Robotics Solutions Business Strategy

November 27, 2017
Seiko Epson Corp.

Epson's Robotics Solutions

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Robots

SCARA Robots

- Robot arm moves horizontally
- Suitable for inserting parts and tightening screws

Compact Vertically Articulated Robots

- Vertically articulated arms that move on 6 axes
- Capable of more complex work than SCARA robots. Suitable for transport, welding and assembly.

Dual-Arm Robots

- Robots with human-like object recognition that freely adjust the force applied by their two arms
- Can move in ways that enable them to perform tasks done by humans

Devices and Options

- Robot performance can be further improved with force sensors, image processing technologies, controllers, and more

IC Test Handlers

Systems that transport semiconductors to testers and sort them based on test results in semiconductor inspection processes

1. Epson’s Robotics Innovations

2. Robotics Solutions Business Strategy

Epson 25 Corporate Vision

EPSON
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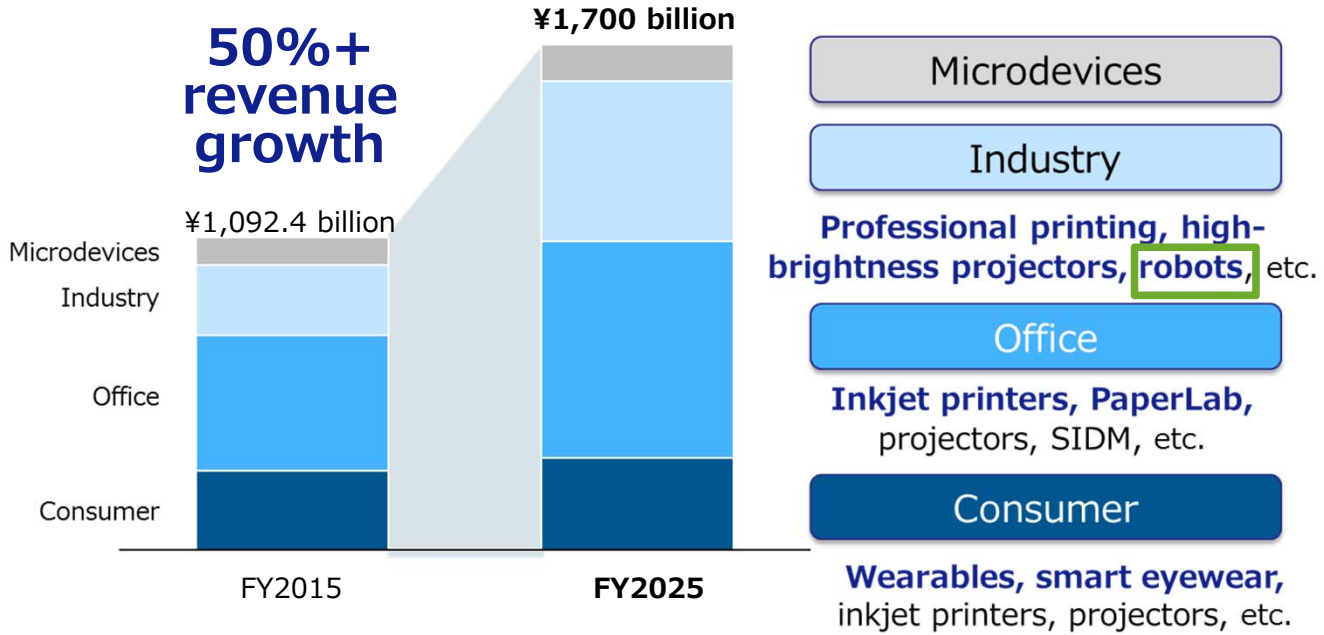
Creating a new connected age of people, things and information with efficient, compact and precision technologies.

Epson 25 Corporate Vision

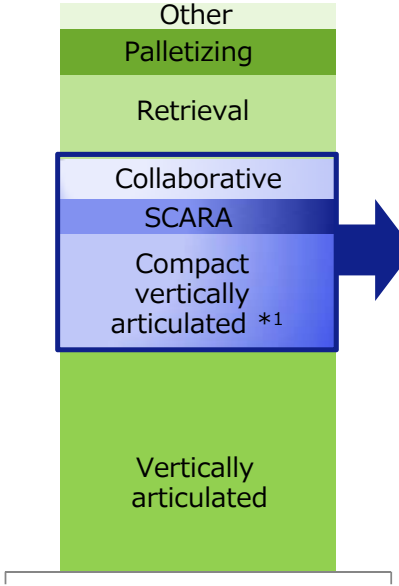
- Revenue to grow by 50% or more over until FY2025



Direction of growth in Epson 25 Corporate Vision

Market Size of Robots

- Epson engineers compact precision robots for assembly and transport applications in manufacturing
- The market for these robots will soar over the next 10 years



Approx. ¥400 billion
Assembly and transport robots

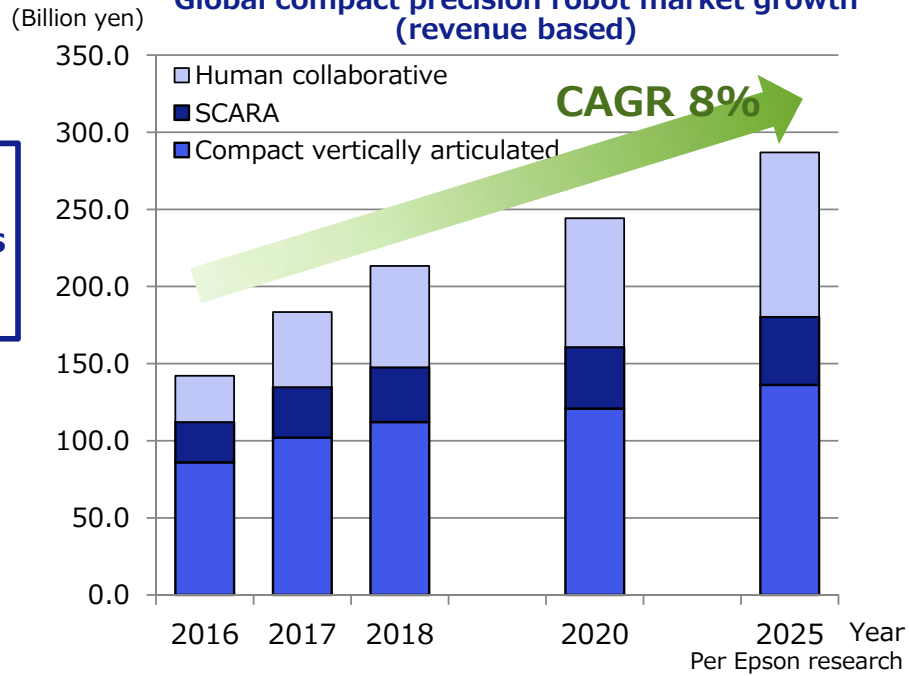
Epson's target market: Compact precision robots Approx. ¥140 billion *2

