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Production In North America-FTCA/RIO

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RIO is the first FUJITSU TEN factory outside Japan, which started operation to counter the strong yen rate and to expand Fujitsu's presence in the U.S.

For the past six years, our standard has been world-class manufacturing with the motto "The challenge to change what we are." Since we are operating this plant under our own production system in a foreign country, considering the different culture, language and values has beep very important. We started operation as a semi-knock down (SKD) manufacturer, but quickly moved to printed circuit boards (PCB), cassette decks, and tuners.

Presently we have the capability to produce 45,000 car radios a month. In march 1994, we will manufacture our 2 millionth radio.

We intend to continue to improve efficiency and quality to increase customer satisfaction. We will contribute to the community, and ensure no environmental damage results from our business activity.

1. Introduction

With its head office located in Los Angeles, California, U.S.A., Fujitsu TEN Corp. of America (FTCA) has a factory and sales, service, and engineering departments. Rushville Manufacturing Operations (RIO) was founded in Rushville, Indiana in 1987 as FTCA's only manufacturing department. RIO started its business with about 30 employees, and in the following year, RIO started delivering products to automobile companies. This report discusses RIO's growth and present state of production.

2. Reasons for the establishment of a production base in rushville

The following are the reasons why we selected Rushville as a production base in America. Rushville is the central city (with a population of about 20,000) in Rush County. It is located in an agricultural region with an abundance of available labour. The city is safe and although small, has excellent facilities such as schools and hospitals. In addition, Rushville is almost the same distance from RIO's principal customers, which are Auto Alliance International, Inc. (AAI), Subaru-Isuzu Automotive Inc. (SIA), and Toyota Motor Manufacturing, U.S.A., Inc. (TMM). As Indiana State is known as the crossroads of America, Rushville has good highway access, and is thus ideal for the transportation of parts and products.

3. Outline of RIO

RIO is located in an industrial area in Rushville. As of the end of September 1993, RIO had 229 employees, including 7 transferred Japanese workers. RIO is producing such audio products as car radios, cassette tape decks with radios, and CD players. It now delivers about 45,000 products every month.

Figure 1. RIO location

Table 1. RIO's history

October '85	A section for preparations for factory construction in the U.S.A. was organized (in Japan).
September '86	An overseas affiliated company was founded.
July '87	The building was completed (3450 m).
September '87	Factory operation started. The monthly production of car radios on a semi-knockdown basis was 4000.
July '88	First-stage expansion of the building was completed with a total area of 5750 m^2.
May '89	The processing of printed circuit boards (on a complete- knockdown basis) started.
September '89	Factory operation in two shifts started.
October '90	Second stage expansion of the building was completed (the total area reached 8950 m^2).
December '90	The assembly of tape cassette decks started.
April '92	The total production reached one million.
January '93	The total production of printed circuit boards reached one million.
August '93	The total production of tape cassette decks reached 400 thousand.

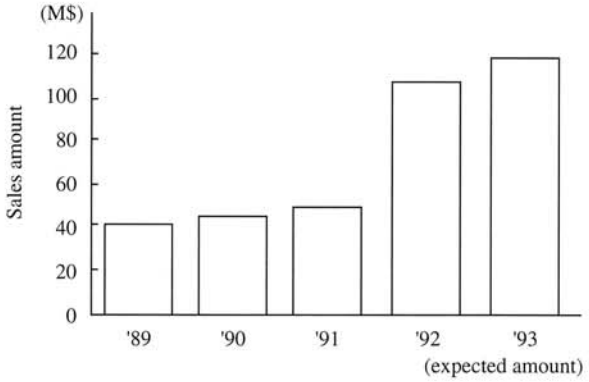


Figure 2. Sales growth

The area of the factory premises is 129,000 m . The buildings cover 8950 m after being expanded twice. In addition to the factory buildings, RIO owns volleyball courts, tennis courts, basketball courts, and softball grounds. RIO allows these facilities to be used not only by its employees but also by local residents, thus promoting good will within the community.

4. Factory management

Important items are discussed at senior staff meetings, which consist of the top management formed by American and Japanese managers. The results of discussion at these meetings are presented at the staff meetings, which consist of managers. At the nightly meeting, all managers discuss actions taken to solve problems that occurred on the current day and present items to be reported. Decisions made and messages presented at the evening meetings are presented to all employees at the morning assembly, which is held every Friday to promote good communication within RIO. In RIO, working groups perform improvement activities (e.g., reducing costs, making proposals for improvement and devices, and improving the living and work environments). The leading organization for these activities is a steering committee called Company-wide Quality Improvement (CWQI).

