An Interview with Toshifumi Tsuji, Senior General Manager, Saitama Factory, Production Headquarters, GLORY LTD.

A Factory Where Work Can Be Shared with Faithful Friends

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Ever since Karel Capek, the Czech writer and playwright, coined the word "robot" there have been many authors, including the late king of animation in Japan, Osamu Tezuka, creator of the iconic "Astro Boy", who have written stories with robot characters. But there have not yet been any for real practical use. The Saitama factory of GLORY LTD., a company producing machinery for counting coins and notes in banks and other financial companies, has finally succeeded in realizing these authors' dreams of robots becoming the friends of human beings. The amazing sight of human-shaped robots and workers collaborating together at the factory brought to mind a scene from the film *i, ROBOT*. But this was reality, not fiction.

Prime Minister Shinzo Abe also visited this factory last June; perhaps it might affect his ideas of structural reform, as robots would certainly change the nature of the Japanese economy. In this same factory, *Japan SPOTLIGHT* had an interview with Mr. Toshifumi Tsuji, senior general manager, and Mr. Yoshitaka Murakami, assistant manager of the Public Relations Department of the General Affairs Headquarters Office of GLORY LTD.

Portrait of the Company & Factory

JS: Could you tell us briefly about your company's business and history?

Murakami: Our company was founded in 1918 as Kokuei Machinery Manufacturing, and it was started as a repair factory for light bulbs. Since then, while working as a subcontractor of a shipbuilding firm, the company was at the same time engaged in developing its own products and finally in 1950 was successful in inventing a coin counter for the first time in Japan and delivering it to Japan Mint. Since then we have been engaged in providing mainly currency-processing machines for financial institutions and also for distributors' facilities and amusement facilities under an integrated system of development, production and maintenance. Besides currency-processing machines, we are producing ticket-vending machine, ballot sorters for handwritten ballots and machines for credit card services. We have been trying to improve the reliability of our products and services having acquired international standards.

Toshifumi Tsuji, Senior General Manager, Saitama Factory, Production Headquarters, GLORY LTD.

JS: Could you tell about the Saitama factory's business?

Murakami: Our Saitama factory was established in 1990. With an increase in the quantity of production, a second factory building was added. Our area in total is around 40,000 square meters, while our factory building space is around 13,000 sq. meters. When it was constructed, it operated as the most advanced automation factory at that time. Until 2000, mainstream production was a line production driven by a large conveyor belt. In 2001, we began cellular manufacturing in order to achieve a multi-product line with small quantity production for each item as efficiently as possible. We are now pursuing further rationalization of the production process by cellular manufacturing and low-cost operations.

In this factory, we are producing more than 20 kinds of machines for the domestic market and more than 15 kinds for overseas

markets. We are engaged in a wide range of activities involving assembling trial products of devised machines, procuring parts and materials, manufacturing and shipping. The Production Department is in charge of component procurement, production and final checks of the products. The Production Engineering Deptartment is in charge of trial production and production facilities, and the Production Control Deptartment is in charge of materials procurement, production process management and product inspection. We also have a Quality Assurance Deptartment in charge of collecting data for quality checking and quality management.

In the production of automated change machines, a low-cost operation is achieved by automatization of simple operations. We are using Nintendo DS to promote paperless check lists in the factory. Above all, we introduced human-shaped robots and achieved stability in product quality and low-cost operation in an assembling unit process. We were awarded a Special Prize from the Ministry of Economy, Trade and Industry (METI) at the fifth Robots Convention in 2012 and also the METI Minister's Prize at the fifth Manufacturing Convention in 2013 for the introduction of robots into our factory.

In accepting parts and components, we doubled our operating efficiency by introducing an automatic classification system for them and made it possible to classify up to 4,800 items per day. The classified items are distributed by a tray among the different assembling processes. In this process, only the items that have passed a rigorous test will be used in the production line.

