Market Report
Smart Robots

January, 2018

Contents

Summary (1/2)

> **Definition of smart robots**
>
> In this report, "smart robots" are defined as robots which have been enhanced with IoT and AI technologies, etc.
>
> Smart robots are further divided into two broad categories: industrial robots, and service robots.

1. Japan's Smart Robot Market

- ➢ Robots can be broadly divided into either industrial robots (handling welding, painting, assembly, transport, etc., at manufacturing sites), and service robots (used for mobility (transportation), medical/nursing/welfare/healthcare, security, cleaning, infrastructure, and so on).

- ➢ For industrial robots handling production line operations such as welding, painting, and assembly, an emerging number of initiatives are using machine learning to improve operational accuracy and predict breakdowns.

- ➢ Other initiatives by domestic players focus on using cloud-based information management systems to quickly respond to problems, as well as machine learning to avoid interference between multiple machines.

- ➢ For mobility and medical/nursing/welfare/healthcare-related robots, players are working on network-based remote control functions and data collection and analysis to improve their services.

- ➢ For security and cleaning robots, players are working to implement functions which use networks to collect data and link with operations centers, as well as remote operations and record checking.

- ➢ For infrastructure-related robots, players are working on network-based remote control functions and data collection and analysis to improve their services.

- ➢ For other robots, machine learning is being used to improve communications and linking with other devices.

- ➢ In addition to the growing number of cutting-edge initiatives in Japan, when it comes to demand for industrial robots, the Japanese market ranks 1st globally by number of robots in operation. Production-wise, around 50% of global robot shipments are manufactured in Japan.

- ➢ Demand for service robots in Japan is expected to grow significantly at a CAGR of 13.9% over the 20 year period leading up to 2035. Japan also has a strong global presence as a production market, ranking 4th in the world by number of service robot manufacturers.

Summary (2/2)

2. Market entry opportunities for foreign companies
  - ➢ Numerous foreign companies developing their business in Japan have become major players in the market.
  - ➢ Effective options for foreign companies entering the Japanese market include forming a development and manufacturing partnership with research institutions or domestic companies in the same industry, or forming a sales partnership with domestic agents to utilize their distribution channels.

3. Business environment surrounding the smart robot market
  - ➢ Upcoming events which gather together different players in the smart robotics field will provide valuable opportunities to discover trends in the Japanese market and find and meet with potential partners.

1. Japan's Smart Robot Market
（１）Usages for Robots

Robots can be broadly divided into either industrial robots (handling welding, painting, assembly, transport, etc., at manufacturing sites), and service robots (used for mobility (transportation), medical/nursing/ welfare/healthcare, security, cleaning, infrastructure, and so on).

Category	Objective	Areas of Utilization	Examples
Industrial Robots	**Ensuring quality, streamlining production, ensuring safety**	**Welding** **Painting** **Assembly** **Transport**	✓ Production line processes (welding, painting, assembly, transport, etc.)
Service Robots	**Expanding capabilities, assistance, lifestyle support**	**Mobility**	✓ Personal mobility, automated driving systems, etc.
		Medical, Nursing, Welfare, Healthcare	✓ Surgery support, delivering medicine and other items within a facility, power-assist/power suits, etc.
		Security	✓ Residential security, outdoor security robots, etc.
		Cleaning	✓ Home cleaning robots, workplace cleaning robots
		Infrastructure	✓ Equipment inspection, investigation, rescue operations, etc.
		Other	✓ Reception duties, communication, telepresence, etc.

For industrial robots handling production line operations such as welding, painting, and assembly, an emerging number of initiatives are using machine learning to improve operational accuracy and predict breakdowns.

