

Agricultural Robots: Market Shares, Strategies, and Forecasts, Worldwide, 2014 to 2020

Mountains of Opportunity



Picture by Susan Eustis

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

Lexington, Massachusetts



CHECK OUT THESE KEY TOPICS

Agricultural Robots: Users Harness Robots to Plow, Plant, Spray, Prune, Milk, Pick, Shear, and Harvest

Agricultural Robots
Automated harvesting systems
Autonomous navigation in the fields
Robotics to automate agricultural operations such as mowing, pruning, seeding, spraying or thinning
Impact of robots in the fields
Innovative hmi for agricultural robotics
Robots in forestry

New standards for agricultural robotics
Uav and rpas for agricultural applications
Cooperative robots in agriculture
Methods for agricultural robots management
Autonomous Plowing
Automatic Harvesting
Adaptive Robots
Reinforcement Learning
Evolution Robotics

Multiple Agents
Robotic Agriculture
Artichoke harvesting
Agricultural robotics
Artificial vision
Outdoor autonomous robot
Energy Harvesting
Wireless Nodes
Microcontroller
Robotic Harvesters
Economies of Scale
Powering Robotic Tractors

Robotic Harvesting: Economies of Scale Provide Growth Strategy

Agricultural Robots: Market Shares, Strategies, and Forecasts, Worldwide, 2014-2020

LEXINGTON, Massachusetts (January 28, 2014) – WinterGreen Research announces that it has published a new study Agricultural Robots Market Shares, Strategy, and Forecasts, Worldwide, 2014 to 2020. The 2014 study has 430 pages, 236 tables and figures. Worldwide markets are poised to achieve significant growth as the agricultural robots are used in every aspect of farming, milking, food production, and animal control to implement automated process for the industry.

Weed control is able to achieve crop-yield increases. Robot technology is deploying machines for weed control, promising to improve crop yields. Robots make the crops safer by eliminating or virtually eliminating herbicides. Downstream processing system solutions and robots achieve automation of process. Robots meet stringent hygiene and safety regulations, work tirelessly 24 hours a day, and relieve human workers of physically arduous tasks. Robots contribute to the freshness, variety and quality of food. Projects are ongoing.

High value crops are a target of agricultural robotic development. What could be tastier than a strawberry, perfectly formed, and perfectly ripened? New agricultural robots are able to improve the delivery of consistent quality food, and to implement efficiency in managing food production.

REPORT # SH25851953	430 PAGES	236 TABLES AND FIGURES	2014
\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING			

WinterGreen Research, INC.

Strawberries are a high profit crop. A new generation of machines has just been born. Strawberry Harvesters with the world's most advanced technology to give maximum performance to a farm. Harvesting robots can optimize the productivity of the farming business. Growers can get the best results in a berry farm using automated process. Automated picking collection systems improve labor productivity, give speed and agility to harvest operations.

The robotic platforms are capable of site-specific spraying. This is targeted spraying only on foliage and selected targets. It can be used for selective harvesting of fruit. The robots detect the fruit, sense its ripeness, then move to grasp and softly detach only ripe fruit.

Agricultural robots address automation of process for agribusiness. The challenge being addressed is to guide farmers towards a new economic model. The aim is to meet demands of a global market. Harvesting is one benefit. Crop-yield increases come from weed control. Robot technology is deploying its machines for weed control, promising to improve crop yields. Robots make the crops safer by eliminating or virtually eliminating herbicides.

Machinery manufacturers and downstream processing industries look for system solutions and robots to achieve automation of process. Robots meet stringent hygiene and safety regulations, work tirelessly 24 hours a day, and relieve human workers of physically arduous tasks. Robots contribute to the freshness, variety and quality of food.

According to Susan Eustis, principal author of the market research study, "Agricultural robotic projects are ongoing. The key to industrial farm robots is keeping costs down. Adapting existing commercial vehicles instead of building new ones is the best way to build viable agricultural robots."

Agricultural robot market size at \$817 million in 2013 are anticipated to reach \$16.3 billion by 2020, a hefty growth for a nascent market. Agricultural robots are but part of an overall trend toward more automated process for every type of human endeavor. Robots are being used more widely than expected in a variety of sectors, and the trend is likely to continue with robotics becoming as ubiquitous as computer technology over the next 15 years.

WinterGreen Research is an independent research organization funded by the sale of market research studies all over the world and by the implementation of ROI models that are used to calculate the total cost of ownership of equipment, services, and software. The company has 35 distributors worldwide, including Global Information Info Shop, Market Research.com, Research and Markets, Electronics.CA, Bloomberg, and Thompson Financial.

WinterGreen Research is positioned to help customers face challenges that define the modern enterprises. The increasingly global nature of science, technology and engineering is a reflection of the implementation of the globally integrated enterprise. Customers trust WinterGreen Research to work alongside them to ensure the success of the participation in a particular market segment.

WinterGreen Research supports various market segment programs; provides trusted technical services to the marketing departments. It carries out accurate market share and forecast analysis services for a range of commercial and government customers globally. These are all vital market research support solutions requiring trust and integrity.

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

Companies Profiled

Market Leaders

**Lely
Yaskawa / Motoman
Yamaha
Kuka**

Market Participants

ABB Robotics	Harvard Robobee	Ossian Agro Automation /
Agile Planet	Harvest Automation	Nano Ganesh
AgRA: RAS Agricultural	IBM	Precise Path Robotics
Robotics and Automation	iRobot	Robotic Harvesting
Agrobot	Jaybridge Robotics	Sicily Tractor Harvesting
Australian Centre for Field	KumoTek	Shibuya Seiki
Robotics	Kyoto University	Shibuya Kogyo
Blue River Technology	Millennial Net	Universidad Politécnic de
Blue River / Khosla Ventures	NARO, a Japanese	Madrid
CNH Industrial / Fiat / Case IH	Incorporated Administrative	University of California, Davis
cRops 312	Agency	Wall-Ye V.I.N. Robot
Fanuc	National Agriculture and Food	Yamaha
Georgia Tech Agricultural	Research Organization	Yaskawa / Motoman
Robots	Japanese National Agriculture	Agricultural Robotic Research
Google / Boston Dynamics	and Food Research	Labs
Google / Motorola	Organization	

**Agricultural Robots: Market Shares, Strategies, and Forecasts,
Worldwide, 2014 to 2020**

Report Methodology

This is the 585th report in a series of primary market research reports that provide forecasts in communications, telecommunications, the Internet, computer, software, telephone equipment, health equipment, and energy. Automated process and significant growth potential are priorities in topic selection. The project leaders take direct responsibility for writing and preparing each report. They have significant experience preparing industry studies. Forecasts are based on primary research and proprietary data bases.