*2 Worldwide track record in 2016

*1 Vertically articulated robots with a max. payload of 20 kg

Per Epson research

Global compact precision robot market growth (revenue based)



Per Epson research

Outlook for Compact Precision Robot Market

- Rising income levels in emerging economies
- Falling birth rates and aging populations in advanced economies

Shortage of manufacturing labor and automation engineers

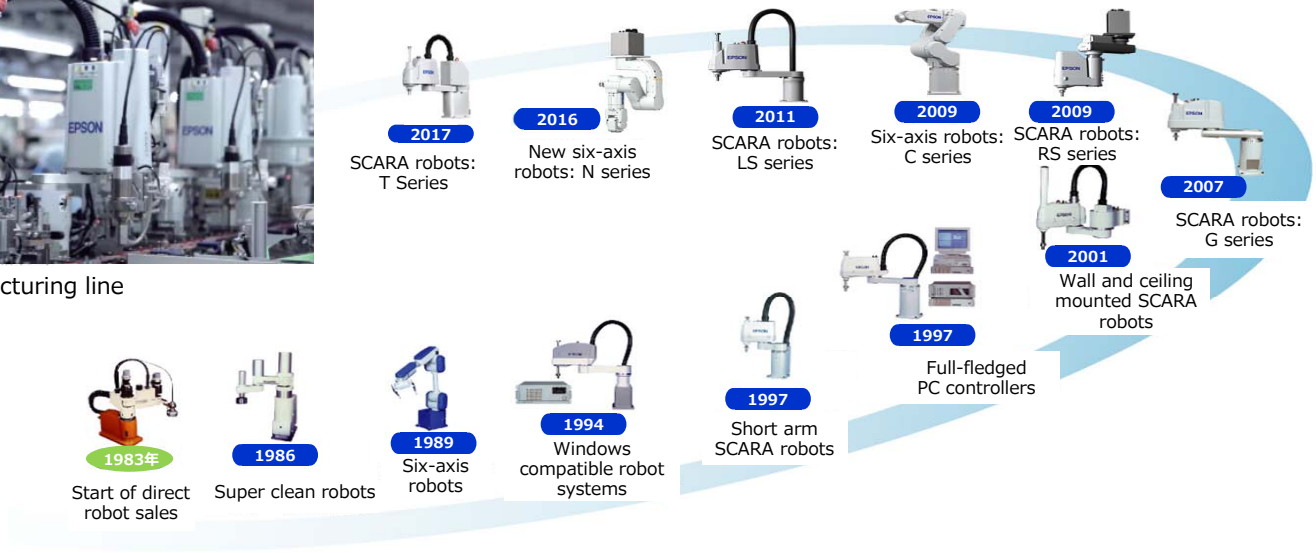
- Increasingly sophisticated and complex products

More products require manufacturing accuracy that cannot be achieved by humans

Need to lower the introduction barriers and increase robot intelligence to promote automation with robots in manufacturing

Strengths of Robotics Solutions

Watch manufacturing line



1 Robotics technologies that combine sensing technologies with efficient, compact and precision technologies

2 Support complex manufacturing processes with line construction expertise and production engineering capabilities

3 Global manufacturing and sales network

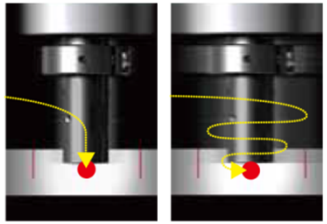
Epson's Strengths: (1) Robotics Technologies

- **Slim, compact, and lightweight robots** enabled by our efficient, compact and precision technologies
- **Speed, precision, and productivity** achieved by **combining our sensing, image processing, and other technologies, and through integrated control**

◆ Efficient, compact and precision technologies

Robots with a unique design enabled by capitalizing on Epson's efficient, compact and precision technologies in the areas of devices, mechanics, electronics and software

◆ Sensing technologies



Robots accurately detect motion and immediately stop at the desired location

Force Sensors

Modulate force applied when probing, aligning, fitting, and pressing

◆ Image processing technologies

Vision Systems

Accurately recognize object shape and orientation

◆ Integrated software technologies

Collectively control of robots, sensors, vision systems and other elements to achieve high speed, precision and productivity

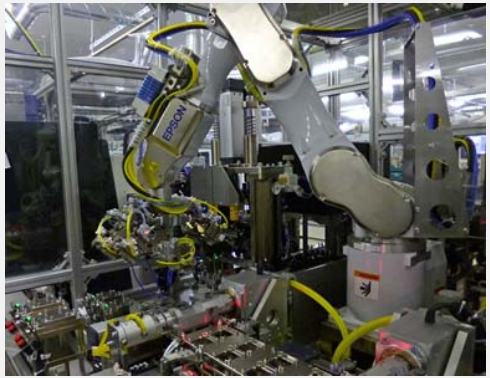
Epson's Strengths: (2) Support Complex Manufacturing Processes

- **Support complex manufacturing processes by providing packaged robotic solutions (robots + peripherals)** based on our expertise in building efficient lines and production engineering capabilities

Application Example: Tohoku Epson (Japan)

- Assembly of the latest inkjet printheads
- Automated precision assembly that would be difficult to achieve by hand

PrecisionCore MicroTFP printhead



Robots, sensing, and image processing technologies

+

Expertise in high-precision, high-efficiency line construction and in production engineering as a result of automating our own production lines

▼

Provide as packaged solutions

Epson's Strengths: (3) A Global Manufacturing and Sales Network

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- Epson is able to capitalize on a global manufacturing and sales network to be a one-stop source for automation proposals, services, and support
  - ➢ Production in China (Shenzhen) – the largest area of consumption – in addition to Japan
  - ➢ Sales and support bases deployed worldwide
  - ➢ Collaborative implementation between sales companies and manufacturing plants
    - ✓ Our salespeople and factory automation field support staff help customers install manufacturing robots on-site
    - ✓ Robots can be tested at an Epson manufacturing site near customer sites

Collaborative Organization

Area	Sales companies	Manufacturing plant
Europe	Epson Europe	Telford (UK)
U.S.	Epson America	Portland
Greater China	Epson China Epson Taiwan	Shenzhen (China)
South-east Asia and India	Epson Singapore Epson Indonesia Epson India	Johor (Malaysia) Batam (Indonesia)
		Indonesia
		Philippines

Vision for the Robotics Solutions Business

Epson 25 Robotics Innovation

Combine and refine our core sensing and smart technologies along with our efficient, compact, and precision technologies in manufacturing, expand their applications, and **create a future in which robots support people in a wide variety of fields.**

1. Robotics technologies that combine sensing technologies with efficient, compact and precision technologies
2. Support complex manufacturing processes with line construction expertise and production engineering capabilities
3. Global manufacturing and sales network

Be a leader in compact, precision robots.
Drive manufacturing innovation and grow faster than the overall market by drawing on our strengths to provide robots that meet a wide range of automation needs and solutions that accomplish sophisticated tasks.

