Agricultural Robots

Driverless Tractors, Unmanned Aerial Vehicles, Material Management, Field Crops and Forest Management, Soil Management, Dairy Management, and Animal Management for Precision Agriculture

The market for agricultural robots is developing at a rapid pace, with a large number of established and startup agricultural technology companies developing, piloting, and launching an innovative range of robotic systems to tackle a wide variety of tasks. Key application areas for agricultural robots include driverless tractors, unmanned aerial vehicles (UAVs), material management, field crops and forest management, soil management, dairy management, and animal management, with a diverse set of subcategories emerging within each of those areas.

The rising demand for agricultural robots is being driven by a number of factors including global population growth, increasing strain on the food supply, declining availability of farm workers, the challenges and complexities of farm labor, the cost of farm workers, changing farmlands, climate change, the growth of indoor farming, and the broader automation of the agriculture industry. Market challenges remain for development of the sector, however, such as unclear value propositions, limited awareness of robotic systems among growers, insufficient robotic solutions, the difficulty of matching human-like dexterity with machines, fragmented technology development, weak administrative support, and infrastructure issues. Against the backdrop of these market drivers and barriers, Tractica forecasts that shipments of agricultural robots will increase significantly in the years ahead, rising from 32,000 units in 2016 to 594,000 units annually in 2024, by which time the market is expected to reach $74.1 billion in annual revenue.

This Tractica report, developed in collaboration with The Robot Report, examines global market trends for agricultural robots and provides 10-year market sizing and forecasts for agricultural robot shipments and revenue during the period from 2015 through 2024. The report examines the market opportunities, barriers, and technology issues for each of the key application markets. Market forecasts are segmented by world region and application type. The study also includes 178 profiles of industry players in the agricultural robot market.

Key Market Forecasts

- Agricultural Robot Revenue and Shipments by Region, World Markets: 2015-2024
- Agricultural Robot Revenue by Application Type, World Markets: 2015-2024
- Agricultural Robot Revenue by Application Type, North America: 2015-2024
- Agricultural Robot Revenue by Application Type, Europe: 2015-2024
- Agricultural Robot Revenue by Application Type, Asia Pacific: 2015-2024
- Agricultural Robot Revenue by Application Type, Latin America: 2015-2024
- Agricultural Robot Revenue by Application Type, Middle East and Africa: 2015-2024

Technologies

- Aerial Photography
- All-season Farming
- Aquaculture
- Aquaponics
- Automatic Feeding
- Automatic Milking
- Automation Software
- Autonomous Ground Vehicles
- Cloud-based Data Analytics
- Hydroponics
- Indoor Cultivation
- Navigation and Mapping
- Object Identification
- Remote Sensing
- Robot Navigation
- Unmanned Aerial Vehicles
- V2V Communication
- Vertical Farming

Application Types

- Driverless Tractors
- Unmanned Aerial Vehicles
- Material Management
- Field Crops and Forest Management
- Soil Management
- Dairy Management
- Animal Management

Geographies

- North America
- Europe
- Asia Pacific
- Latin America
- Middle East and Africa
# Table of Contents

1. Executive Summary
   1.1. Introduction
   1.2. Agricultural Robot Market Segmentation
   1.3. Market Dynamics
   1.4. Strategic Recommendations to Market Players
   1.5. Global Market Forecast