The primary research is conducted by talking to customers, distributors and companies. The survey data is not enough to make accurate assessment of market size, so WinterGreen Research looks at the value of shipments and the average price to achieve market assessments. Our track record in achieving accuracy is unsurpassed in the industry. We are known for being able to develop accurate market shares and projections. This is our specialty.

The analyst process is concentrated on getting good market numbers. This process involves looking at the markets from several different perspectives, including vendor shipments. The interview process is an essential aspect as well. We do have a lot of granular analysis of the different shipments by vendor in the study and addenda prepared after the study was published if that is appropriate.

Forecasts reflect analysis of the market trends in the segment and related segments. Unit and dollar shipments are analyzed through consideration of dollar volume of each market participant in the segment. Installed base analysis and unit analysis is based on interviews and an information search. Market share analysis includes conversations with key customers of products, industry segment leaders, marketing directors, distributors, leading market participants, opinion leaders, and companies seeking to develop measurable market share.

Over 200 in depth interviews are conducted for each report with a broad range of key participants and industry leaders in the market segment. We establish accurate market forecasts based on economic and market conditions as a base. Use input/output ratios, flow charts, and other economic methods to quantify data. Use in-house analysts who meet stringent quality standards.

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

Interviewing key industry participants, experts and end-users is a central part of the study. Our research includes access to large proprietary databases. Literature search includes analysis of trade publications, government reports, and corporate literature.

Findings and conclusions of this report are based on information gathered from industry sources, including manufacturers, distributors, partners, opinion leaders, and users. Interview data was combined with information gathered through an extensive review of internet and printed sources such as trade publications, trade associations, company literature, and online databases. The projections contained in this report are checked from top down and bottom up analysis to be sure there is congruence from that perspective.

The base year for analysis and projection is 2010. With 2010 and several years prior to that as a baseline, market projections were developed for 2011 through 2017. These projections are based on a combination of a consensus among the opinion leader contacts interviewed combined with understanding of the key market drivers and their impact from a historical and analytical perspective. The analytical methodologies used to generate the market estimates are based on penetration analyses, similar market analyses, and delta calculations to supplement independent and dependent variable analysis. All analyses are displaying selected descriptions of products and services.

This research includes reference to an ROI model that is part of a series that provides IT systems financial planners access to information that supports analysis of all the numbers that impact management of a product launch or large and complex data center. The methodology used in the models relates to having a sophisticated analytical technique for understanding the impact of workload on processor consumption and cost.

WinterGreen Research has looked at the metrics and independent research to develop assumptions that reflect the actual anticipated usage and cost of systems. Comparative analyses reflect the input of these values into models.

The variables and assumptions provided in the market research study and the ROI models are based on extensive experience in providing research to large enterprise organizations and data centers. The ROI models have lists of servers from different manufacturers, Systems z models from IBM, and labor costs by category around the world. This information has been developed from WinterGreen research proprietary data bases constructed as a result of preparing market research studies that address the software, energy, healthcare, telecommunications, and hardware businesses.

YOU MUST HAVE THIS STUDY

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

**Agricultural Robots: Market Shares, Strategies, and Forecasts, Worldwide,
2014-2020**

Table of Contents

Agricultural Robots devices create efficiency for farmers from automated process that can be used to manage repetitive processes including milking, seeding, harvesting, pruning. The systems have become very sophisticated in the manner in which they use sensors and cameras to leverage cognitive computing decision making software systems. Technologies that make Agricultural Robots feasible are closely associated with new materials for tractor building and with smaller, lighter, more feature loaded electronics and sensors for steering and for decision making.

Agricultural Robots Market Shares, Strategies, and Forecasts, Worldwide, 2014-2020

Table of Contents

Agricultural Robots Executive Summary

The study is designed to give a comprehensive overview of the Agricultural Robots equipment market segment. Research represents a selection from the mountains of data available of the most relevant and cogent market materials, with selections made by the most senior analysts. Commentary on every aspect of the market from independent analysts creates an independent perspective in the evaluation of the market. In this manner the study presents a comprehensive overview of what is going on in this market, assisting managers with designing market strategies likely to succeed.

AGRICULTURAL ROBOT MARKET EXECUTIVE SUMMARY	29
Agricultural Robot Market Driving Forces	29
Agricultural Robot Target Markets	32
Robotic Agriculture Trends	33
Agricultural Robot Market Shares	37
Agricultural Robot Market Forecasts	40

Agricultural Robots Market Description and Market Dynamics

1. MARKET AGRICULTURAL ROBOT DESCRIPTION AND MARKET DYNAMICS	43
1.1 Agricultural Markets	43
1.1.1 Automation Potential In The Agricultural Industry	44
1.1.2 Robots Find A Place in the Agriculture Industry	45
1.1.3 Agricultural Robots Make Production More Efficient	46

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

1.1.4	Use Of Industrial Robots for Agriculture	47
1.1.5	Agricultural Robotics and Automation	47
1.2	RAS Agricultural Robotics and Automation (AgRA) Technical Committee	49
1.3	Farm Bots Pick, Plant and Drive	51
1.3.1	Relying On Illegal Immigrants Can Be A Legal Liability	51
1.4	Nursery & Greenhouse Sector	52
1.4.1	Harvest Automation Labor Process Automation	52
1.4.2	The Growing Season Is Also The Shipping Season	53
1.5	Improving Nursery Efficiency	54
1.5.1	Small Mobile Robot for Plants and Shrubs	54
1.6	Agricultural Producers Seek To Improve Operations	55
1.6.1	Increasing Cows Days Of Grazing	57
1.7	cRops (Clever Robots for Crops) Robots To Harvest High Value Crops	60
1.8	European Union Seventh Framework Program	61
1.9	Strawberries	62
1.9.1	Strawberries in the US	62
1.10	Transformational Agricultural Robots	64

Agricultural Robots Market Shares and Market Forecasts

This section selectively describes market shares, forecasts, segments, and regional revenue. Numbers are the result of primary research in all cases. Selected companies are described from an independent analyst perspective with a thumbnail sketch or analysis of their market numbers or commentary on their strengths and weaknesses. Some of the analysis is focused on looking at the topic segment by segment, including company descriptive analyses by segment and subsegment.