1. Epson’s Robotics Innovations

2. Robotics Solutions Business Strategy

Growth Strategy of the Robotics Solutions Business

Vision for the Robotics Solutions Business

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Initiatives in Robotics Solutions Business

1. Expand the robot lineup and refine robotics technology

   Build a lineup to meet the automation needs of our customers

   1) Epson robot base technologies and current lineup
   2) SCARA robot lineup
   3) Compact vertically articulated robot lineup
   4) Collaborative robots
   5) Devices and options
   6) Future lineup

2. Support more complex manufacturing

   Make it easier for customers to automate more complex tasks by providing packaged solutions that include robots, sensors, and others.

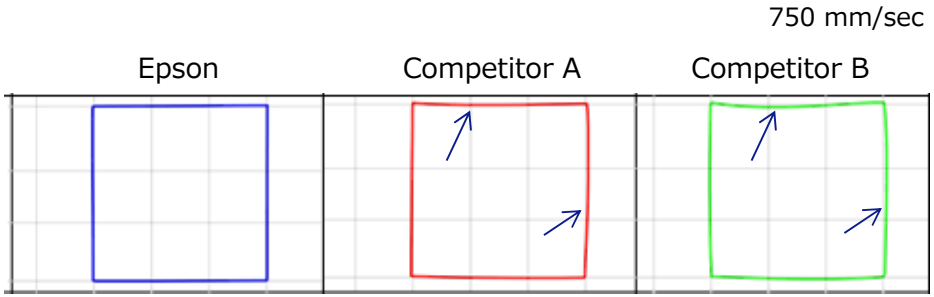
Initiatives in Robotics Solutions Business

1. Expand the robot lineup and refine robotics technology
2. Support more complex manufacturing

1-1. Epson Robot Base Technologies

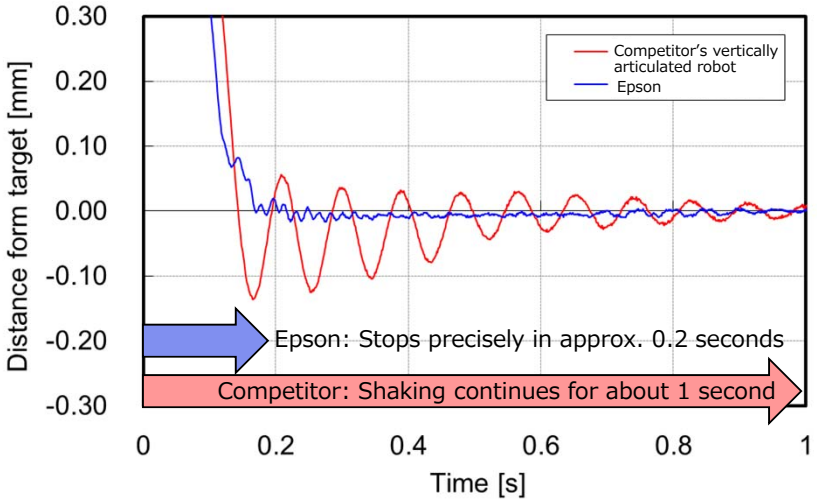
- A combination of unique sensing technologies that enable high precision and low residual vibration at high speeds
  - ➢ Speed and precision
    Move fast and accurately on the designated path
  - ➢ High speed and low residual vibration
    Move quickly and stop precisely

Comparison of path of a 150 x 150 mm square



Comparison of the Epson SCARA robot LS3 and similar models from competitors

Comparison of residual vibration



Comparison of the Epson compact vertically articulated robot C8L and a similar model from a competitor

1-1. Current Lineup

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Robots utilizing robotics technologies

1-2 SCARA robots

Simple vertical & horizontal movement. Enable automation at low cost.

LS Series
LS3/6/20

G Series
G1/3/6/10/20

RS Series
RS3/4

T3

1-3 Compact vertically articulated robots

Perform complex tasks that require vertical, horizontal, and diagonal movement

N2

C Series
C4/8

Devices and options

1-5 Force sensors

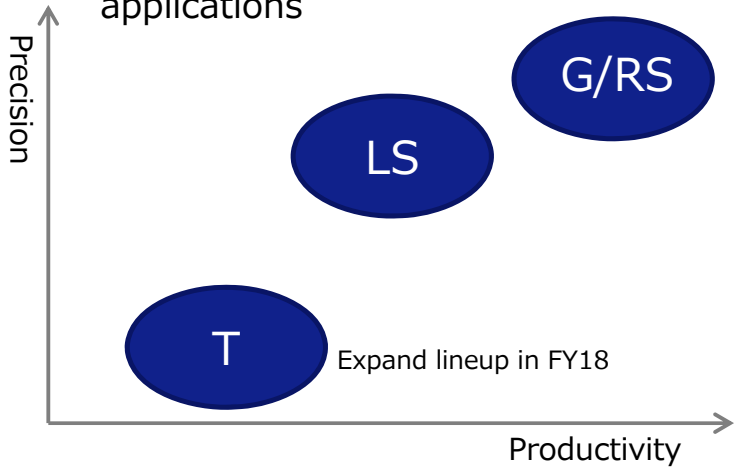
Perform tasks that previously relied on human senses

1-5 Vision system

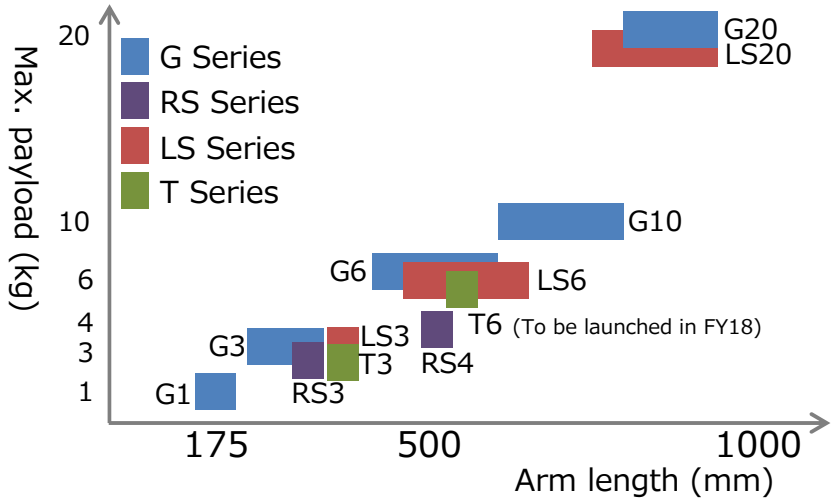
Use for positioning

1-2. SCARA Robot Lineup

- Epson is the global market share leader* in SCARA robots. We aim to further increase our revenue and market share by expanding applications and the product lineup.
- Current Lineup
  - ➢ Product lineup to suit customers' applications



  - ➢ Various payloads and arm lengths



* Market share based on industrial SCARA robot revenue & unit shipments, 2011-2016. (Source: Fuji Keizai "2012 - 2017 Worldwide Robot Market and Future Outlook").

