

## The Innovator of Aluminum



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## Sing 37

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[ Featured article ]

## GF Fun Case Collection

<http://global.sus.co.jp/>

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## Sometimes try changing your point of view

**Yasuo Ishida,  
Representative Director of  
SUS Corporation**

In June 2017, SUS took part in an event called, "Amazing! Shizuoka" organized by Shizuoka Science Museum adjacent to its main offices. This was a workshop where companies and organizations in Shizuoka Prefecture introduce their own technology to children. SUS used aluminum pipe structural material GF (or Green Frame) to let children experience the interesting features and user-friendliness of aluminum pipe structures and made various exhibits to learn mechanisms such as pulleys and links in a fun way. This current issue of Sing summarizes the "GF Fun Case Collection" while focusing on what was used at this event and it is given as a special feature.

What we are covering here is "toys" that we made for children. However, these toys incorporate many different mechanisms and showcase the varying shapes that can be created by combining existing parts. You might call it a kind of basic prototyping.

This proved a fine opportunity to explore new combinations of parts and ideas on new products that are not usually made elsewhere. Here we took “toys” as our theme which is something we don’t usually make. Besides that,

production lines by combining multiple Karakuri devices. We created this featured article with the intent of sharing such new suggestions with our customers. By all means, please see the results for yourself!

### What is Karakuri?

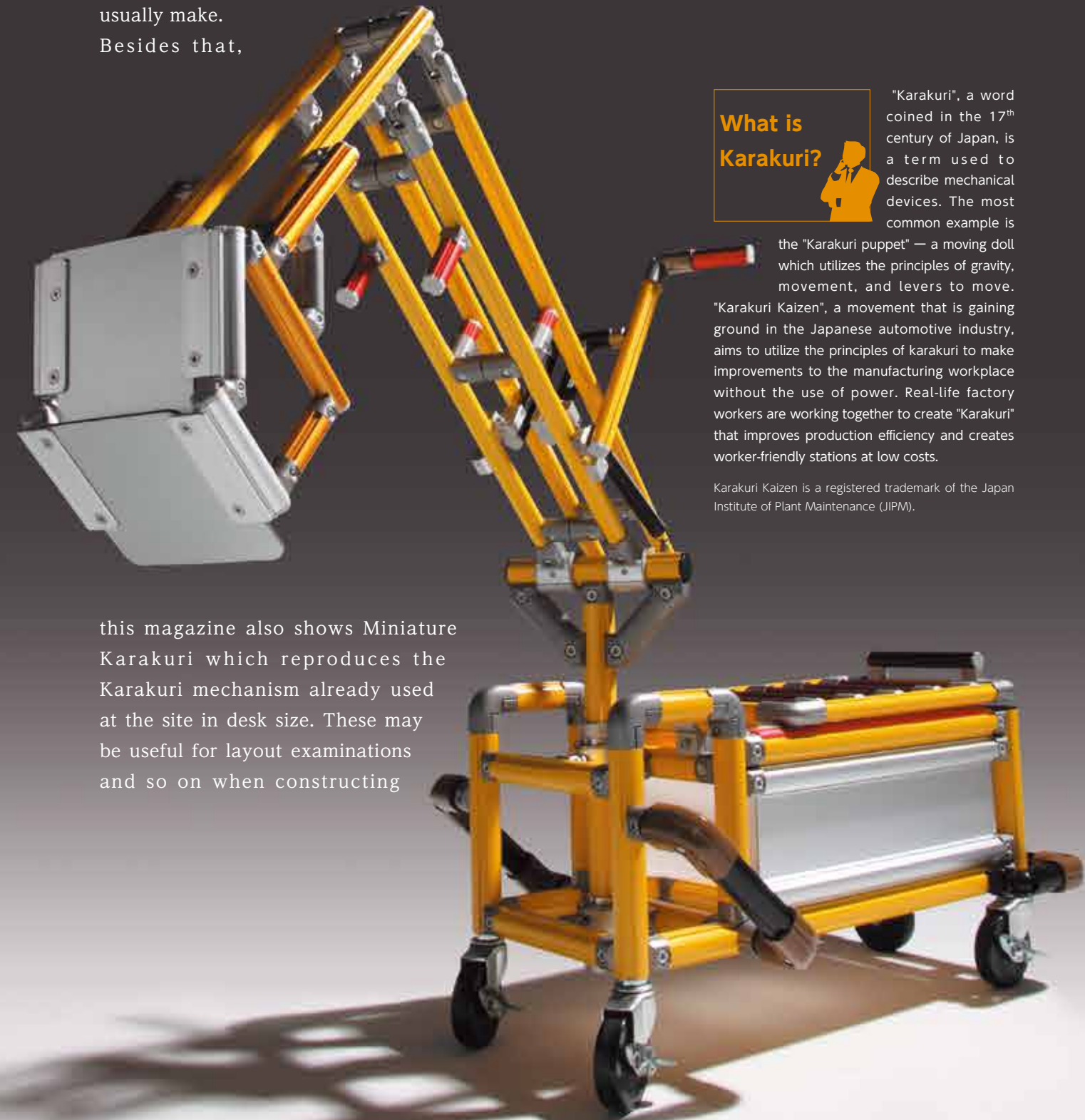


"Karakuri", a word coined in the 17<sup>th</sup> century of Japan, is a term used to describe mechanical devices. The most common example is

the "Karakuri puppet" — a moving doll which utilizes the principles of gravity, movement, and levers to move.

"Karakuri Kaizen", a movement that is gaining ground in the Japanese automotive industry, aims to utilize the principles of karakuri to make improvements to the manufacturing workplace without the use of power. Real-life factory workers are working together to create "Karakuri" that improves production efficiency and creates worker-friendly stations at low costs.

Karakuri Kaizen is a registered trademark of the Japan Institute of Plant Maintenance (JIPM).



this magazine also shows Miniature Karakuri which reproduces the Karakuri mechanism already used at the site in desk size. These may be useful for layout examinations and so on when constructing

# WHAT WILL YOU



# MAKE?

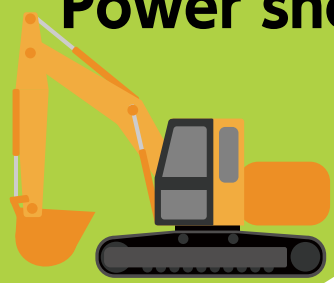


## ***GF Fun Case Collection***

Though GF aluminum pipe structural material is normally used at manufacturing sites, we also made them into toys that are fun for children to play with. Who knows? Perhaps a new idea will emerge from all these gadgets that excite kid's curiosity and creativity.



# Making a heavy vehicle with GF 1 Power shovel



## Recreate it in GF

A "heavy vehicle" including all kinds of mechanisms is recreated with a combination of GF movable parts used for Karakuri. Here, an arm using a link mechanism can fold, extend and be freely manipulated.

**Change shovel angle freely to any angle you want**

Put these parts to use!

**Link Connector S V (GFJ-041)**



To link the shovel parts together, use 4 Link Connector SVs whose angle is freely changeable even after fastening. Pull the lever right in front to lift the dump truck shovel upwards.

**Base of the arm rotates smoothly**

Put these parts to use!

**Rotary Connector (GFJ-A94)**



Passing the base of the arm through the Rotary Connector allows sliding it in any direction you want.

Arms are built to be slim using GF-S.

Arm folds like this

Lowering the arm to the seat side stores it compactly as shown here.

Put these parts to use!

**I want the arm to move stably**

**Tension Spring**



**Spring Post Connector (GFJ-B10)**



**Connector Piece S Top (GFJ-B70)**



Pulling back the lever with your right hand makes the spring expand, so that a balancing force stabilizes the dump car shoveling operation. Mounting is also easy with these installation parts.

Put these parts to use!

**Adjust the hand angle**

**Hinge Connector (GFJ-A04)**



**Left hand**

Lowering it forward raises the near side of the arm.

**Right hand**

Pulling towards you raises the shovel.

## Specifications

Image shows a recreated power shovel with baking-finished yellow frame used as an area guard etc. The design that has feet on the front part and a bumper on the rear as shown gives it fully playful feeling. The weight was dispersed with multiple frame pieces on the upper seat surface to give plenty of sitting support. To move forward just push off with your feet.

## So how do you use it?

Operate the arm with the levers at the 2 locations and scoop up the balls while adjusting the position and angle.





# Dump truck



## Recreate it in GF

This dump truck with load bed lets you play with it along with a power shovel in one set. After loading the ball and moving it, you can tilt the load bed with a single lever to unload it.

Put these parts to use!



To maintain strength

**Point Connector (GFJ-A15A)**



Point Connector is a convenient part for strengthening the frame connected at a right angle.

Tilt the load bed

You can store items inside the seat.

Put these parts to use!



To link tilting of the load bed with ejecting the load

**Hinge Connector (GFJ-A04)**



Load bed lid is fastened with two Hinge Connectors so it opens naturally when tilted.

Put these parts to use!



I want to convey lever operation to the load bed

**Rotary Connector (GFJ-A94)**



Rotating parts used in the joints of the link mechanism, convert the "lower lever forward" action to a "tilt the load bed" action.

Load bed is normally held horizontally.

Lowering the lever forward tilts the load bed and ejects the balls.

## Specifications

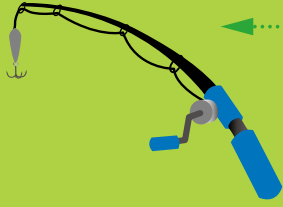
The structural design around the steering wheel and seat follow up on the power shovel contour and attaches the load bed at the rear. Once you scoop up balls with the power shovel, you can carry them wherever you want to play!

## So how do you use it?

First back up and approach the ball pool and then use the lever to tilt the load bed with the lever. You can do all this while still sitting in the dump truck.



## Sport fishing



## Recreate it in GF

Catch fish with a fishing rod and fishing pond made from GF! Then lift the fish out with a strong magnet.

Make a reel winder mechanism for the fishing rod.

Put these parts to use!

**One Way Clutch (GFJ-C19)**



This mechanism only allows movement in one direction so you can clamp the fishing line at the raised position.

Put these parts to use!

I want to join the fishing line to the fishing rod

**Eye Bolt M6 (GFW-247)**



**Connector Piece S Side (GFJ-B71)**



Pass the wire through the Eye Bolt ring and guide it in the movement direction.

We made maximum use of GF-S in order to make it more compact.

Turn the handle to wind up the fishing line.

I need to stabilize the tilt of the fishing rod.

Put these parts to use!

**Tension Spring**



Like the power shovel arm, it stabilizes the operation of the fishing rod by balancing the force with a spring.

**Spring Post Connector (GFJ-B10)**



Put these parts to use!

I want to move the fishing rod left and right

**Slide Connector S Free (GFJ-C18)**



Unlike the Hinge Connector, it does not rotate and can only slide. Making it longer will stabilize it when a load is applied.

## Specifications

Adjust the tilt of the rod and the left and right positions and move it so that the fishing line is directly above the fish. To lower (wind out) the fishing line, release the One Way Clutch. Once you have hooked a fish, set the lock and wind in the fishing line.

## Golf



## Recreate it in GF

Simple but surprisingly difficult golf game. Aim for a hole-in-one!

Freely choose the club position and swing downwards.