2	AGRICULTURAL ROBOTS MARKET SHARE AND	
MARKET FORECASTS		66
2.1	Agricultural Robot Market Driving Forces	66
2.1.1	Agricultural Robot Target Markets	69
2.1.2	Robotic Agriculture Trends	70
2.2	Agricultural Robot Market Shares	74
2.2.1	Lely Group Revenue	77
2.2.2	Use Of Standard Industrial Robots In Agriculture	78
2.2.3	Kuka	78
2.2.4	Fanuc	79
2.2.5	Agrobot High Value Crop Robotic Automation	80
2.2.6	John Deere Autonomous Tractors	80
2.2.7	Harvest Automation	82
2.2.8	Vision Robotics	82
2.3	Agricultural Robot Market Forecasts	82
2.3.1	Agricultural Robot Market Segments	86
2.3.2	Agricultural Robotics Key Economic Enabler	88
2.3.3	High Value Fruit Crops: Strawberries	90
2.3.4	Nursery And Garden Products	91
2.3.5	Ornamental Plant Markets	91
2.3.6	Golf courses Robotic Mowing	92
2.3.7	Crop Dusting With Remote-Controlled Helicopters	92
2.3.8	Distributed Robotics Garden	96
2.3.9	Cultibotics	97
2.3.10	Agricultural Robot Vision Pruning Systems	99

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

2.4	Agricultural Robot Pricing	99
2.4.1	Harvest Automation	100
2.4.2	Shibuya Seiko Co. Strawberry Picking Robot	100
2.4.3	Wall-Ye V.I.N. Robot Functions	100
2.4.4	iRobot Automated Lawn Mowing	100
2.5	Agricultural Robots TCO / ROI	102
2.5.1	Cost Structures and Roles of Agricultural Robots	106
2.6	Agricultural Robot Regional Analysis	106
2.6.1	Production of Agricultural Robotics in China	108
2.6.2	Chinese Agricultural Machinery	109
2.6.3	Agricultural Robots in Africa	109

Agricultural Robots Product Description

This section describes selected companies and selected products. Products for this market segment are described with attention to the most significant aspect of features and functions in this category of product. The juxtaposition of a range of different product descriptions from a single market category provides a really good way to access market directions and achieve market competitive analysis. This section is arranged in three pieces: immersive products, conference room products, and end point products. Company products are described in the appropriate sections, meaning a company is mentioned several times in the chapter in different places.

3	AGRICULTURAL ROBOTS PRODUCT DESCRIPTION	113
3.1	John Deere Autonomous Tractor	113
3.1.1	John Deere Crop Spraying	115
3.2	Kuka	116
3.2.1	Kuka Robots in the Agricultural Industry	118
3.2.2	Kuka Robots in the Food Processing Industry	119
3.2.3	Kuka Automation in Agriculture	121
3.3	FANUC	124
3.3.1	Fanuc Vegetable Sorting Robot	124
3.3.2	FANUC Robodrill DiA5 Series	126
3.4	ABB Robots	128
3.4.1	ABB Symphony Plus	128
3.5	Yaskawa	130
3.5.1	Yaskawa Industrial AC Drives 1/8 thru 1750 Horsepower	132
3.5.2	Yaskawa Specialty Pump Drives 3/4 thru 500 Horsepower	133
3.5.3	Yaskawa Servo Systems and Motion Controllers	133
3.5.4	Motoman Robot Handling and Palletizing Bags of Livestock Feed	134
3.5.5	Motoman Agriculture Robotics Palletizing Bags Solution	135
3.5.6	Motoman Robotics Agricultural Robot Palletizing	
	Bags Fixtures / Tooling Details	136
3.5.7	Motoman Agricultural Grain Bin Dryer Fan Wheels	137
3.5.8	Motoman Robotics Fixtures/Tooling Details	140
3.5.9	Motoman Agricultural Irrigation Pipe	140
3.5.10	Motoman Robotics Fixtures/Tooling Details	143
3.5.11	Motoman Agricultural Equipment	143
3.5.12	Motoman Robotics Fixtures/Tooling Details	147
3.5.13	Motoman Round Baler Pickup Frames for Agricultural Equipment	147
3.5.14	Motoman Robotics Fixtures/Tooling Details	150
3.5.15	Motoman Skid Steer Loader Mount Plates	150
3.5.16	Motoman Bags of Livestock Feed	153

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

3.5.17	Motoman Robotics Fixtures/Tooling Details	156
3.6	Harvest Automation	156
3.6.1	Harvest Automation Technology	161
3.6.2	Harvest Automation Behavior-Based Robotics	161
3.7	Robotic Harvesting	161
3.7.1	Robotic Harvesting Strawberry Harvester	162
3.8	Agrobot SW 6010	163
3.8.1	Agrobot AGB: Harvesting High Level System	165
3.8.2	Agrobot AG Vision	166
3.9	Blue River Technology	167
3.9.1	Blue River Precision Lettuce Thinning - 40/42" Beds	169
3.9.2	Blue River Precision Lettuce Thinning - 80/84" Beds	171
3.9.3	Lettuce Bot, Blue River Technology	172
3.10	cRops (Clever Robot for Crops)	172
3.10.1	cRops European Project, Made Up Of Universities And Labs	174
3.11	Jaybridge Robotics Agriculture	177
3.11.1	Jaybridge Robotics Kinze Partnering, Autonomous Vehicle Row Crop Harvesting	178
3.11.2	Jaybridge Software Expertise	179
3.12	Nano Ganesh	180
3.13	Aqua Spy	180
3.14	8 Villages	180
3.15	IBM / Bari Fishing Market App	181
3.16	M Farm	184
3.17	Sustainable Harvest	185
3.18	Tractor Harvesting	185
3.19	Spensa Technology Pest Control	187
3.20	The Pebble Watch	187
3.21	Louisiana State University AgBot	188
3.21.1	AgBot Uses Autonomous, Advanced GPS System	189
3.21.2	Agbot Small Robots Versatility	189
3.21.3	Delivery Robot	190
3.22	Harvard Robobee	190
3.22.1	Harvard Robobee Practical Applications	191
3.22.2	Harvard Robobee Vision and Aims	191
3.22.3	Harvard Robobee Body, Brain, and Colony	193
3.22.4	Harvard Robobee Body	193
3.22.5	Harvard Robobee Flexible Insect Wings And Flight	
	Stability In Turbulent Airflow	196
3.22.6	Harvard Robobee Sensor Networks	197
3.22.7	Harvard Robobee Colony	200
3.22.8	Harvard Robobee Sensor Network Development	201
3.23	iRobot's Automatic Lawn Mower	208
3.24	MIT Autonomous Gardener Equipment Mounted On The Base of a Roomba	210
3.25	Carnegie Mellon University's National Robotics Engineering Center	212
3.25.1	Carnegie Mellon. Self-Guided Farm Equipment	213
3.26	Cesar the LettuceBot	215
3.27	Universidad Politécnic de Madrid Rosphere	216
3.27.1	Rosphere Spherical Shaped Robot	217
3.28	Shibuya Seiko Co.	219
3.28.1	Shibuya Seiko Co. Strawberry Picking Robot	219
3.28.2	Shibuya Seiko Robot Can Pick Strawberry Fields	219
3.29	University of California, Davis Robots For Harvesting Strawberries	220
3.30	Wall-Ye V.I.N. Robot	222
3.30.1	Wall-Ye V.I.N. Robot Functions	222