1-2. SCARA Robot Lineup: G/RS and LS

- G Series and RS Series
  - Flagship models that deliver among the industry's highest speeds and precision and lowest residual vibration in the assembly of precision parts, where high speed and accuracy are essential
  - Main regions/ applications
    Europe and America/ Assembly of automobile part and medical consumables
- LS Series
  - General-purpose models equipped with sensors that enable them to offer a good balance of speed and precision in high-speed transport applications
  - Main regions/ applications
    Greater China/ Material feeding to solar wiring systems

G
Payload: 1 to 20 kg
Arm length: 175 to 1,000 mm

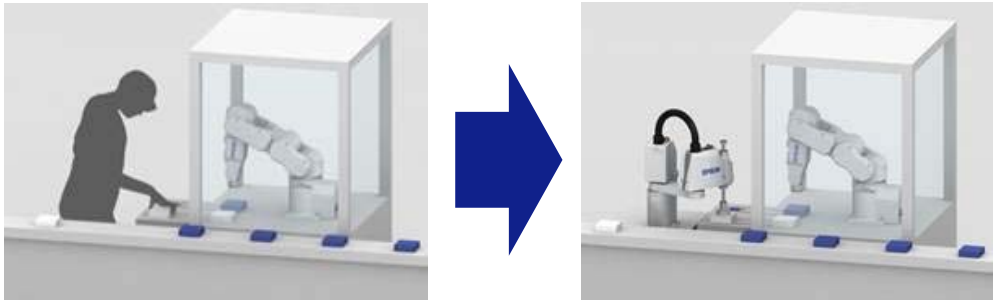
RS: Ceiling mounted
Payload: 3 to 4 kg
Arm length: 350 to 550 mm

Payload: 3 to 20 kg
Arm length: 400 to 1,000 mm

1-2. SCARA Robot Lineup: T

- T Series
  - Perform simple parts transport tasks that do not require precision or speed and that were previously performed manually
  - Low-cost entry models with built-in controllers for simple installation
  - Main regions/ applications
    Worldwide/ Material handling tasks previously performed by humans

Example of a parts transport task that can be automated



Payload: 3 kg
Arm length: 400 mm

1-2. SCARA Robot Lineup: Expand Lineup

- Strengthen the T Series (T6 to be added in FY18)
  - Extend the arm length to 600 mm and doubled the payload to 6 kg to support large parts in simple parts transfer applications
  - Improve productivity by supporting dual end-effectors capable of transporting two parts

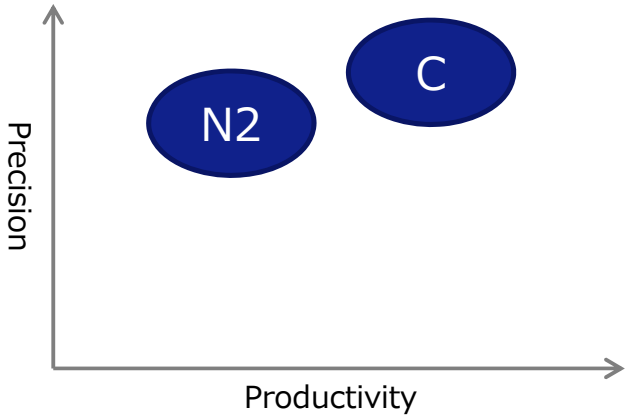
Payload: 6 kg
Arm length: 600 mm

- Strengthen LS/G Series
  - LS Series
    Increase speed to improve productivity in transport applications
  - G Series
    Increase speed, precision and payloads to support high product mixes in assembly applications

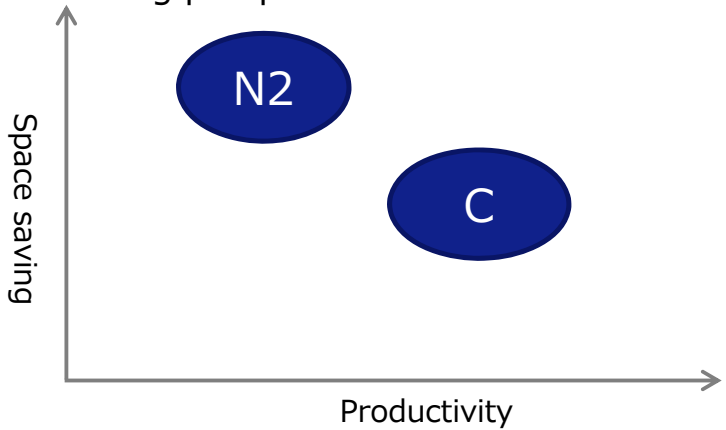
1-3. Compact Vertically Articulated Robot Lineup

Grow sales by launching differentiated products that meet customer needs, such as the uniquely engineered robots in the N series

- Current Lineup
  - Lineup from a productivity and precision perspective



  - Lineup from a productivity and space saving perspective



1-3. Compact Vertically Articulated Robot Lineup: C and N2

- C Series
  - Designed for use in complex assembly jobs requiring high speed and precision, these lightweight, compact flagshipmodels offer among the best-in-class speed, precision, and vibration performance.
  - Main regions/ applications
    Greater China/ Assembly of smartphone parts and LCDpanels
    Europe and America/ Automobile part assembly

Payload: 4 to 8 kg
Arm length: 600 to 1,400 mm

- N2
  - A unique design maximizes space and operation efficiency.
    Can be installed in human work spaces to automate processes without changing system layouts.
    - ✓ Approx. 40% smaller footprint than the C4
    - ✓ Shortens system startup and cycle times with the shortest possible arm paths
  - Main regions/ applications
    Worldwide/ Transport to module testers

Payload: 2.5 kg
Arm length: 450 mm

1-3. Compact Vertically Articulated Robot Lineup: Expand Lineup

- VT Series (to be launched in FY18)
  - Support simple transport tasks that do not require precision or speed and that were performed by humans
  - These low-cost entry-level models have a built-in controller and a new design for easy installation
  - Main regions/ applications
    Worldwide/ Parts transport performed by humans and transport PCBs* and other parts requiring advanced water- and dust-proofing

VT

Payload: 6 kg
Arm length: 920 mm

- New N Series (to be launched from FY18)
  - An expanded lineup with improved sensors will support a wide range of applications (e.g., transport, assembly and packing) with higher speeds
  - Main regions/ applications (N6):
    Worldwide/ Transport to inspection machines of IT products and transport of automobile parts