2. Market Issues
   2.1. Market Drivers
      2.1.1. Global Population Growth and Food Demand
      2.1.2. The Availability of Farm Workers
      2.1.3. Difficulties and Dangers Involved in Farm Jobs
      2.1.4. Increasing Wages of Hired Farm Workers
      2.1.5. Demand for Automated Applications
         2.1.5.1. Driverless Tractors
         2.1.5.2. Unmanned Aerial Vehicles
         2.1.5.3. Material Management
         2.1.5.4. Field Crops and Forest Management
         2.1.5.5. Soil Management
         2.1.5.6. Dairy Management
         2.1.5.7. Animal Management
      2.1.6. Reshaping, Shrinking, and Abandoned Farmland
      2.1.7. Growing Indoor and Urban Farming
      2.1.8. Climate Change
   2.2. Market Challenges
      2.2.1. Unclear Value Proposition
      2.2.2. Awareness
      2.2.3. Insufficient Solutions and Difficult to Replace
         Human-Like Dexterity
      2.2.4. Fragmented Developments and Poor
         Administrative Support
      2.2.5. Infrastructural Issues
   2.3. Ecosystem Players
      2.3.1. Farm and Industrial Automation Vendors
      2.3.2. Industrial Robot Vendors
      2.3.3. Mobile Robot Vendors
      2.3.4. Sensor Technology Vendors
      2.3.5. Agricultural Research Organizations, Labs

3. Technology Issues
   3.1. Heterogeneity of the Operating Environment
   3.2. Precise Identification and Classification of Targets and
      Obstacles
   3.3. Outdoor Positioning and Navigation Technology
   3.4. Transforming Food Systems and Complex Agricultural
      Practices
   3.5. Safety and Standards
   3.6. Energy Efficiency
   3.7. Farm Layouts and New Robots

4. Key Industry Players
   4.1. Key Industry Players
      4.1.1. AGCO
      4.1.2. AMAZONEN-Werke
      4.1.3. Autonomous Solutions Inc.
      4.1.4. Autonomous Tractor Corporation
      4.1.5. CLAAS
      4.1.6. Clearpath Robotics
      4.1.7. CNH Industrial
      4.1.8. Deepfield Robotics
      4.1.9. DeLaval
      4.1.10. GEA Group
      4.1.11. Harvest Automation
      4.1.12. John Deere
      4.1.13. Kinze Manufacturing
      4.1.14. Kongskilde Industries
      4.1.15. Kubota
      4.1.16. Lely
      4.1.17. Mitsubishi Mahindra Agricultural Machinery
      4.1.18. Panasonic Corporation
      4.1.19. Shibuya Seiki
      4.1.20. Trimble
      4.1.21. Yamaha Motor Company
      4.1.22. Yanmar
   4.2. Emerging Players
      4.2.1. 3D Robotics
      4.2.2. Abundant Robotics
      4.2.3. Adigo AS
      4.2.4. AeroFarms
      4.2.5. AgEagle
      4.2.6. AGERpoint
      4.2.7. AgJunction
      4.2.8. Ag Leader Technology
      4.2.9. Aglytix
      4.2.10. AgNav
      4.2.11. AgPixel
      4.2.12. Agribot
      4.2.13. Agribotix
      4.2.14. Agri-Copter
      4.2.15. Agrobot
      4.2.16. Airinov
      4.2.17. All Drone Solutions
      4.2.18. Arable Labs
      4.2.19. AutoProbe Technologies
      4.2.20. Blue River Technology
      4.2.21. BouMatic Robotics BV
      4.2.22. CARRE
      4.2.23. Ceres Imaging
      4.2.24. Clear Flight Solutions
      4.2.25. Conic System
      4.2.26. Costruzioni Meccaniche Ferrari
      4.2.27. Delair-Tech
      4.2.28. Digital Harvest
      4.2.29. DroneDeploy
      4.2.30. ecoRobotix
      4.2.31. Effidence
      4.2.32. F. Poulsen Engineering
      4.2.33. FarmBot Inc
      4.2.34. Franklin Robotics
      4.2.35. Fullwood LTD
      4.2.36. Gamaya
      4.2.37. Garford Farm Machinery
      4.2.38. Grimme Group
      4.2.39. HADA (Previously KSF)
      4.2.40. HETWIN
      4.2.41. Hi-phen
      4.2.42. Hokofarm Group (previously Insentec)
      4.2.43. Holland Green Machine
      4.2.44. Hortau
      4.2.45. Irmato
      4.2.46. Iron Ox
      4.2.47. ISEKI
      4.2.48. L’Avion Jaune
      4.2.49. Logiqs BV
      4.2.50. Maf Roda
      4.2.51. Mavrx
      4.2.52. Mirai Group
      4.2.53. Motorleaf
      4.2.54. Naïo Technologies
      4.2.55. OnFarm
      4.2.56. Pix4D
4.2.58. Precision Makers
4.2.59. Priva Group
4.2.60. Raussendorf Machine & Equipment
4.2.61. Raven Industries
4.2.62. RoboticsPlus
4.2.63. Robotnik
4.2.64. Rogue Rovers
4.2.65. SAC
4.2.66. senseFly
4.2.67. Shenzhen DJI Innovations
4.2.68. SlantRange
4.2.69. Sorter
4.2.70. SPREAD
4.2.71. SQUSE (Sukyu)
4.2.72. SwarmFarm Robotics
4.2.73. TerrAvion
4.2.74. Trioliet BV
4.2.75. TTA BV
4.2.76. Urban Crops
4.2.77. Vision Robotics
4.2.78. Vi trover SJCS
4.2.79. Wall-Ye

