Robotics Solutions Business Strategy

November 27, 2017
Seiko Epson Corp.
Epson’s Robotics Solutions

**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

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

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

*2 Worldwide track record in 2016

**Approx. ¥400 billion**
Assembly and transport robots

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

**Global compact precision robot market growth (revenue based)**

- **CAGR 8%**
- *Human collaborative*
- *SCARA*
- *Compact vertically articulated*

Per Epson research
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

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

**Image processing technologies**

- **Force Sensors**
  - Modulate force applied when probing, aligning, fitting, and pressing

**Integrated software technologies**

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

**Vision Systems**

Accurately recognize object shape and orientation
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

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

PrecisionCore MicroTFP printhead
Epson’s Strengths: (3) A Global Manufacturing and Sales Network

- 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

<table>
<thead>
<tr>
<th>Area</th>
<th>Sales companies</th>
<th>Manufacturing plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>Epson Europe</td>
<td>Telford (UK)</td>
</tr>
<tr>
<td>U.S.</td>
<td>Epson America</td>
<td>Portland</td>
</tr>
<tr>
<td>Greater China</td>
<td>Epson China</td>
<td>Shenzhen (China)</td>
</tr>
<tr>
<td></td>
<td>Epson Taiwan</td>
<td></td>
</tr>
<tr>
<td>South-east Asia and India</td>
<td>Epson Singapore</td>
<td>Johor (Malaysia)</td>
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<tr>
<td></td>
<td>Epson Indonesia</td>
<td>Batam (Indonesia)</td>
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<tr>
<td></td>
<td>Epson India</td>
<td>Indonesia</td>
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<tr>
<td></td>
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<td>Philippines</td>
</tr>
</tbody>
</table>
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
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.
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

- Speed and precision
  Move fast and accurately on the designated path

Comparison of residual vibration

- High speed and low residual vibration
  Move quickly and stop precisely

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

- Speed and precision
  Move fast and accurately on the designated path

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

- Speed and precision
  Move fast and accurately on the designated path

Comparison of residual vibration

- High speed and low residual vibration
  Move quickly and stop precisely

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

- Speed and precision
  Move fast and accurately on the designated path
1-1. Current Lineup

Robots utilizing robotics technologies

1-2 SCARA robots
Simple vertical & horizontal movement. Enable automation at low cost.

1-3 Compact vertically articulated robots
Perform complex tasks that require vertical, horizontal, and diagonal movement

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

<table>
<thead>
<tr>
<th></th>
<th>Max. payload (kg)</th>
<th>Arm length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>G Series</strong></td>
<td>20</td>
<td>175</td>
</tr>
<tr>
<td><strong>RS Series</strong></td>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td><strong>LS Series</strong></td>
<td>3</td>
<td>1000</td>
</tr>
<tr>
<td><strong>T Series</strong></td>
<td>1</td>
<td>1000</td>
</tr>
</tbody>
</table>

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.
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

- 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

Payload: 6 kg
Arm length: 600 mm
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 flagship models offer among the best-in-class speed, precision, and vibration performance.
  - Main regions/applications
    - Greater China/Assembly of smartphone parts and LCD panels
    - Europe and America/Automobile part assembly

- **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
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

- 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

* 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

Efficient, compact and precision technology devices and options

- Functional improvements

- Force sensors
- Vision systems
- Accelerometers
- Initial measurement units (IMU)
- Other devices
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)

The amount of deformation for Epson (blue) is less than other companies (red) even with an applied load

Comparison of variations in measured values with zero force

The variations in measurement for Epson (blue) is less than 1/30 of that of other companies (red)
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

(1) Recognize the position and orient parts in advance with the vision system
(2) Alignment with the position and orientation during movement

High-speed assembly work

(1) Recognize the position and orient parts without stopping during movement
(2) Correct and position the parts while moving

Catch on Fly
1-6. Future Lineup

Robots that capitalize on Epson’s robotics technologies

1-2 SCARA robots
- G Series G1/3/6/10/20
- LS Series LS3/6/20
- T3
- T6*
- RS Series RS3/4

1-3 Compact Vertically Articulated Robots
- C Series C4/8
- N2
- N6*
- VT6*

1-4 Collaborative robots (FY18-)
- Conceptual image

* To be launched in FY18

Devices and options

1-5 Force sensors

1-5 Vision system
1. Expand the robot lineup and refine robotics technology

2. Support more complex manufacturing
# 2. Support more complex manufacturing: Concept

- Provide automation package solutions for a variety of work

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

- 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.

![Diagram of coating system]

**Distance sensor**
- Maintain constant distance to the surface

**Robot controller**
- Robot speed
- Control the amount of coating material applied, in real time*1

**Coating system**
- Dispense controller
- Dispenser *2

*1 Real-time coating control
- Yes
- No

*2 Dispenser: System to dispense liquid

- No liquid pooling
- Liquid pooling
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 then 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

Current

- Robots
  - All models
- Sensors
  - Options

Epson’s package

- Unnecessary

Selection

- Peripheral equipment

Setup

- Peripheral equipment

Program

- Peripheral equipment
  - PLCs, peripheral equipment and robot controllers

Adjustment

- Peripheral equipment
  - Devices, options, robots, peripheral equipment and sensors

*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)

- 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

Compact precision robot market

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCARA robots</td>
<td></td>
<td></td>
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<tr>
<td>Epson volume share</td>
<td>28%</td>
<td></td>
</tr>
<tr>
<td>Approx.</td>
<td>40%</td>
<td></td>
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<tr>
<td>Compact vertically articulated robots</td>
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<td></td>
</tr>
<tr>
<td>Approx.</td>
<td>10%</td>
<td></td>
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<tr>
<td>Collaborative robots</td>
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<td></td>
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<tr>
<td>Approx.</td>
<td>5%</td>
<td></td>
</tr>
</tbody>
</table>

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

- **For the manufacturing industry**
  - SCARA robots
  - Compact vertically articulated robots
  - Collaborative robots

- **Backyard**

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales Revenue (approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2016</td>
<td>¥16.9 billion</td>
</tr>
<tr>
<td>FY2017</td>
<td>¥22 billion</td>
</tr>
<tr>
<td>FY2020</td>
<td>¥40 billion</td>
</tr>
<tr>
<td>FY2025</td>
<td>¥100 billion *</td>
</tr>
</tbody>
</table>

* Including IC test handlers sales