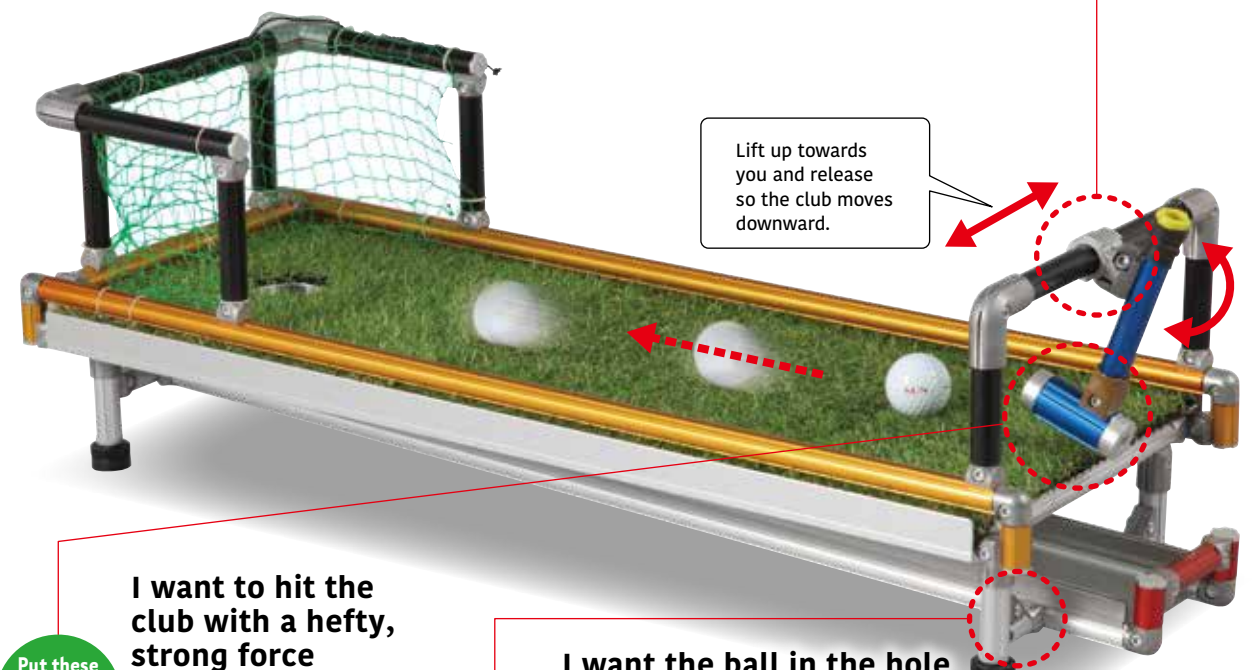
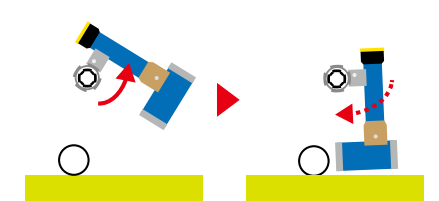
Put these parts to use!

**Hinge Connector S (GFJ-A64)**



A single Hinge Connector as one part that can both rotate and slide allows easily shifting right or left and swinging the club downwards.

▼ Motion of the club



Lift up towards you and release so the club moves downward.

Put these parts to use!

I want to hit the club with a hefty, strong force

**Weight Frame**



We use a Weight Frame in the head of the club with a weight that allows hitting the ball with plenty of force within just a limited movement range.

Put these parts to use!

I want the ball in the hole to return to its original position

**Multi Connector S R Inner (GFJ-244)**



**Corner Bracket S (GFJ-C53)**



The rail can be mounted diagonally below the bed by using an R type connector that can clamp the inserted frame while rotated to a desired position under the table. Using Corner Brackets allows you to clamp the frame even in a very small space.

## Specifications

Once you set the ball in place decide the club's position, swing downward and hit the ball. If you take the grass lawn resistance into account, the ball might stop halfway. So the position where you set the ball is also important.

Miniature Karakuri made from GF  
**Miniature Flip-Flop Chuter**



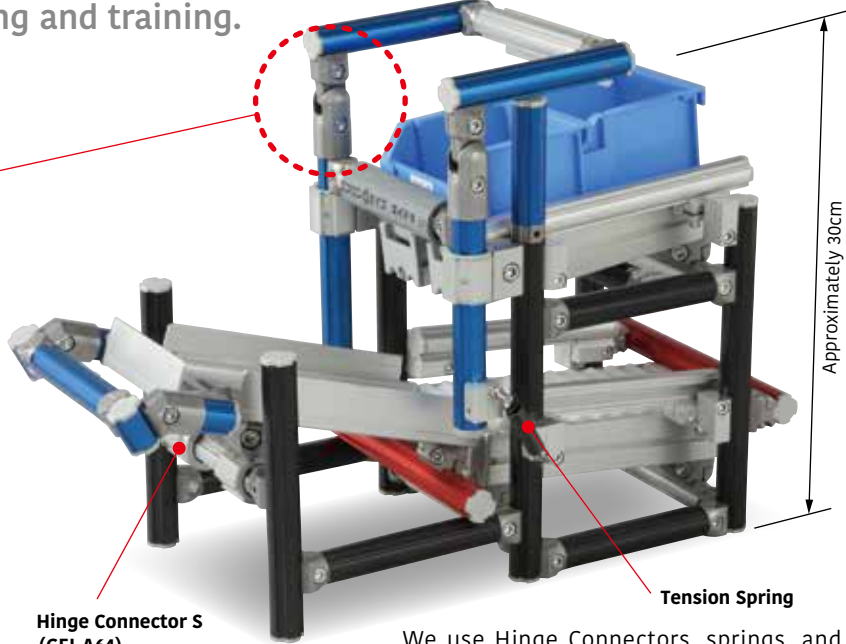
# Recreate it in GF-S

The Karakuri is made in a compact desktop size. This makes it ideal for hands-on learning and training.

Put these parts to use!  
**Links the table and separator**  
**Link Connector S V (GFJ-041)**



It also moves freely even after coupling so the separator automatically falls under its own weight when the table rises.

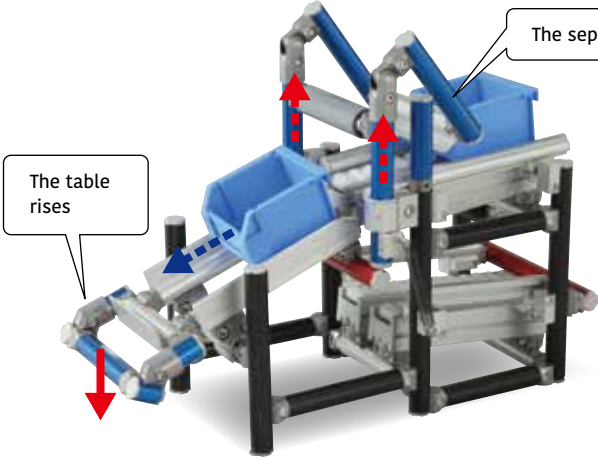


**Hinge Connector S (GFJ-A64)**

**Tension Spring**

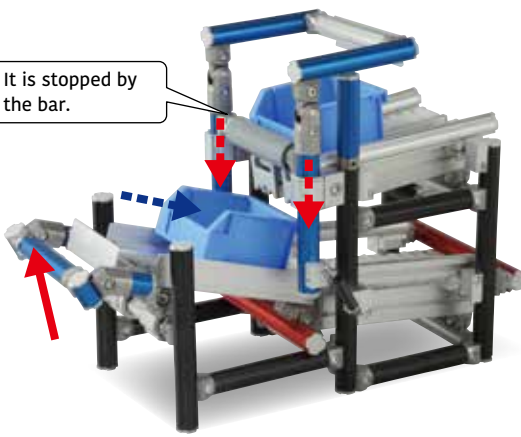
We use Hinge Connectors, springs, and other items to make a mechanism to slide and rotate the frame.

Approximately 30cm



The table rises

The separator drops.



It is stopped by the bar.

The red frame at the bottom of the table lifts to release the bar by pushing the left and right blue frames upward. At the same time, the separator mechanism operates so that only one container moves along the line.

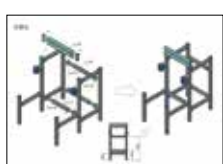
When the table tilts, the bar lowers due to the force of the spring, and the container that was stopped at the top rack proceeds to the front of the bar. Containers within the table flow to the lower rack.

**Specifications** I made a "Flip-Flop Chuter" that proved highly popular even among other Karakuri. It uses a GF-S series having external dimensions of 19mm. Raising the return table separates out one upper container and when tilted, it is ejected to the lower rack. It is also loaded with features that all fit into a compact package.

## Miniature Karakuri assembly kit Now on sale!

The miniature version of Karakuri also sells with a kit that has the essential parts needed for assembly. Currently, there are 5 lineup types including a "Flip-Flop Chuter", "Tote Separating Chuter" and "Horizontal Turn" type. Please try experiencing Karakuri assembly for yourself and have fun!

※ The color of the kit frame is silver.



Comes with assembly instructions

We will deliver frames (pre-cut) along with the necessary parts as a set.

## Vehicle made by GF 1 Pedal-free tricycle



# Recreate it in GF

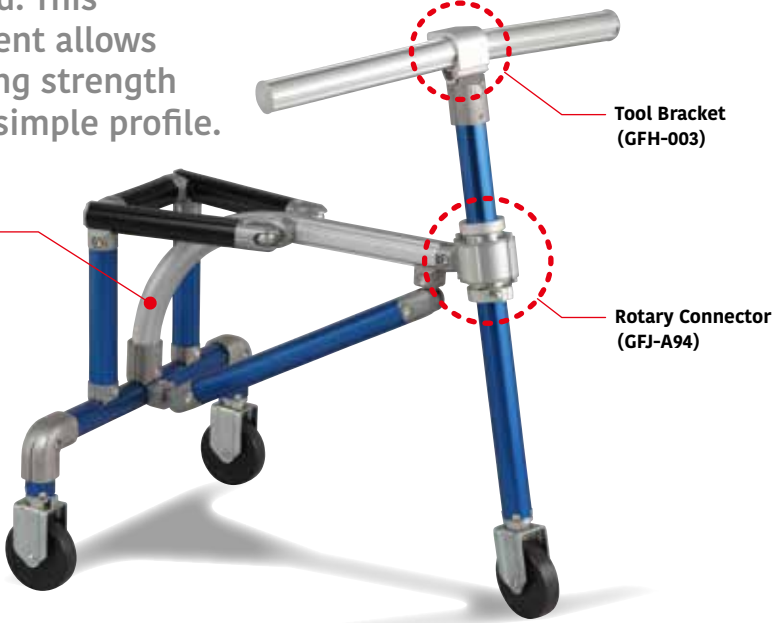
A tricycle for children to move forward by kicking against the ground. This arrangement allows maintaining strength yet has a simple profile.

Put these parts to use!  
**Design around the seat**  
**Bent frame**



Expresses real vehicle lines.

※ Does not come with brakes ※ Do not use on public roads ※ Not subjected to durability test



**Tool Bracket (GFH-003)**

**Rotary Connector (GFJ-A94)**

**Specifications** The shape of a tricycle is recreated by making full use of Free Connectors and Bent frames to allow freely deciding the mounting angle. A Rotary Connector is used for the steering wheel and front wheel shaft and easily rotates with just the strength of a child. The grip of the handle is slightly bent at the center and clamped with a Tool Bracket.

## Vehicle made by GF 2 Kick scooter



# Recreate it in GF

A toy for moving forward by using your feet to kick off the ground. Good for acquiring a sense of balance while standing.

Put these parts to use!  
**Maintains strength**  
**Rotary Connector (GFJ-A94)**



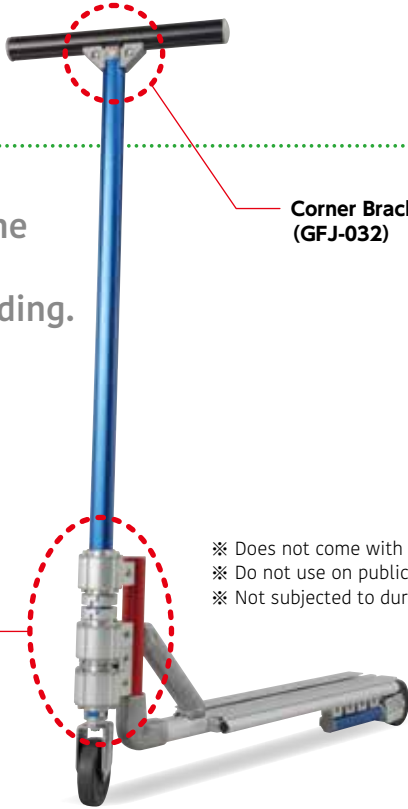
The coupling section of the base where a heavy load is applied is carefully reinforced for safety.

**Point Connector Long (GFJ-B80)**



**Corner Bracket (GFJ-032)**

※ Does not come with brakes  
 ※ Do not use on public roads  
 ※ Not subjected to durability test




**Specifications** To reinforce the grip part of the handle using compact Corner Brackets for a neat appearance. Because a large momentum load is applied to the connection between the steering wheel and board section, it is reinforced with a Point Connector Long and multiple Rotary Connectors joined together.



Living creatures  
made with GF

# GF Zoo

When you gaze at the GF parts, you can see that they have many different shapes. Here, I focused on this "shape" and tried to create various animals. Maybe not so useful but slightly cute don't you think? This is for the opening of the GF Zoo.



## Bird

### Recreating a bird with GF

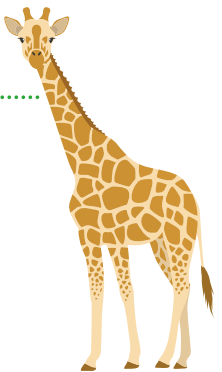
We utilized a Base Stand for clamping partitions as the bird's face, and utilized a Flexible Arm with freely changeable angles as the neck. The angle of the wing and other items are adjusted with an R type connector that can rotate the inserted frame in any desired direction. Loosening the bolts allows you to change the bird's pose as you like.