4.3. Other Significant Industry Participants
4.3.1. Aarav Unmanned Systems
4.3.2. Ag Business & Crop Inc.
4.3.3. Agribots
4.3.4. Agrifac Machinery
4.3.5. Agrinetix
4.3.6. Agri Optics
4.3.7. Agrovia
4.3.8. AGX Tecnologia
4.3.9. ALCI Visionics & Robotics
4.3.10. AMS-Galaxy-USA
4.3.11. Aris B.V.
4.3.12. CMW Horticulture
4.3.13. Crop Production Services
4.3.14. Demtech Services Inc.
4.3.15. Deveron UAS
4.3.16. DICKEY-John
4.3.17. EGATEC A/S
4.3.18. Empire Unmanned
4.3.19. Energid Technologies Corporation
4.3.20. Euro.cri (BFR Systems)
4.3.21. Event 38 Unmanned Systems
4.3.22. FF Robotics
4.3.23. Force-A
4.3.24. FT Sistemas
4.3.25. Geo-Konzept
4.3.26. Harvest CROO Robotics
4.3.27. Helper Robotech Co. Ltd. (HRC)
4.3.28. HETO Agrotechnics
4.3.29. HoneyComb Corp.
4.3.30. Hortiplan
4.3.31. HUVR
4.3.32. ISO Group
4.3.33. Landview Technologies Inc.
4.3.34. LD-Agro
4.3.35. Leading Edge Technologies
4.3.36. LemnaTec
4.3.37. Mack Robotics Inc.
4.3.38. Measure
4.3.39. MicaSense
4.3.40. Mid-Tech Services Inc.
4.3.41. Near Earth Autonomy
4.3.42. Pastoral Robotics
4.3.43. Photon Systems Instruments (PSI)
4.3.44. Precision Ag Solutions Company
4.3.45. Qubit Phenomics
4.3.46. Robotic Milking Integration Solutions (RMIS)

4.3.47. Rowbot
4.3.48. Schuitemaker
4.3.49. Sentera
4.3.50. SkySquirrel Technologies
4.3.51. Steketee B.V.
4.3.52. TeeJet Technologies
4.3.53. Tillet and Hague Technology
4.3.54. Transplant Systems
4.3.55. UAV-IQ WineFlight
4.3.56. Urbinati
4.3.57. Valmont Industries Inc.
4.3.58. VineRangers
4.3.59. VineView Scientific Aerial Imaging
4.3.60. Visser Horti Systems
4.3.61. Wilbur-Ellis

4.4. Academic and Research Labs / Programs
4.4.1. Ag Robotics Lab (ARL) at Polytechnic University of Valencia
4.4.2. Australian Centre for Field Robotics (ACFR) at the University of Sydney
4.4.3. Cambridge Consultants
4.4.4. Clever Robots for Crops
4.4.5. Fraunhofer Institute for Manufacturing Engineering and Automation IPA
4.4.6. Fujitsu Laboratories
4.4.7. Georgia Institute of Technology Agricultural Technology Research Program
4.4.8. Hokkaido University Laboratory of Vehicle Robotics (VeBots)
4.4.9. Iowa State University Robotics Laboratory
4.4.10. Irstea
4.4.11. Japanese National Agriculture and Food Research Organization (NARO)
4.4.12. Lincoln University Lincoln Agritech
4.4.13. Queensland University of Technology (QUT) Institute for Future Environments
4.4.14. SmartBot
4.4.15. Wageningen University & Research
4.4.16. Washington State University Center for Precision & Automated Agricultural Systems

