

Surgical Robots: Market Shares, Strategies, and Forecasts, Worldwide, 2015-2021

Table of Contents

Surgical Robots: Executive Summary

The study is designed to give a comprehensive overview of the Surgical 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.

Surgical Robot Market Shares and Forecasts	34
Surgical Robot Market Driving Forces	34
Surgical Robotics Market Driving Forces	37
Healthcare Robotics Enabling Technology	42
Robotic-Assisted Minimally Invasive Surgery Market Driving Forces	42
Entrepreneurial Manufacturers with FDA-Approved Products Provide Sourcing To Larger Companies	44
Surgical Robot Market Risks	45
Medical Surgical Robots: Robotic Minimally Invasive Surgery Market Shares	46
Medical Surgical Robots: Robotic-Assisted Minimally Invasive Surgery Market Shares	48
Robotic Surgery Equipment Market Forecasts	50
1. Surgical Robots Market Description and Market Dynamics	53

Surgical Robot Table of Contents**and List of Tables and Figures**

1.1	Robotic Surgical System	53
1.1.1	Market Strategy for the Robotic Surgical System	58
1.1.2	Focus on Key Institutions	60
1.2	Focus on Leading Surgeons to Drive Rapid and Broad Adoption	60
1.2.1	Maintain Market Leadership	61
1.2.2	Develop Industry Alliances	61
1.2.3	Increasing Patient Awareness	61
1.3	Clinical Applications For Technology	62
1.4	Elder Assistance Robot Market Strategy	63
1.5	Medical / Surgical Delivery Robots	64
1.5.1	Assistive Technology	64
1.6	Rehabilitation Robots	66
1.7	Neuroscience Basic Mechanisms Of Neurogenesis And Neuroplasticity	67
1.7.1	Neuro-Developmental Engineering	68
1.7.2	Intelligent Rehabilitation	69
1.7.3	Bilateral and Unilateral ADL-Focused Robot Therapies	70
1.7.4	Robotic Rehabilitation Assistive Technology	71
1.7.5	Robots, Aged Care, And Emotional Bonding With Machines	74
1.7.6	InTouch Health Remote Presence	74
1.7.7	InTouch Platforms Integrate Seamlessly With da Vinci Systems	75
1.7.8	In Touch Health Remote Presence RP-7s Robot Doctors	76
1.8	Educational Robots For Children in Hospitals	76
1.9	Hospital Robots	77
1.10	Mechanized Couriers	77
1.10.1	Man vs. Machine: Robots at Japanese Hospital	78
2.	Surgical Robot Market Shares and Forecasts	80

Surgical Robot Table of Contents**and List of Tables and Figures**

2.1 Surgical Robot Market Driving Forces	80
2.1.1 Surgical Robotics Market Driving Forces	83
2.1.2 Healthcare Robotics Enabling Technology	88
2.1.3 Robotic-Assisted Minimally Invasive Surgery Market Driving Forces	88
2.1.4 Entrepreneurial Manufacturers with FDA-Approved Products Provide Sourcing To Larger Companies	90
2.1.5 Surgical Robot Market Risks	91
2.2 Medical Surgical Robots: Robotic Minimally Invasive Surgery Market Shares	92
2.2.1 Medical Surgical Robots: Robotic-Assisted Minimally Invasive Surgery Market Shares	94
2.2.2 Medical Surgical Robots Markets And Systems Shares, Units And Dollars, Worldwide, 2014	97
2.2.3 Medical Robotic Surgery by Segment	103
2.2.4 Intuitive Surgical Robotics da Vinci® System	103
2.2.5 Intuitive Surgical Cardiothoracic Surgeries	104
2.2.6 Intuitive Surgical Head and Neck Cancer	105
2.2.7 Intuitive Surgical Improve Its Procedure Volumes	105
2.2.8 Intuitive Surgical Overcomes The Difficulty Of Market Saturation	108
2.2.9 Intuitive Surgical	109
2.2.10 Intuitive Surgical Potential Competition From Google and Johnson & Johnson	110
2.2.11 Google and Johnson & Johnson	111
2.2.12 Hansen Medical	112
2.2.13 Think Surgical	113
2.2.14 iRobot and InTouch Health	114

Surgical Robot Table of Contents**and List of Tables and Figures**

2.2.15	MAKO Surgical	114
2.2.16	Accuray	114
2.2.17	Accuray CyberKnife Robotic Radiosurgery System	116
2.2.18	Accuray Results	117
2.2.19	Restoration Robotics	119
2.2.20	Titan Robot	120
2.2.21	Titan Robot Partners	123
2.2.22	Medrobotics Positioning	126
2.3	Robotic Surgery Equipment Market Forecasts	126
2.3.1	Surgical Robot Systems Forecasts	129
2.3.2	Medical Robotic Surgery Challenges	132
2.3.3	Surgical Robot Disposable Instruments Forecasts	136
2.3.4	Surgical Robot Systems vs. Disposable Instruments Forecasts	138
2.3.5	Surgical Robot Application Forecasts	140
2.3.6	Growth Of Laparoscopic Robotic Prostatectomy	140
2.3.7	Medical Robot Systems Market Drivers	144
2.3.8	Surgical Robot Market Segment Forecasts Dollars and Units	145
2.3.9	Cancer Robotic Surgery Learning Curves	150
2.3.10	Robotic Surgery Equipment	150
2.3.11	U.S. Minimally Invasive Spinal Implant Market To Outpace Growth In Traditional Spine Market	151
2.3.12	Medtronic Dominates MIS Spine Markets	153
2.3.13	Asia - Pacific Minimally Invasive Surgery Spinal Device Market	154
2.3.14	Medicare and Medicaid Impact	154
2.3.15	Hip and Knee Robotic Surgery	154