N6

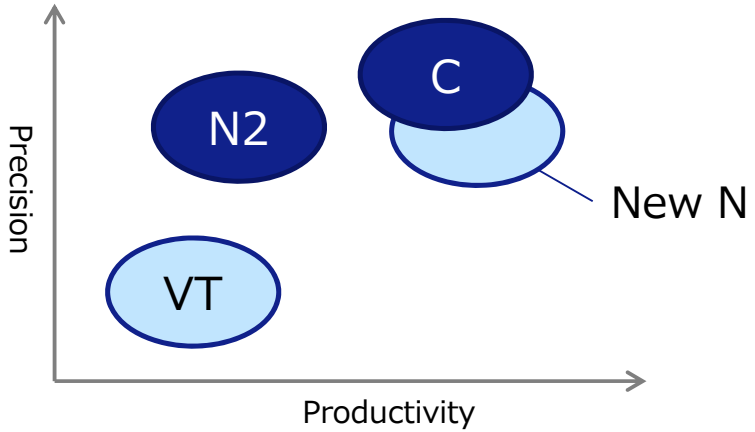
Payload: 6 kg
Arm length: 1,000 mm
To be launched in FY18

* PCBs : Printed Circuit Board

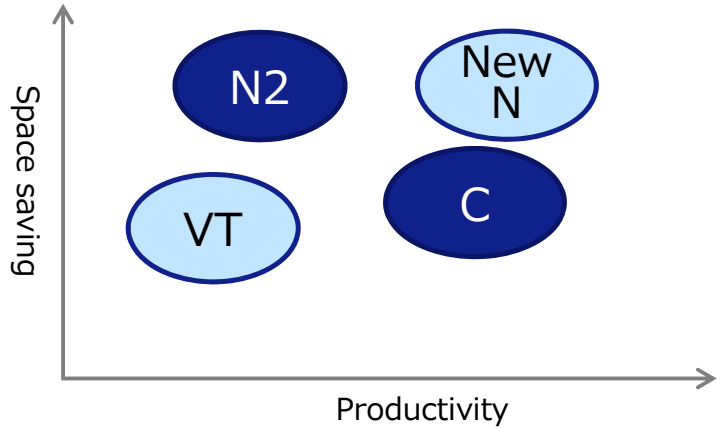
1-3. Compact Vertically Articulated Robot Lineup: Expand Lineup

- New Lineup
  - ➢ Develop a broad lineup to meet the diverse needs of customers

➢ Lineup from productivity and precision perspective



➢ Lineup from a productivity and space saving perspective



VT series to be launched in FY18
New N series to be launched starting in FY18

1-4. Collaborative Robots: New Market Entry

- Develop SCARA and compact vertically articulated robots equipped with sensors that make them more simple and safe
- Enter the exploding market for collaborative robots in FY18 with robots engineered for simple use
  - ➢ Simple
    - ✓ Programming: Select and arrange the order of operation instructions on a PC screen
    - ✓ Teaching: Move the robot arm by hand to the operation position from start to end point
  - ➢ Safe
    - ✓ Robot decelerates when a human approaches and halts when there is contact

1-5. Devices and Options

- Improve robot functions by offering devices and options that use Epson's crystal and MEMS* sensors for outstanding sensing precision

* Micro Electro Mechanical Systems

Epson robots

Functional improvements

Force sensors

Vision systems

Accelerometers

Initial measurement units (IMU)

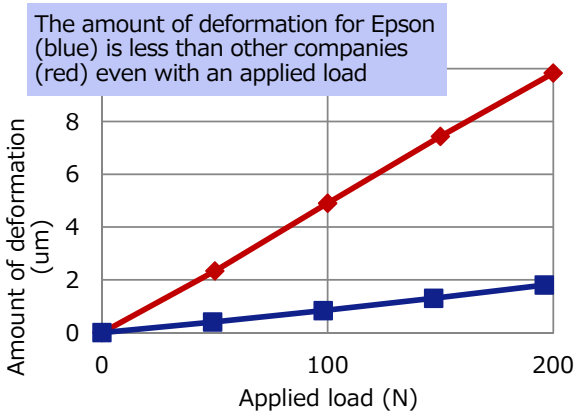
Other devices

Efficient, compact and precision technology devices and options

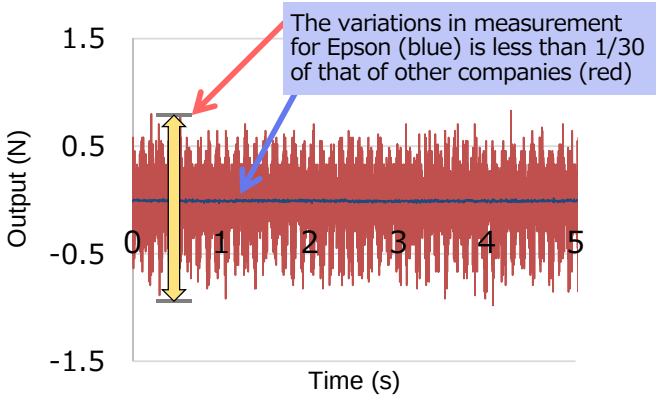
1-5. Devices and Options: Force Sensors

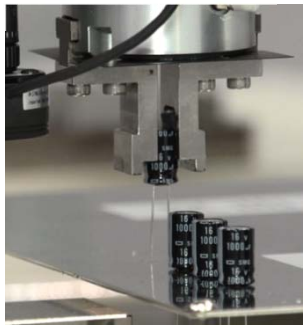
- Highly sensitive force sensors enable robots to fit & insert parts in processes that previously relied on a human sense of touch
  - ➢ High rigidity: A crystal piezoelectric sensor deforms very little under an applied load, enabling accurate zero clearance insertion
  - ➢ High sensitivity: Our sensors detect forces as small as 1/30th those of our competitors, enabling applied force to be finely adjusted during insertion of delicate parts

High rigidity
(amount of deformation when force is applied)