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

3.30.2	Wall-Ye V.I.N. Robot Security System	225
3.30.3	Wall-Ye V.I.N. Robot Prunes 600 Vines Per Day	225
3.31	Vision Robotics	226
3.31.1	Vision Robotics Automated Tractors	227
3.32	Nogchui Autonomous Tractor	228
3.32.1	Professor Nogchui Agricultural Tractor Robot Uses Navigation Sensor Called AGI-3 GPS Compass Made by TOPCON	232
3.32.2	Professor Nogchui Agricultural Tractor Robot Mapping System	232
3.32.3	Nogchui Autonomous Tractor Robot Management Systems	233
3.33	Microsoft Agricultural Robot Software	234
3.34	Australian Centre for Field Robotics Herder Robot	235
3.34.1	Robotic Rover Herds Cows	236
3.35	Chinese Agricultural Robots	237
3.36	Oracle Robot	239
3.37	3D Robotics	239
3.38	Lely Automatic Milking Robots	245
3.38.1	Lely Astronaut Milking Robots	245
3.38.2	Lely Concept and Management	247
3.38.3	Lely Correct Feed Management	247
3.38.4	Lely Milk Robots At Large Dairy Farms	248
3.38.5	Lely Free Cow Traffic	255
3.39	Kyoto University Tomato Harvesting Robot	257
3.40	Yamaha Crop Dusting Drones	261
3.41	RHEA Robot Fleets for Accuracy	262
3.41.1	RHEA Synchronized Weeding	266
3.41.2	Synchronized Spraying	270
3.42	Precise Path Robotics	275

Agricultural Robots Technology

4. AGRICULTURAL ROBOTS TECHNOLOGY	4-1
4.1 Harvest Automation Proprietary Sensor Technology	277
4.1.1 Harvest Automation Robot System Architecture	278
4.1.2 Harvest Automation Technology	278
4.1.3 Behavior-Based Robotics	279
4.1.4 Proprietary Sensor Technology	279
4.1.5 System Design & Architecture	280
4.2 Welding Robots	280
4.3 Material Handling Robots:	281
4.4 Plasma Cutting Robots:	281
4.5 Agricultural Robotics and Automation Scope:	282
4.5.1 IEEE Standards Initiatives	285
4.5.2 Delft Robotics Institute	285
4.6 Robotics and Automation	287
4.7 An Electronic System Improves Different Agriculture Processes	290

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

Agricultural Robots Company Profiles

This section selectively describes company strategies, partners, acquisitions, and revenue by segment and regional revenue when available. Companies are described by looking at what is most interesting about that company. The descriptions collectively give a sense of market directions within the industry segment. The alphabetical listing of company thumbnail sketches provides an accessible way to find out what is going on in any particular company.

5	AGRICULTURAL ROBOTS COMPANY DESCRIPTION	291
5.1	ABB Robotics	291
5.1.1	ABB Revenue	292
5.1.2	ABB Strategy	293
5.1.3	ABB Global Leader In Power And Automation Technologies	293
5.1.4	ABB and IO Deliver Direct Current-Powered Data Center Module	294
5.1.5	ABB / Validus DC Systems DC Power Infrastructure Equipment	295
5.1.6	ABB Technology	296
5.1.7	ABB Global Lab Power	297
5.1.8	ABB Global Lab Automation	298
5.2	Agile Planet	300
5.3	AgRA: RAS Agricultural Robotics and Automation (AgRA)	301
5.4	Agrobot	302
5.4.1	Agrobot Innovation and Technology for Agribusiness	304
5.5	Astronaut	307
5.6	Australian Centre for Field Robotics	307
5.7	Blue River Technology	308
5.7.1	Blue River / Khosla Ventures	309
5.8	CNH Industrial / Fiat / Case IH	310
5.8.1	Case IH Customers Work Directly With Design Engineers	311
5.9	cRops	312
5.10	Fanuc	316
5.10.1	FANUC Corporation	317
5.10.2	Fanuc Revenue	318
5.11	Georgia Tech Agricultural Robots	319
5.12	Google	321
5.12.1	Google / Boston Dynamics	322
5.12.2	Boston Dynamics LS3 - Legged Squad Support Systems	323
5.12.3	Boston Dynamics CHEETAH - Fastest Legged Robot	325
5.12.4	Boston Dynamics Atlas - The Agile Anthropomorphic Robot	326
5.12.5	Boston Dynamics BigDog	328
5.12.6	Boston Dynamics LittleDog - The Legged Locomotion Learning Robot	329
5.12.7	Google Robotic Division	331
5.12.8	Google Self-Driving Car	331
5.12.9	Google Cars Address Vast Majority Of Vehicle Accidents Due To Human Error	333
5.12.10	Google Business	333
5.12.11	Google Corporate Highlights	334
5.12.12	Google Search	335
5.12.13	Google Revenue	337
5.12.14	Google Second Quarter 2013 Results	337
5.12.15	Google Revenues by Segment and Geography	340
5.12.16	Google / Motorola Headcount	341
5.12.17	Google / Motorola	341

WinterGreen Research, INC.