Surgical Robot Table of Contents**and List of Tables and Figures**

2.4 Surgical Robot Applications	154
2.4.1 Urology	155
2.4.2 Gynecology	155
2.4.3 General Surgery	156
2.4.4 Cardiac	156
2.4.5 Head and Neck Surgery	156
2.4.6 US Target Procedures:	156
2.4.7 Intuitive Surgical da Vinci Surgical System Procedure Volume	158
2.4.8 Reported Clinical Benefits of da Vinci® Hysterectomy Procedures for Benign Conditions	161
2.4.9 Robotic Surgery ENT Opportunity	164
2.4.10 General Surgery Robot Market Opportunities	165
2.4.11 Radiation Oncology	166
2.4.12 Number of Surgeries Incidence of Disease	168
2.4.13 Hair Loss	168
2.5 Robotic Surgery Equipment Prices	169
2.5.1 Intuitive Surgical da Vinci Surgical System Prices	169
2.5.2 Accuray	171
2.6 Robotic Surgery Equipment Regional Market Segments	171
2.6.1 Intuitive Surgical Regional Revenue	173
2.6.2 Intuitive Surgical European Demand	174
2.6.3 Intuitive Surgical in Japan	175
2.6.4 Chinese and Taiwanese Markets for Minimally Invasive Spinal Devices	175
2.6.5 China Emerging as a Surgical Robot Market	176
2.6.6 Aging Taiwanese Population	176

2.6.7	Brazil	176
3.	Surgical Robots Product Description	177
3.1	Key Players In The Global Medical Robots	177
3.2	General Surgery, Gynecology, Urology	178
3.3	Intuitive Surgical da Vinci Xi®	178
3.3.1	Intuitive Surgical da Vinci Xi Surgical System Minimally Invasive Surgery	181
3.3.2	Intuitive Surgical da Vinci Surgical System	182
3.3.3	Intuitive Surgical da Vinci Surgical System Components	189
3.3.4	Intuitive Surgical Patient-Side Cart and Electromechanical Surgical Arms	192
3.3.5	Intuitive Surgical 3-D Vision System	193
3.3.6	Intuitive Surgical Firefly Fluorescence Imaging	193
3.3.7	Intuitive Surgical da Vinci Skills Simulator	194
3.3.8	Intuitive Surgical Instruments and Accessories	194
3.3.9	Intuitive Surgical da Vinci Single-Site	195
3.3.10	Intuitive Surgical EndoWrist One Vessel Sealer	196
3.3.11	Intuitive Surgical Accessory Products	196
3.3.12	Intuitive Surgical Da Vinci Minimally Invasive Surgical Product	197
3.3.13	Intuitive Surgical Cardiac Surgery	198
3.4	Titan Medical	205
3.4.1	Titan Medical SPORT™ Surgical Next Generation System	210
3.4.2	Titan Visualization Viewing Portal	221
3.4.3	Titan Integration Successful Deployments Into Single 25mm Incision in Abdominal Cavity	224
3.4.4	Titan Medical Surgical Robotic System	225

Surgical Robot Table of Contents**and List of Tables and Figures**

3.4.5	Titan Robotic Single Incision Platform:	226
3.4.6	Titan Medical Amadeus Robotic Surgical System	226
3.5	Cardiac / Vascular Surgery	227
3.5.1	Varicose Veins	228
3.6	Hansen Medical Magellan™ Robotic System	230
3.6.1	Hansen Medical Magellan Robotic System	231
3.6.2	Magellan™ Robotic System Benefits	232
3.6.3	Hansen Medical Magellan Robotic System	234
3.6.4	Hansen Medical Magellan Robotic Catheter Intravascular Navigation	236
3.6.5	Hansen Sensei® X Robotic Catheter System	237
3.6.6	Hansen Medical Magellan 1 mm Tip Movement	240
3.6.7	Hansen Medical Sensei® Robotic System Indications for Use	241
3.6.8	Hansen Advanced Robotic Solution for Arrhythmias	242
3.6.9	Hansen Medical Sensei X Robotic System	243
3.7	Spine Surgery	245
3.7.1	Scoliosis an Abnormal Curvature Of The Spine	246
3.8	Mazor Robotics	247
3.8.1	Mazor Robotics Renaissance® Spine Procedures	249
3.8.2	Mazor Robotics Leading Spine Surgery Innovation	255
3.8.3	Mazor Robotics Spine Procedures	255
3.8.4	Mazor Robotics Minimally Invasive Spine Fusion:	257
3.8.5	Mazor Robotics Scoliosis Correction Surgery:	258
3.8.6	Mazor Robotics Vertebroplasty:	259
3.8.7	Mazor Robotics Spine Biopsies:	260

Surgical Robot Table of Contents**and List of Tables and Figures**

3.9	Cancer Surgery	260
3.9.1	Lumpectomy	261
3.9.2	Modified Radical Mastectomy	262
3.9.3	Lung Cancer Surgery	263
3.10	Accuray CyberKnife M6 Series	265
3.10.1	Accuray CyberKnife M6 FIM System	270
3.10.2	Accuray / CyberKnife VSI System	275
3.10.3	Accuray CyberKnife Robotic Radiosurgery System	277
3.10.4	Accuray / TomoTherapy System	277
3.10.5	Accuray CyberKnife G4 System	279
3.10.6	Accuray Multileaf Collimator	280
3.10.7	Class A User Licenses for Accuray Products Awarded to 16 Hospitals in China	281
3.10.8	Accuray Solutions	282
3.10.9	Accuray TomoTherapy System	283
3.11	Knee and Hip Surgery	283
3.11.1	Hip Replacement	284
3.12	Stryker / MAKO Surgical	285
3.12.1	Stryker Robotic Joint Surgical	303
3.12.2	MAKO Surgical RIO Robotic Arm	308
3.13	Pharmacy and Compounding Automation	310
3.14	Aesynt / Health Robotics / Robot-Rx®	310
3.14.1	Aesynt MedCarousel®	311
3.14.2	Aesynt PROmanager-Rx™	311
3.14.3	Aesynt MedShelf-Rx™	312
3.14.4	Aesynt NarcStation™	312