5. Market Forecasts
5.1. Definitions and Forecast Assumptions
5.2. Global Market
5.3. North America
5.4. Europe
5.5. Asia Pacific
5.6. Latin America
5.7. Middle East & Africa
5.8. Conclusions and Recommendations

6. Company Directory
7. Acronym and Abbreviation List
8. Table of Contents
9. Table of Charts and Figures
10. Scope of Study, Sources and Methodology, Notes
Tables

- Agricultural Robot Revenue by Region, World Markets: 2015-2024
- Agricultural Robot Revenue by Application Type, World Markets: 2015-2024
- Agricultural Robot Revenue by Region, World Markets: 2015-2024
- Agricultural Robot Shipments by Application Type, World Markets: 2015-2024
- Agricultural Robot Revenue by Application Type, North America: 2015-2024
- Agricultural Robot Shipments by Application Type, North America: 2015-2024
- Agricultural Robot Revenue by Application Type, Europe: 2015-2024
- Agricultural Robot Shipments by Application Type, Europe: 2015-2024
- Agricultural Robot Revenue by Application Type, Asia Pacific: 2015-2024
- Agricultural Robot Shipments by Application Type, Asia Pacific: 2015-2024
- Agricultural Robot Revenue by Application Type, Latin America: 2015-2024
- Agricultural Robot Shipments by Application Type, Latin America: 2015-2024
- Agricultural Robot Revenue by Application Type, Middle East and Africa: 2015-2024
- Agricultural Robot Shipments by Application Type, Middle East and Africa: 2015-2024
- Agricultural Robot Average Selling Price by Application Type, World Markets: 2015-2024

Charts

- Agricultural Robot Revenue and Shipments, World Markets: 2015-2024
- Agricultural Robot Revenue by Application Type, World Markets: 2015-2024
- Agricultural Robot Revenue by Region, World Markets: 2015-2024
- Agricultural Robot Shipments by Region, World Markets: 2015-2024
- Agricultural Robot Revenue by Application Type, World Markets: 2015-2024
- Agricultural Robot Revenue by Application Type, North America: 2015-2024
- Agricultural Robot Shipments by Application Type, North America: 2015-2024
- Agricultural Robot Revenue by Application Type, Europe: 2015-2024
- Agricultural Robot Shipments by Application Type, Europe: 2015-2024
- Agricultural Robot Revenue by Application Type, Asia Pacific: 2015-2024
- Agricultural Robot Shipments by Application Type, Asia Pacific: 2015-2024
- Agricultural Robot Revenue by Application Type, Latin America: 2015-2024
- Agricultural Robot Shipments by Application Type, Latin America: 2015-2024
- Agricultural Robot Revenue by Application Type, Middle East and Africa: 2015-2024
- Agricultural Robot Shipments by Application Type, Middle East and Africa: 2015-2024