5.13	Harvard Robobee	343
5.13.1	Harvard Robobee Funding	343
5.13.2	Harvard Robobee Main Area Of Research	344
5.13.3	Harvard Robobee OptRAD is used as an Optimizing Reaction-Advection-Diffusion system.	345
5.13.4	Harvard Robobee The Team	346
5.14	Harvest Automation	347
5.14.1	Harvest Automation Ornamental Horticulture	347
5.14.2	Harvest Automation M Series C Financing	348
5.14.3	Harvest Robotic Solutions For The Agricultural Market	349
5.14.4	Harvest Automation Robots	349
5.15	IBM	352
5.15.1	IBM Strategy	352
5.15.2	IBM Business Partners	354
5.15.3	IBM Messaging Extension for Web Application Pattern	355
5.15.4	IBM MobileFirst	356
5.15.5	IBM Business Analytics and Optimization Strategy	357
5.15.6	IBM Growth Market Initiatives	357
5.15.7	IBM Business Analytics and Optimization	357
5.15.8	IBM Strategy	358
5.15.9	IBM Smarter Planet	359
5.15.10	IBM Cloud Computing	361
5.15.11	IBM Business Model	361
5.15.12	IBM Business Revenue Segments And Capabilities	362
5.16	iRobot	369
5.16.1	iRobot Home Robots:	370
5.16.2	iRobot Defense and Security: Protecting Those in Harm's Way	370
5.16.3	iRobot Role In The Robot Industry	371
5.16.4	iRobot SPARK (Starter Programs for the Advancement of Robotics Knowledge)	371
5.16.5	iRobot Revenue	372
5.16.6	iRobot Acquires Evolution Robotics, Inc.	372
5.16.7	iRobot / Evolution Robotics	374
5.17	Jaybridge Robotics	374
5.17.1	Jaybridge Robotics Software Solutions	374
5.17.2	Jaybridge Systems Integration for Autonomous Vehicles	376
5.17.3	Jaybridge Robotics Rigorous Quality Processes	376
5.17.4	Jaybridge Robotics Professional, Experienced Team	376
5.17.5	Jaybridge Robotics Seamless Working Relationship with Client Teams	377
5.18	Kuka	377
5.18.1	Kuka Revenue	378
5.18.2	Kuka Competition	378
5.18.3	Kuka Innovative Technology	379
5.18.4	Kuka Well Positioned With A Broad Product Portfolio In Markets With Attractive Growth Prospects	379
5.18.5	Kuka Strategy	380
5.18.6	Kuka Corporate Policy	381
5.19	KumoTek	383
5.19.1	KumoTek Robotics Software Specialists	384
5.20	Kyoto University	384
5.21	Lely	385
5.21.1	Lely Group Business Concepts	387
5.21.2	Lely Group Revenue	388
5.22	Millennial Net	388
5.22.1	Millennial Net Wireless Sensor Network:	389
5.22.2	Millennial Net 1000-Node MeshScape GO Wireless Sensor Network (WSN) Agricultural Sensors	390

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

5.22.3	Millennial Net's MeshScape GO WSN Technology	391
5.23	National Agriculture and Food Research Organization	392
5.23.1	NARO, a Japanese Incorporated Administrative Agency	393
5.23.2	National Agriculture and Food Research Organization (NARO) third mid-term plan (from 2011 to 2015)	394
5.23.3	National Agriculture and Food Research Organization Stable Food Supply	395
5.23.4	National Agriculture and Food Research Organization Development For Global-Scale Issues And Climate Change	396
5.23.5	National Agriculture and Food Research Organization Development To Create Demand For New Food Products	396
5.23.6	National Agriculture and Food Research Organization Development For Utilizing Local Agricultural Resources	397
5.23.7	Japanese National Agriculture and Food Research Organization	397
5.24	Ossian Agro Automation / Nano Ganesh	398
5.25	Precise Path Robotics	401
5.26	Robotic Harvesting	402
5.27	Sicily Tractor Harvesting	403
5.28	Shibuya Seiki	405
5.28.1	Shibuya Kogyo Pharmaceutical Application Examples	406
5.28.2	Shibuya Kogyo Robotic System For Handling Soft Infusion Bags	407
5.28.3	Shibuya Kogyo Robotic Cell Culture System "CellPRO"	407
5.28.4	Shibuya Kogyo Robotic System For Leaflet & Spoon Placement	408
5.28.5	Shibuya Kogyo Robotic Collating System	409
5.28.6	Shibuya Kogyo Automated Aseptic Environmental Monitoring System	410
5.29	Universidad Politécnic de Madrid	411
5.30	University of California, Davis	412
5.31	Wall-Ye V.I.N. Robot	412
5.32	Yamaha	412
5.33	Yaskawa	416
5.33.1	Yaskawa Revenue	416
5.33.2	Yaskawa Business	417
5.33.3	YASKAWA Electric Motion Control	418
5.33.4	YASKAWA Electric Robotics	419
5.33.5	YASKAWA Electric System Engineering	419
5.33.6	YASKAWA Electric Information Technology	419
5.33.7	Yaskawa / Motoman	419
5.34	Agricultural Robotic Research Labs	420
5.34.1	Outdated links	421
5.34.2	Agricultural Robotic Companies	422
5.34.3	IEEE Agricultural Technical Committee	422
5.34.4	Agricultural Robotic Conferences	422
5.34.5	Agricultural Robotic Publications	423
5.34.6	Selected VC Funding In Robotics	423
	WINTERGREEN RESEARCH,	426
	WinterGreen Research Research Methodology	427

List of Tables and Figures

Agricultural Robots Executive Summary

Figure ES-1	29
Agrobot Strawberry Picker	29
Table ES-2	31

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

Agricultural Robot Market Driving Forces	31
Table ES-3	32
Agricultural Robot Target Markets	32
Table ES-4	34
Robotic Agricultural Trends	34
Table ES-5	35
Agriculture Robotic Activities	35
Table ES-6	36
Market Forces for Agricultural Modernization	36
Table ES-7	36
Robotics – State of the Art Advantages	36
Table ES-8	37
Agricultural Robot Challenges	37
Figure ES-9	39
Agricultural Robot Market Shares, Dollars, Worldwide, 2013	39
Figure ES-10	41
Agricultural Robot Market Forecasts Dollars, Worldwide, 2014-2020	41

Agricultural Robots Market Description and Market Dynamics

Table 1-1	44
Aspects of Agricultural Sector Modernization	44
Figure 1-2	48
Agricultural Robotics Positioned To Meet The Increasing Demands For Food And Bioenergy	48
Source: John Deere.	48
Figure 1-3	49
Autonomous Orchard Vehicle	49
Figure 1-4	50
Automated Picker Machine	50
Table 1-5	53
Nursery Robot Benefits	53
Figure 1-6	58
Cows Grazing	58
Figure 1-7	60
European Union Seventh Framework Program cRops (Clever Robots for Crops) Focus On Harvesting High Value Crops	60
Figure 1-8	64
Transformational Agricultural Robots	64

Agricultural Robots Market Shares and Market Forecasts

Figure 2-1	66
Agrobot Strawberry Picker	66
Table 2-2	68
Agricultural Robot Market Driving Forces	68
Table 2-3	69
Agricultural Robot Target Markets	69
Table 2-4	71
Robotic Agricultural Trends	71
Table 2-5	72