Surgical Robot Table of Contents**and List of Tables and Figures**

3.14.5 Health Robotics Part of Aesynt	313
3.14.6 Health Robotics S.R.L.	313
3.14.7 Health Robotics S.R.L. i.v.STATION® ONCO	316
3.15 Minimally Invasive Surgery Products	319
3.16 Freehand	319
3.16.1 FreeHand Robotic Camera Controller for MIS	319
3.16.2 FreeHand OR Productivity Prosurgics Robotic Value and Challenges	324
3.16.3 FreeHand Disposable Supplies	325
3.16.4 FreeHand Robotic Camera Controller for MIS	325
3.16.5 FreeHand	328
3.17 Restoration Robotics Artas Robotic System	330
3.17.1 Restoration Robotics Strengths and Challenges	339
3.18 THINK Surgical	339
3.18.1 THINK Surgical TCAT™ Computer Assisted Tool	341
3.18.2 THINK Surgical Independent Clinical Studies	344
3.18.3 THINK Surgical® Surgical Assistant Strengths and Challenges	344
3.19 Robotic Angioplasty / Interventional Cardiology	345
3.20 Corindus	346
3.20.1 CorPath Robotic Angioplasty	347
3.20.2 Corindus Command. Control CorPath® 200 System	347
3.20.3 Corindus Standard in Precision PCI.	349
3.21 Motion Computing Motion C5v Tablet	353
3.22 Vycor Brain Access System (VBAS)	354
3.22.1 Vycor's VBAS Minimally Invasive Neurosurgical Device	355
3.23 Shoulder	356
3.24 Tornier	357

3.25 Image Guided Surgery	358
3.26 Covidian	361
3.27 AVRA Surgical	367
3.27.1 AVRA Surgical Light-Weight Robotic Arms on Surgeon Console	368
3.27.2 AVRA Robotic Surgical Instruments	369
3.28 Medrobotics Techonology	370
3.28.1 Medrobotics Cardiac Surgery Snake Robot	371
3.28.2 Medrobotics Flex® Retractor	372
3.28.3 Medrobotics Flexible Robot Platform	373
3.28.4 Medrobotics Snakelike Robots for Heart Surgery	373
3.28.5 Medrobotics Cardiac Surgery Snake Robot	375
3.28.6 Minimally Invasive Surgery Positioning:	378
3.29 Changzhou Kangxin Medical Instruments Co., Ltd.	379
3.30 Guangzhou Baitang Medical Instrument Co., Ltd.	380
3.31 Guangzhou Beco Electronic Technology Co., Ltd.	380
4. Medical Robot Technology and Disease Statistics	381
4.1 Robotic Surgical Clinical Applications	381
4.1.1 Surgical Procedures	383
4.1.2 U.S. Robotic Surgical Procedures	384
4.1.3 Robotic Urologic Prostatectomy Surgery	384
4.1.4 Robotic Gynecologic Surgery	386
4.1.5 Robotic Myomectomy	386
4.1.6 Robotic Cardiothoracic Surgery	387
4.1.7 Robotic Internal Thoracic Artery Dissection	388
4.1.8 Robotic Thoracoscopy	388
4.1.9 Robotic Coronary Artery Bypass	389
4.1.10 Robotic General Surgery	390

Surgical Robot Table of Contents

and List of Tables and Figures

4.1.11	Types of Spinal Condiitons for Which Surgery is Needed	392
4.2	Incidence of CHF	394
3.31.1	US Inpatient Surgery 2014	395
4.3	Transmyocardial Laser Revascularization	396
4.4	AI Robot	397
4.4.1	Korea Focusing On Creating A Growth Engine In Research & Development	397
4.5	Care-O-bot Robot Mechanics	399
4.5.1	Care-O-bot Architecture	400
4.6	Government Regulation	402
4.6.1	California Regulation	405
4.6.2	International Regulation	405
4.7	Third Party Reimbursement	406
	5. Surgical Robots Company Description	409
5.1	Accel Spine	409
5.2	Accuray	409
5.2.1	Accuray Revenue for Second Quarter of Fiscal Year 2015	410
5.2.2	Accuray CyberKnife System	415
5.2.3	Accuray Strategy	418
5.2.4	Accuray International Presence	421
5.2.5	Accuray Competition	421
5.2.6	Accuray Noteworthy Awards:	425
5.2.7	Accuray Installed Base	426
5.2.8	New Data Validates CyberKnife SBRT for Prostate Cancer Treatment	427
5.3	Aesynt / Health Robotics	427