## Giraffe

### Recreating a giraffe with GF

We changed the frame length to make a giraffe parent and child. Corner Bracket bolts became the eyes and the narrow Multi Connector S Inner on the frame insertion side expresses the slender legs.

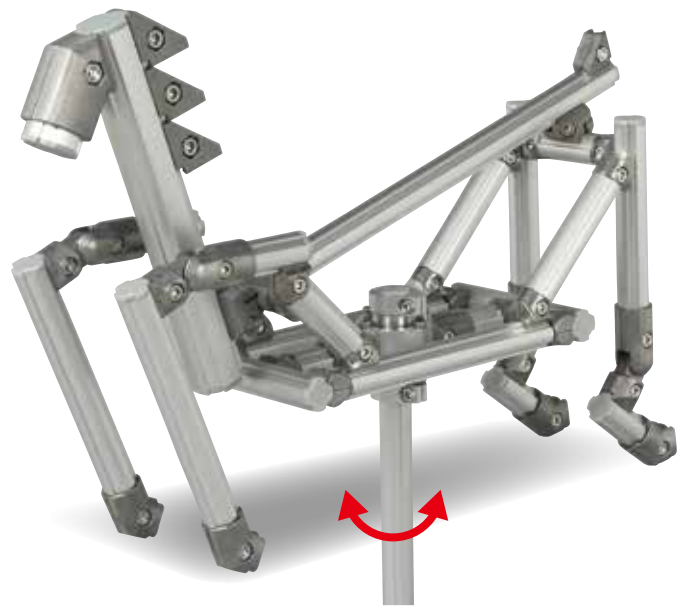


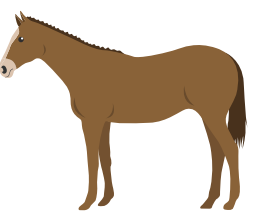


## Elephant

### Recreating an elephant with GF

GF-G with an outer dimension 43 mm is utilized as the body of a large elephant. The protrusion size is the same as the GF-N with an external size of 28 mm so installation is easy. The Point Connector N-S utilized for reinforcement when connecting GF-N and GF-S is focused on the point where the narrowness changes along the way and can be thought of as the elephant's face.














## Horse

### Recreating a horse with GF

A horse where we were particular about movement as well as shape. The joints of the leg are coupled with a Link Connector SV and movement suggests a kind of wavy motion. We tried to imitate an image of a horse galloping around. The face and hooves are created by different sizes of external type 45-Degree Connectors. It cannot stand on its own so we added a stand and it rotates round and round via a Rotary Connector.

Put these parts to use!



<p>Base Stand (GFN-E08)</p> 	<p>Flexible Arm</p> 	<p>Corner Bracket/S (GFJ-032/GFJ-C53)</p> 	<p>Multi Connector S R Inner (GFJ-244)</p> 	<p>45-Degree Connector Outer / S (GFJ-007/GFJ-035)</p> 	<p>Point Connector N-S (GFJ-B89)</p> 	<p>Link Connector S V (GFJ-041)</p> 	<p>Rotary Connector (GFJ-A94)</p> 
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# SiO Controller

This controller is designed for people who are using electric automation on the factory floor for the first time.

## SiO2, a slim and compact karakuri controller.

The new SiO controller is centered around our commitment to simplifying electric automation. By utilizing the world standard e-CON connector, you can join input/output devices simply by plugging them in. The programming software's multiple-choice format makes navigating the operating system easier than ever. Anyone can use the SiO2 controller.



# INNOVATION



## ***Production Site INNOVATIONS***

These highly popular production site innovations will prove really useful for a broad spectrum of business and industries. This time we cover case examples of improvements at two customers and "Cross-Industry Exchange Meetings" which are a place to exchange information between staff from different industries working on production site improvements. The first improvement case we present is from the DENSO CORPORATION Kota Plant which is a global automobile parts manufacturer providing advanced automobile technology, systems and products. The second case is from the Takano Company Limited Shimojima Factory which mainly manufactures office chairs. Takano Company Limited which started out manufacturing springs is also active in many other fields ranging from health and welfare-related items to exterior and electronics-related businesses. We were also able to ask about a Cross-Industry Exchange Meeting held in response to a request from Akebono Brake Fukushima Manufacturing Co., Ltd. with the cooperation of DENSO FUKUSHIMA CORPORATION including what happened in the meeting and impressions the members had after it ended. These introduce case examples and special measures crammed with ideas custom-tailored to the characteristics and challenges of the actual work site, so please be sure to check it out!

### **Intro to Improvement Examples**

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**Takano Company Limited, Shimojima Factory ..... P27~**

### **Cross-Industry Exchange Meetings**

**DENSO FUKUSHIMA CORPORATION × Akebono Brake Fukushima Manufacturing Co., Ltd. ... P33~**



# What is the essence of easy-to-use? Achieving a workplace with smooth workflow through engineering that blends electrical and mechanical technology.

DENSO CORPORATION, Kota Plant will celebrate its 30th anniversary this year. At this plant, the semiconductor manufacturing division 1, IC1 plant is introducing improved equipment that since last year combines electrical or motor-driven parts along with Karakuri (mechanical-contrivance) mechanisms. Please take advantage of our years of experience and knowhow by checking out some samples of our work that transform requests from the work site into actual items that meet production needs.



Device Manufacturing Div. 1,  
 IC1 plant manager  
 Mr. Masahiro Hanji



Manager of semiconductor  
 manufacturing division 1,  
 IC1 plant 3<sup>rd</sup> Production  
 Section  
 Ms. Kimie Kimura



Semiconductor  
 manufacturing division 1,  
 IC1 plant  
 Mr. Naoto Ikeda



Semiconductor  
 manufacturing division 1,  
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 Mr. Shouji Ura



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<https://www.denso.com/global/en/>

Making effective use of motorized parts to safely convey heavy workpieces with no wasted effort

### First of all please give us an overall view of the Kota Plant.

Here at the Kota Plant we manufacture wafers for semiconductor materials, and assemblies using them, and manufacture electronic components mounted on PCB or IC substrates. Among all these operations we handle semiconductor or namely IC fabrication at Semiconductor manufacturing division 1, IC1 plant that does semiconductor or IC assembly. Completed sensors and other components are incorporated into automotive parts such as engines, air conditioners, head lights. These components are essential for device and mechanism operation and control.

We have been using SUS products such as GF aluminum pipe structural material in this field for about 8 years now, and are working night and day to improve them to obtain maximum use of their best features. Since GF (also called Green Frame) is easy to handle, improvements can be quickly made and the price is reasonable. At the actual work site, besides production efficiency and ease operation, we are also extremely careful and particular about creating a clean environment since we deal with extremely fine and intricate products such as ICs and electronic components.

### We heard that you have been incorporating many motor-driven parts into your operation since last year. What is the reason behind that?

Throughout the years, DENSO has been conducting daily improvement activities led by the plant manager in which everyone takes part. These are called EF or Excellent Factory activities. This is not a partial effort on a line-by-line basis but may take place throughout the entire factory. Last year for example, the IC1 plant started a policy "to minimize

lifting things up and moving them." The problem here is weight. Our products are small one by one, but we carry some of them in bulk amounts so they can be quite a heavy weighing from 10 to 40 kilograms. This situation makes it difficult to build facilities by ordinary means without motorized power, and at the same time, there were safety problems. We heard that in such cases information that using Power Units from the electronic manufacturing division could improve things so we got them to give us some equipment and started using electrical power-driven parts.

Nonetheless, the Power Unit (rod type), which was first released, only had a maximum stroke of 300 mm so was only useful in a few situations. We therefore repeatedly requested new products from the salespeople. We finally started making full use of such tools when the Power Unit (slider type) finally appeared. It had a maximum stroke of 500 mm, and we began to think we finally had something suitable for the situation at our work sites!

### We heard that you also started using the SiO Controller. Is that right?

The great thing about the SiO was that it allowed coupling electric parts with sensors etc. The cost could be kept low and we could motorize the operation. We think that the SiO had many I/O points to allow making improvements and it effectively widened the range of tasks we could now accomplish.

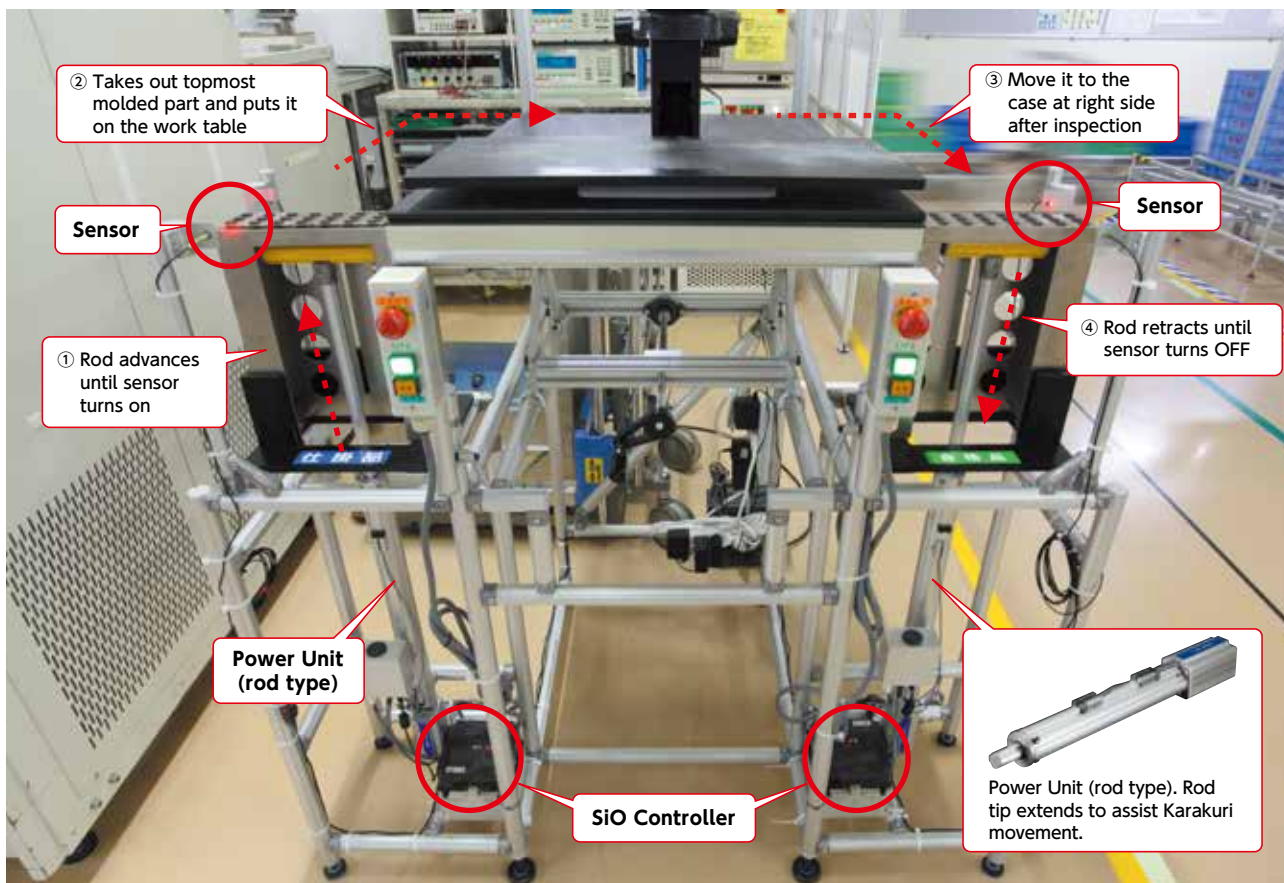
On the other hand, because there are more opportunities to utilize it, the skill level required from the work site grew higher. In some cases, the number of I/O points available from one SiO unit might be insufficient but the work scale keeps on steadily expanding. Another issue is that it takes a longer time to actually start using it at the work site. Yet there is also the positive fact that it gives rise to steadily expanding dreams for the future.