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

Agriculture Robotic Activities	72
Table 2-6	73
Market Forces for Agricultural Modernization	73
Table 2-7	73
Robotics – State of the Art Advantages	73
Table 2-8	74
Agricultural Robot Challenges	74
Figure 2-9	76
Agricultural Robot Market Shares, Dollars, Worldwide, 2013	76
Table 2-10	77
Agricultural Robot Market Shares, Dollars, Worldwide, 2013	77
Figure 2-11	80
Agrobot Strawberry Picker	80
Figure 2-12	81
John Deere Autonomous Tractors	81
Figure 2-13	84
Agricultural Robot Market Forecasts Dollars, Worldwide, 2014-2020	84
Table 2-14	84
Agricultural Robot Market Forecast, Shipments, Dollars, Worldwide, 2014-2020	85
Table 2-15	86
Agricultural Robot Market Industry Segments, Cow Milking and Barn Systems, Strawberries and High Value Crops, Wheat, Rice, Corn Harvesting, Grape Pruning and Harvesting, Nursery Management, Golf Course and Lawn Mowing, Drone Crop Dusting Segments, Dollars, Worldwide, 2014-2020	86
Table 2-16	87
Agricultural Robot Market Industry Segments, Cow Milking and Barn Systems, Strawberries and High Value Crops, Wheat, Rice, Corn Harvesting, Grape Pruning and Harvesting, Nursery Management, Golf Course and Lawn Mowing, Drone Crop Dusting Segments, Percent , Worldwide, 2014-2020	87
Figure 2-17	89
Multiple Small Intelligent Machines Replace Large Manned Tractors	89
	
Table 2-18	89
Agricultural Robots for Ornamental Plant Handling Benefits	91
Figure 2-19	91
UC Davis Using Yamaha Helicopter Drones For Crop Dusting	92
Figure 2-20	94
Yamaha Crop Duster	94
Figure 2-21	96
Distributed Robotics Garden	96
Figure 2-22	98
Modernized Agriculture Telegarden, As Installed At Ars Electronica	98
Table 2-23	102
Voluntary Cow Traffic Benefits	102

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

Table 2-24	103
Cow Traffic System Cubicles ROI Metrics	103
Table 2-25	104
Lely Example of Herd Size and Robots / Farm Worker	104
Table 2-26	105
Roles of Agricultural Robots	105
Figure 2-27	106
Cost Structures and Roles of Agricultural Robots	106
Figure 2-28	107
Agricultural Robotic Regional Market Segments, 2013	107
Table 2-29	108
Agricultural Robot Regional Market Segments, 2013	108

Agricultural Robots Product Description

Figure 3-1	113
John Deere Autonomous Tractors	113
Figure 3-2	114
John Deere Autonomous Tractor Flexible Uses	114
Figure 3-3	115
John Deere Crop Spraying	115
Figure 3-4	116
Kuka Agricultural Robots	116
Figure 3-5	116
Kuka Material Handling Robots	116
Figure 3-6	117
Kuka Industry Standard Robots Used in Agriculture	117
Figure 3-7	118
Kuka Welding Robots in the Agricultural Industry	118
Figure 3-8	119
Kuka Robots in the Agricultural Industry	119
Figure 3-9	120
Kuka Robots in the Food Processing Industry	120
Figure 3-10	122
Kuka Agricultural Robots	122
Figure 3-11	124
Kuka Plasma Cutting Robot	124
Figure 3-12	125
Fanuc M-3iA Robots Sorting Boxes	125
Figure 3-13	126
FANUC Robodrill DiA5 Series	126
Figure 3-14	127
FANUC Welding Robots	127
Figure 3-15	127
FANUC Material Handling Robots	127
Figure 3-16	128
FANUC Plasma Cutting Robot	128
Figure 3-17	129
ABB Welding Robots	129
Figure 3-18	129
ABB Material Handling Robots	129
Figure 3-19	130

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

Yaskawa Plasma Cutting Robot	130
Figure 3-20	131
Yaskawa Robots Used in Agriculture	131
Figure 3-21	132
Yaskawa Industrial AC Drives 1/8 thru 1750 Horsepower	132
Figure 3-22	133
Yaskawa Specialty Pump Drives 3/4 thru 500 Horsepower	133
Figure 3-23	134
Motoman Robot Handling and Palletizing Bags of Livestock Feed	134
Table 3-24	135
Motoman Robot Handling and Palletizing Bags of Livestock Feed Project Challenges	135
Table 3-25	136
Motoman Agriculture Robotics Palletizing Bags Solution	136
Table 3-26	138
Motoman Agricultural Grain Bin Dryer Fan Wheels Project Challenges	138
Table 3- 27	139
Motoman Agricultural Grain Bin Dryer Fan Wheels Robotics Solution	139
Figure 3-28	140
Motoman Agricultural Irrigation Pipe	140
Table 3-29	141
Motoman Agricultural Irrigation Pipe Project Challenges	141
Table 3-30	142
Motoman Agricultural Irrigation Pipe Robotics Solution	142
Figure 3-31	143
Motoman Agricultural Equipment	143
Table 3-32	145
Motoman Agricultural Equipment Project Challenges	145
Table 3-33	146
Motoman Agricultural Equipment Robotics Solution	146
Figure 3-34	147
Motoman Round Baler Pickup Frames for Agricultural Equipment	147
Table 3-35	148
Motoman Round Baler Pickup Frames for Agricultural Equipment Project Challenges	148
Table 3-36	149
Motoman Round Baler Pickup Frames for Agricultural Equipment Robotics Solution	149
Figure 3-37	150
Motoman Skid Steer Loader Mount Plates	150
Table 3-38	151
Motoman Skid Steer Loader Mount Plates Project Challenges	151
Table 3-39	152
Motoman Skid Steer Loader Mount Plates Robotics Solution	152
Figure 3-40	153
Motoman Bags of Livestock Feed	153
Table 3-41	154
Motoman Bags of Livestock Feed Project Challenges	154
Table 3-42	155
Motoman Bags of Livestock Feed Robotics Solution	155
Figure 3-43	157
Harvest Automation Shrub Robot	157
Figure 3-44	158