In the trial product assembling area, we assemble a trial product inside the area in order to shorten the lead time from its devising to mass production. We arrange an automation process and cellular manufacturing in the most efficient manner and try to keep production costs low and quality high in achieving a reduction in lead time. No matter how automatized the production line may be, human labor will not cease to exist in a process such as cellular manufacturing.

At the Saitama factory we are doing our best in human resources development by setting up a training place in the factory where workers can learn and share the skills of basic operations. Thus we can improve the skills of an individual worker and reduce the number of errors in operations. We are actively carrying out technical skills training as defined by a national skills examination system and many of our workers have passed such an exam. All workers participate in our Glory Up Technology Small group (GUTS) program aimed at improving the quality of our products, and the best working place within our company is awarded with a prize at our annual convention.

JS: Could you tell us how your human-shaped robots were introduced?

Tsuji: As you can see from what we have said, our company has been doing many things in automatization to enhance our productivity. This is not only at the Saitama factory but also at the headquarters factory in Himeji, and the other production facilities are all always promoting automatization. The Saitama factory was built in 1990 and we completed automatization of the assembling process in 1992. We have a corporate culture to promote automatization in our trials to achieve efficiency in the production process by considering continuous automatization as the key objective in our long- and mid-term management plans.

We first saw a human-shaped robot in 2009 and though we were not sure if it would be useful for us or not, we thought we should try to introduce one, and did so in 2010. We have lots of assembly lines and test how much work robots can do, and then introduce them on our product line. They are different from the industrial robots we were used to. Considering these robots' capacity to do as humans do, we would like them to succeed human beings in the mass production process. We are trying to have robots do whatever humans can do and even what humans hate to do.

JS: Does this mean there are concerns that human workers could all be replaced by robots?

Tsuji: No, not necessarily. The introduction of human-shaped robots in this factory was based on the need to return production to Japan in accordance with a model change in unit products manufactured in our factory in China. In this decision, we thought we should achieve a profitability using robots equal to that achieved in the factory in China which was taking advantage of cheap production costs there. We are continuing to manufacture the old model products in China, so we did not intend to save labor costs by the introduction of these robots.

JS: In the future, we will face a labor shortage problem due to the progression of depopulation. Would human-shaped robots be an effective solution for this?

Tsuji: Yes, I think so. Our company is now trying to recruit workers in this neighborhood, as our production has increased this year from last year. However, we cannot secure as many workers as we expected. In this light, it would be a merit to have human-shaped robots. At the moment we are introducing them into production lines, but in the future every worker in our company should have one robot and through collaboration between them the most efficient business could be realized.

JS: Do you think introducing human-shaped robots as part of automatization for raising productivity was a management success?

Tsuji: Yes. I think we achieved a certain success. In terms of raising productivity, we are still on the way to our ultimate goal. We are in

the process of gaining a return on investment. However, we have been successful in going beyond the scope of initial automatization towards new automatization. With our trials, I believe human-shaped robots will evolve further.

JS: Can you trust the robots to work in dangerous situations or on what humans would find difficult to do?

Tsuji: That is the idea behind the existing industrial robots. In our case, humans have to do what only they can do, such as counting coins or notes, since our products would need to pass a rigorous standard. We leave the robots to do more routine processes and integrate these into those to be done by humans. In other words, humans would do what the robots cannot do and both collaborate to assemble a product.

JS: Is this still at an experimental stage?

Tsuji: We have already put it into practice in one of the production lines and we are planning to expand it.

JS: Do you think the introduction of robots is truly beneficial for your factory?

Tsuji: Yes. Our factory workers greatly enjoy working with robots and many people come to visit our factory to see the robots working with the workers, and that has animated our workplace.

Robots & Safety

JS: Do you have any concerns about safety in the operation of robots?

