

ST Liquid Crystal Display Corp.



The logo combines the initials S and T from Sony and Toyoda. It expresses the close relationship between the two companies and our hopes for continued growth in the future. Thus it reflects our stance of commitment to achieving our dreams for the future. The whole square itself invokes an image of our high-quality screens.

Sony + Toyoda

A Genetic Arrangement for Craftsmanship

—— Towards a new LCD Age

Do you know the word “kanban”?

It refers to the Toyota system of production, which features the ultimate in rationality, is recognized for its revolutionary nature worldwide, and is being adopted by more and more companies everywhere.

— The kanban method refers to a representative technique for implementing the fundamental “just in time” concept, which calls for producing exactly the required items in exactly the required amounts at exactly the required times.

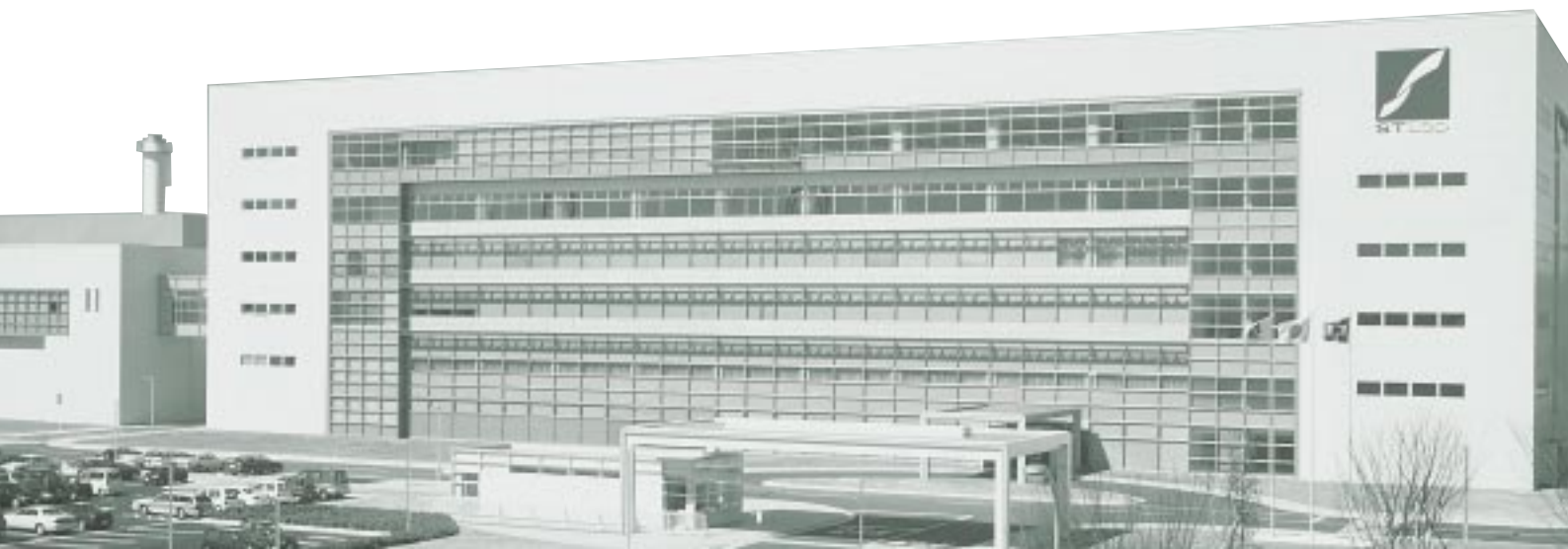
This production method and the concept of craftsmanship that forms its background have now been injected into the most advanced LCD manufacturing plant.

ST Liquid Crystal Display Corp. was created by a tie-up between Sony Corporation and Toyoda Automatic Loom Works, Ltd., the originator of the Toyota Group.

We asked Akira Kojima, Executive Vice President of ST Liquid Crystal Display Corp. to tell us about the events leading up to the creation of this company, its strengths, and its future prospects.



Akira Kojima
ST Liquid Crystal Display Corp.
Executive Vice President
(Late Senior Managing Director at
Sony Kokubu Corp.)