Surgical Robot Table of Contents**and List of Tables and Figures**

5.3.1 Aesynt / Health Robotics S.R.L.	428
5.4 Alliance Spine	429
5.5 Alphatec Spine	430
5.6 Amedica	434
5.7 Apollo Spine	435
5.8 Ascendx Spine	435
5.9 AVRA Surgical	436
5.9.1 AVRA Portable Lightweight And Maneuverable Robotic Adaptable Platform	437
5.9.2 AVRA Surgeon's Console	437
5.10 Back 2 Basics Spine	438
5.11 Captiva Spine	439
5.12 Centinel Spine	439
5.13 Corindus	440
5.13.1 FDA Clears Corindus Robotic-Assisted System For Coronary Artery Disease Stent	443
5.14 Elekta AB	446
5.14.1 Elekta Radiosurgery Solutions, -Guided Cancer Care	449
5.14.2 Elekta Radiosurgery Solutions	449
5.11.3 Elekta AB Information-Guided Cancer Care	449
5.14.3 Elekta AB Advanced Brachytherapy Solutions	450
5.12 Freehand	450
5.12.3 Freehand 2010 / ProSurgics	451
5.13 Globus Medical	452
5.14 Hansen Medical	452
5.14.3 Hansen Medical Sensei System	454

Surgical Robot Table of Contents**and List of Tables and Figures**

5.14.4 Hansen Medical Magellan Robotic System	456
5.14.5 Hansen Medical Competition	456
5.14.6 Hansen Medical Revenue	458
5.14.7 Hansen Revenue	459
5.15 Healthcare Robotics Lab	462
5.16 Intuitive Surgical	463
5.16.1 Intuitive Surgical Robotics da Vinci® Surgical System	467
5.16.2 Intuitive Surgical Robotics da Vinci Surgical System Xi	468
5.16.3 Intuitive Surgical Business Strategy	471
5.16.4 Intuitive Surgical Systems	473
5.16.5 Intuitive Surgical Patient Value As Equal To Procedure Efficacy / Invasiveness	474
5.16.6 Intuitive Surgical Business Model	475
5.16.7 Intuitive Surgical Revenue	476
5.16.8 Intuitive Surgical Regulatory Activities	477
5.16.9 Intuitive Surgical Economic Environment.	477
5.17 Johnson and Johnson / DePuy Synthes	478
5.17.1 Google Collaborating With Johnson & Johnson To Develop Surgical Robots	479
5.17.1 DePuy	479
5.18 K2M	479
5.19 Lanx / EBI Holdings / BioMet /	480
5.19.1 BioMet	480
5.19.2 EBI Holdings,	481
5.19.3 Lanx	481
5.20 LDR	482

Surgical Robot Table of Contents**and List of Tables and Figures**

5.21 Life Spine	483
5.22 Mazor Robotics	483
5.22.1 Mazor Robotics 2014 Revenue	483
5.23 Medrobotics	486
5.23.1 Medrobotics Closes On \$10 Million Financing	488
5.23.2 Medrobotics Several Generations Of Snake Robot Platforms	489
5.23.3 Medrobotics Advances Clinical Development of Snake Robot for Surgery	489
5.23.4 Medrobotics Positioning	489
5.23.5 Medrobotics Cardiac Surgery Gold Standard	490
5.23.6 Medrobotics Snake Robot Technologies For Use In A Wide Range Of Surgical And Interventional Applications	491
5.23.7 Medrobotics Technology & Research Center	493
5.24 Medtronic	494
5.25 NLT Spine	496
5.26 NuVasive	496
5.27 Otto Bock HealthCare	497
5.28 RTI Biologics / Pioneer Surgical Technology	499
5.29 Precision Spine	500
5.30 Restoration Robotics	501
5.30.1 ARTAS Technology Series: Patient Movement Compensation	501
5.31 SI-BONE	503
5.32 Spinal Elements	505
5.33 Spineart	505
5.34 SpineGuard	506
5.35 Spine Frontier	506

Surgical Robot Table of Contents**and List of Tables and Figures**

5.36 Spineology	507
5.37 Spine Smith Partners	507
5.38 Spine Surgical Innovations	508
5.39 Spine View	508
5.40 Spine Wave	508
5.41 Stryker / MAKO Surgical	509
5.41.1 Stryker Revenue	510
5.41.2 Stryker Orthopaedics	511
5.41.3 Mako Robotic Arm Technology Assists in Total Hip Replacement	512
5.41.4 Mako Surgical Business	513
5.41.5 Mako Products	514
5.41.6 Mako Surgical Strategy	517
5.41.7 Mako Surgical Revenue	520
5.42 Think Surgical	520
5.42.1 Think Surgical Technology Virtual Model Of a Patient Joint	521
5.42.2 Think Surgical's Next-Generation Robodoc® Assists In Surgery	522
5.42.3 THINK Surgical Receives 510(k) Clearance from the United States Food and Drug Administration (FDA)	524
5.43 Titan Medical	526
5.44 TranS1	529
5.45 UC Berkeley	530
5.46 Varian Medical Systems.	530
5.47 Vecna Robotics	532
5.48 Victrex plc / Invibio	533
5.49 Vycor	536
5.50 Wenzel Spine	538

Surgical Robot Table of Contents**and List of Tables and Figures**

5.51 X-spine	539
5.52.1 X-spine Systems	540
5.53 Zyga Technology	540
5.54 Surgical Robot Companies	541
Table ES-1	34
Surgical Robot Medical Specialties Addressed	34
Table ES-2	35
Types Of Procedures Performed Using Robotic Surgical System	35
Table ES-3	36
Innovative Surgical Robot Features	36
Table ES-4	36
Surgical Robot Market Positioning	36
Table ES-5	38
Surgical Robotics Market Driving Forces	38
Table ES-6	39
Surgical Robot Key Factors Driving Market Growth	39
Table ES-7	40
Surgical Robot Key Market Challenges	40
Table ES-8	41
Robotics Market Driving Factors	41
Table ES-9	42
Healthcare Robotics Enabling Technologies	42
Table ES-10	43
Robotic-Assisted Minimally Invasive Surgery Market Driving Forces	43
Figure ES-11	49
Medical Surgical Robots Market Shares, Shipments, Dollars, Worldwide 2014	49
Table ES-12	52
Surgical Robot Forecasts Dollars, Worldwide, 2015-2021	52
Figure 1-1	54