**CASE 1** Level lifter using Power Unit & SiO



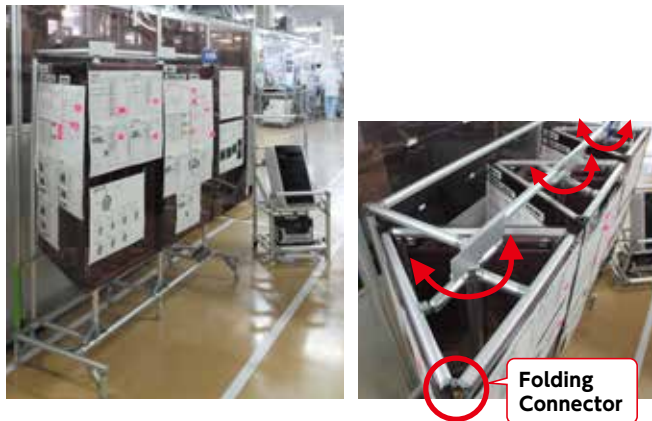
This is a level lifter that easily extracts and stores molded parts. Placing a case holding the molded part onto the left side of the work table advances the Power Unit rod until an upper edge sensor turns on, bringing up the molded part to extraction position. After taking the topmost molded part, the rod again advances until the sensor turns on while maintaining a specified height. After inspection, the product is stored in a case on the right side. Here, the rod repeatedly retracts until the sensor turns off. The first of these units was made by combining switches with a Power Unit which has a pitch-feed function. It saved us 70 hours a month of work time so we then put 3 of these units on the line. From the 4th unit onwards we got more sophisticated and started using the SiO Controller and were able to handle different molded part sizes with just a single unit. Besides the Kota Plant, we laterally expanded use to include the DENSO Takatana Plant.



Level lifters moving in opposite direction are placed on the left and right side of the work table. Extraction and storage can always take place at an identical position, reducing the risk of scratches and impacts.

**CASE 2** Triangular bulletin board with no gaps on display

Rotating bulletin board has a triangular shape instead of the previous square shape. Bulletin boards do not hit each other even if there are no gaps between displays.



Global Corporate Improvement  
to Assist Cutting Edge Auto  
Manufacturing

How do you incorporate Karakuri into your work?

We never stop trying to improve the workplace but we think it was about 5 years ago when we first started using Karakuri at our IC1 plant. It was still in the early period when we learned about the structure and assembly of motion units that we had found out about from SUS through their catalog (Japanese version). However, as mentioned before we ran into issues such as the "Weight" problem and even if everything looked okay it still wouldn't work the way we wanted on the work site. But we kept on trying and finally raised quality levels in what was a step-by-step process.

Though without a regular schedule, we set about educating our start on-site. We gave safety instructions in a so-called "Karakuri Koubou"\* which is an area where anybody who registered could get instruction. Here in part of the IC1 plant, those members normally in charge of production lines can get advice on making improvements from Mr. Sano and Mr. Ura who are central figures in kaizen improvements. Lessons start out with simple carts and work tables and gradually transition to Karakuri mechanisms, and then learning by experience about pulley movements and the like. Fabricating even complex items just as you envisioned them leads to a feeling of achievement and even enjoyment that also energizes improvement activities where the emphasis is on experiencing things for yourself. Normal work duties prevent spending a lot of time here but it does train students correctly. These persons can take charge of making simple improvements at the work site while pursuing high quality as taught by Mr. Ura and Mr. Sano.

\*Koubou means workshop.

Is there some special point that separate Karakuri mechanism from motorized devices?

For example, when you want to deliver work pieces conveyed by way of a linked cart and a chuter,

supplying power to a moving trolley is a hard task. In such cases, you can divide up the task by supplying motor power to the chuter and installing a shutter mechanism made from a Karakuri mechanism onto the cart.

You need to use motorized power in order to get complex tasks done. If you make large-scale equipment just from Karakuri mechanisms then you'll experience more and more breakdowns and maintenance will take much more time and effort. If dealing with heavy workpieces, tough operating conditions will cause rapid deterioration. Ultimately it will stop working and be a pain for the worker to deal with. Those are the times where you apply motorized operation on sections where Karakuri mechanisms alone can't handle the task. Karakuri mechanisms can be fun and interesting like artwork but when the people in charge of it are transferred elsewhere you now have no one available to fix problems that occur. Motorized or power-driven parts may seem expensive when you buy them but the operation will be stable, minor adjustments are easy, and they will seem cheap later on in view of the man-hours saved after installation. Also once you have motorized power, the repeatability and extendibility to other situations will improve. In the case of Karakuri mechanisms, even if one device looks like another there will be slight differences in specifications depending on who actually made it. Simplifying complex mechanisms by motorizing them can also save time and expenses when using the equipment elsewhere. Before trying this, select the best method to use after considering what you want to do and how it will be used later on.

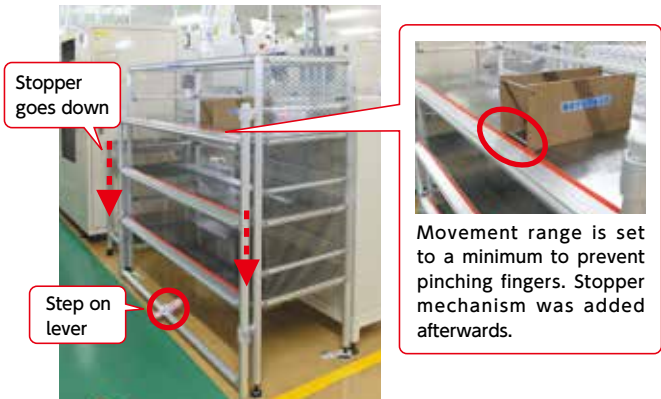


Miniature Karakuri mechanisms that students will learn are on display in front of the Karakuri Koubou.



**CASE 3** Rack with stopper stays stable even during earthquakes

Rack with stopper eliminates the risk of heavy jig falling over during earthquakes or the like. Foot-operated lever means you can take out objects with both hands and removing your foot from the lever makes it return to the stopper so it is fail-safe.



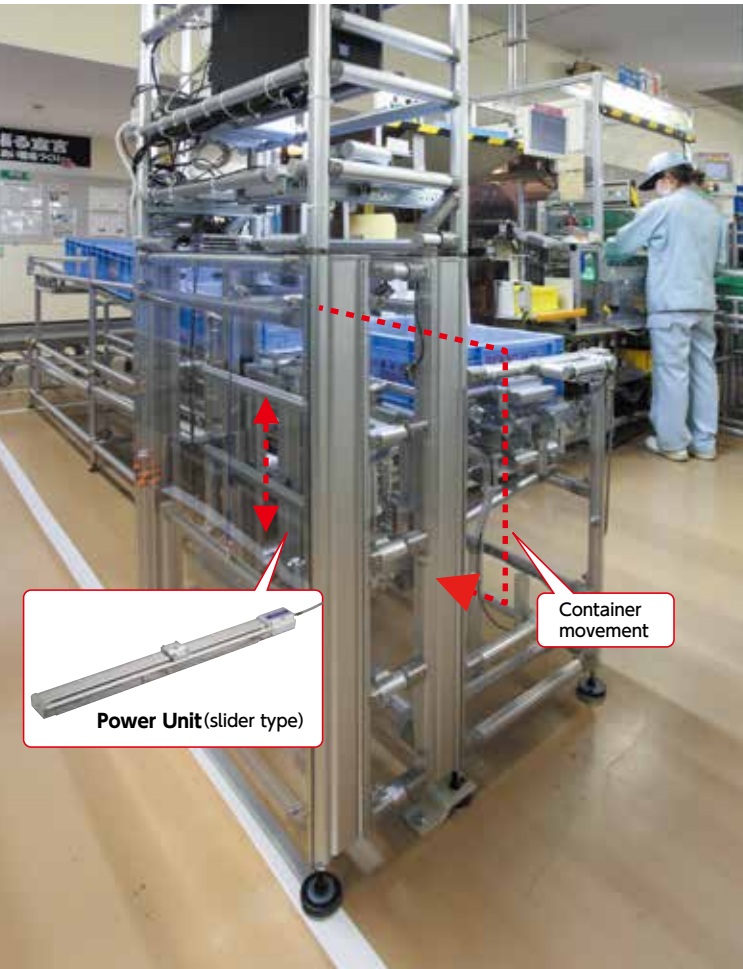
**CASE 4** Elevator recreated from a Karakuri mechanism to a motorized power mechanism

Elevator unit sends empty containers from the top stage of the chuter (pick-n-place) and when full, ejects them to the bottom stage. This was usually made from ordinary Karakuri mechanisms but they broke down and no longer functioned normally so the boxes were replaced by manual labor. After motorizing the operation, problems disappeared and just pressing a switch automatically ejected the boxes so waiting time was eliminated.

Before (Karakuri version)



After (Motorized version)



**Rated by those at the workplace**



Group leader Mr. Hiroyuki Nishida At IC1 Plant, Semiconductor manufacturing division 1

Full containers carried by the motorized elevator may weigh as much as 8 kilograms each. Some work sites have many female workers so having these workers replace the boxes by hand is a big load and is also hazardous. However, after starting to use the motorized elevator, lifting tasks involving heavy loads were eliminated and the members were satisfied. Moreover maintenance work up in the past was a hassle but since the first unit was installed from summer last year up to now there have been no problems whatsoever and no trouble.

**Tell us about the process up to mounting the improvement mechanism.**

When making a machine or a device, we rely on opinions from the work site but at first everything is really vague. We hear comments such as, "I want to be able to do this" or "It would be great if it is like this" and we think how to actually make those thoughts a reality. Once we build a prototype, then everyone again gives their opinions and the device is gradually transformed to match people's needs. This process of starting from a state with no solid concepts is tough yet is linked to the fun of "How do I make it happen." Besides what you were asked to build you may also have your own ideas to propose. To figure out how to streamline operation and save man-hours you have to arrange things and get the workplace involved. We also share information with other ongoing projects within DENSO and if we find something good we try to laterally expand it. Right now we are doing the same in the Takatana Plant where semiconductor manufacturing is done same as the Kota Plant and preparations are proceeding for installing our improvements and Karakuri there (example on P.19, case 1). Though there is somewhat of a difference in measures taken at each plant, work is proceeding while jointly sharing information.

**We also ultimately seek the opinions and needs of SUS.**

It has been nearly 8 years since we first started using Green Frames. We can assemble them quickly with

one wrench and we feel that the speed of making these improvements gets faster. The work site now looks better due to the aluminum color. The fact that it is recyclable is a very big appeal point and you can also reuse frames after disassembling them. There are now more parts and usability is vastly improved as well. Although aluminum has the advantage of being easy to machine and process, it also has the problem of softness when using it with a harder stainless steel jig. We are using it carefully since foreign matter is the big enemy of semiconductors. Rub marks from jigs and other items can be a source of foreign matter. Cleaning up the cutting chips after cutting and machining costs both time and trouble so we need some kind of solution to these problems. Whether a request is for new products or requests for design and assembly, we believe that our current relationship where we communicate frankly with each other has advantages for all of us. In the future, we are hoping to make even better improvements to create a better work site.



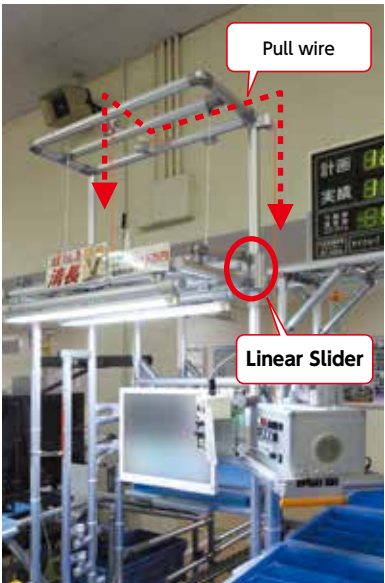
New devices are currently being fabricated and new products are being actively adopted. Many items are being designed developed for GF movable parts and motorized parts based on opinions and requests from DENSO staff.

**CASE 5** Automatic camera adjustment! Visual external appearance device

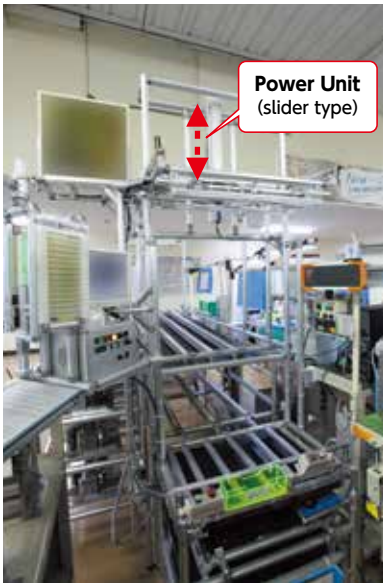
This is an inspection device that automatically adjusts the camera and lighting above the workplace to an ideal position to match the stacking height. At first, the Power Unit (rod type) was pulled by a wire to raise and lower it but the wire was found to stretch during use and there were height deviations. However, on the improved model, the camera and lighting are directly mounted on the Power Unit (slider type) so this problem was completely eliminated.

Operation of the early model is now also stable by using the wire while fully stretched. The name "Kiyonaga" on the nameplate was given by the local site staff members.