Since its establishment, RIO's policy for factory management has been to root company activities in Rushville, and RIO has been successful in various aspects. One of them is that RIO has actively expedited the manufacture of as many kinds of parts as possible within its factory, thus having the effect of creating local jobs. RIO started its business with product assembly followed by the processing of printed circuit boards and the manufacture of tuner modules. It is the only Japanese company that achieved internal manufacture of tape cassette decks in the U.S.A.

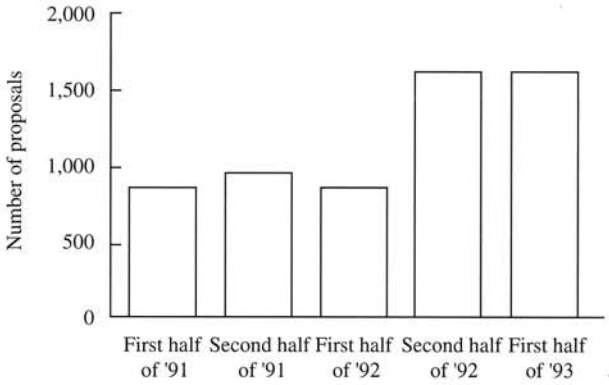
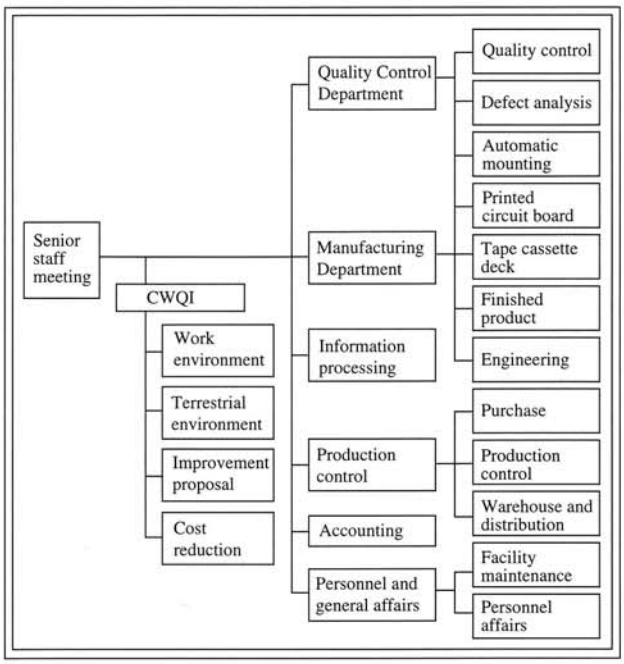


Figure 3. Number of improvement proposals

Figure 4. View of RIO's factory

Table 2. RIO organization



5. Factory layout

5.1 Factory layout

The factory consists of three areas: a 1350 m office area, a 3400 m warehouse area, and a 4200 m manufacturing area.

In the office area are training rooms, conference rooms, the personnel and general affairs department, and the production control department. In the warehouse area, trucks can directly enter the warehouses to protect products from rain and snow and to prevent them from being damaged. In the manufacturing area, we have incorporated various devices into the factory layout to improve quality and production efficiency and to shorten the production lead time. Examples are presented below.

1) Improvement in quality

Because Rushville has a continental climate, it is hot in summer and the temperature falls down to -20° C in winter. Thus, the factory is in a very harsh environment. Areas (except the warehouse area) in the factory are fully equipped with air conditioning and heating to maintain consistent product quality. The humidity is low in winter, and sometimes static electricity damages parts. To prevent parts from being damaged, humidifiers help keep the humidity in the factory constant. Workers wear antistatic shoes. The shoes are checked for effectiveness with a static-electricity tester every day before the workers begin their jobs. In the automatic part mounting process, the surface of printed circuit boards is cleaned, dust collection mats are placed, and entry into the work room is restricted to people related to the work. These measures are implemented to prevent soldering defects.

2) Improvement in production efficiency

The product assembly line is arranged in the shape of the letter U. Workers stand when they are working. Each worker takes charge of several processes. The advantage of the assembly line arranged in the shape of the letter U is that workers do not need to move a long distance. Workers manually carry products to the jig or robot in the following process. Thus, transfer by other people is not needed. In the U-shaped layout, a worker can help workers who are in charge of the processes before and after the process for which that worker is responsible. As a result, the load can easily equalized over the entire production line. The number of facilities and workers can also be increased or decreased easily. The U-shaped layout is thus adaptable to changes in production quantity.