Figures

- Agricultural Robot Segmentation
- Global Population Growth: 1950-2050
- Global Urban and Rural Population: 1950-2050
- Fatal Injury Rate by Industry in the United States: 2014
- Hired Workers and Wage Rates in U.S. Agriculture, 2000-2014
- Concept Driverless Tractor
- Agricultural Drone Solution - Agrion (using DJI Phantom)
- Material Handling Robot HV-100
- Sorting and Packing Installations for Fresh Fruit and Vegetables
- Tomato Harvesting Robot
- Multi-Purpose Robotic Platform – BoniRob, QUT’s AgBot II
- Milking Robot - Astronaut, Mione
- Feeding Robot - Triomatic T30, Juno
- Shrinking Arable Land: 1970-2050
- Indoor Vertical Farm
- Impact of Climate Change on Crops
- Project MARS
- Strawberry Picking
- QZSS in Agriculture
- The Food System
- Robot Safety Standards
- Autonomous Vegetable Harvesting Robot, Ladybird Using Solar Panels
- Barn Layout
- Fendt Varioterminal
- Fendt GuideConnect (Unmanned Tractor behind Manned Tractor)
- AmaSpot Sensor Nozzle System
- AmaSpot Sensor Nozzle System: (1) GreenSense Fluorescence Sensor (2) Nozzle Switching via Pulse Width Frequency Modulation
- ASI Mobius Control Software System Showing Action Plan
- ASI Vehicle Automation Kit
- ATC The Spirit Prototype
- AutoDrive and eDrive on Converted John Deere Tractor
- CLAAS CAM PILOT
- GPS Pilot and Guidance System
- Grizzly Robotic Utility Vehicle
- Warthog Amphibious Unmanned Ground Vehicle
- Case IH Magnum Autonomous Concept Tractor
- New Holland T8 NHDrive Autonomous Concept Tractor
- Adaptable Robotic Platform BoniRob
- Deepfield 4D-Scan (Portable Device, Can Also Be Incorporated on BoniRob)
- Voluntary Robotic Milking System
- Automated Rotary Robotic Milking System
- Mione Robotic Milking System
- SRone Manure Scraper
- HV-100
- HV-100 Product Specification
- John Deere Concept Fully Autonomous Cableless Tractor
- TANGO E5 Autonomous Mower
- Kinze Driverless Grain Cart Receiving Corn from a Combine While Keeping Up with Combine
- Kinze Autonomous Grain Harvesting System User Interface
- Vibro Crop Intelli Row Crop Cultivator
- Vibro Crop Robotti
- Kubota M7001 Series
- Kubota Driverless Tractor Prototype
- Lely Astronaut A4 Milking Robot
- Lely Discovery
- Robotic Rice Transplanter Prototype
- Panasonic Tomato-Picking Robot
• Factory Farm in Singapore Built by Panasonic
• Shibuya Seiki Robotic Strawberry Picker
• Shibuya Seiki Tray Conveyor Sorter
• Future Farms
• Trimble Ag Software (Connected Farm)
• GreenSeeker
• Yamaha RMax Remotely Piloted Helicopter
• Yamaha Fazer Remotely Piloted Helicopter
• Yanmar Concept Driverless Tractor YT01
• Yanmar Manned Tractor Controls Driverless Tractor
• 3DR Site Scan
• Autonomous Apple Picker
• Field Flux Robot
• AeroFarms Indoor Vertical Farming
• AgEagle RX60
• GroveTracker Software
• Outback Max Terminal
• SteerCommand Automated Steering
• SolverPod Analytics
• AG-NAV Navigation System
• AgPixel’s Specialty Classification Map
• Agrobot Agrirobot
• Agrobotics FarmLens
• Agri-Copter Drone
• Agrobot Strawberry Harvester 6010
• SenseFly’s eBee Equipped with the multiSPEC 4C
• ROAM System - Remotely Operated Agriculture Mapping
• Arable Labs Lipsepod
• AutoProbe Being Towed
• LettuceBot - Precision Thinning
• Milking Robots MR-S1 and MR-D1
• ANATIS - Fully Autonomous Weeder and Hoeing Device (jointly with Naio)
• Imagery Products from Ceres Imaging
• Robirds
• EMP-300 Automatic Grafting Machine
• Driverless Robotic Transplanter FUTURA
• DT18 Agri Package
• RMax Being Tested
• Drone Deploy Aerial Mapping App
• Row Crop Weeder
• EffiBot
• Robovator, Vision-Based Thermal Weeder
• FarmBot Genesis
