three-node R&D system in Japan, the US, and Europe. From this system emerged a number of unique Sharp technologies and devices, including elemental technologies for MPEG4^{*3}, seamless image compositing processes, and 3D displays. This system became a foundation upon which Sharp is still building today.

Restructuring the Sales Organization in Japan and Implementing New Measures

In concert with the growth of mass merchandisers in the retail consumer electronics industry, Sharp reorganized its domestic sales subsidiaries. In April 1992, the three sales companies in Japan (with the exception of the Okinawa district) were reorganized into two companies: Sharp Electronics Sales Corporation (SEH), which took charge of local retailers, and Sharp Live Electronics Sales Corporation (SLH), which took charge of retailers operating over a broad territory (including volume retailers). One example of the detailed support that SLH provided was the centralized, nationwide supply of product and promotional information—something that had previously been handled by individual regional companies.

This new structure also supported frontline sales activities through new information tools and communication networks. In 1992, Sharp distributed dedicated electronic organizers to all 2,300 sales representatives in Japan. These devices could, for instance, be programmed with data about best-selling product models based on sales figures entered by sales staff and compiled at the Head Office. In 1997, a satellite-based digital communication service was begun. Videos containing new product introductions or promotional information were assembled and distributed to each location nationwide via a communications satellite.

*1 In 2005, STTM constructed a copier factory and was re-established as Sharp Manufacturing (Thailand) Co., Ltd. (SMTL).

*2 In 2005, SYI and SYA were merged to form P.T. Sharp Electronics Indonesia (SEID).

*3 MPEG4 is a technical standard for video and audio compression/decompression designed for low bit-rate ("slow") communication channels such as mobile phones.