Company name: ST Liquid Crystal Display Corp.
 Established: October 22, 1997
 Capital: 30 billion Yen (50% from Sony Corporation, and 50% from Toyoda Automatic Loom Works, Ltd.)
 Business: Manufacture of low-temperature polycrystalline silicon TFT LCDs
 President: Koji Iwata (Director, Toyoda Automatic Loom Works, Ltd.)
 Employees: 400 (As of November 1, 1999)
 Location: Higashiura city, Chita county, Aichi Prefecture



Episode

Toyoda Automatic Loom Works' production management technology proved its worth throughout the process from the construction of the factory building, through the installation of production equipment, to bringing production up to full operating levels. First of all, a policy of "visible management" was thoroughly implemented, and the progress of every area was posted at the meetings of all personnel held three times a day. For areas that were behind in any way, the reason for the delay was determined and follow-up measures were taken immediately. This allowed preparation for production to proceed with no delays.

Meanwhile, this project was a continuing battle against the mud due to the unpaved roads and the summer heat, the lunch truck food, and the temporary toilets took a heavy toll on our strength. Fortunately, these are now but fading memories. Kojima joked: "Someone wrote "The best seat in Nagoya" on a temporary toilet door. I sure learned a lot on that project."

A challenge — Therefore a tie-up

— First, could you tell us about the process by which this joint company was created?

The background here is that Sony had already studied and adopted the Toyota production system, first in end product manufacturing and then in semiconductor manufacturing. Then, Sony proposed a plan to create a factory to mass produce low-temperature polycrystalline silicon TFT LCDs. Toyoda Automatic Loom Works, Ltd., as the originator of the Toyota Motor Corporation, can be seen as the professional's professional when it comes to manufacturing, and thus was an ideal partner for a manufacturing project. From Toyoda Automatic Loom Works, Ltd.'s standpoint, electronics seemed an attractive area, and they respected Sony's technological prowess. In other words, it was not a matter of one party being the leader, but rather a tie-up in which both parties extended a hand to the other.

— Executive Vice President Kojima, did you have experience with Toyota's production system at Sony Kokubu Corp.? Yes. I learned by experience for about three

and a half years. At least this time I understood the words from the start. (Laughs.) This system has its own vocabulary. Words such as kanban, andon (described later), and "gouguchi" (which means mass production). — Was there any special meaning to the fact that the tie-up is concerned with low-temperature polycrystalline silicon TFT LCDs?

The conventional amorphous TFT LCDs are already being mass produced not only in Japan, but in Taiwan and Korea as well. We were not interested in an established product but rather wanted to compete in the low-temperature polycrystalline silicon TFT LCD area, since that is the next-generation device in this area. We wanted to use our technological advantage to create a new market. The intentions of both companies were in perfect agreement on this point.

— Unlike amorphous TFT LCDs, low-temperature polycrystalline silicon TFT LCDs allow peripheral circuits to be formed on the same glass substrate as the display devices themselves, thus allowing improved precision and increased reliability. However, the LCD manufacturing process is already extremely complex. Won't this make LCD

manufacturing even more difficult?

As someone who has been working with ICs for many years, I feel that even though the precision of the manufacturing process is different, the degree of fine-grained control of the state of the materials on the substrate required in LCD manufacture is on the same order as that required in IC manufacture. Furthermore, the size of the glass substrates used here are the largest in the industry for a polycrystalline silicon process, namely 600 by 720 by 0.7 mm. A high level of technological prowess is required to control the surface morphology and create uniform quality in the millions of transistors that are formed on that surface. This problem presents a true challenge, and is the reason that our two parent companies decided to work together.

Not merely automation, but automation with human involvement

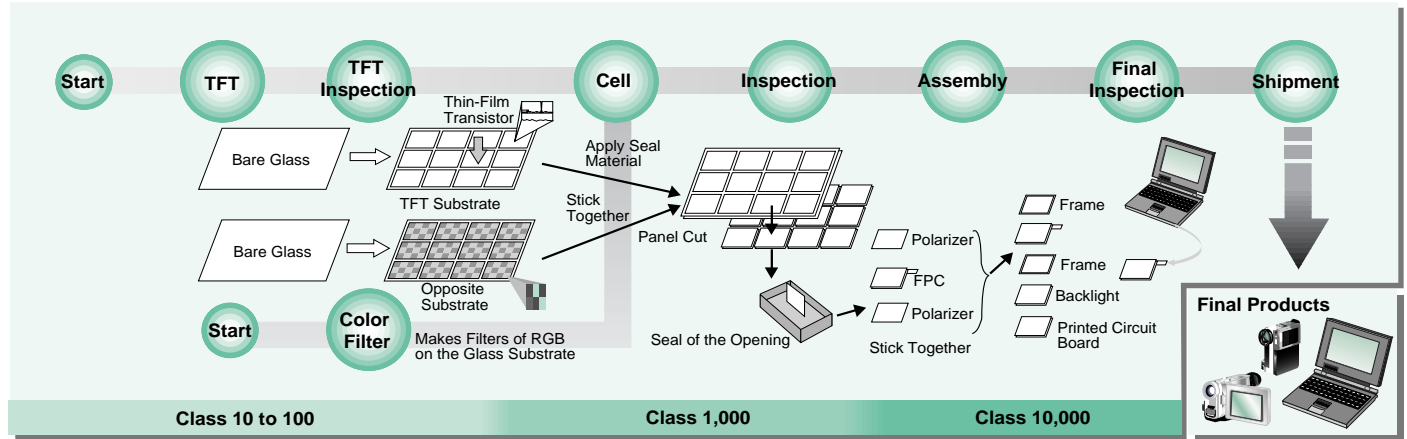
— In the Toyota production system, the terms "just in time" and "kanban system" are well known.