Surgical Robot Table of Contents**and List of Tables and Figures**

Medical Multi Articulating Arms	54
Figure 1-2	55
Instruments That Support Multiple Approach Paths To A Surgical Target	55
Figure 1-3	57
Robotic Surgery Improved Visualization Features	57
Table 1-4	59
Robotic Surgical Specialties Procedure Marketing Efforts Focus	59
Table 2-1	80
Surgical Robot Medical Specialties Addressed	80
Table 2-2	81
Types Of Procedures Performed Using Robotic Surgical System	81
Table 2-3	82
Innovative Surgical Robot Features	82
Table 2-4	82
Surgical Robot Market Positioning	82
Table 2-5	84
Surgical Robotics Market Driving Forces	84
Table 2-6	85
Surgical Robot Key Factors Driving Market Growth	85
Table 2-7	86
Surgical Robot Key Market Challenges	86
Table 2-8	87
Robotics Market Driving Factors	87
Table 2-9	88
Healthcare Robotics Enabling Technologies	88
Table 2-10	89
Robotic-Assisted Minimally Invasive Surgery Market Driving Forces	89
Figure 2-11	95
Medical Surgical Robots Market Shares, Shipments, Dollars, Worldwide 2014	95
Table 2-12	96
Medical Surgical Robots Market Shares, Dollars, Worldwide, 2014	96
Table 2-13	97

Surgical Robot Table of Contents**and List of Tables and Figures**

Medical Surgical Robots Markets and Systems Shares, Units and Dollars, Worldwide, 2014	97
Table 2-14	98
Medical Surgical Robots Units and Installed Base, Units, Worldwide, 2014	98
Figure 2-15	99
Surgical Robot Systems Hospital Market Trends	99
Figure 2-16	100
Surgical Robot Systems Hospital Return on Investment (ROI)	100
Table 2-17	101
Surgical Robots Number of Procedures by Vendor, Worldwide, 2014	101
Table 2-18	102
Surgical Robots Number of Procedures by Type, Cardiac, Thoracic, Urology, Gynecologic, Joint Replacement, Colorectal, Pediatric, and General Surgical, Number, Worldwide, 2014	102
Table 2-19	107
Intuitive Surgical daVinci Installed Base and Product Shipments Units and Dollars, Worldwide, 2014	107
Table 2-20	113
Hansen Medical Sensei® X Robotic Catheter System	113
Figure 2-21	113
Think Surgical Robodoc	113
Figure 2-22	121
Titan Medical Novel Robotic Platform for Single Port Access Surgery	121
Figure 2-23	122
Titan Medical Amadeus Composer Surgical System	122
Figure 2-24	124
Titan Medical Robotic Surgery Target Opportunity	124
Figure 2-25	125
Titan Medical Robotic Surgery Opportunity Analysis	125
Table 2-26	128
Surgical Robot Forecasts Dollars, Worldwide, 2015-2021	128
Table 2-27	129

Surgical Robot Table of Contents**and List of Tables and Figures**

Surgical Robot Forecasts Dollars, Worldwide, 2015-2021	129
Figure 2-28	130
Surgical Robot Systems Forecasts, Dollars, Worldwide, 2015-2021	130
Table 2-29	133
Challenges of Open Surgery and Minimally Invasive Surgery	133
Table 2-30	134
Challenges of Developing Medical Robotic Surgery Systems	134
Table 2-31	135
Surgical Robotic Product Development Challenges	135
Figure 2-32	136
Surgical Robot Disposable Instruments Forecasts, Dollars, Worldwide, 2015-2021	136
Figure 2-33	138
Surgical Robot Systems vs. Disposable Instruments Forecasts, Dollars, Worldwide, 2015-2021	138
Table 2-34	139
Surgical Robot Market Segment Forecasts, Dollars and Units, Worldwide, 2015-2021	139
Table 2-35	141
Robotic Surgery Market Segment Forecasts, Dollars, Worldwide, 2015-2021	141
Table 2-36	142
Robotic Surgery Market Segment Forecasts, Percent, Worldwide, 2015-2021	142
Table 2-37	143
Surgical Robot Market Challenges	143
Table 2-38	145
Surgical Robot Market Segment Forecasts Dollars and Units, Worldwide, 2015-2021	145
Table 2-39	147
Benefits of Robotic Surgery For The Surgeon	147
Table 2-40	148
Benefits of Robotic Surgery For The Patient	148
Table 2-41	149

Surgical Robot Table of Contents**and List of Tables and Figures**

Benefits of Robotic Surgery For The Hospital	149
Figure 2-42	159
Intuitive Surgical Prostatectomy Procedure Growth	159
Figure 2-43	160
Intuitive Surgical Prostatectomy Procedure Growth	160
Figure 2-44	162
Intuitive Surgical Hysterectomy Procedure Growth	162
Figure 2-45	163
Intuitive Surgical Hysterectomy Market Potential	163
Figure 2-46	164
Titan Medical Describes Surgical Robot ENT Market Potential	164
Figure 2-47	165
Titan Medical Describes Robotic General Surgery Market Potential	165
Table 2-48	167
Accuray CyberKnife M6 Series Benefits:	167
Figure 2-49	170
Surgical Robot Recurring Revenue Model	170
Figure 2-50	172
Surgical Robot Regional Market Segments, Dollars, 2014	172
Figure 2-51	173
Surgical Robot Regional Market Segments, 2014	173
Table 3-1	177
Key Players In The Global Medical Robots Market	177
Figure 3-2	182
Intuitive Surgical da Vinci Surgical System	182
Figure 3-3	184
Intuitive Surgical. da Vinci Surgical System EndoWrist® Instruments	184
Figure 3-4	186
Intuitive Surgical. da Vinci Surgical System Vision System	186
Table 3-5	188
Intuitive Surgical da Vinci Surgical System Features	188
Table 3-6	190