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

Harvest Automation Shrub Robot In Garden	158
Figure 3-45	159
Harvest Automation Robot Provides Marketplace Sustainability	159
Table 3-46	160
Harvest Automation Shrub Robot Features:	160
Table 3-47	160
Harvest Automation Shrub Robot Functions:	160
Figure 3-48	162
Robotic Harvesting of Strawberries	162
Figure 3-49	163
Agrobot SW 6010	163
Figure 3-50	165
Agrobot AGB: Harvesting High Level System	165
Figure 3-51	166
Agrobot AG Vision	166
Figure 3-60	168
Blue River Technology Agricultural Robot	168
Figure 3-61	169
Blue River Precision Lettuce Thinning Agricultural Robot	169
Table 3-62	170
Blue River Technology Agricultural Robot Functions	170
Figure 3-63	171
Blue River Precision Lettuce Thinning - 80/84" beds	171
Table 3-64	173
cRops Robotic Platform Functions	173
Table 3-65	175
cRops Robot System European Project Supporters	175
Figure 3-66	176
cRops Robot System	176
Figure 3-67	177
cRops Robot Target System	177
Figure 3-68	177
Jaybridge Robotics Driverless Tractor	177
Figure 3-69	181
IBM / Bari Fishing Market App	181
Figure 3-70	182
IBM / Bari Real Time Fishing Market App	182
Figure 3-71	183
IBM / Bari Fishing Market Need Matching App	183
Figure 3-72	186
Small Tractor Used For Manual Artichokes Harvesting	186
Figure 3-73	188
LSU AgBot	188
Table 3-74	191
Harvard Robobee Robot Applications	191
Table 3-75	192
Nature-Inspired Robotic Research Aims	192
Figure 3-76	193
Robobee Boby, Brain, Colony	193
Figure 3-77	194
Harvard Robobee Propulsive Efficiency	194
Figure 3-78	195
Robobee Boby, Brain, Colony	195

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

Figure 3-79	197
Harvard Robobee Studies of Stability And Control In Unsteady, Structured Wakes	197
Table 3-80	198
Harvard Robobee Sensor Networks	198
Figure 3-81	199
Harvard Robobee Computationally-Efficient Control System	199
Table 3-82	202
Harvard Robobee Sensor Network Design Challenges	202
Table 3-83	203
Harvard Robobee Challenges In Development Of A Sensor Network	203
Table 3-84	204
Harvard Robobee Sensor Network Context Challenges	204
Table 3-85	205
Harvard Robobee Sensor Network Elements	205
Table 3-86	206
Harvard Robobee Sensor Network Limitations	206
Table 3-87	207
Harvard Robobee Software Language Limitations	207
Table 3-88	208
Harvard Robobee Software Language Current Efforts	208
Figure 3-89	209
Robomow RL850 Automatic Lawn Mower	209
Figure 3-90	211
MIT smart gardener robot	211
Figure 3-91	213
Carnegie Mellon Self-Guided Farm Equipment	213
Figure 3-92	214
Carnegie Mellon Self-Guided Equipment Running on Farm	214
Figure -3-93	215
Cesar the LettuceBot	215
Figure 3-94	216
Benefits of Lettuce Harvesting Robot	216
Figure 3-95	217
Rosphere	217
Figure 3-96	218
Rosphere Induction Of Forward/Backward And Turning Movements	218
Figure 3-97	221
University of California, Davis Robot For Harvesting Strawberries	221
Table 3-98	223
Wall-Ye V.I.N. Robot Functions	223
Table 3-99	224
Wall-Ye V.I.N. Robot Technology	224
Table 3-100	224
Wall-Ye V.I.N. Robot Features	224
Figure 3-101	226
Vision Robotics Snippy Robotic Vine Pruner	226
Figure 3-102	229
Nogchui Autonomous Tractor Grading	229

Japan; Autonomous tractor

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.



Figure 3-103	230
Nogchui Autonomous Tractor Working Field	230
Figure 3-104	233
Professor Nogchui Autonomous Tractor Navigation Map Information	233
Figure 3-105	234
Microsoft Agricultural Robot Software	234
Figure 3-106	235
Herder Robotic Rover	235
Figure 3-107	237
Chinese Farmbot Tractor Image	237
Figure 3-108	239
3D Robotics	239
Figure 3-109	240
3D Robotics Drone Spray Application	240
Figure 3-110	241
3D Robotics Uses Pesticides And Fungicides Only When Needed	241
Figure 3-111	242
3D Robotics Data For Marketing	242
Figure 3-112	243
3D Robotics Aerial Views of Crops	243
Figure 3-113	244
3D Robotics Aerial Views Multicopter To Fly Over Vineyards	244
Figure 3-114	245
Lely Automatic Milking	245
Figure 3-115	246
Astronaut Milking Robot	246
Figure 3-116	249
Lely Milking System Farm	249

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

Figure 3-117	250
Lely Cattle Feeding System Farm	250
Figure 3-118	251
Lely Automated Process for Managing Milking and Farm	251
Figure 3-119	252
Lely Correct Cattle Feeding Management	252
Figure 3-120	253
Lely Automated Process Cattle Feeding Management	253
Figure 3-121	254
Lely Multi-Barn Cattle Feeding Management	254
Figure 3-122	256
Lely Cattle Milking Management	256
Figure 3-123	257
Kyoto University Tomato Harvesting Robot	257
Figure 3-124	258
Kyoto University Fruit Harvesting Robots In Greenhouse	258
Figure 3-125	259
Kyoto University Tomato Cluster Harvesting Robot	259
Figure 3-126	260
Kyoto University Strawberry Harvesting Robot In Plant Factory	260
Figure 3-127	263
RHEA Robot Fleets for Seeding	263
Figure 3-128	264
RHEA Robot Fleet Mapping for Seeding	264
Figure 3-129	265
Robot Fleet Deterministic Route Planning for Seeding	265
Figure 3-130	266
Orthogonal Inter Row Mechanical Weeding for Organic Farming	266
Table 3-131	267
HGCA Laser Weeding	267
Figure 3-132	268
RHEA Laser Weeding	268
Figure 3-133	269
RHEA Horibot Cutter and Sprayer	269
Figure 3-134	270
RHEA Broad leafed Weed Sensing And Spraying	270
Table 3-135	271
RHEA Broad Leafed Weed Sensing And Spraying	271
Figure 3-136	272
RHEA Multiple Small Intelligent Machines Replace Large Manned Tractors	272
Figure 3-137	273
RHEA Cooperative Fleet Of Robots	273
Figure 3-138	274
RHEA Hexacopter (Aerial Mobile Unit)	274

Agricultural Robots Technology

Table 4-1	277
Harvest Automation Proprietary Sensor Technology Functions	277
Table 4-2	278
Harvest Automation Robot System Architecture	278
Table 4-3	279