Right. This is known as a "exchange" system. To put it simply, when a single operation in a later stage in the process completes, exactly the amount of materials consumed are



Toyoda Automatic Loom Works, Ltd., which was established in 1926 to manufacture the automatic loom invented by Sakichi Toyoda, the king of the weaving world, later went on to enter the automobile business. The model A1 passenger car was completed in 1935. The automobile division was later spun off and became the Toyota Motor Corporation.

■ Birth of LCD Panel



delivered from the previous stage. If materials arrive before the later stage completes, the materials could collect at that stage. This does not directly connect with products delivered to the customer. Since only product that is required is pulled from the line, the line reliably produces exactly that amount of product. This Toyota production system is now being introduced in factories worldwide, regardless of the type of industry. It aims at eliminating unreasonable efforts, variation, and waste. (These three are “muri,” “mura,” and “muda” in Japanese.)

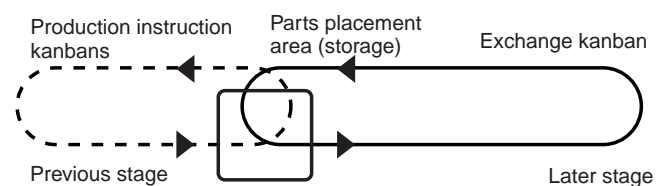
— The basic approach is actually quite simple and easy to understand. However, just because it’s written in a book, it doesn’t mean that everything will go smoothly if you just follow the directions. The most important point is to change the value systems of every person involved in production. Since the actual line is like a living organism, one has to be conscious of making improvements (kaizen) every day according to the conditions that day, and letting those improvements accumulate. I was told many times that even if you think you are right today, you have no way of knowing what will be correct tomorrow. At Toyoda Automatic Loom Works, Ltd., they even use

the phrase “the spirit of kaizen.” — Could you give us some specific examples of the efforts expended on kaizen? One example would be the way one looks at things. We are told that when we enter the production facilities we should always have a conscious goal, such as to check to operating state of the facilities, or to try to find wasted motion by employees so that we can discover issues and problems. Then, do not leave the facility until you have found the problem. This is strongly required of everyone, regardless of the type of job. Another idea that is carried out thoroughly is the concept of “visual management” as represented by the kanban and andon techniques. Here, it is never the case that one does not quite know what the person next to you is doing. All information on what each employee is expected to do, and how much is to be done, as well as all information on the current progress status, is made publicly available. — This means that it is immediately obvious if a particular process or operation is delayed. Doesn’t this result in a lot of pressure? If a delay occurs, everyone chips in to help out. That’s the culture here. The andon was

originally introduced so that if a problem occurred in any step, everyone in the vicinity would notice immediately and be able to follow up. Employees are never left behind. Assume that a problem occurs in operator A’s work. That’s because either employee training was inadequate or the process itself is problematic. Thus operator A is being required to do something harder than that required of operators B and C; in other words, there has been an unfair work allocation. This approach is taken for everything. The employee is central, in all cases all the time. — This is quite different from the normal impression one has of “automation,” isn’t it? Toyoda Automatic Loom Works, Ltd. has a slogan that goes “Automation with Human Involvement” (the actual Japanese involves a play on words using Chinese characters). It’s a bit difficult to understand, but the basic idea is to incorporate human intelligence into the system so that defective materials are not moved on to the next stage in the manufacturing process. Within that context, the daily improvements then accumulate. This process removes unreasonable efforts, variation, and waste