Surgical Robot Table of Contents**and List of Tables and Figures**

Intuitive Surgical da Vinci Xi Surgical System Surgeon Console Features	190
Figure 3-7	191
Intuitive Surgical. da Vinci Surgical System Surgeon Console	191
Figure 3-8	192
Intuitive Surgical. da Vinci Surgical System Patient-Side Cart	192
Figure 3-9	197
Intuitive Surgical Da Vinci Surgery	197
Table 3-10	198
Intuitive Surgical Da Vinci Surgical System Components	198
Table 3-11	200
Minimally Invasive Da Vinci Surgery Benefits To Cardiac Patients	200
Figure 3-12	201
Intuitive Surgical da Vinci System State-Of-The-Art Robotic Surgical Platform	201
Table 3-13	201
Intuitive Surgical da Vinci Si Surgical System Core Benefits:	201
Figure 3-14	202
Intuitive Surgical da Vinci SI Surgical System Dual Console Used For Training And Collaboration	202
Figure 3-15	203
Intuitive Surgical da Vinci Surgical System, Surgeon Operates Seated Comfortably At A Console	203
Figure 3-16	204
Intuitive Surgical da Vinci Surgical System Patient Side Cart	204
Figure 3-17	205
Titan Single Port Orifice Robotic Technology SPORT™ Surgical System	205
Figure 3-18	206
Titan SPORT™ Surgical System:	206
Table 3-19	208
Titan MedicalSPORT™ Surgical System Patient Benefits:	208
Table 3-20	209
Titan MedicalSPORT™ Surgical System Surgeon Benefits:	209
Table 3-21	210

Surgical Robot Table of Contents**and List of Tables and Figures**

Titan MedicalSPORT™ Surgical System Hospital Benefits:	210
Table 3-22	211
Titan Medical next generation SPORT™ Surgical System Uses	211
Figure 3-23	212
Titan Medical Next Generation SPORT™ Surgical System Market Opportunity	212
Figure 3-24	213
Titan Medical Next Generation SPORT™ Surgical System Competitive Positioning	213
Figure 3-25	214
Titan Medical Next Generation SPORT™ Surgical System Market Business Model	214
Figure 3-26	215
Titan Medical Next Generation SPORT™ Surgical System Development Strategy	215
Figure 3-27	216
Titan Medical Next Generation SPORT™ Surgical Instruments	216
Table 3-28	217
Titan Medical Next Generation Sport™ Surgical Instruments Metrics	217
Table 3-29	218
Titan Medical Next Generation SPORT™ Surgical Instruments	218
Figure 3-30	219
Titan Medical Next Generation SPORT™ Surgical Instrument Controlability	219
Table 3-31	220
Titan Medical Next Generation SPORT™ Surgical Instrument Usability Studies and Data Analysis	220
Figure 3-32	221
Titan Medical Next Generation SPORT™ Surgical Instrument Visualization	221
Figure 3-33	223
Titan Medical Next Generation SPORT™ Surgical Instruments	223
Table 3-34	224
Titan Integration Successful Deployments Into Single 25mm Incision in Abdominal Cavity	224

Surgical Robot Table of Contents**and List of Tables and Figures**

Table 3-35	225
Titan Robotic Surgical System Benefits:	225
Table 3-36	227
Titan Amadeus Features	227
Figure 3-37	231
Hansen Medical Magellan Robotic System	231
Table 3-38	232
Hansen Medical Magellan™ Robotic System Benefits	232
Table 3-39	233
Hansen Medical Magellan Peripheral Vascular Intervention Impact On Medical Care 233	
Figure 3-40	234
Hansen Medical Magellan Robotic System	234
Table 3-41	235
Hansen Medical Magellan Robotic Catheter Functions:	235
Table 3-42	236
Hansen Medical Magellan Features	236
Figure 3-43	237
Hansen Sensei X	237
Figure 3-44	238
Hansen Medical Sensei Robotic System	238
Figure 3-45	239
Hansen Intellisense Force Feedback Visual Display	239
Figure 3-46	241
Hansen Sensei Robotic System	241
Table 3-47	242
Hansen Advanced Robotic Solution for Arrhythmias Features	242
Figure 3-48	243
Hansen Medical Sensei X Robotic System	243
Table 3-49	244
Hansen Medical Sensei® X Robotic Catheter System	244
Figure 3-50	248

Surgical Robot Table of Contents**and List of Tables and Figures**

Mazor Robotics' Renaissance® System For Robotic Guidance	248
Figure 3-51	250
Mazor Robotics Adult Reconstructive Surgery	250
Figure 3-52	251
Mazor Robotics Biopsies	251
Figure 3-53	252
Mazor Robotics Leading Spine Surgery Innovation: Minimally-Invasive Surgery, Scoliosis Surgery, Spinal Fusion, Vertebroplasty	252
Figure 3-54	256
Mazor Robotics Renaissance® Guidance System	256
Figure 3-55	261
Lumpectomy	261
Figure 3-56	262
Modified Radical Mastectomy	262
Figure 3-57	264
Lung Cancer Surgery	264
Table 3-58	265
Accuray CyberKnife M6 Series Benefits:	265
Table 3-59	266
Accuray CyberKnife M6 Series Functions	266
Table 3-60	267
Accuray CyberKnife M6 Series Uses	267
Table 3-61	268
Accuray CyberKnife M6 Series Features	268
Table 3-62	269
Accuray CyberKnife M6 Patient Comfort Features	269
Figure 3-63	270
Accuray CyberKnife M6 FIM System	270
Table 3-64	271
Accuray CyberKnife M6 FIM System Features	271
Figure 3-65	272
Accuray CyberKnife M6 FM System	272