Early model



Improved model





**CASE 6** Karakuri signal notifies of previous process status

When the finished product is loaded on a cart and placed in the gate, the upper flag rises. From the next process at a remote location, we can see at a glance that the product was sent out, so no useless walking is needed.

In this arrangement, pressing the trigger with the cart within the gate pulls a wire strung on the gate and the flag on the upper section rises. After the cart moves out, the flag returns to the original position by spring.

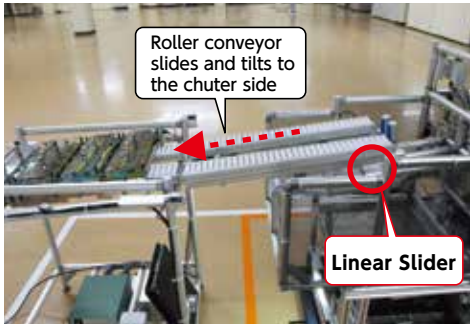
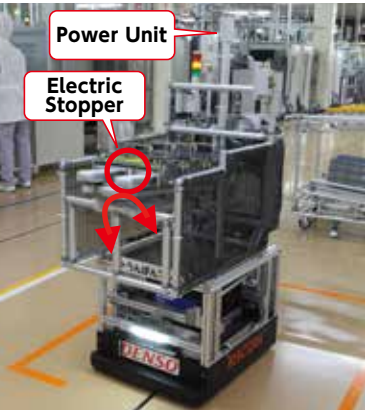


**CASE 7** Automatic Handover from Cart to Chuter and even in remote locations is also OK



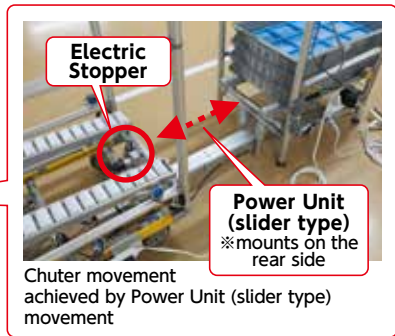
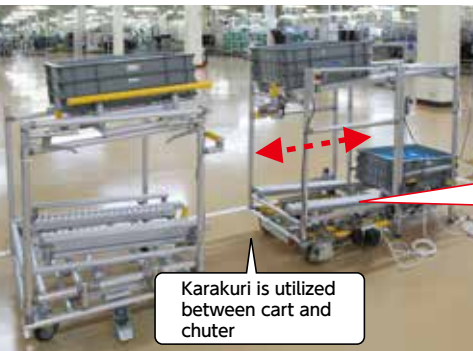
Separating the installation positions of the chuters lined up along the production line from the AGV path position is required for safety reasons but causes problems with the automatic handover. To fill this gap at the worksite we tried fabricating a new means for making handovers without manual labor.

**Step 1** AGV cart has slide mechanism built into jig loader section



The jig loader is the movable type but only slides during handover. During handover, the roller conveyor stores inside the cart and so can then swivel and return to the jig acceptor location.

**Step 2** Movable chuter moves back and forth to handover position



This case shows that automatic handover is possible by having the chuter on the acceptor side move to the cart position. Stopper utilizes both Karakuri and motorized devices.

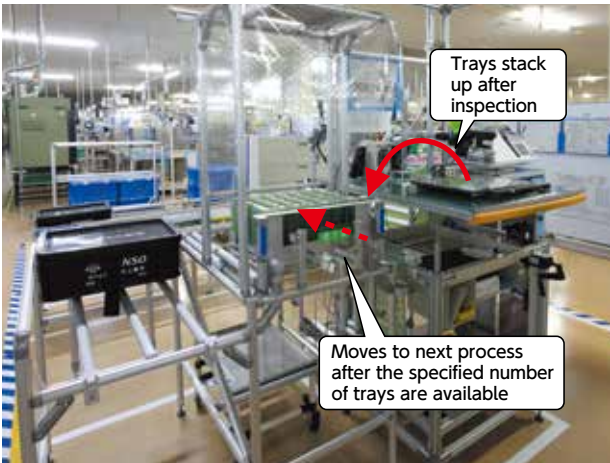
**Product introduction**

**i-ART** intelligent Accuracy Refinement Technology

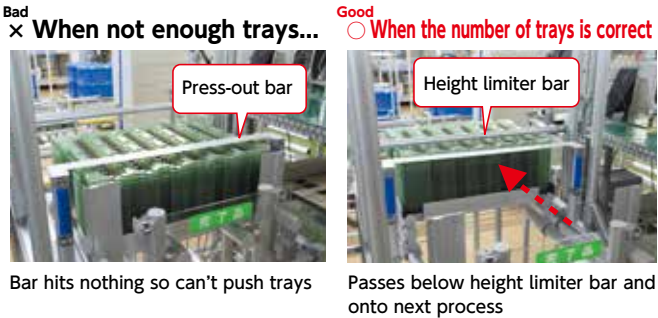
i-ART is a product for clean diesel engine offering the world's top level of clean exhaust gas, quietness, and improved combustion. By embedding a compression sensor inside the injector (fuel injection device) within the engine, it enables to measure changes in the fuel compression and temperature inside the engine. This also regulates the fuel injection timing to a 10,000<sup>th</sup> of a second. This technology from DENSO is the first of its kind in the world and is a flagship product of the Kota Plant that earned the "Nikkei Sangyo Shimbun Awards, Excellence Award" as part of the 2013 Nikkei Superior Product and Service Awards.



**CASE 8** Fail-safe mechanism prevents total number error even if too many or too few trays



This Karakuri device prevents having the wrong number of stacked trays when sending trays to the next process after completing the external inspection. The worker stacks the trays in the lane next to the inspection table and when the specified number of trays is reached he presses on a bar to send them to the next process. The position of the tray press-out bar matches the height of the specified number of trays. If there are too few trays, the bar passes over them so they can't be pushed. If there are too many trays, they catch on the height limiter bar so in this way, only the specified number of the trays can reach the next process.



**CASE 9** Automatic resin thawing device cuts 90 minute work loss to zero



Resins and adhesives used in semiconductor manufacturing are stored at minus 35°C or less so they must be left at normal temperature for about 90 minutes to thaw before using. Normally, on a 2-shift day-night system, members from the previous shift take these materials out from the freezer but there was a problem of a 90 minute work loss at the start of work on Mondays.

To handle this problem we fabricated a device to open the freezer lid 90 minutes before the start of work by starting up a Power Unit by way of a calendar timer. By letting resin and adhesives droop down the rear of the lid we can complete the process in one movement. When the lid opens, the Power Unit and power to the freezer turn off and the clock operates so everyone knows how much time has elapsed since the lid opened.



This improvement based on comments from workers saying, "We want to eliminate that 90 minute loss!" and though simple, it is extremely effective.



**Takano Company Limited,  
 Shimojima Factory**

# Becoming a worksite that responds to seasonal changes in market needs with a multi-product variable quantity production.

Takano Company Limited started out as a spring manufacturer and is now active in many fields including office furniture and health and welfare. The Shimojima Factory belongs to the Takanao Office Furniture Operation and mainly designs, develops and manufactures rotary chairs for offices. Here we report on-going progress in improvement at the worksite incorporating both the latest technology and human effort.



Office Furniture Operation  
 General Manager  
 Mr. Toshiaki Kobayashi



Office Furniture Operation  
 Manager  
 Mr. Toru Hashizume



Office Furniture Operation  
 Assistant Manager  
 Mr. Makoto Ozawa

## COMPANY DATA

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Highly skilled employees work within the sewing process in the chuter which is a unique specialty of Takano.



Achieving high quality and high efficiency manufacturing to meet demand that drastically changes with the season

### Takano seems to operate a wide range of businesses!

Yes, we were first founded in 1941 as a company that manufactures springs. Precision springs are the origin point of Takano and are currently being adopted into various products such as automobiles. The office furniture business started out from designing and manufacturing folding spring chairs in 1962 which made full use of spring technology. Since that time, we have also expanded into areas such as health and welfare-related businesses and building exterior business. Furthermore, the challenge of creating a new business is not limited to using existing technology. We also operate an electronics business based on LCD or liquid crystal display inspection equipment developed and commercialized through joint industry-academic research, and this is one of the current pillars of our company.

The Shimojima Factory where we work is part of the office furniture division and mainly involved in assembling office chairs. There is another plant which is the Ina Factory where we handle sheet metal which is one type of office chair material and does welding pipe bending, painting, etc. The finished parts of the Ina Factory are shipped to the Shimojima Factory and assembled into chairs.

### Please tell us about special features of Shimojima Factory and where you place your major effort.

The number and type of chairs to be assembled at the Shimojima Factory can range from 3,000 to 4,000, including features such as the color and material of the fabric and whether there are parts such as armrests. Moreover, office chairs tend to be purchased in groups and by the end of March, and the volume of the orders varies greatly depending on the season. We also have to flexibly respond to all types of production variations. These circumstances mean there is a lot of manual assembly required. Meanwhile, it is getting harder to secure a sufficient number of staff so streamlining the operation and improving productivity is essential.

So, what we are emphasizing now is the 5-year medium-term management plan, "Innovation 68" for the year 2020. That is the year of the Tokyo Olympic Games. We gave it this name since Takano will reach its 68<sup>th</sup> operating term in 2020. As part of this plan, the manufacturing division of the office furniture business is promoting "multi-product variable quantity production." This is essentially a TSS (Takano Seisan System) activity based on the Toyota Production System. Each department is required to achieve a one-year goal by improving productivity, saving expenses, and reducing quality defects. On the manufacturing site, each employee is working to change the layout and to build and improve the workbenches and so on with the aim of building an optimum production line. Under these circumstances, all employees are making improvements by utilizing Green Frame (GF) aluminum pipe structural material.





Once the sewing process is ready, turning on a switch runs the AGV cart. A mechanism links the cart and chuter together to automatically deliver containers. The cart goes back and forth between the sewing process and the assembly process up to four times per hour.

#### What was the trigger for the adoption of GF?

The trigger was a factory tour we made to an automobile manufacturer. I was curious to see GF carts and workbenches being used in large quantities at the production site. At the same time, I received an introduction to GF from within the company saying things like, "We offer these kinds of products", I liked the look of it and it was lightweight and easy to handle so I decided to try it for the first time. What then happened was that we started

using it almost everywhere at our company instead of iron pipe which was the mainstream at the time. The first serious improvements we made using GF were AGV carts and chuters incorporating Karakuri mechanisms. At the Shimojima Factory, we build an assembly line for each type of chair, but it takes as much as 3 to 4 years to become really skilled on it, and the sewing processes that require veteran level skills are concentrated into one location. So we made equipment to automatically transport materials to the next process which was previously



A see-saw type table capable of easily inserting the finished chair by tilting toward the worker side and returning it to the conveyor by lifting up from the front when packing is finished.



The AGV advances and its momentum uncouples the stopper and takes in the container.

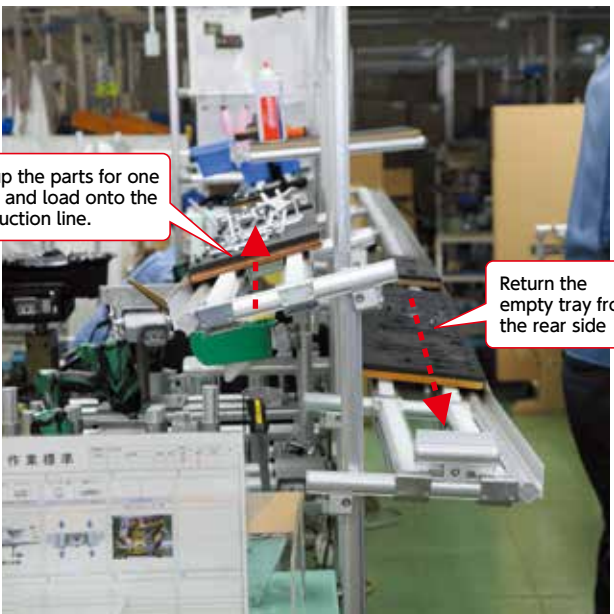
handled by human workers. When parts completed in the sewing process are loaded into a container and placed in a chuter, the AGV cart automatically accepts and conveys it to the assembly process. The AGV cart delivers the container holding the parts, then automatically picks up the empty container and returns to the sewing process. When making it we looked at the mechanism that we saw at SUS showroom and units that are listed in the catalog. We installed an elevator at the same time as installing the Karakuri so that the AGV cart can automatically move back and forth between the first floor and the second floor, and so in this way we were able to automate the transportation.

Everyone works to make the improvement activities Succeed through steady efforts and the latest in technology

It seems that everyone is going ahead with improvement activities but how are these rated in terms of ease of use?