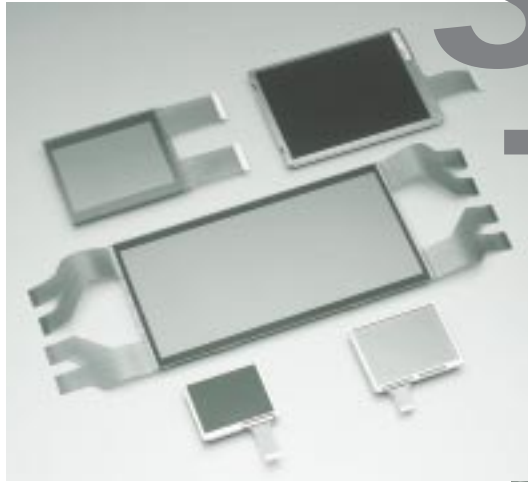
Basic Ideas Behind the Kanban System (Information transmission using kanbans)

1. Parts created in the previous stage are placed in the parts placement area along with “production instruction kanbans.”
2. An employee from the later stage takes “exchange kanbans” to the parts placement area and exchanges them for the corresponding number of parts. At that time, that employee removes the production instruction kanbans and leaves them in a file.
3. Employees from the previous stage produce the number of parts corresponding to the production instructions kanbans, and stock them in the parts placement area.



* The number of parts exchanged and the number produced are managed precisely in this manner using kanbans.

Sony+ Toyota



Have a Dream for Liquid Crystal

from the process, and, when quality control has been thoroughly achieved, those aspects that can be left to machines are automated. This is very different from the idea of putting all one's efforts into automating everything that can be possibly automated.

This production system, which is firmly grounded in Japan's culture and social characteristics, has been realized here as a leading-edge semiconductor and LCD production line, and may become a major step towards the 21st century if it can be maintained and managed. As our first results, we would like to see a level of quality that will fully satisfy our customers and a reduction in lead times. Of course, that is said everywhere. (Laughs.) Since we have the specific strategy of learning from different industries, there is a tangible value in winning the race to achieve the shortest lead times in the world.

Development in pursuit of dreams and careful quality control. If these two genes were combined...

— Since two different cultures met in this project, there must have been confusion and misunderstandings. I'm sure you wouldn't believe me if I claimed

that there were no problems, even at the start. Although we never got to the point of going at each other's throats face to face, there were times in the early stages when one of us would be unable to accept without question what the other said and would seethe silently.

For example, as I mentioned before, Toyoda Automatic Loom Works, Ltd. places great importance on identifying and exposing problems. Even in the process of moving from development to mass production, the more problems were found, the happier they seemed. The idea is that quality can be controlled much more thoroughly if as many problems as possible are discovered and resolved before starting full-scale production. However, in the semiconductor world, industry and science have to coexist due to the behavior of molecules, atoms, and even quanta. This means that there is a much larger component of investigation and improvement (kaizen) during production line operation than there is in car manufacturing.

— Did workers with experience on car assembly lines find this distressing at the mass production stage?

Not only that, but Sony also has a culture which takes the attitude that as long as the item in question is a product that customers

will appreciate, no matter how trivial, and even if no one else will bother with it, that item is worth working on. Anyway, the two companies have different "sensibilities."

Still, it goes without saying that in addition to product development capabilities, Sony also requires even stronger production technologies. Furthermore, at the same time as requiring careful one-step-at-a-time quality control, Toyoda Automatic Loom Works, Ltd., also requires the ability to respond even more quickly to changes in the market. Cars are now referred to as "moving information centers," and it is expected that in the future, market changes will quickly become even more rapid. We need to ask where we can find points of mutual agreement. That is the key to making this company success. Our dreams can grow to the extent that we can fuse the cultures of the two companies. Maybe we'll find ourselves making cars at some point in the future. Such as peculiar cars! (Laughs.)



The "electronic kanban" used at ST Liquid Crystal Display Corp. Even though the system has been made electronic, the basic concept, namely that only the number of items actually consumed in the later stage will be shipped from the previous stage, remains unchanged.

Andon. The andon system created by Kiichiro Toyoda, eldest son of the weaving king Sakichi Toyoda, to increase productivity in weaving, is still used even today.



RGVs (rail guided vehicles) automatically transport exactly the quantities actually processed at each manufacturing stage from the delivery center in the previous stage.

"These are like trains that connect stations. These are reserved seat trains that only allow the actually required amount of materials to ride." (Akira Kojima)