Surgical Robot Table of Contents**and List of Tables and Figures**

Table 3-66	273
Accuray CyberKnife M6 FM System Design Features	273
Figure 3-67	274
Accuray CyberKnife M6 FI System	274
Figure 3-68	275
Accuray / CyberKnife VSI System	275
Table 3-69	278
Accuray TomoTherapy System Benefits	278
Figure 3-70	286
Stryker RIO Robotic Arm Interactive System	286
Figure 3-71	287
Stryker reproducible surgical precision Knee Repair	287
Table 3-72	288
Stryker Robotic Surgical Instruments for Knee Replacement Benefits	288
Table 3-73	289
Stryker Patient Specific Pre-Operative Planning	289
Figure 3-74	290
Stryker Anatomic Implant Fit	290
Table 3-75	291
Stryker Anatomic Implant Fit	291
Figure 3-76	292
Anatomic Implant Fit Components	292
Table 3-77	293
Anatomic Implant Fit Components	293
Table 3-78	294
Stryker Bicompartamental Knee Surgery Solution	294
Figure 3-79	295
Stryker Preserving Bone with Restoris MCK BiCOmpartmental	295
Figure 3-80	296
Stryker Preserving Bone	296
Figure 3-81	297
Stryker Preserving Bone and Planning	297

Surgical Robot Table of Contents**and List of Tables and Figures**

Figure 3-82	298
Stryker Real-Time Intra-Operative Adjustments	298
Table 3- 83	299
Real-Time Intra-Operative Adjustments	299
Figure 3-84	300
Surgeon-Controlled Robotic Arm Assisted Reaming and Cup Impaction	300
Table 3-85	301
Stryker Surgeon-controlled Robotic Arm Assisted Reaming and Cup Impaction	301
Figure 3-86	302
Stryker Robotic Surgical Results Summary	302
Figure 3-87	303
Stryker Robotic Joint Surgical Summary	303
Figure 3-88	304
Stryker Robotic Joint Surgical Summary	304
Figure 3-89	305
Stryker RESTORIS® Tapered Femoral Stem and RESTORIS® PST® Acetabular Cup Hip Implant System	305
Figure 3-90	307
Mako Robotic Arm Technology Assists in Total Hip Replacement	307
Figure 3-91	308
MAKO Surgical Resurfaces Rather Than Replaces Joints	308
Figure 3-92	309
Stryker Robotic Arm Total Hip Replacement Tool	309
Table 3-93	315
Health Robotics i.v.STATION®, i.v.SOFT®, and i.v.STATION® ONCO Functions	315
Table 3-94	316
Health Robotics i.v.STATION®, i.v.SOFT®, and i.v.STATION® ONCO Benefits	316
Figure 3-95	318
Aesynt i.v.Station Onco	318
Table 3-96	319
FreeHand Robotic Camera Controller for MIS	319
Figure 3-97	321

Surgical Robot Table of Contents**and List of Tables and Figures**

FreeHand Next Generation Camera Controller For Minimally Invasive Surgery	321
Figure 3-98	323
FreeHand OR Productivity ProSurgics	323
Table 3-99	325
FreeHand Camera Holder Functions	325
Figure 3-100	328
OR Productivity ProSurgics FreeHand	328
Figure 3-101	330
Restoration Robotics ARTAS® Robotic System	330
Table 3-102	331
ARTAS Robotic System Key Features	331
Table 3-103	333
ARTAS Robotic System Key Technology	333
Table 3-104	334
ARTAS® Robotic System Two-Needle System and Skin Tensioner	334
Table 3-105	335
ARTAS Robotic System Key Features	335
Figure 3-106	336
Restoration Robotics ARTAS	336
Table 3-107	337
Restoration Robotics ARTAS Hair Transplant System Functions	337
Table 3-108	338
Restoration Robotics ARTAS System Features:	338
Figure 3-109	340
THINK Surgical TPLAN™ 3D Planning Workstation	340
Figure 3-110	342
THINK Surgical TCAT™ Computer Assisted Tool	342
Figure 3-111	346
Corindus CorPath Robotic Angioplasty	346
Table 3-112	349
Corindus Robotic-Assisted Control Benefits	349
Figure 3-113	351