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

Proprietary Sensor Technology	279
Table 4-4	280
System Design & Architecture	280
Table 4-5	286
Tight Scientific Collaboration Between Different Disciplines	286
Figure 4-6	287
IEEE Agricultural Robots	287
Figure 4-7	288
IEEE Orchard Robots	288
Figure 4-8	289
IEEE Automated Agricultural Robot	289

Agricultural Robots Company Profiles

Table 5-1	296
ABB Product Launches	296
Table 5-2	297
ABB Global Lab Target Technologies	297
Table 5-3	299
ABB's Global Lab Automation Target Solutions	299
Table 5-4	300
ABB Active Current Research Areas	300
Figure 5-5	302
Agrobot Strawberry Picker	302
Figure 5-6	303
Agrobot Strawberry Picker	303
Figure 5-7	304
Agrobot Robot for Agriculture	304
Table 5-8	305
Agrobot Innovation and Technology for Agribusiness	305
Figure 5-9	305
Agrobot Innovation and Technology for Agribusiness	306
Table 5-10	307
Agrobot SW6010 Support	307
Table 5-11	312
cRops technology Functions	312
Table 5-12	313
cRops Intelligent Tools	313
Table 5-13	314
cRops Target Markets	314
Table 5-14	315
cRops Robotic Platform Customized Automated Processes	315
Figure 5-15	318
Fanuc Revenue	318
Figure 5-16	319
Fanuc Revenue	319
Figure 5-17	323
Boston Dynamic LS3	323
Figure 5-18	325
Boston Dynamic CHEETAH	325
Figure 5-19	326
Boston Dynamic Atlas	326

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

WinterGreen Research, INC.

Figure 5-20	328
Boston Dynamic BigDog	328
Figure 5-21	330
Boston Dynamics LittleDog -	330
Table 5-22	332
Google Autonomous Vehicles Technology	332
Table 5-23	344
Harvard Robobee Project Characteristics	344
Figure 5-24	346
Harvard Robobee Kilobot Robot Group	346
Table 5-25	350
Harvest Automation Robot Navigation	350
Table 5-26	351
Harvest Automation Robot Sensor Network Functions	351
Table 5-27	354
IBM Systems Target Industries	354
Table 5-28	375
Jaybridge Robotics Software Solutions	375
Table 5-29	375
Jaybridge Robotics Software Functions	375
Figure 5-30	382
Kuka Positioning with Smart Tools	382
Figure 5-31	386
Lely's Astronaut A4 Milking Robot	386
Table 5-32	391
Millennial Net's MeshScape System Functions	391
Table 5-33	392
MeshScape GO Deployment Components:	392
Table 5-34	394
National Agriculture and Food Research Organization (NARO) Plan Goals	394
Figure 5-35	401
Precise Path Robotics	401
Figure 5-36	404
Sicily Small Tractor Used For Manual Artichoke Harvesting	404
Figure 5-37	408
Shibuya Kogyo Robotic System For Leaflet & Spoon Placement	408
Figure 5-38	409
Shibuya Kogyo Robotic Collating System	409
Figure 5-39	410
Shibuya Kogyo Automated Aseptic Environmental Monitoring System	410
Table 5-40	411
Universidad Politécnic de Madrid Projects	411
Figure 5-41	413
UC Davis Using Yamaha Helicopter Drones For Crop Dusting	413
Figure 5-42	414
Yamaha Crop Dusting Initiatives	414
Figure 5-43	418
YASKAWA Electric Group Businesses	418

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING

ABOUT THE COMPANY

WinterGreen Research, research strategy relates to identifying market trends through reading and interviewing opinion leaders. By using analysis of published materials, interview material, private research, detailed research, social network materials, blogs, and electronic analytics, the market size, shares, and trends are identified. Analysis of the published materials and interviews permits WinterGreen Research senior analysts to learn a lot more about markets. Discovering, tracking, and thinking about market trends is a high priority at WinterGreen Research. As with all research, the value proposition for competitive analysis comes from intellectual input.

WinterGreen Research, founded in 1985, provides strategic market assessments in telecommunications, communications equipment, health care, Software, Internet, Energy Generation, Energy Storage, Renewable energy, and advanced computer technology.

Industry reports focus on opportunities that expand existing markets or develop major new markets. The reports access new product and service positioning strategies, new and evolving technologies, and technological impact on products, services, and markets. Innovation that drives markets is explored. Market shares are provided. Leading market participants are profiled, and their marketing strategies, acquisitions, and strategic alliances are discussed. The principals of WinterGreen Research have been involved in analysis and forecasting of international business opportunities in telecommunications and advanced computer technology markets for over 30 years.

The studies provide primary analytical insight about the market participants. By publishing material relevant to the positioning of each company, readers can look at the basis for analysis. By providing descriptions of each major participant in the market, the reader is not dependent on analyst assumptions, the information backing the assumptions is provided, permitting readers to examine the basis for the conclusions.

About The Principal Authors

Ellen T. Curtiss, Technical Director, co-founder of WinterGreen Research, conducts strategic and market assessments in technology-based industries. Previously she was a member of the staff of Arthur D. Little, Inc., for 23 years, most recently as Vice President of Arthur D. Little Decision Resources, specializing in strategic planning and market development services. She is a graduate of Boston University and the Program for Management Development at Harvard Graduate School of Business Administration. She is the author of recent studies on worldwide telecommunications markets, the top ten internet equipment companies, the top ten contract manufacturing companies, and the Top Ten Telecommunications market analysis and forecasts.

Susan Eustis, President, co-founder of WinterGreen Research is a senior analyst. She has done research in communications and computer markets and applications. She holds several patents in microcomputing and parallel processing. She has the original patents in electronic voting machines where she was featured in People Magazine in 1976. She has new patent applications in format varying, multiprocessing, and electronic voting. She is the author of recent studies of the Solar Renewable Energy, Wind Energy, Thin Film Batteries, Business Process Management marketing strategies, Internet equipment, biometrics, a study of Internet Equipment, Worldwide Telecommunications Equipment, Top Ten Telecommunications, Digital Loop Carrier, Web Hosting, Web Services, and Application Integration markets. Ms. Eustis is a graduate of Barnard College. Susan Eustis was named as top female executive of the year by Who's Who Worldwide in 2012. She was named page one of the top 100 Industry leaders in Who's Who Worldwide in 2013.

REPORT # SH25851953

430 PAGES

236 TABLES AND FIGURES

2014

\$3,900 SINGLE COPY -- \$7,800 WEB SITE POSTING