3) Reduction of the production lead time

In the automatic parts mounting process, the facilities are installed to form a straight line so that the distance printed circuit boards (magazine racks) are moved can be minimized. Fujitsu TEN has made carts dedicated to efficiently carrying printed circuit boards (a cart can carry four magazine racks). RIO uses an on-demand supply system to prevent the overproduction of products and to minimize the number of products that reside in a process.

5.2 Distribution system

RIO's distribution system is described below.

1) Delivery of parts

Parts transported in containers from Japan and those procured locally are delivered to warehouses every Friday.

2) Inspection of parts

Delivered parts are classified into those that do not require inspection and those that require inspection. Parts that do not require inspection are stored in warehouses as they are. For parts that require inspection, samples are inspected in the quality control department (D) in the warehouse area. Then, the parts are stored in warehouses.

3) Supply of parts to the Manufacturing Department

An on-demand supply system using cards called kanban is applied to parts stored in warehouses. A fixed

number of parts for use by the manufacturing department are supplied periodically. In the past, parts shortages sometimes interrupted jobs or part supply errors occurred. To prevent these problems, we implemented an organized, fixed-inventory control system. Managers train the workers in the proper control procedures. By following these steps (basic rules), we have prevented defects and losses.

4) Automatic part mounting process
In the assembly process, facilities are installed in the order of the reflow soldering and component mounting unit, the horizontal component inserter, the vertical component inserter, and the chip component mounting unit. When printed circuit boards are carried to the printed circuit board processing line, the number of times magazine racks are transferred from one cart to another is minimized to prevent damage to the printed circuit boards. For this purpose, printed circuit boards are carried on dedicated carts used for transfers between machining processes.
5) Printed circuit board processing and assembly line
Automation has been improved by leaps and bounds by installing component inserters, in-circuit testers, and automatic function testers. To enable this, the printed circuit board processing and assembly line was built in a straight line. As a result, the process can be managed easily (from human to facility) when new facilities are installed.
6) Product assembly and processing line
The product assembly and processing line is arranged in the shape of the letter U (see Section 5.1) to improve production efficiency. Finished products are put in bins and are transported to the warehouse area.
7) Product shipment
After being inspected before shipment, products are packaged in the quantity of one unit. Some customers demand just-in-time supply of products eight times a day. To satisfy this requirement, the shipment area of the warehouses is in operation for 16 hours a day.

6. Production system

6.1 Outline of the manufacturing department

The Manufacturing Department of RIO has seven printed circuit board processing lines, two cassette deck assembly lines, eight finished-product assembly lines, one automatic component mounting line, and a production engineering department. The manufacturing department is managed by five managers and nine team leaders. The basic management policy is "establishing a safe work environment and ensuring a high quality level, thereby being trusted by customers at a high level." Manufacturing managers are given thorough training to learn management methods and problem solving techniques related to such important items as daily management, error management, and facility maintenance. As a result, the manufacturing department can now be managed by Americans. Japanese employees, however, are still needed to solve big problems and to start the manufacture of a new model. This is because managers employed locally do not have enough experience or knowledge, and information needs to be exchanged between Rushville and Japan. It is hoped that these jobs can be performed by local employees in the future.

6.2 Construction of the production system

Since the establishment of RIO's factory, the target quality level and production efficiency were of those attained by the Kobe Plant in Japan. Thus, a Japanese production system, Japanese facilities, and rules as applied in Japan were introduced. The difference in the efficiency between RIO's factory and the Kobe plant, however, could not be lessened. The analysis of the causes revealed the following points:

1) No training system had been established, and thus most employees, including managers, do not have enough knowledge or experience.
2) The number of line workers available did not reach the required number because the absence rate and turnover rate are high. Thus, it is difficult to maintain product quality and production efficiency.
3) Employees were less aware of quality.

Because of these disadvantages, RIO's factory cannot attain the product quality and the production efficiency that are at the same level as those attained by Kobe Plant. This is true even if RIO's factory uses the same facilities and manufacturing process design as those used by the Kobe plant. The analysis also revealed that an attempt to introduce the same production methods as are used in Japan cannot be understood by the people employed in Rushville because they have different customs and a basic way of thinking different from those of Japanese people.

To compensate for the disadvantages, the advantages of the production systems used in the U.S.A. and Japan were adopted and the following improvements were made:

1) Establishment of a production engineering department
A production engineering department was organized,

and local engineers were trained. RIO's original automated machines were made, facilities were modified so that their specifications would be suitable for the build of American people, and the functions of existing automated machines were extended. These jobs were performed mainly by American employees, and the outcome was that the operation of the tape cassette deck, tuner, printed circuit board manufacturing lines could be started primarily by American employees.