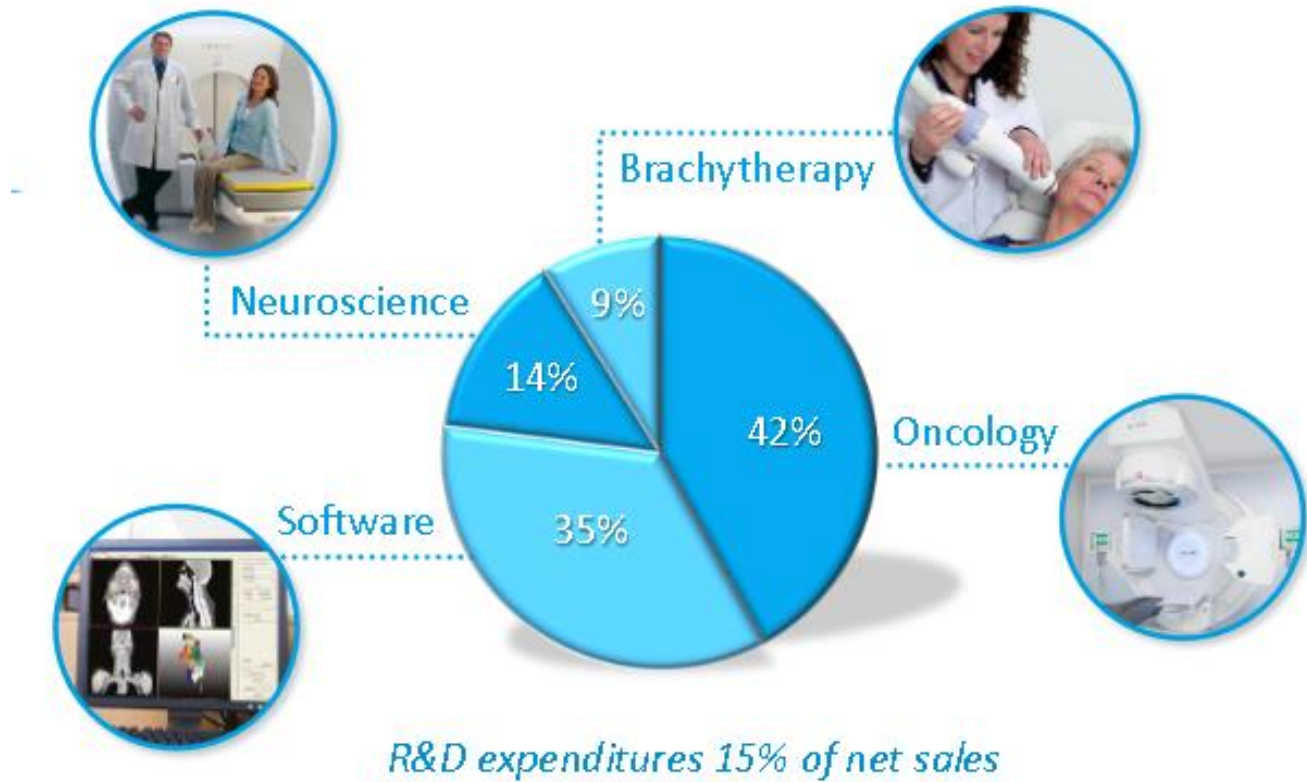
Surgical Robot Table of Contents**and List of Tables and Figures**

Occupational Hazards in Cath Lab	351
Figure 3-114	352
Corindus Robotic Assisted PCI	352
Table 3-115	359
Interventional and Surgical Imaging Applications	359
Figure 3-116	362
Covidian Surgical Instruments: Stapling, Vessel Sealing, Ultrasonic Dissection, Hernia Repair, Hand Instruments & Ligation Devices	362
Figure 3-117	372
Medrobotics Flex® Retractor	372
Table 3-118	376
Medrobotics Medical Field Target Markets	376
Figure 3-119	377
Federal Reserve Chairman Ben Bernanke Looking At Snaking Robot Camera Made by Medrobotics	377
Table 4-1	382
Robotic Surgery Surgical Specialty Focus	382
Table 4-2	385
Intuitive Surgical da Vinci Surgical System Improved Visualization Of The Gross Anatomy	385
Table 4-3	392
Types of Spinal Condiitons for Which Surgery is Needed	392
Table 4-4	393
Spinal Disorder Treatments	393
Table 4-5	395
US Inpatient Surgery 2014 Statistics	395
Figure 4-6	399
Care-O-bot Robot Mechanics	399
Figure 4-7	401
Care-O-bot Architecture	401
Table 5-1	417
Key Features of CyberKnife System and CyberKnife® VSI™ System	417

Surgical Robot Table of Contents

and List of Tables and Figures

Table 5-2	419
Accuray Strategy	419
Table 5-3	420
Accuray Key Elements Of Strategy	420
Table 5-4	423
Factors Impacting Accuray Marketing	423
Figure 5-5	442
Corindus CorPath Study Results	442
Figure 5-6	448
Elekta AB Product Positioning	



448

Table 5-7	457
Hansen Medical Robotic-Assisted Minimally Invasive Surgery Principal Competitive Factors	457
Figure 5-8	468

Surgical Robot Table of Contents**and List of Tables and Figures**

Intuitive Surgical Platform, daVinci Xi	468
Table 5-9	472
Intuitive Surgical Strategy To Improve Candidate Surgical Procedures	472
Table 5-10	478
Johnson and Johnson Family of Companies Comprises:	478
Table 5-11	486
Medrobotics Positioning 2015	486
Table 5-12	491
Medrobotics Cardiac Surgery Improvements	491
Table 5-13	492
Medrobotics Snake Robot Technologies For Use In A Wide Range Of Surgical And Interventional Applications	492
Table 5-14	493
Medrobotics Snake Robot Technologies Specialist Areas Served	493
Table 5-15	497
Otto Bock HealthCare Product Solutions	497
Table 5-16	498
Otto Bock HealthCare Service Solutions:	498
Figure 5-17	500
Pioneer Surgical International Products	500
Figure 5-18	504
SI-BONE SI Joint Repairs	504
Figure 5-19	512
Mako Robotic Arm Technology Assists in Total Hip Replacement	512
Table 5-20	517
MAKO Robotic Surgery Benefits	517
Table 5-21	527
Titan Medical Investment Summary	527
Figure 5-22	528
Titan Medical Business Goals and Timetable	528
Table 5-23	535
Invio Medical-grade PEEK* technology Research projects	535

Surgical Robot Table of Contents

and List of Tables and Figures