Comparison of variations in measured values with zero force



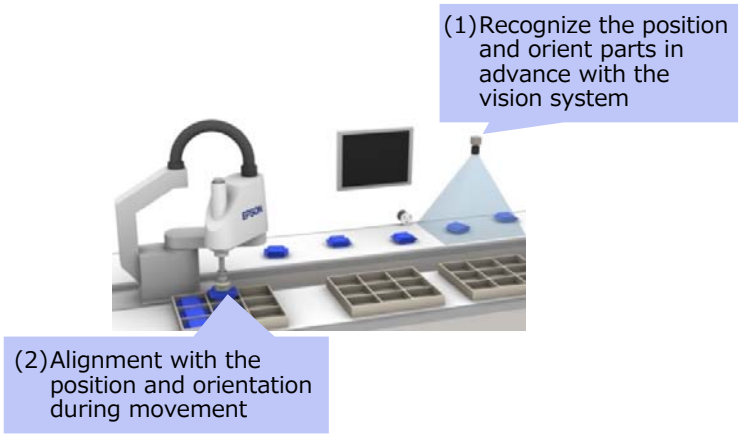


Capacitor prong insertion

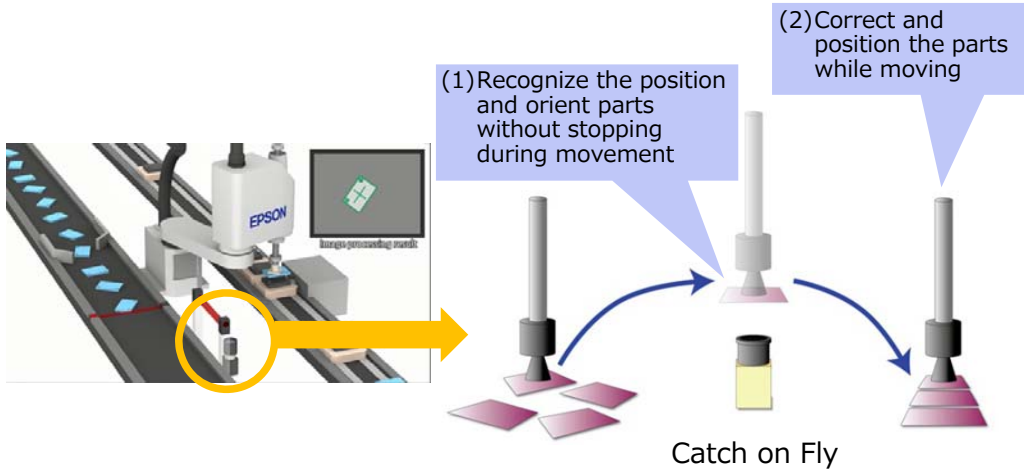
1-5. Devices and Options: Vision Systems

- Vision systems are used for locating and positioning
- Fast, accurate positioning is enabled by a robot controller that factors in the individual error of a particular arm length to make corrections, and monitors the grip during movement

Transport and alignment between conveyors and pallets



High-speed assembly work



1-6. Future Lineup

Robots that capitalize on Epson's robotics technologies

* To be launched in FY18

1-2 SCARA robots

LS Series
LS3/6/20

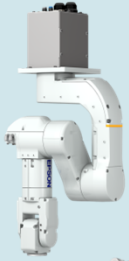
G Series
G1/3/6/10/20

RS Series
RS3/4

T3

T6*

1-3 Compact Vertically Articulated Robots



N2

C Series
C4/8

VT6*

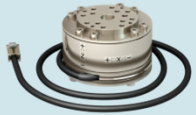
N6*

1-4 Collaborative robots (FY18-)

Conceptual image

Devices and options

1-5 Force sensors



1-5 Vision system

Initiatives in Robotics Solutions Business

1. Expand the robot lineup and refine robotics technology
2. Support more complex manufacturing

2. Support more complex manufacturing: Concept

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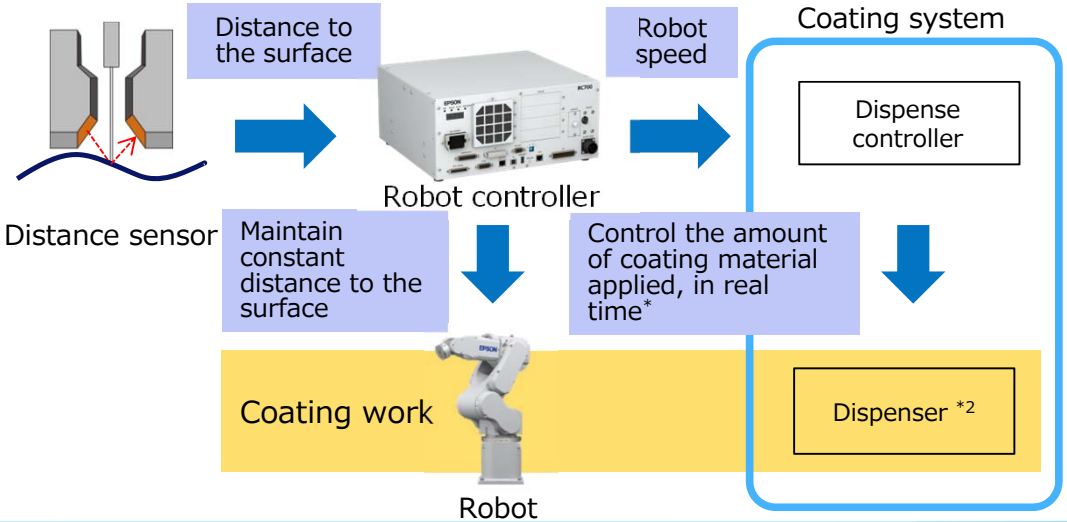
- Provide automation package solutions for a variety of work

	Electronic Devices	Automobile Parts	Medical	Food / Daily Necessities
Transport	Machine tending Simple transport High speed transport Palletization (alignment of parts on trays)	Machine tending High-mix low-volume lots Palletization	Simple transport High speed transport High-mix low-volume lots Palletization	Simple transport High speed transport Palletization
Assembly	Coating High precision assembly Wiring/ connector insertion	Fitting assembly Coating High precision assembly Wiring/ connector insertion	Fitting assembly High precision assembly Wiring/connector insertion	Fitting assembly Coating
Processing	Grinding Deburring	Grinding Deburring		Grinding Deburring
Packing	Boxing	Boxing	Boxing	Boxing

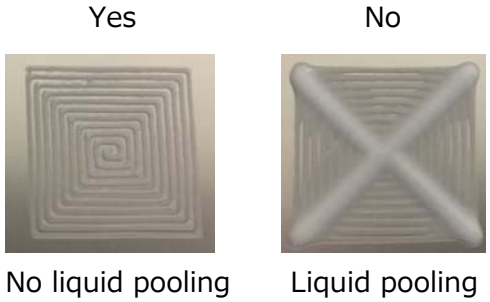
Partially automated　Not automated

2. Support more complex manufacturing: Coating

- Cheaply apply even coatings at high speed with a robot controller that together controls the robot and coating system from distance sensor input
  - Provide distance sensors to maintain a constant distance between the robot and surface being coated to enable high-speed coating
  - The robot speed is sent to a dispenser controller to automatically adjust the amount of coating according to the speed