• Tertill Solar-Powered Continuous Roving Robot Weeder
• Fullwood M2erlin Robotic Milking System
• Hyperspectral Imaging by Gamaya
• Robocrop InRow Weeder
• Grimme ErgoDrive Control System
• CEROS - Robot Sprayer
• Aramis II Feed Robot
• Phenomobile, Self-Driving Mobile Phenotyping Device
  Developed in Conjunction with INRA, Arvalis, Meca 3D, and Effidence
• Astrea 20.20 Two-Box Milking Robot
• S55 Spray Robot
• Hortau’s WEB-TX4 Field Monitoring Station
• Rombomatic Steps - Clipping, Treating with Rooting Powders, Planting
• Iron Ox Robotic Greenhouse
• ISeki GRF800-U Fully Automated Grafting Robot
• L’Avion Jaune YellowScan
• Logiqs Automatic Transport Vehicle
• Maf Roda Globalscan Grader
• Mavrx Scout
• Mirai Plant Factory Room
• Motorleaf Overview (Hardware and Software)
• Oz Weeding Robot
• Cloud-Based OnFarm Farm Management System
• Pix4D Software Used in Dole’s Pineapple Farm
• PrecisionHawk Four Steps to Information Delivery, Streamlining Data Collection to Analytics
• Precision Makers Greenbot
• Priva Group Kompano Deleaf-line Robot
• Rausendorf Robot CÄSAR
• Raven Industries Slingshot Field Hub
• RoboticsPlus Multipurpose Orchard Robot
• Robotnik Automation VINBOT
• Rogue Rovers FarmDogg
• SAC RDS Futureline MAX
• SenseFly’s eBee SQ Advanced Agricultural Drone
• DJI Agras MG-1 Octocopter
• SlantRange SL2i and SL2p Multispectral Sensors
• ViSort Vision Software System
• SPREAD’s Kameoka Plant
• Automatic Tomato Harvesting Robot
• SwarmFarm SwarmBot
• TerrAvion OverView Software Service
• Triomatic Feeding Robot
• TTA Midi Curve Automatic Transplanters
• Urban Crops FarmFlex Container
• VR Lettuce Thinner
• Solar Powered VITIROVER Vineyard Robot
• Wall-YE Robot Pruning and in Preparation for Harvesting
• Prototype Vinerobot
• Swagbot, Mantis and Shrimp, RIPPA
• Vision-Based Eco-Friendly Sprayer
• Sweet-pepper Harvesting Robot, Apple Harvesting Robot, Close Range Precision Spraying Robot
• Fraunhofer EFFIROB Concept, AgriApps
• Fujitsu Labs Akisai
• Intelligent Cutting and Deboning System
• Unmanned Tractors Running in Orderly Manner, Unmanned Tractor
• Tomato Picking
• Irstea Baudet-Rob and AdAP2E Robot Projects
• NARO’s Rice Planting Robot Using Kubota’s Rice Planter as Base
• Kale Yield Scanner
• QUT AgBot II
• Various AgroBots under SmartBot Project, Goose Buster
• Sweet-pepper Harvesting Robot Sweeper
• Agricultural Robot Market Key Takeaways
Key Questions Addressed

- What is the current state of the agricultural robot market and how will it develop over the next decade?
- What are the key drivers of market growth, and the key challenges faced by the industry?
- What are the major applications for agricultural robots and what are their respective growth profiles?
- What are the technology challenges associated with agricultural robots?
- Who are the important players in the agricultural robot market?
- What is the size of the agricultural robot market opportunity?

Who Needs This Report?

- Agricultural robot manufacturers
- Farm and industrial automation companies
- Mobile and field robot vendors
- Software developers and systems integrators
- Agricultural sensor technology vendors
- Agricultural robot research organizations
- Government agencies
- Investor community

Report Details

<table>
<thead>
<tr>
<th>Price</th>
<th>$4,200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pages</td>
<td>225</td>
</tr>
<tr>
<td>Tables, Charts, and Figures</td>
<td>190</td>
</tr>
<tr>
<td>Publication Date</td>
<td>4Q 2016</td>
</tr>
</tbody>
</table>

To Order This Report:

Phone: +1.303.248.3000
Email: sales@tractica.com