Category	Direction of Smartification	Examples	
		Company (product in brackets)	Details on Initiatives
Industrial Robots	Improve accuracy of operations	✓ Fanuc (Wire-cut electric discharge machine)	• Utilized AI technology (machine learning) in its wire-cut electric discharge machine to estimate and control fluctuations in processing accuracy caused by temperature changes, improving accuracy of the compensation function by 30%.
		✓ Yaskawa Electric (Grinding and assembly robot)	• To promote the robotization of complicated contact tasks (grinding, etc.) which otherwise require skilled workers, developed a "teaching-by-demonstrating function" which intuitively teaches movements to robots through demonstrations given by humans.
	Predicting breakdowns	✓ Fanuc (Injection molding machine)	• Developed function that uses deep learning to assess and gauge how worn down an expendable part of an injection molding machine has become, and will alert users before the part breaks down. Up until now, users used sight alone to judge a part's condition and predict when to replace it. Deep learning technology makes sophisticated analysis possible, and notifies users of appropriate timing for replacement.
		✓ Hitachi Zosen, NTT Data (Welding/machining equipment)	• Combining NTT Data's monitoring for machining equipment, which uses IoT technology for analyzing operational noises, and Hitachi Zosen's maintenance experience, focuses on operating sounds from equipment and creates models of normal machine operations vs. abnormal operations to prevent emergency shutdowns.

Source: Company websites

（2）Smartification of Robots in Different Industries　−Industrial Robots (2/2)

Other initiatives by domestic players focus on using cloud-based information management systems to quickly respond to problems, as well as machine learning to avoid interference between multiple machines.

Category	Direction of Smartification	Examples	
		Company (product in brackets)	Details on Initiatives
Industrial Robots	Response to problems	✓ Yaskawa Electric (Various industrial robots)	• Utilizes the cloud to share information necessary for resolving any problems that arise (name of robot model, product specifications, alarm number, inquiry history, etc.), making it easier to send information and reduce downtime.
	Avoid interference between machines	✓ Fanuc (Various industrial robots)	• Uses simulators to have several robots in one line learn routes that will prevent them from colliding, before assigning positions so as to prevent interference and damages to the actual robots.[1]

Sources: *1　2016 document from the Industrial Structure Council's Working Group on Distribution Strategy
All other information gathered from company websites.

1. Japan's Smart Robot Market
（2）Smartification of Robots in Different Industries －Service Robots
(Mobility/Medicine, Nursing, Welfare, Healthcare)

For mobility and medical/nursing/welfare/healthcare-related robots, players are working on network-based remote control functions and data collection and analysis to improve their services.

Category	Areas of Utilization		Direction of Smartification	Examples (red indicates foreign companies)	
				Company (product in brackets)	Details on Initiatives
Service Robots	**Mobility**		Remote operations	✓ WHILL (Wheelchair)	• Smartphones can be used to set precise speeds and speed up or slow down personal mobility vehicles. • Vehicles can be remotely controlled even without a passenger onboard.
	Medicine Nursing Welfare Health-care	**Medicine**	Remote operations	✓ Intuitive Surgical (US) (Surgical robot)	• Surgeons can use a 3D monitor to remotely control endoscope cameras and robotic arms during an operation. As of the end of Sept. 2016, has installed 237 systems in Japan.[1]
		Auto-nomous mobile robots for hospitals	Remote monitoring Data collection through telecommunications	✓ Panasonic (Autonomous mobile robot for hospitals)	• Operational monitoring system using a hospital's LAN (wired and wireless) network to continually check the status of robots moving around within a hospital. • Can be used to maintain accurate and efficient in-facility deliveries by recording "who", "when", "where deliveries were made", and "where it was opened", ensuring traceability and pinpointing operational areas needing improvement.
		Power-assist	Accumulation and analysis of usage data	✓ Cyberdyne (Medical robot suit)	• Uses network to save settings used by each power suit wearer, as well as record number of times worn and other data. • Thorough customization possible even for multiple users.

Sources: *1 Japan Robotic Surgery Society website
All other information gathered from company websites.