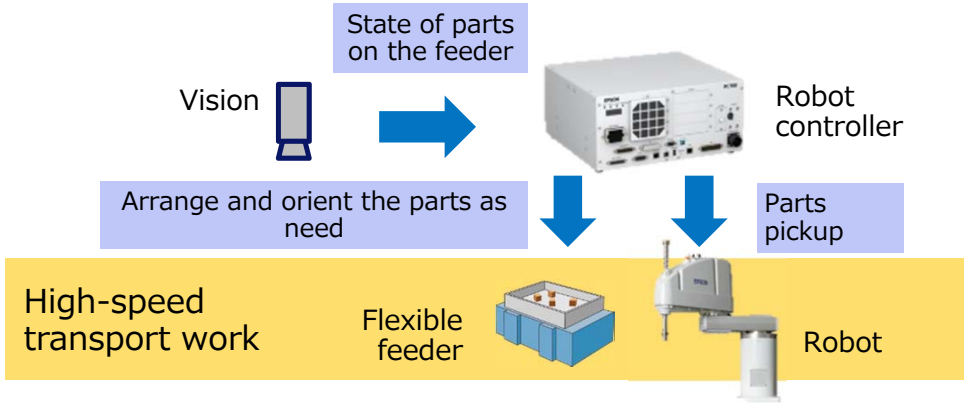
*1 Real-time coating control



*2 Dispenser: System to dispense liquid

2. Support more complex manufacturing: High-speed transport

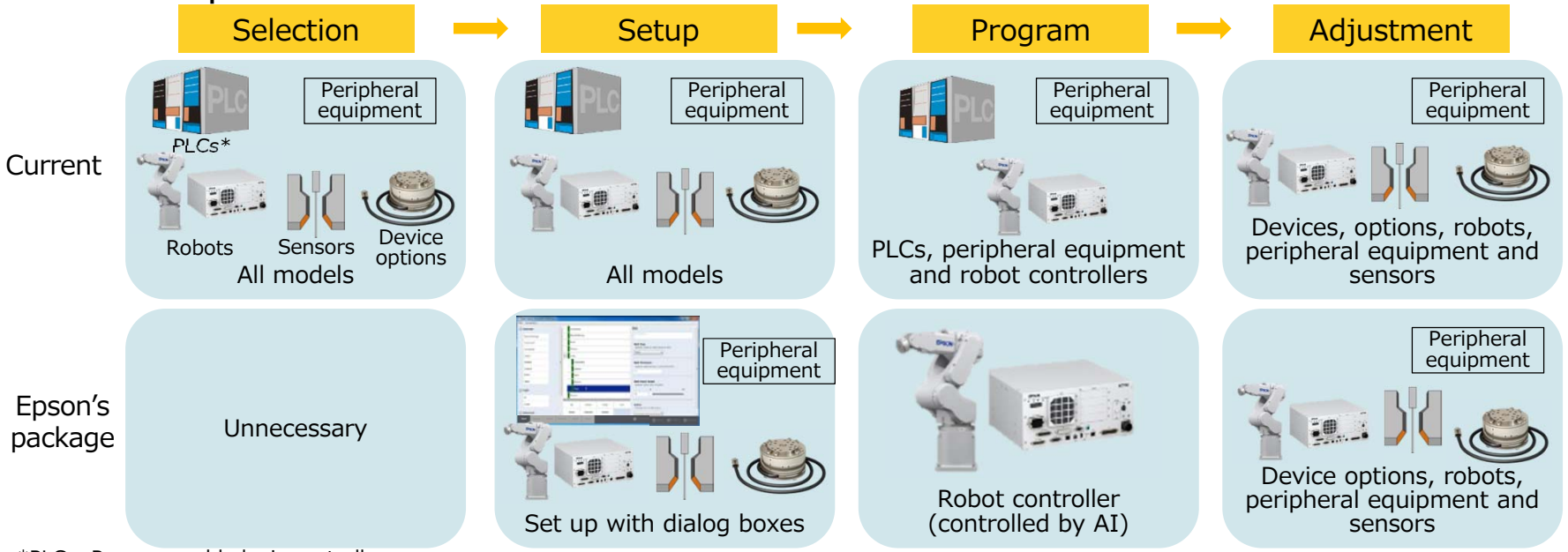
- Provide packaged solutions that combine the robots, vision and flexible feeders* necessary for high-speed transport
  - ➢ Improve productivity
    - ✓ The vision system automatically recognizes the state of parts on the feeder. The feeder than automatically arranges and aligns parts so that robots can pick them up in the most efficient manner.



* Flexible feeder: System that separates and turns parts with vibrations

2. Support more complex manufacturing: Sample package

- Provide packaged solutions that combine the robots, devices, options, peripheral equipment, and sensors necessary for various tasks
  - ➢ Providing these as a package greatly reduces the work that needs to be performed to achieve automation

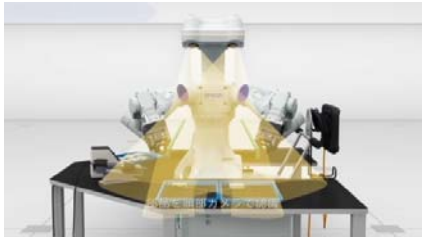


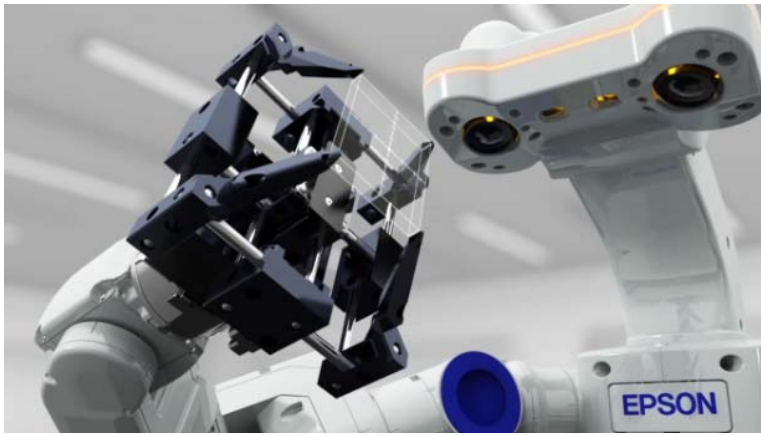
*PLCs: Programmable logic controllers

2. Support more complex manufacturing: WorkSense dual-arm robot

- WorkSense robots harness the power of the full range of Epson's robotics technologies to work on a standalone basis to automate work performed by humans

- The first WorkSense robots will be for used in limited spaces for high-mix, low-volume production that does not require speed





Strengthening the Infrastructure of the Robotics Solutions Business

Strengthening Business Infrastructure (Development, Production, Sales and Support)