Tsuji: The working robots are operating under 80 watts and humans cannot be injured, even if they collide with them. In addition, we are using them in a way that cannot hurt workers. Their operation capacity is also limited, since they cannot carry heavy items. The robots' operations are repetitive and while one program is running, it is all safe. We set up the initial stage of a program very carefully, and once it is running it is all safe until converted to a new one.

Murakami: In addition, we are devising a process without physical contact between a human and a robot. There is a conveyer belt between a human and a robot in each operation, and thus they would not have any direct contact with each other.

Expansion of Robot Utilization

JS: Have any of your factories overseas introduced robots as in Saitama?

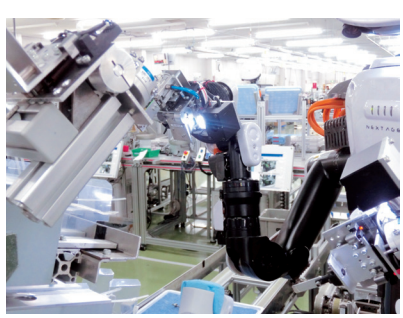
Tsuji: No. Only in Japan.

JS: Is there any possibility of other companies using robots, having seen your success?

Tsuji: Yes, that's possible. However, human-shaped robots are difficult to control, so it would be difficult to master good ways of using them.

JS: In your case, in introducing human-shaped robots, you must have taken advantage of know-how you developed in promoting automatization since founding your company. On the other hand, have you done your own trial-and-error tests since their introduction into a factory?

Tsuji: We purchased human-shaped robots from Kawada Industrials Inc. but we are producing arms on our own and also the connecting facilities around a robot as well. On controlling software, we are programming on our own while learning from Kawada Industrials Inc. I think our trial-and-error process is key to our success, in addition to our existing know-how. We need to set up the detailed operations of a robot, such as speed, power to grasp an object, manual of operation, etc. We need to do this on our own in order to respond to possible trouble quickly and know better how to repair it. Otherwise, the costs of repair would be enormous. Unless a company has such a capacity in technological development, it may not be able to utilize human-shaped robots very well.



Industrial Evolution

JS: Do you think human-shaped robots can enhance the potential of Japanese industrial development?

Tsuji: Yes. They will make a positive contribution to our industrial evolution in the long run. In our experience, a new challenge like the introduction of human-shaped robots could vitalize our company and enhance our technological potential. Therefore, it is important for us to discover new challenges from now on as well.

JS: According to Kawada Industrials Inc., collaboration between producers and users will be crucial for the development of robots. As a result of this collaboration, robots will acquire a new capacity. If a user company is reluctant to open such an outcome of collaborative product development to other users, the whole industrial development brought about by robots would be limited. For industrial development, users should open their know-how gained by a producer-user collaboration in product development to the public. What do you think about this?

Tsuji: We are open to other users of robots. We accept guests visiting our factory and open our automation processes through human-shaped robots to the public. We also believe it will be important for us to share our information on robot technology with other companies as much as possible.

JS: Japanese robot technology seems to be more advanced than in any other country. Do you think there is anything in the Japanese character that has brought this about?

Murakami: Some media people from another country visiting our factory once told us that Japanese have been used to considering robots as close friends or colleagues since their childhood, as symbolized in popular animations for children, such as "Astro Boy" or "Doraemon, Gadget Cat from the Future", whereas in other nations they are considered merely as one of the labor force. This special Japanese affection for robots could be an advantage in our development of robot technology.

We were invited to see some production lines where humans and robots were working together, and continued our interview there, with some working employees joining us.

JS: Each robot seems to have a name. How do you give them such names?

Tsuji: We name the robots after a nation's currency. The first robot introduced in this factory was named "Yen". Then we named the rest after the names of the other national currency coins that our company deals with. We have introduced 18 robots so far and each one has its own name in accordance with this principle. We will have the 19th one soon and it already has a name.

JS: How many countries' currencies do you deal with?