（２）Smartification of Robots in Different Industries －Service Robots
(Security, Cleaning)

For security and cleaning robots, players are working to implement functions which use networks to collect data and link with operations centers, as well as remote operations and record checking.

Category	Areas of Utilization	Direction of Smartification	Examples (red indicates foreign companies)	
			Company (product in brackets)	Details on Initiatives
Service Robots	Security	Gather data Link with operations centers and security guards	✓ ALSOK (Security robot)	• Shares information in real-time with operations centers and security guards on customers and any abnormalities detected during patrol. • Comes equipped with intruder detection and facial recognition functions that work within a set area and assist in early identification of a suspicious or specific person.
	Cleaning	Remote operations Checking past cleaning records	✓ iRobot (US) (Cleaning robot)	• Using a smartphone app, users can operate their Roomba from wherever they are, manage cleaning schedules, and check information such as areas cleaned and cleaning times, and so on.

1. Japan's Smart Robot Market
（２）Smartification of Robots in Different Industries　－Service Robots (Infrastructure)

For infrastructure-related robots, players are working on network-based remote control functions and data collection and analysis to improve their services.

Category	Areas of Utilization	Direction of Smartification	Examples	
			Company (product in brackets)	Details on Initiatives
Service Robots	Infra-structure	Infra-structure inspect-ions	Remote monitoring and operations control	✓ iXs Research (Equipment inspection robot)	• Uses 3.5G mobile network (WiMAX, E-mobile, etc.) for controlling and monitoring robots even from extremely distant locations.
			Data collection and analysis through telecommunications	✓ Terra Drone, KDDI (Equipment inspection drone)	• Currently developing operations control system that connects drones to 4G LTE networks and uses 3D maps to prevent collisions with other drones and buildings, and a cloud system that accumulates/analyzes data gathered by drones.
		Rescue	Remote operations Data collection through tele-communications	✓ Topy Industries (Rescue robot)	• Using a joystick and touch pad, robots can be remotely controlled at disaster sites through either a wired or wireless connection. • Sends camera images and other gathered data over wired or wireless connections.

Source: Company websites

1. Japan's Smart Robot Market
（2）Smartification of Robots in Different Industries －Service Robots (Other)

For other robots, machine learning is being used to improve communications and linking with other devices.