2) Automation of visual inspection
Efforts were made to eliminate testing errors caused by operators and to construct a test line that does not require skilled workers. Display using liquid crystals, the inspection of illumination using liquid crystals, the display and judgment of the results of function inspection in the printed circuit board test process were automated using cameras. For these purposes, efforts were made to install and operate the facilities newly developed in the Kobe plant at RIO in an early stage.

3) Improvement activities
To improve the ability and an awareness of quality that managers and workers have, themes were determined and improvements were made by all employees together, grouped by lines.

4) Introduction of a bar code system (for supply of parts)
To shorten the time required to supply parts and to reduce the number of parts supply errors, a bar code label was affixed to each part container instead of a part supply slip. Bar codes are read automatically when parts are supplied. Because bar code labels were affixed, parts can be checked automatically in the automatic component mounting process, and improper component loading in automatic part inserters can be prevented.

5) Clarification of work rules
Employees collected and classified individual working rules defined during job improvement, and then each employee was notified of these rules.

6) Introduction of relief person system
If a worker is not available in a production line, a relief person is assigned to continue smooth production.

7) Presentation of quality and production information
To improve the awareness of each employee, various kinds of information about quality and production are presented at the entrance of the cafeteria (dining room and lounge), where employees gather. This enables employees to always see daily data changes.

Because these measures were taken, both production efficiency and quality were improved significantly (see Figs. 6 and 7), and American employees show a tendency to actively expedite improvement.

Issues related to safety occurred, however, as the number of products manufactured, employees, and facilities increased. Thus, the following measures were taken.

While efficiency was being improved, the repetition of simple jobs over a long time caused certain injuries, such as carpal tunnel syndrome (*1) and inflammation of tendon sheaths. Thus, facilities were modified to ease the stress on the wrists of workers. Some of the facilities in RIO were developed for use in Japan, and it was found that they do not satisfy the safety standards related to safety sensors and grounding defined by Occupational Safety and Health Administration (OSHA). Thus, these facilities were modified to conform to the safety standards applied in the U.S.A. Specifications for use in the U.S.A. are reported to Kobe plant as necessary, and are applied to the next model of facilities.

Figure 5. Assembly lines in RIO's factory

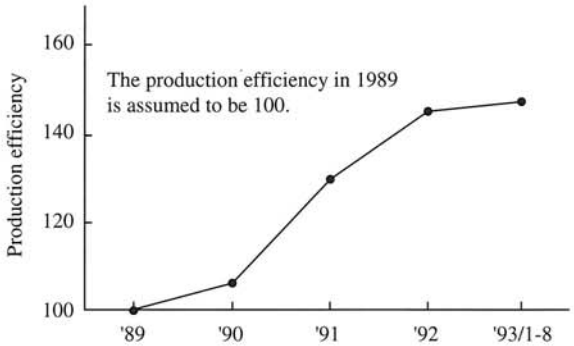


Figure 6. Production efficiency ratio

*1 Carpal tunnel syndrome: Functional disorder of wrist

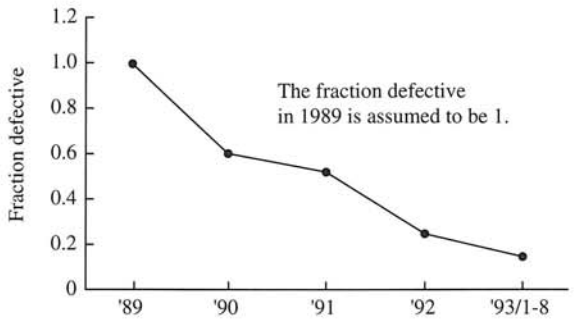


Figure 7. Defect ratio at customer

7. Quality control

The Quality Control Department consists of a parts inspection group, a unit and product inspection group, and a quality assurance and fault cause analysis group.

In general, the quality of Japanese products has often been reputed to be good in the past. In contrast, the quality of products made in other countries is likely to be considered to be poor. To ensure the same quality as that of Japanese products, quality control groups have made various improvements in RIO.

1) Audit inspection is performed in each step of manufacturing to ensure the quality of products processed in the previous phase.
2) RIO's original quality control system was established. This system processes and distributes correct quality information quickly (quality information processing system using bar codes).
3) RIO employees visit customers periodically. They collect quality information, provide the customers with technical assistance, and solve the problems faced by RIO and the customers to improve mutual communication and reliance.
4) Training on the following items is provided for employees so that they can raise their basic knowledge and awareness of quality:
    1 Soldering and measures against static electricity (theory and practice)
    2 In-house work rules and production system (understanding of importance of rules and the original production system)
    3 Product flow and quality assurance (confirmation of quality assurance operations in individual processes at the factory by checking actual products)

As a result of these efforts, the quality of RIO's products is reputed by customers to stand comparison with that of products made in Japan, and the quality of some models is reputed to be superior.