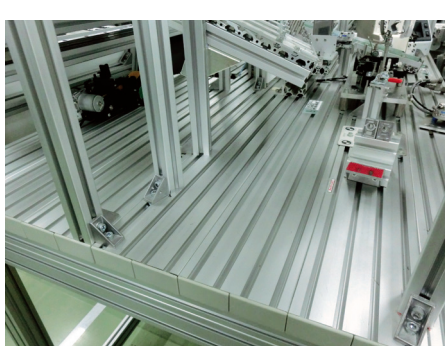
Tsuji: We deal with around 80 nations' currencies.

JS: After seeing your production lines, it is certainly true that you do not have to be so concerned about the workers' safety.

Tsuji: I would like you to note that each product line has its own character. There are some lines where four fixed human-shaped robots are working in a row, and there are some where an industrial robot is set between human-shaped ones, or in another line a human-shaped robot is moving and operating.

JS: There are also some product lines where one worker and four human-shaped robots are working together.

Tsuji: Yes. These lines are manufacturing coin and banknote recyclers for cashiers. In these lines, the four robots are in charge of the first half of the operation process and a human worker is engaged in the second half of the process. After each robot finishes its operation, it pushes a button for a conveyor to deliver the product to the next robot.



An example of a work table for robots. Some parts or arms can be set without limits from side to side and up and down for a robot's work.

JS: What would happen if anything extraordinary occurred?

Tsuji: They are programed to stop operating when they cannot do their job well or anything unexpected or irregular happens.

JS: Would there be an alarm if, for example, a screw used in parts was missing?

A male employee: Yes, there will be an alarm.

JS: The robots seem to be working quietly. How many hours do they work per day?

Tsuji: They work continuously all day long from morning until night, including the lunch break on a day when the factory is operating.

A male employee: Generally, when the whole factory stops operating on occasions such as inventory clearance, we would do maintenance for the robots, and even on other occasions we check them spontaneously.

JS: Many female employees are working in this factory. How long are the employees obliged to take a training program before joining the operations in a product line?

Tsuji: They have to take a three-day training program to work in our factory. After that, each employee is assigned to a product line after an observation period in which his or her fitness for each product line's work is judged. In this factory, 340 people are working including permanent and non-permanent workers and those sent on contracts with cooperating companies.

JS: This factory should provide a big job opportunity for the local residents here. Could you let us know about your Corporate Social Responsibility (CSR) activities, if any, in the local area?

Tsuji: In the summer vacation we organize a "Special School for Experiencing Science by GLORY" for children in this neighborhood. We also have an event called "GLORY THEATER for CHILDREN" at the end of every year to which we invite school pupils and their parents.

JS: We would like to ask a female worker here how long she has been working in this product line?

A female employee: I have been working with this robot for one year.

JS: Is it working as you expect?

A female employee: Yes. I have done what the robot is now doing in assembling a product by myself. There were some difficult points for me, but the robot does very well in handling those points. So I have confidence in the robot.

JS: How many people are developing these product lines using the robots?

Tsuji: Six people are working on it.

JS: The operations seem to be so complicated. This means you have a different program for each of the 18 robots in total?

Tsuji: Yes, we do have different ones. They would be able to do something rather complicated or something that you would need dexterity in doing, such as stripping off a seal or inserting a spring.

JS: Thank you so much for showing us your amazing factory. We are certainly impressed by your wonderful colleagues. JS

Sidebar

The "Robot Revolution" — the Strategy Announced by the Japanese government in January 2015

Robots will be at the core of innovation in Japan, in the following areas:

1. Through remarkable technological progress in use of sensors and Artificial Intelligence (AI), automobiles, home electronics, cellphones and even homes used in daily human life would function as a robot.
2. Expansion of the use of robots:
   i) More use of robots in assembling processes
   ii) Use in wholesale & retail businesses, or hotels and other services
   iii) Use in caregiving
   iv) Use in construction services and disaster relief
   v) Use in agriculture
3. Robots would help create innovation by using "Big Data" under the integration of robotics & IT.