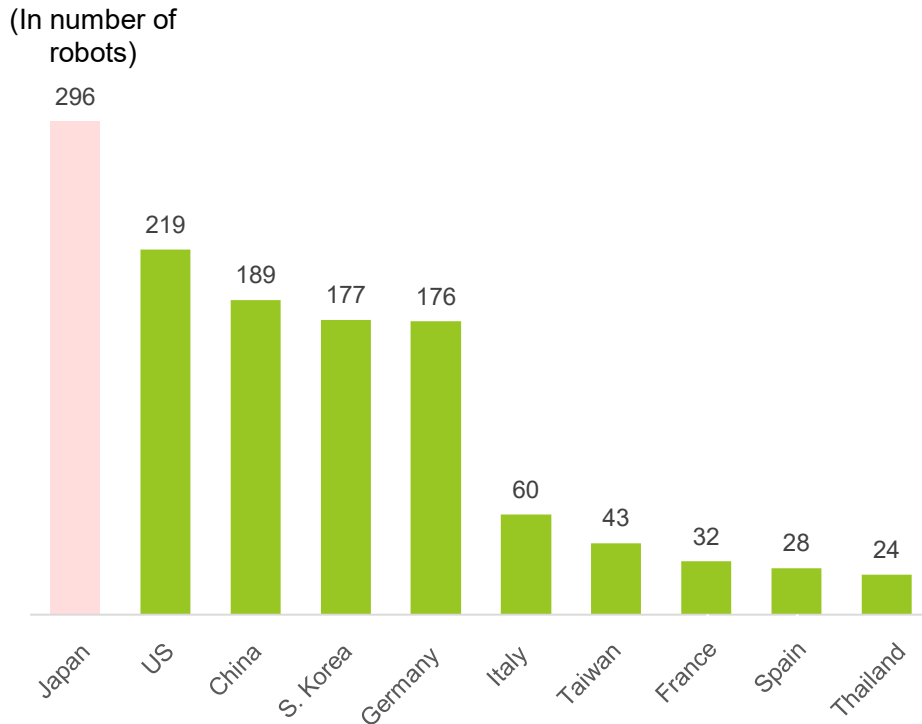| Category	Areas of Utilization		Direction of Smartification	Examples (red indicates foreign companies, * indicates JETRO-supported companies)	
				Company (product in brackets)	Details on Initiatives
Service Robots	Other	Communi-cation	Improve communications Provide information through telecommunications	✓ Fujisoft (Conversation robot for elderly)	• Through conversation, Fujisoft's communication robot, PALRO, accumulates a lifelog on the user's actions and ideas, etc., to continually deepen its knowledge of the user. • Provides weather, news, and other information.
			Link with digital signage and automatic doors, etc.	✓ SoftBank Robotics (Reception/ Guide robot)	• Two-way communication is used to provide guidance to visitors, such as determining contents of digital signage depending on greetings from Pepper reception robots and customers' reactions. • Links up with sensors on automatic doors to determine when someone has entered or left a room, and with sensors on shelves to provide product explanations, etc.
		Tele-presence	Remote operations	✓ Double Robotics (US) (Telework robot)	• Telepresence robot remotely controlled via internet. An attached iPad enables users to be "present" via video call, move around the office, and join in meetings.
				✓ Revolve Robotics (US) (Telework robot)	• Offers the Kubi telepresence robot, which uses an iPad attached to a base plate and enables users to remotely control the direction the iPad faces.
		Education	Improve communications	✓ AKA* (US) (English education robot)	• Improves communication through machine learning and natural language processing, which enables robot to learn and become smarter the more it is used.

Source: Company websites

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1. Japan's Smart Robot Market
（３）Trends in Market Size　－Industrial Robots

In addition to the growing number of cutting-edge initiatives in Japan, when it comes to demand for industrial robots, the Japanese market ranks 1st globally by number of robots in operation. Production-wise, around 50% of global robot shipments are manufactured in Japan.
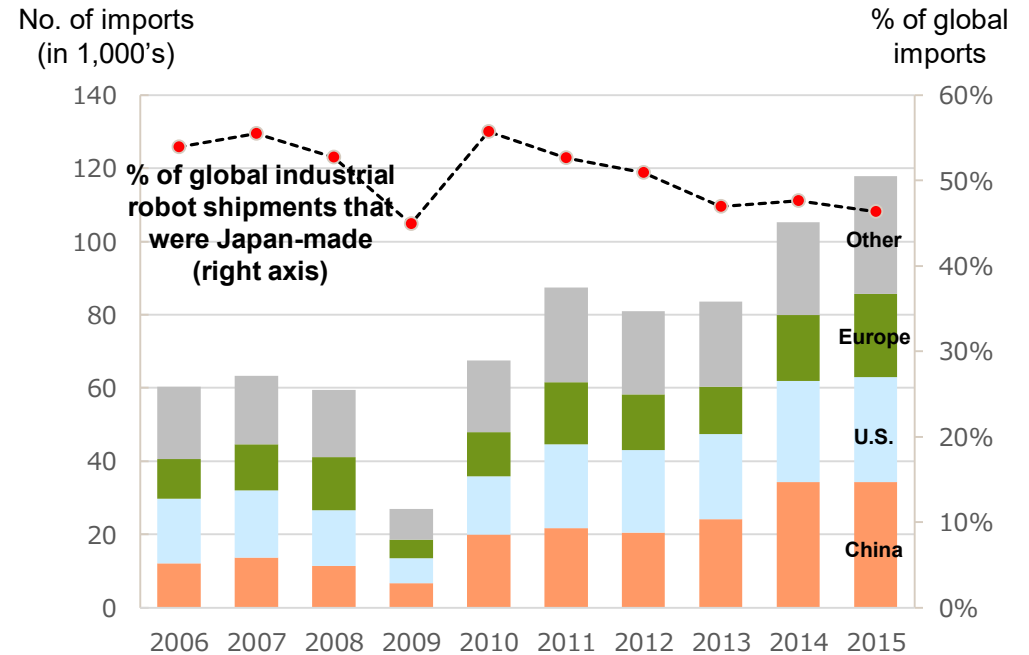
Demand in Japan's Market	Japan as a Production Market