I actually tried using it, and I felt it was easier to

assemble than an iron pipe. Also, the AGV cart and chuter I described earlier were my first Karakuri devices but these were easy to use because there are a lot of those kinds of parts around. Since the Shimojima Factory has many women workers, being a lightweight gadget also has a lot of appeal. Improvement proposals such as shelves and carts using GF are ongoing and these seem to be highly rated. Also, the appearance of the finished equipment is stylish and these don't get dirty easily



Set up the parts for one chair and load onto the production line.

Return the empty tray from the rear side

At the far side of the photo, workbenches for assembly are lined up. The worker assembles the parts on the tray in order.



A parts shelf of a work table installed to tilt so the operator can easily take it out. Parts are supplied from outside to the line, and then the emptied containers are ejected from the feet.

This line at the current site was constructed by the working members with their own hands. This new product line is made during the September - October period and production then starts up.





In this arrangement when the finished parts catch on the Linear Slider, they are automatically sent to the next process by balance achieved by weights.

Automated processes can utilize common parts to assemble for various office chairs with just a small number of parts. Dual-arm robots assemble the parts in sequence. Equipment is installed and put to use by in-house engineers.

which makes them very popular. Another great benefit is that they are easy to recycle. One request we got was that, it would be nice to have a cutter that generates no chips. Our current handy cutter requires power, so we are using electric tools but these require time and effort to clean away the chips that come out during use. Also, since an electric cutter can be hazardous I thought it would prove more convenient if there were a hand tool available that was easy to use.

#### **Tell us what points you are fussy about and special contrivances when building a production line.**

Approximately 50 parts are used per one rotary office chair, which is where we pour most of our efforts. The mechanism that swivels and raises and lowers the chair is what uses the most parts and the latest products have functions that allow the seat surface to move freely. Assembling them without

errors requires not only efficiency but also extreme care regarding quality. What we are doing now is managing the total number of parts to be put on the assembly line after arranging the parts for one chair in the tray. If the tray is not empty when it returns then you can assume something went wrong during assembly. If summertime for example is set to 1 or namely our baseline, then the volume of winter production will likely triple, so we are trying to create an arrangement that maintains quality even if experienced workers are not available.

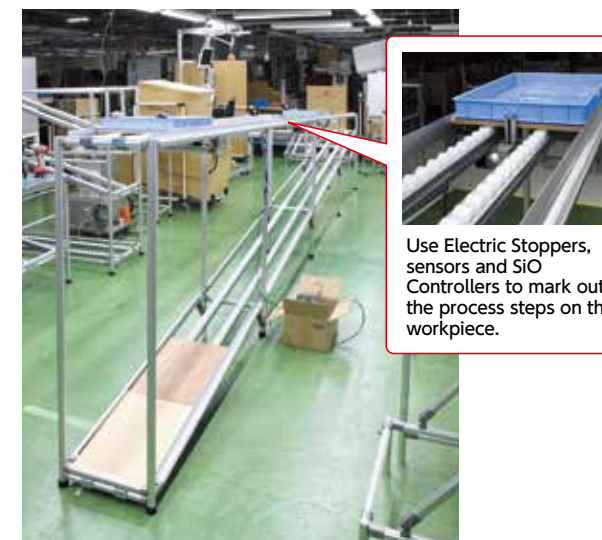
At the same time, we are using robots and IoT. In the past, equipment dedicated to one type of mass production was the mainstream approach, but now we are promoting the introduction of general-purpose machines that are compatible with multi-product small volume production. In the assembly process, we also use a double-arm robot, which can be used for different varieties of tasks if you re-teach it as needed. The robot equipment also constantly

checks the operating rate using the in-house system, and records the frequency and cause of shortstops due to breakdowns. For the AGV introduced earlier, not only the operating rate but also the location at that time can be confirmed. We will check the situation on a daily basis so that we can utilize it to the fullest. If we do actually start using it, we investigate the cause if any problem occurs and make improvements.

#### **How do you approach fostering new human resources and information sharing, etc.?**

There is an organization called the "TQM Promotion Office" at the main office that oversees company-wide fostering of human resources. The information exchange centers around the JIT Promotion Committee and we visit the factory every month to share what we learned from the visit. Once a year there is also a JIT (Just In Time) meeting that reports improvement cases at each factory to the president. In those cases, that information is circulated throughout all the plants.

Even still, the products that Takano handles cover a wide range, and the information required by departments is often different, so operations are more active within the department. For example, in the case of the office furniture business, we hold a



Use Electric Stoppers, sensors and SiO Controllers to mark out the process steps on the workpiece.

Equipment under construction by using SiO Controller. It is planned to use multiple Electric Stoppers for use at their favorite positions along the long distance chuter.

report meeting on TSS activities once a month for two days. The Shimojima Factory on the first day and the Ina Factory on the second day and based on reports from each section, we share the content of the initiatives and progress on improvement.

#### **Please tell us about activities you have planned and what areas you are aiming for from hereon.**

To achieve the medium-term management plan called Innovation 68, we will continue to streamline production and make high quality products. Even in the new product lines for this fiscal year, we are incorporating new ideas aiming at quality improvement, so we think that we can improve it even better as we actually implement it.

We are also currently building new equipment using the SiO Controller. We anticipate that the SiO Controller can be applied to motorized tasks even if the workers don't have a detailed knowledge of electricity, and we are very thrilled about this. Until now, moving mechanisms could not be actually introduced at the work site without help from production engineering staff but if this could be accomplished on the worksite at the worker level then it would save time and we could open up many more new possibilities. The capability for the worker to do this by themselves is a big appeal point for SUS products. In the future, we will continue to work at creating workplaces capable of high productivity to make it easy for workers themselves to accomplish things.



Everybody at Takano listens to the controller's explanation. Training sessions by development staff at SUS were also held later on.





***Make daily improvements  
 by listening to what people  
 say at the actual worksite!  
 Aiming to make it easy to  
 move around the worksite by  
 trial and error attempts and  
 creative arrangement.***

On November 9, 2017, four people from the Akebono Brake Fukushima Manufacturing Co., Ltd. visited DENSO FUKUSHIMA CORPORATION to hold a cross-industry exchange meeting. This resulted from cooperation with DENSO FUKUSHIMA in response to a request from Akebono Brake Fukushima Manufacturing staff saying "We want to know about efforts made by other companies and apply them in our future improvement activities". Here we will give a number of examples described that day, as well as how this exchange went and the impressions of the improvement staff, etc.

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<https://www.akebono-brake.com/english/>

We overcame our tough founding period and are currently introducing new equipment into our evolving factory at a non-stop rate.

DENSO FUKUSHIMA was established in April 2008 as a production base in East Japan for the DENSO Group. Despite the impact of the Great East Japan Earthquake, DENSO began production of car air conditioners, which was the mainstay product in 2011. Even after that they still continued expanding while increasing the number of product items and in the year 2018 are now near to completing a new factory. This is a huge factory exceeding 30,000 square meters and along with large injection molding machines, the latest robots and the equipment that was designed to streamline production and to lighten the burden on the worker as much as possible. In the cross-industry exchange meeting, case examples centering on Karakuri mechanisms were introduced.



The Akebono Brake Fukushima Manufacturing staff all listen to a description of the manufactured products from Mr.Taguchi, plant manager at DENSO FUKUSHIMA. They not only learn about Karakuri improvements but also the history and measures taken by the entire plant.

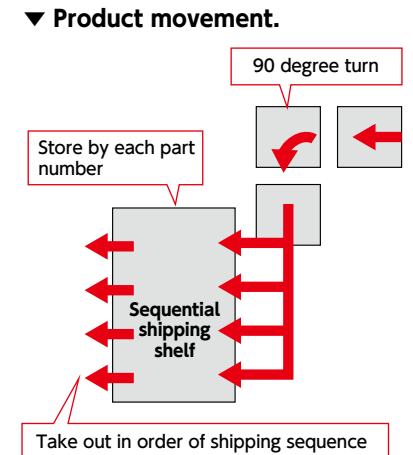
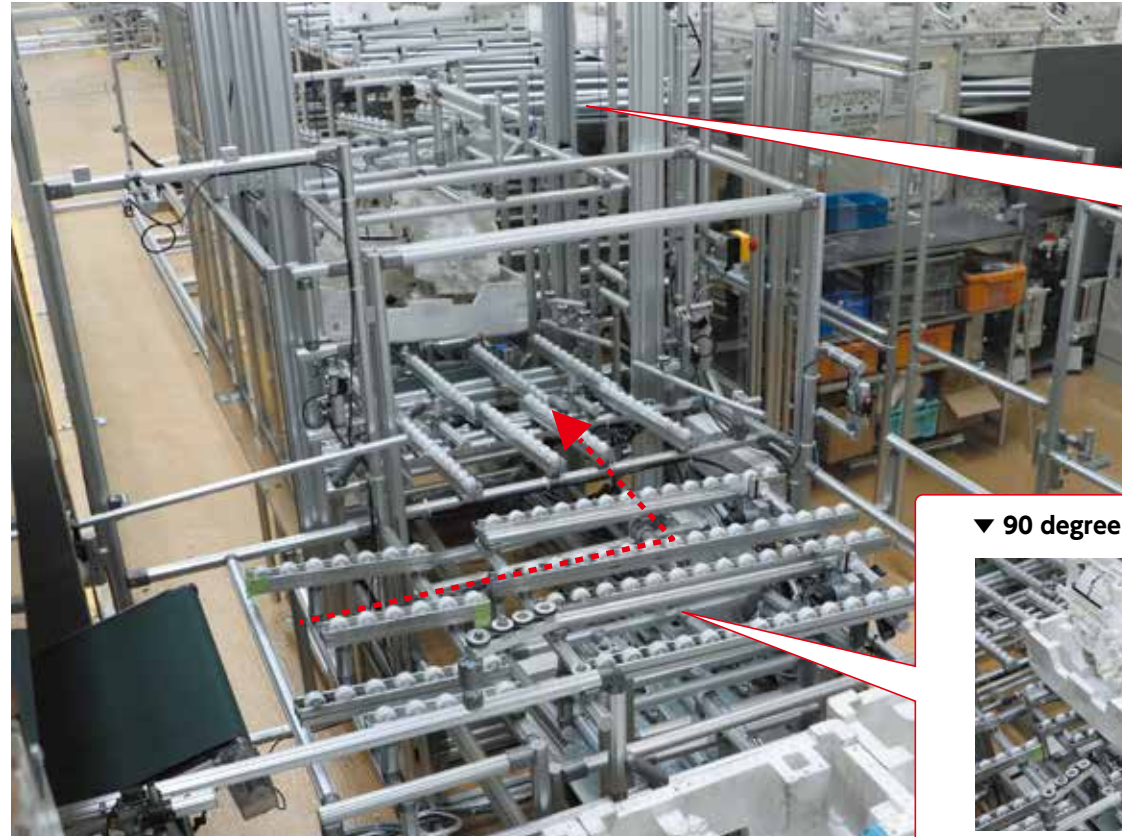


Excerpt from AGC (Automatic Guided Cart) interviewed in the Sing 33 issue (Japanese version only). A mechanism to automatically handover the workpiece by way of a Karakuri mechanism was introduced.

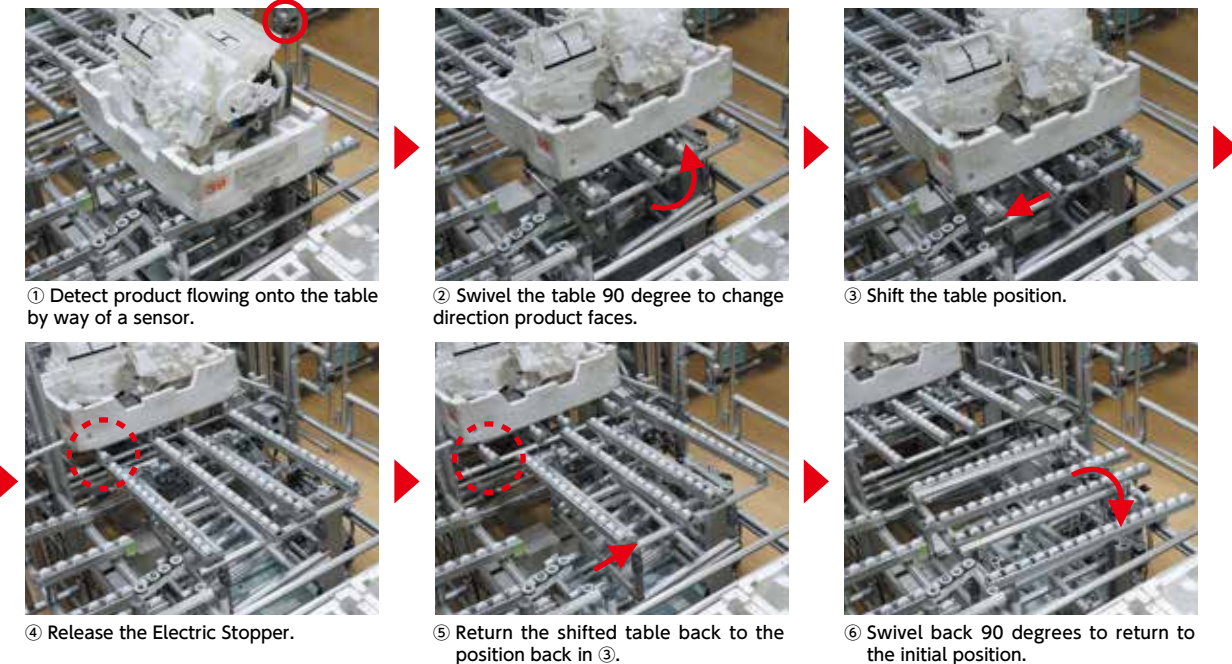


**CASE 1** Automate the sorting work which usually takes a lot of time and trouble by manual labor to achieve “sequential delivery” by placing the item on a sequential shipping shelf.