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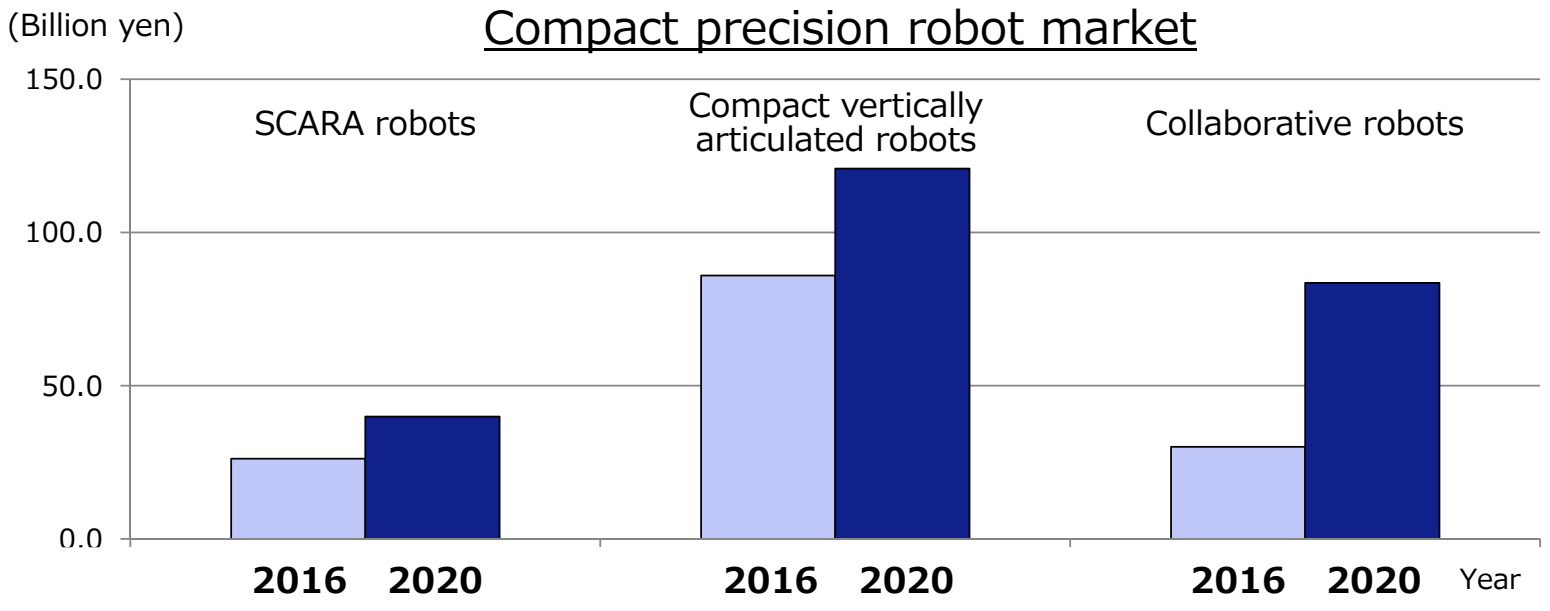
- Development, production, sales and support infrastructure already in place
- Execute M&As if needed

Areas of Focus	
Development	➢ Personnel for new product development ➢ Development of software at our center in Japan and Toronto to add smart features ➢ Interface standardization
Production	➢ Support business expansion by optimizing efficiency at our existing bases and augmenting our production organization
Sales and support	➢ Develop a sales and support organization that collaborates with our worldwide manufacturing sites

Performance Targets of the Robotics Solutions Business

Market Expansion and Share Targets in Compact Precision Robots



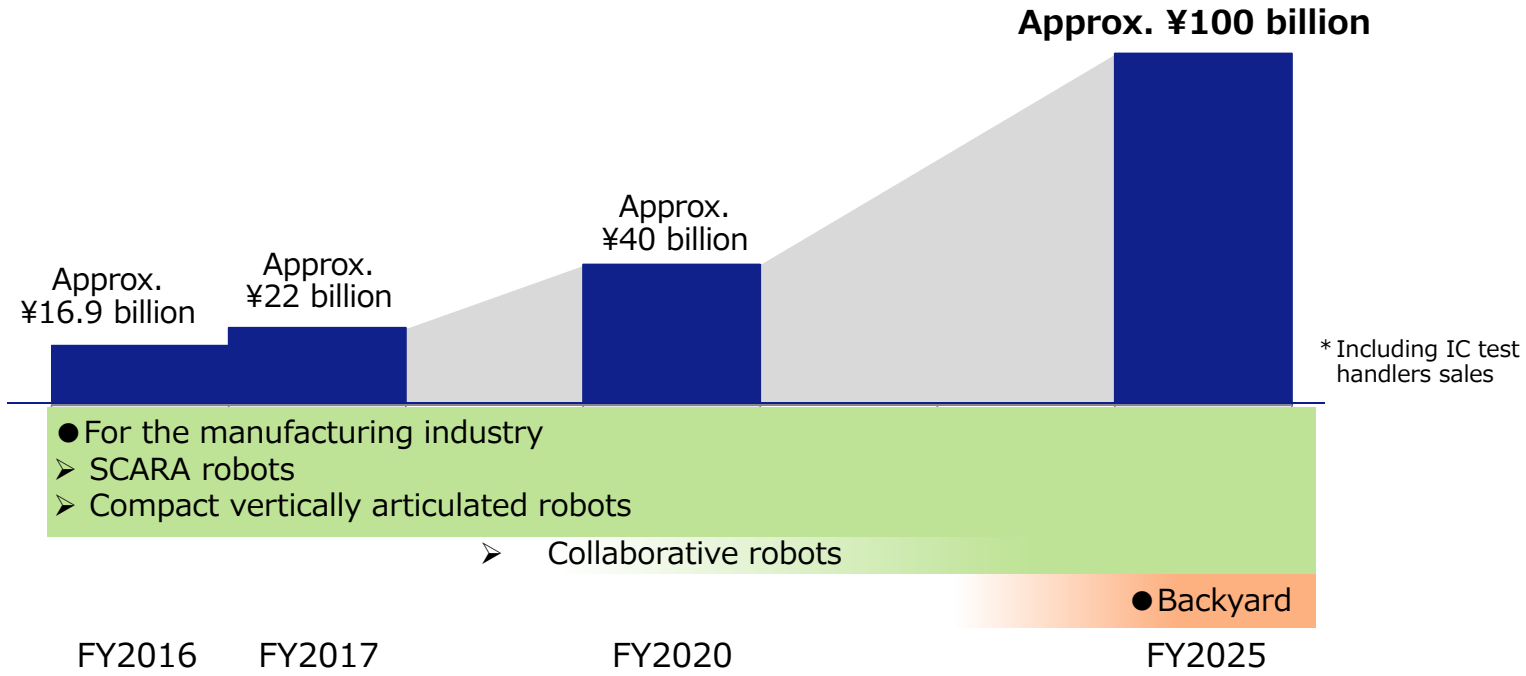
	SCARA robots		Compact vertically articulated robots		Collaborative robots	
Epson volume share	28%	Approx. 40%	4%	Approx. 10%	–	Approx. 5%

Research by Epson

Performance Targets

- Develop the robotics solutions business into a core business for Epson, and reach revenue of **100 billion yen** by FY2025

Sales revenue target for the robotics solutions business

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