No. of Industrial Robots in Operation, by Country (2014)[*1]

(In number of robots)

Japan: 296
US: 219
China: 189
S. Korea: 177
Germany: 176
Italy: 60
Taiwan: 43
France: 32
Spain: 28
Thailand: 24

Japan-made Robot Imports as Percentage of Global Shipments[*2]

No. of imports (in 1,000's) — left axis
% of global imports — right axis

% of global industrial robot shipments that were Japan-made (right axis)

Other, Europe, U.S., China
2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

Sources: *1 Japan Robot Association, *Supply and Demand Trends in the Robotics Industry 2016*
　　　　 *2 Japan Robot Association, *Supply and Demand Trends in the Robotics Industry 2016;*
　　　　　 International Federation of Robotics website
NB: The market information provided on this page is for the overall industrial robot market rather than smart robots specifically.

1. Japan's Smart Robot Market
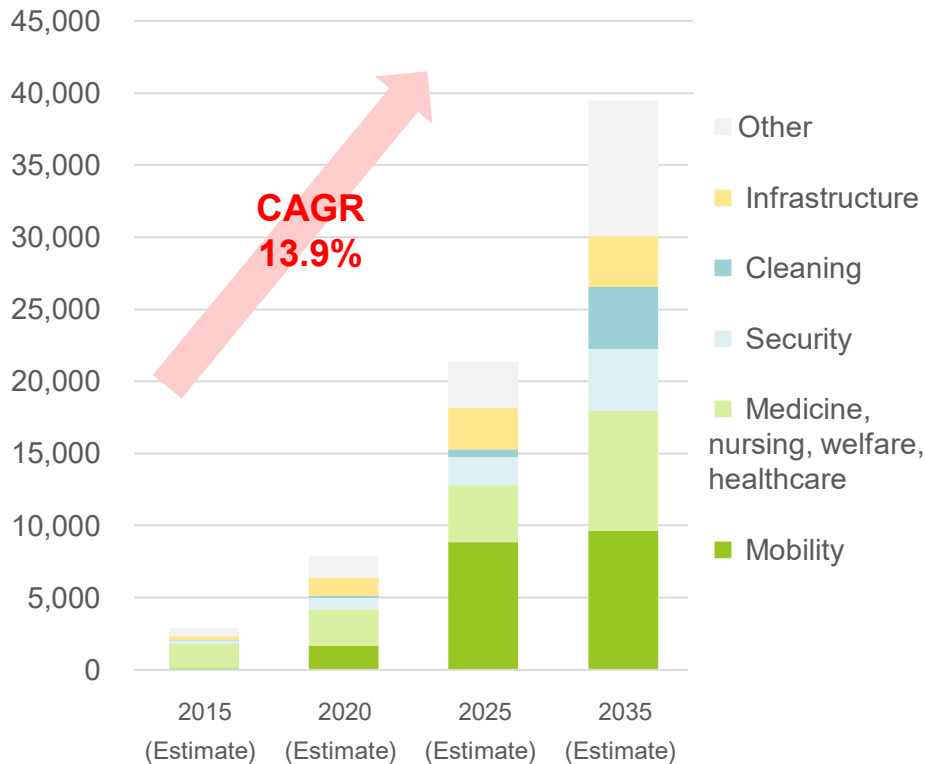## （３）Trends in Market Size　－Service Robots

Demand for service robots in Japan is expected to grow significantly at a CAGR of 13.9% over the 20 year period leading up to 2035. Japan also has a strong global presence as a production market, ranking 4th in the world by number of service robot manufacturers.