Currently, automobile makers are doing mixed car manufacturing by making multiple models on one production line. DENSO FUKUSHIMA must then deliver their products so as to correspond to that car maker’s production sequence. In order to respond to demand, they created a system to store products produced in lots, onto shelves by each part number and then take them out from storage in the order that the products are needed. After a product flowing on the line changes direction with a 90 degree turn, its QR code is scanned and it is automatically conveyed to the corresponding shelf. While still turned 90 degrees the stroke is too large and it cannot fit within the shelf width, so we added a motion to shift the table after rotation. The parts were originally stored or removed from the shelf manually by a human worker. Now however, automating that step using electrical motor drive saves man-power.



▼ 90 degree turn motion



**CASE 2** Don’t reduce workability, reduce the number of drivers!  
 Idea workbench that uses Linear Sliders



Attach Linear Slider to both sides of the frame from which driver hangs, to make it slide outwards and inwards.

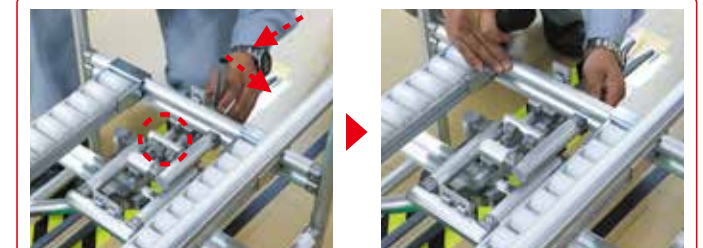
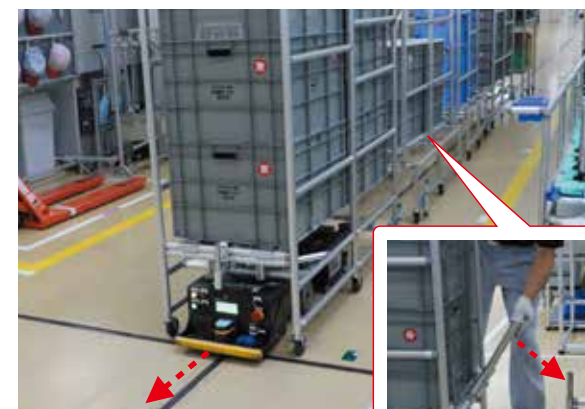


Clamp a Spring Balancer to the Linear Slider and hang a driver from it.



We made use of a Linear Slider (GFW-440) to allow freely moving the driver hung from overhead in the X and Y directions. This was an idea we came up with to reduce the number of drivers, and just a slight force is all you need to move the driver to the required position. There is also a type that slides on a bent frame, and because the standard item cannot be used here, we cut the Linear Slider of length 100 mm by half. We also do the pipe bending in-house.

**CASE 3** Streamlining long-distance conveying by AGC capable of simple coupling and decoupling



Decoupling section is foldable so as not to interfere with unloading items. Just pressing slightly inwards unhooks the center section to allow rotation and storage.



Easy coupling just by lowering part attached to rear of cart.

The AGC moving back and forth from the parts warehouse and production line is the type that tows by way of sliding under the cart and hooking it by way of a pin. The operator conveys the cart loaded with items to sequentially predetermined positions and makes the AGC leave when the necessary number of items is loaded. The hauling distance is about 130 meters each way and it moves so as to vertically cross the interior of the factory. Up to five carts can be connected.



CASE  
4

AGC with elevator function  
handles different height chuters  
on just 1 unit



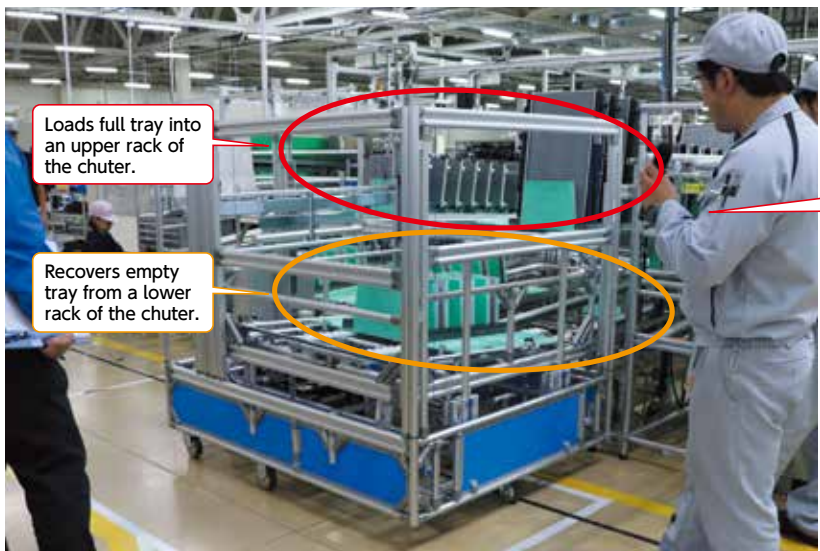
Shown here with table raised, the AGC battery provides power for motorized up-down movement.

▼ Empty tray ejection state



The AGC complying with its program conveys the full tray loaded from the chuter in the floor to the assembly process and ejects the recovered tray. When the cart is empty, the table tilt changes.

▼ Supply to assembly process and recovery



Loads full tray into an upper rack of the chuter.

Recovers empty tray from a lower rack of the chuter.



View of the assembly process. Worker starts assembly using the workpiece supplied from the upper rack and ejects the now empty tray to the lower rack.

A new AGC whose operation started just before the Cross-industry exchange meeting. A full tray is loaded from a high position relative to the chuter in the assembly process and the empty tray is recovered from the low position. An elevator function was added to the cart table to allow loading and recovering from a different height with just one unit. In the assembly process, assembly starts from the loaded trays flowing in from the top rack and the empty trays are sent one after another to the lower rack. Next, when the worker releases the lock, the table automatically falls due to the balance with the weight, and after the tray is discharged it rises to accept the next tray. This new AGC will be adjusted at the site for about one week until its operation is stable.

# Q & A Time

After the tour, we held a question and answer session for everyone from Akebono Brake Fukushima Manufacturing. Here is an excerpt from the Q&A session.

## DENSO FUKUSHIMA CORPORATION



Mr. Akiba and Mr. Ariga from DENSO FUKUSHIMA Production Division Production Engineering Department, who fabricated the equipment shown at the exchange meeting.



Mr. Taguchi, thermal plant manager for the DENSO FUKUSHIMA Production Division, who took charge of the exchange meeting.



## Akebono Brake Fukushima Manufacturing Co., Ltd.



The four members of Akebono Brake Fukushima Manufacturing mainly involved in making improvements took part in the session.



**Q1** We plan to introduce AGC from hereon and are making an assessment. You showed us various ways of using these at the work site, but what kind of criteria did you use for selecting a standard model?

**A** We also learned a lot from the DENSO plants and found that the right machine model differs according to the application. A type that only moves forward is cheap to purchase but just as you might expect a machine with plenty of functions is what offers real value. Moreover, the ability to move directly sideways after moving forward is a feature offered by some manufacturers. We are trying to assess what will work best by judging the balance of cost and functions.

**Q2** I was surprised to see female workers removing the aluminum pipe structural material GF parts from the parts drawers. Do the on-site staff also handle upgrading and improving the equipment?

**A** Here in the Production Engineering Division, we are working on improvement activities that boost productivity while constantly listening to comments from the workplace but just doing that is not enough. So we talked to the members of actual work sites who said, "We want to get hands-on experience with the equipment as much as possible" and in fact are making improvements with their own hands. Our work site has a stock of frames and parts such as GF and cutting machines and one can pretty much use them any way they want. This easy handling is one of the great features of SUS frames.

**Q3** I feel GF or namely Green Frames offer widely diverse items and allow making a variety of shapes by combining standard parts. But do you employ custom methods such as your own unique frame and parts processing techniques?

**A** Though based on structural parts when you fabricate a Karakuri there is always some section that never works as planned. When that happens we try to machine the part ourselves or tell SUS "Hey, we need this kind of part." We don't place limits or restrictions but work on the task without any restrictions and try to make it easy to use.

## Finishing up the exchange meetings

**We asked their feelings about the exchange and measures to incorporate the improvements.**

**You took part in the cross industry exchange meetings, what did you think about them?**

Learning what approaches other companies were taking was an extremely refreshing experience. What left an impression on me was the proactive approach those on the actual work site were taking towards making improvements. When a



Akebono Brake Fukushima Manufacturing Co., Ltd.  
 APS Section, APS Group  
 Group Leader  
 Mr. Kazuya Sato

woman at the factory took out some GF parts and started work I thought, "I wonder what she is doing?" and got extremely curious. At the Akebono Brake Fukushima Manufacturing, those like us in charge of production there were involved with tasks from assembly through repairs after installation and so I really sensed a different company climate there. I was also surprised that they were also adding touches by bending GF pipe and cutting Linear Sliders. The machining itself is not difficult but coming up with the ideas is where they excelled. At our company, we had just started using GF about 3 months before and whatever the material we used I again realized how important our own ideas are and wanted to learn from these people. I was able to know how parts were used and found it to be a true learning experience.

**So how did you generally go about amassing information about improvement activities?**

Including Fukushima, the Akebono Brake Industry Co., Ltd. has manufacturing operations in six places throughout Japan and those in charge of improvements all get together once a month to share information. Here, we are also beginning to introduce Karakuri improvements but for now at the supervisor level. Whereupon, starting just this year is an effort made by the members of Saitama City Iwatsuki Ward who assembled a miniature version of the Karakuri improvements. The mini version circulates to each factory so the members at each worksite can also learn about these mechanisms. This system aims at teaching what Karakuri is, in order to get ideas from the actual work site. Ultimately it would be great if they became able to fabricate these improvements themselves. In addition, since about four years ago, we also got the opportunity to once a year select an outstanding prize from the best Karakuri produced at each factory in the company. The judges oversee

members who are not engaged in manufacturing work and we ask them to view it with simple and unprejudiced eyes. One condition for exhibits is that they are items actually used on the production line. In addition, as an information gathering activity, we may visit the Karakuri improvements at the Karakuri KAIZEN® exhibition sponsored by the Japan Institute of Plant Maintenance or also participate in other company Karakuri events. We would like to put something of our own on exhibit at the exhibition someday.

**Please tell about some issues you encountered when working with Karakuri.**

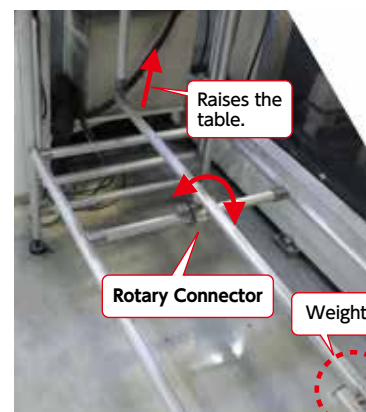
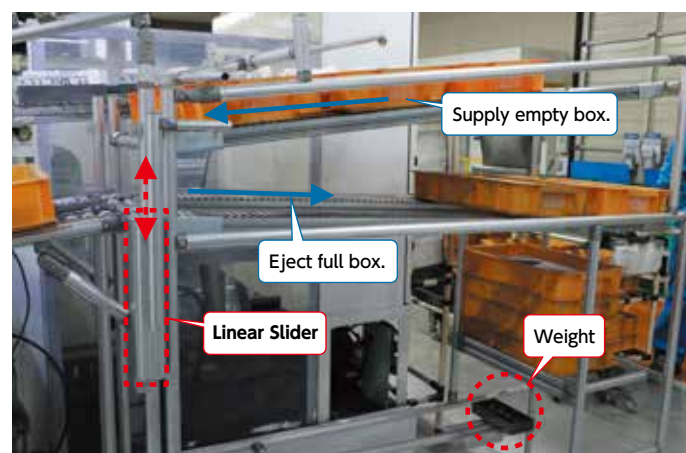
After listening to the feedback from people at the work site, saying that "It would be convenient if it worked like this", we then make what they want, however the equipment we made might not actually be used. I think that this is caused by the gap between one image and another. How one actually reflects the view of people from the work site is the big issue. Even the improvement activity supervisors have different approaches so I think what is important is to give and share opinions and then solve problems that arise after installation one at a time as they appear.