However, the quality of RIO's products is not yet reputed to be higher than the quality of products from other companies in the market. Because of this, RIO is now improving quality, with the following three points being important issues:

1) To form a system to perform overall analysis and control of product quality at the factory and in the field (final users)
2) To completely prevent the manufacture of defective products and their transfer to other processes by reviewing labor, machine, material, and method of processes
3) To raise employees' awareness of quality and ensure they follow standards and rules

8. Procurement of parts and production control

RIO's Production Control and Purchase Department consists of one American manager and four employees. These five people procure about 900 types of parts and control production for 9 types of products.

8.1 Production control

A material requirement planning (MRP) program is implemented on personal computers for production control. A centralized database is used to control the inventory and delivery of parts and delivery time changes, to check progress in production, and to control product shipment. This control information can be accessed from any department via an in-house LAN, and clerical work can be performed efficiently. For production control, daily jobs are performed with importance being put on the following two points:

1) Production of the required number of products
   When a production plan is prepared, data on actual orders and expected orders received from customers, the results of daily shipment, and inventory are considered.
2) Centralized management of part and engineering change information

A control form is prepared that indicates EC information (e.g., part number, time, related parts, and reasons) issued by the design department and information about the need for approval by the customer and reliability testing. This

form is used at the EC meeting held weekly, the information is checked, and the preparation status is reported to the related departments. A report on the manufacture of the first lot after an engineering change is made is issued at the same time that parts for the change is obtained. The report is used to prevent mixed use of old and new parts and to check the product flow in each manufacturing process.

8.2 Procurement of parts

There are two types of parts procurement performed by the purchasing department. One type is the procurement of Japanese parts via the head office in Japan. The other is the procurement of parts in the U.S.A., in which RIO directly purchases parts from suppliers. Since its establishment, RIO has considered the problems of trade imbalance and the higher yen. In addition, RIO has the policy that it contributes to the local society in Rushville through the operation of RIO's factory. According to this policy, RIO is making effort to procure as many parts as possible in the U.S.A. RIO now purchases sheet metal parts, molded resin parts, aluminum die-cast parts, and some electronic components in the U.S.A. Under the leadership of a full-time Japanese employee, a project team for procuring parts in the U.S.A. acts beyond the boundary between sections. The project team selects suppliers, examines materials, discusses press dies, provides technical advice, and performs part qualification testing. RIO now has dealings with about 30 companies. Because of the recent rise of the value of the yen, the export of finished products and parts from RIO to Japan is increasing gradually.

9. Future issues

After the Plaza Accord was reached, Japanese automobile manufacturers and car audio system manufacturers have actively constructed factories in the U.S.A. Fujitsu TEN also established RIO in Indiana State six years ago, which is our factory for manufacturing and delivering products to U.S. automobile manufacturers. The sales of RIO increased satisfactorily in this period because the sale of customers was satisfactory. RIO is gradually being affected by the recent collapse of the bubble economy in Japan and the doldrums of Japanese economy due to the higher yen. RIO thinks that business will be tough from now on. It is making the following efforts to become an American company that takes root in Indiana State:

1) Increasing the ratio of American managers
   The factory has so far been managed by both Japanese and American managers. In the future, organizations and systems will be changed so that the working method and product quality can be improved and the percentage of procurement of parts in the U.S.A. can be increased under the leadership of American managers.
2) Developing new business fields
   In addition to producing car audio systems such as car stereo systems and CD players, RIO will from now on plan new business that supports the next era of RIO and obtain new customers.
3) Global communication
   So far, RIO has made effort to improve communication between factories in North America. In the future, RIO will develop a system that can exchange information about quality and production with Fujitsu TEN's divisions in Japan and factories in Asia. As a result, RIO will improve inter-communication.

10. Conclusion

RIO is the first factory that Fujitsu TEN established outside Japan. In the beginning, an attempt was made to apply Japanese production systems (e.g., facilities, jigs, and kanban system) in the U.S.A. However, not all Japanese production systems could be applied to RIO as they were because the way of thinking, education, and customs are different from those of Japan. Rather, while we were working in cooperation with the American people, we found that American people have various techniques and ways of thinking that are better than those which Japanese people have, Since then, we have tried to establish a brand-new production system through discussion with American people and by combining the advantages of Japan and the U.S.A.

Finally, we would like to profoundly thank the people of the Indiana State Government and of Rushville who made efforts in planning and establishing RIO's factory.

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