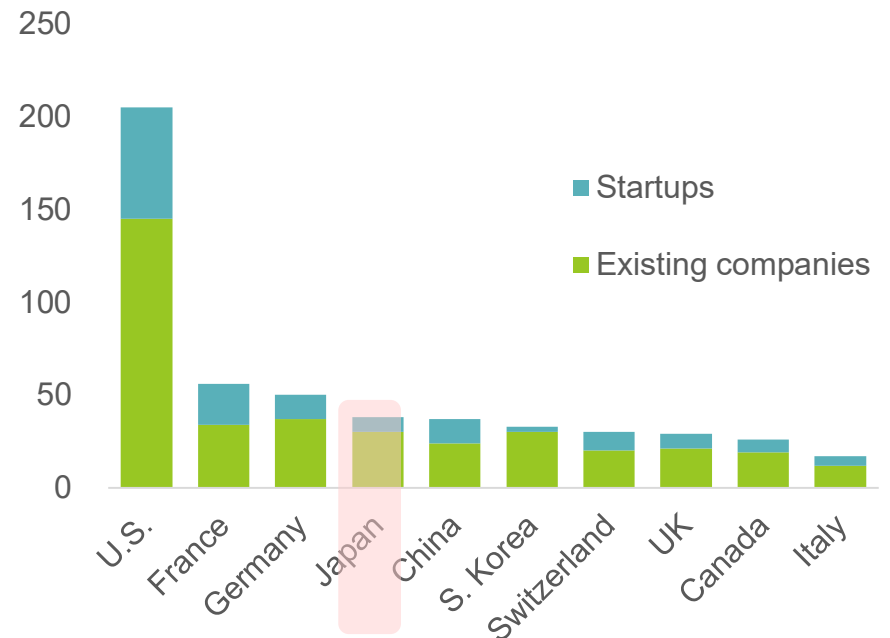| Demand in the Japanese Market	Japan as a Manufacturing Market

Domestic Market Size of Service Robots, by Category[1]

(Unit: in 100M yen)

CAGR 13.9%

Legend: Other, Infrastructure, Cleaning, Security, Medicine, nursing, welfare, healthcare, Mobility

X-axis: 2015 (Estimate), 2020 (Estimate), 2025 (Estimate), 2035 (Estimate)

No. of Service Robot Manufacturers, by Country[2]

(Unit: no. of companies)

Legend: Startups, Existing companies

X-axis: U.S., France, Germany, Japan, China, S. Korea, Switzerland, UK, Canada, Italy

Sources: *1 NEDO, *Projected Robot Industry Market by 2035* (2010)
　　　*2 Rough estimate. Data from the International Federation of Robotics website
NB: The market information provided on this page is for the overall service robot market rather than smart robots specifically.

2. Market Entry Opportunities for Foreign Companies
（1）Main Players (1/2)

Numerous foreign companies developing their business in Japan have become major players in the market.

Category	Areas of Utilization	Examples of Major Market Entrants (red indicates foreign companies)		
Industrial Robots	**Welding** / **Painting** / **Assembly** / **Transport**	✓ ABB (Switzerland) ✓ KUKA (Germany) ✓ Staubli (Switzerland)	✓ Fanuc ✓ Yaskawa Electric ✓ Kawasaki Heavy Industries	✓ Daihen ✓ Nachi-Fujikoshi
Service Robots	**Mobility**	✓ Ninebot (China) ✓ Airwheel (China)	✓ WHILL	
	Medicine Nursing Welfare Health-care → **Medicine**	✓ Intuitive Surgical (US)	✓ Panasonic	
	Autonomous mobile transport	✓ Panasonic		
	Power assist	✓ Cyberdyne		
	Monitoring, Senior Care	✓ Yukai Engineering	✓ Intelligent System	✓ Pip Robot Technology
	Security	✓ ALSOK		

Source: Company websites

2. Market Entry Opportunities for Foreign Companies
（１）Main Players (2/2)

Numerous foreign companies developing their business in Japan have become major players in the market.