Though there was some talk at the exchange meeting, transport does not produce added value just by itself, so we also want to automate this as much as possible and are also considering including introducing AGC. I was impressed with the automated workpiece exchange on AGC at DENSO FUKUSHIMA but on asking the supervisor about it, I also realized that this was achieved through trial and error. I will absorb opinions from the site and then want to create equipment that will prove useful for a long time.

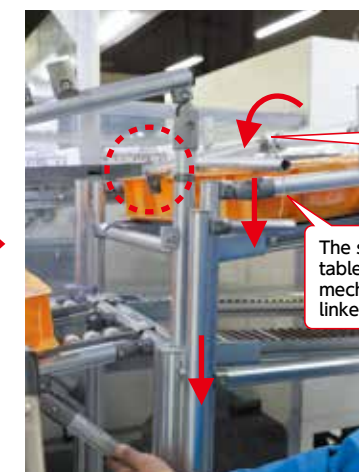
※Karakuri KAIZEN® is a registered trademark of the Japan Institute of Plant Maintenance.

### Unit No. 1: GF Karakuri device from Akebono Brake Fukushima Manufacturing! Gravity Operated Flip-Flop chuter

Lastly, we took a tour of GF Karakuri just starting to put to work at the factory.



We adjusted the balance of the weight so that when an empty box is loaded the table goes down, and when the box is placed the table rises.



Hinge Connector

When an empty box enters from the top rack, the table moves downward due to the weight of the container. At this time, the stopper attached to the top tilts along with the mechanism to stop the second container from flowing. A Hinge Connector is used as the movable portion of the stopper. The completed container is then pushed by the operator and ejected to the lower rack.





# USA Local Report

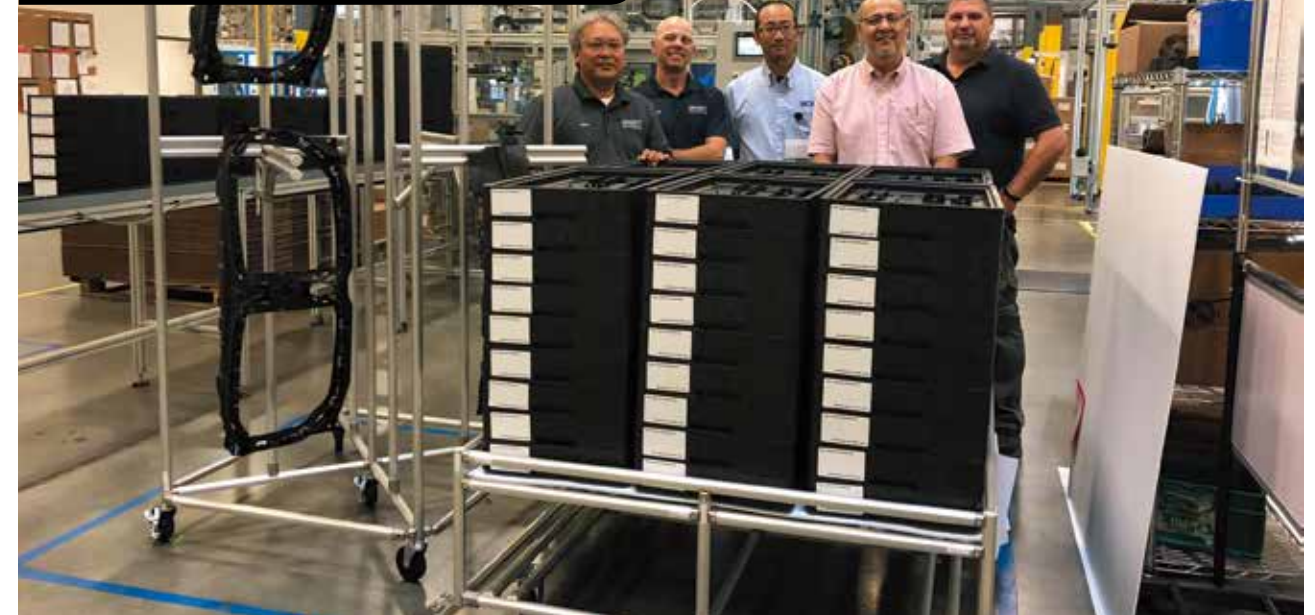
◎USA Local Report ② ★ **DENSO Manufacturing Michigan Inc.**

◎USA Local Report ① ★ **Geiger Automotive**



Name : Masatomi (Max) Sato  
Title : Engineering Manager  
Company : Geiger Automotive  
Experience : Sanoh Industrial Co., Ltd. (19 years),  
Geiger Automotive (1.3 years)

## Geiger Automotive



Industrialization Team. Mr. Sato on the far left.

### How did you first hear about SUS?

When I was working at our parent company, Sanoh Industrial Co., Ltd.

### What have been the greatest benefits of using SUS products?

It has easier and faster assembly than other rack suppliers.

### What specific features do you like the most?

The components arrive "Ready to Assemble," so there is no need to look for specific screws or nuts. SUS sends all the parts so we don't have to search for anything. This helps us save time. The way the connectors bite onto the frame is much easier than the other products we were using. I like how SUS makes drawings. If I ask for a drawing in the late afternoon, I can still get the drawing the next morning. SUS's overseas office is working while we are asleep and this decreases the lead time. We just sent SUS the designs we used with our past supplier and SUS's engineers redesigned them with SUS products.

### What is it like to work with SUS and its people?

It is very accurate and there is fast correspondence. Even though SUS is in Illinois, the staff still came to our site about four times. I didn't expect that. I thought that they might come once. This meant that we can get good face-to-face communication.

### Tell me about your current projects with SUS.

We were working on a parts project for [an automotive supplier]. Mostly carts for transferring items from one machine to another. We also have another design which we are calling a "rack" for a similar purpose.

### Was there a specific problem you were trying to solve?

Not really. The old carts and racks weren't visually very nice. The SUS ones look nicer and easier. After we assembled them, we noticed that they were easier to assemble, too. The previous products we used would take three hours and three people to make one cart. With SUS's products we can do it in two hours with two people.

### What feedback do you get from your team members about these products?

Everybody's liking it. It's easy to build which is helpful for us. It looks cleaner. We usually buy light gray and blue structures. The raw aluminum is cleaner in terms of image... Our team members are really happy that I pushed for SUS's products.

### Do you have anything you want to tell the SUS community all over the world?

The SUS staff is very reliable and they are always on time with the right solution. We can trust SUS in quality, lead time, and support.





## DENSO Manufacturing Michigan Inc.

Name : Bob Baker  
 Title : Manager of Industrial Engineering Department  
 Company : DENSO Manufacturing Michigan Inc.  
 Experience : 15 years



The shooters are for a line that assembles radiators and fan shrouds.

### How did you first hear about SUS?

Through a trip to the company's home plant in Japan, witnessing them using the products and deciding to bring it into the plant.

### When did you make the switch to SUS?

About 3-4 years ago. We were using resin-coated steel piping at first. It worked well, but it was limited in a lot of ways. There was a limitation on reducing incidental work time (time spent pushing carts back and forth, etc). Not enough types of brackets... We wanted to increase productivity and reduce assembly time.

### How did you do that?

We saved time by having a dedicated team. We have two fabrication teams, kaizen technicians, and a smaller group of three people dedicated to the final assembly area that does a lot of work with karakuri. I'm in charge of the kaizen support team and it was my idea to form it. I wanted to reduce the stress on my staff and it worked.

### What were the main reasons you switched to SUS?

There were two main reasons. One: it's easy to do karakuri with SUS products. Two: it's easy to assemble.

We did our own internal test with one of our workers who was skilled with the resin-coated steel piping system. We had him build a table with the steel piping and then a table with SUS's products. I think there was a difference in time of about 30%. SUS's products were faster to assemble, even though he wasn't as familiar with them.



### How is it that SUS saves so much time?

One of the ways SUS's products save time is that the bolts and accessories come partially assembled. The bolts and nuts are already in place. With other systems, you have to twist and twist to get the bolt tightened, but with SUS it's just one and a half turns and you're done.

### What have been the greatest benefits you've reaped from using SUS?

The greatest benefits have been the two points which I just mentioned, it's easy to do karakuri and it's easy to assemble, but also that SUS's products allow us to continually improve. With the variety of brackets and versatility, there's really no limitations



on what we can do.

Of course, SUS isn't as strong as the resin coated steel piping, and there are some adjustments to make and remeasure because the brackets aren't perfectly 90° all the time, but even with those adjustments, it's still a lot faster.

### What has it been like to work with SUS?

It seems like there is a high turnover of personnel, and it's hard to retrain the SUS staff as to what, exactly, DMMI needs for its orders. At first, when SUS was new in the States, keeping and getting stock was a problem... backordered parts were a problem... It's a lot better now, but delays on parts still occur. Overall, it's been a good experience. SUS is really responsive to our inquiries.



### How has using SUS made your job, specifically, easier?

Our team implements a lot of kaizen and SUS helps us to think differently about improvements. SUS gives us more opportunities for cost savings.

### If you could send one message out to the entire SUS community all over the world, what would it be?

A few years ago, we told SUS about an idea we had for a swivel bracket and then it showed up in the catalog. I'm not sure if it was directly because of us, but it happened. I'd want people to know that SUS is willing to listen. Don't hesitate to give your ideas to SUS.





## Toyota Motor North America representatives visit SUS Chiba Plant

# *Gain deeper knowledge of SUS products and Karakuri, for application to Kaizen in the workplace*



Practice Assembling Karakuri

### Hoping to gain a broad knowledge of Karakuri for use in Kaizen activities

On June 19th, sixteen members in charge of Kaizen (continuous improvements) at Toyota Motor North America visited the SUS Chiba Plant to take a tour of the factory and participate in a seminar on SUS products. Toyota Motor North America is an important customer of SUS America. They have purchased many SUS products, including mainly GF aluminum pipe structural material. However, they wished to know more about SUS products that can be used for Karakuri (non-electric mechanical devices), understand aluminum frames besides GF such as SF and ZF, and apply this knowledge to future Kaizen activities, so SUS decided to hold this seminar. The program was as follows.

1. Introduction to new SUS products including GF, SF, and ZF
2. Factory Tour
3. Practice Assembling Karakuri
4. CAD Lecture on GF and Karakuri



Factory Tour



CAD Lecture on GF and Karakuri



Assembling Karakuri and completed Return Table.



Introduction to new SUS products including GF, SF, and ZF

### Broaden imagination by actually assembling Karakuri

Of all the parts of this program, practice assembling Karakuri evoked the greatest response. Three Karakuri assembly tasks were given: 1) Moving Pulley, 2) Self-Braking Trolley, 3) Return Table. Participants split into three teams, each of which was assigned one of these Karakuri to build. Even SUS employees were surprised to see how quickly the teams were able to make the Karakuri. Perhaps this should have been expected, as the participants were familiar with GF and use it for Kaizen activities on a regular basis. While it was originally planned for each team to assemble just one Karakuri, each team was able to assemble two in the allotted time. Participants responded favorably to the tasks. They told us that the seemingly simple assembly process offered much to learn when they could actually see and touch the parts used, and that it gave them great new ideas.

### Share technical information and raise the standard of technical skills

The most common response from participants who experienced this seminar was satisfaction with understanding the mechanisms of new SUS products and Karakuri. One participant told us "I found new means of solving problems on various manufacturing site." Another participant commented "I will share what I learned and the knowledge I gained with my team members to spread it horizontally throughout my organization." In fact, there is some disparity in technical skills for conducting Kaizen activities among Toyota Motor North America engineers. Their desire to share technical information and raise the average skill level in order to standardize these technical skills was a major factor in the decision to hold this seminar. Another participant shared their opinion on the CAD lecture, saying, "I would like it if you converted the basic units of Karakuri into CAD data. That would enable me to adjust the size and develop Karakuri for each production line, so I don't have to design each one from scratch." From these comments it seems the seminar was very meaningful for deepening the relationship between Toyota Motor North America and SUS.