Category	Areas of Utilization		Examples of Major Market Entrants (red indicates foreign companies, * indicates JETRO-supported companies)		
Service Robots	Infrastructure	Cleaning	✓ iRobot (US) ✓ Ecovacs (China)	✓ Panasonic ✓ Toshiba Lifestyle Products & Services	
		Infrastructure inspection	✓ DJI (China) ✓ Parrot (France) ✓ 3D Robotics (US)	✓ AREVA (France) ✓ iXs Research ✓ Terradrone	✓ KDDI
		Rescue	✓ Topy Industries		
	Other	Commun-ications	✓ Suzhou Pangolin Robot* (China)	✓ SoftBank Robotics ✓ Fujisoft	✓ OryLab ✓ FRONTEO
		Tele-presence	✓ Double Robotics (US)	✓ Revolve Robotics (US)	
		Education	✓ AKA* (US) ✓ ROBOTIS* (South Korea)		

Source: Company websites

2. Market Entry Opportunities for Foreign Companies
（２）Potential Partners for Market Entry

Effective options for foreign companies entering the Japanese market include forming a development and manufacturing partnership with research institutions or domestic companies in the same industry, or forming a sales partnership with domestic agents to utilize their distribution channels.

Types of Partnerships		Examples
Technical Partnership	• Licensing agreements and joint development contracts between multiple companies, and centering on intellectual property rights (technical patents, know-how, etc.).	• US-based AI startup, Skymind, formed a partnership with SoftBank to jointly develop a prototype for a robot which can identify and locate moving objects within a room – a necessary function for robots across a variety of fields, including factory work.
Production Partnership	• Enhancing production capabilities by contracting out a part of production or the manufacturing process.	• On June 27, 2016, US company AKA announced that it had signed a memorandum of understanding with Vaio for manufacture and maintenance of the former's AI robot, Musio. • On May 30, 2017, AKA announced that they will join forces with Kashiwazaki US TEC and will manufacture Musio in Japan.
Sales Partnership	• Partnership which utilizes sales channels, a partner's brand, or other sales resources.	• In October 2017, Tokyo-based Creek and River partnered with Taiwanese AI and robotics startup, Intumit, to allow Creek and River distribution rights in Japan for Intumit's AI platform, Smart Robot.

3. Business Environment of the Smart Robot Market
（1）Trade Fairs

Upcoming events which gather together different players in the smart robotics field will provide valuable opportunities to discover trends in the Japanese market and find and meet with potential partners.

Industrial Robots	Service Robots

RoboDEX

- Exhibits technologies that promote the implementation of a robotics society, such as industrial robots, service robots, drones, development technologies for robots and drones, IT, AI, and more.

Smart Factory Expo

- Gathers the latest technologies and solutions for making smart factories into a reality, including IoT solutions, FA/robots, AI, etc.

Held concurrently:
Date: Jan. 17 – 19, 2018   Venue: Tokyo Big Sight

Industrial Robot Development Technology Exhibition

- Exhibits various kinds of underlying technologies necessary for developing industrial robots.

Service Robot Development Technology Exhibition

- Exhibits various kinds of underlying technologies necessary for developing service robots.

Robot IT Solutions Exhibition

- Gathers communications technologies and system technologies necessary for robotics development.

Held concurrently:
Date: Jun. 7 – 8, 2018   Venue: Intex Osaka

Source: Trade fair official websites