

INTRODUCTION	XV
STUDY GOALS AND OBJECTIVES.....	XV
REASONS FOR DOING THE STUDY	XV
INTENDED AUDIENCE.....	XVI
SCOPE OF REPORT	XVI
METHODOLOGY	XVII
INFORMATION SOURCES.....	XVIII
AUTHOR CREDENTIALS	XVIII
RELATED BCC REPORTS	XVIII
BCC ONLINE SERVICES.....	XVIII
DISCLAIMER	XIX
EXECUTIVE SUMMARY	XX
<i>SUMMARY TABLE WORLDWIDE SALES OF IMAGING</i>	
<i>COMPONENTS AND TOP THREE IMAGING COMPONENTS</i>	
<i>(\$ MILLIONS)</i>	XXI
<i>SUMMARY FIGURE WORLDWIDE SALES OF IMAGING</i>	
<i>COMPONENTS (\$ MILLIONS)</i>	XXI
OVERVIEW	1
FUNDAMENTALS OF IMAGING	1
APPLICATION SECTORS OF IMAGING.....	2
<i>TABLE 1 WORLDWIDE SALES OF IMAGING COMPONENTS TO</i>	
<i>VARIOUS IMAGING APPLICATIONS GROUPS (\$ MILLIONS)</i>	3
<i>FIGURE 1 COMPARISON OF SHARES OF IMAGING APPLICATIONS,</i>	
<i>2007 AND 2012 (%)</i>	4
MEDICAL APPLICATIONS.....	4
Computed Tomography (CT).....	5
Magnetic Resonance Imaging (MRI).....	6
Ultrasonography.....	6
X-rays	7
MASS CONSUMPTION APPLICATIONS	7
Cameras	8
Cameras (Continued).....	9
Impact Printers.....	10
Inkjet Printers	11
Laser Printers.....	11
HDTV	12
Projectors	13
INDUSTRIAL, SCIENTIFIC, AND DEFENSE (ISD)	
APPLICATIONS	14
Radio Detection and Ranging (Radar).....	14
Machine Vision	15
Telescopes	16

STEPS IN IMAGING PROCESS	17
<i>TABLE 2 WORLDWIDE SALES OF IMAGING COMPONENTS TO VARIOUS IMAGE PROCESSING GROUPS, THROUGH 2012 (\$ MILLIONS)</i>	17
<i>FIGURE 2 COMPARISON OF SHARES OF IMAGE PROCESSING GROUP, 2007 AND 2012 (%)</i>	18
FUNCTIONAL ANALYSIS OF IMAGING COMPONENTS.....	19
IMAGE CAPTURE.....	19
LASER IMAGING COMPONENTS	20
<i>TABLE 3 WORLDWIDE SALES OF IMAGING LASER COMPONENTS, THROUGH 2012 (\$ MILLIONS)</i>	20
Introduction and History.....	20
Implementation Methodologies.....	20
Implementation Methodologies (Continued)	21
Applications and Innovations	22
<i>TABLE 4 WORLDWIDE SALES OF IMAGING LASER COMPONENTS TO END- APPLICATIONS, THROUGH 2012 (\$ MILLIONS)</i>	22
<i>FIGURE 3 COMPARISON OF SHARES IMAGING APPLICATIONS, 2007 AND 2012: IMAGING LASER (%)</i>	23
Light Detection and Ranging (LIDAR)	24
Laser Printer.....	24
Rheumatoid Arthritis Scanner.....	25
Agfa.....	25
Konica Minolta.....	25
Maptek.....	25
Atomic Force Microscope	26
Benefits and Limitations.....	26
IMAGING LENS	27
<i>TABLE 5 WORLDWIDE SALES OF IMAGING LENS, THROUGH 2012 (\$ MILLIONS)</i>	27
History and Breakthroughs.....	27
Implementation Methodologies	28
Implementation Methodologies	29
Applications and Innovations	30
<i>TABLE 6 WORLDWIDE SALES OF IMAGING LENS TO APPLICATIONS, THROUGH 2012 (\$ MILLIONS)</i>	30
<i>FIGURE 4 COMPARISON OF SHARES OF IMAGING APPLICATIONS, 2007 AND 2012: IMAGING LENS (%)</i>	31
Rogers and Varioptic.....	32
Keeler	32
Lensfinder	32
University of California, Berkeley	32
UKA.....	33
Benefits and Limitations.....	33

IMAGING SENSORS.....	33
<i>TABLE 7 WORLDWIDE SALES OF IMAGING SENSORS, THROUGH 2012 (\$ MILLIONS)</i>	34
Introduction and History.....	34
Implementation Methodologies.....	34
Implementation Methodologies (Continued)	35
Implementation Methodologies (Continued)	36
Implementation Methodologies (Continued)	37
Implementation Methodologies (Continued)	38
Implementation Methodologies (Continued)	39
Applications and Innovations	40
<i>TABLE 8 WORLDWIDE SALES OF IMAGING SENSORS TO APPLICATIONS, THROUGH 2012 (\$ MILLIONS)</i>	40
<i>FIGURE 5 COMPARISON OF SHARES OF IMAGING APPLICATIONS, 2007 AND 2012: IMAGING SENSOR, 2007-2012 (%)</i>	41
United Microelectronics (UMC).....	42
Kodak.....	42
Micron.....	42
SUPERCONDUCTING WIRES.....	42
<i>TABLE 9 WORLDWIDE SALES OF SUPERCONDUCTING WIRES (\$ MILLIONS)</i>	43
Introduction and History.....	43
Implementation Methodology.....	44
Applications and Innovations	45
MRI.....	45
Los Almos National Laboratory	46
University of Illinois, Urbana Champaign	47
Oak Ridge National Laboratory	47
IMAGE ANALYSIS.....	48
IMAGING ASIC	48
<i>TABLE 10 WORLDWIDE SALES OF IMAGING ASICS (\$ MILLIONS)</i>	48
Introduction and History.....	49
Implementation Methodologies.....	49
Applications and Innovations	50
<i>TABLE 11 WORLDWIDE SALES OF IMAGING ASIC TO APPLICATIONS, THROUGH 2012 (\$ MILLIONS)</i>	50
<i>FIGURE 6 COMPARISON OF SHARES OF IMAGING APPLICATIONS, 2007 AND 2012: IMAGING ASIC (%)</i>	51
Teledyne	52
TI	52
Benefits and Limitations.....	52
IMAGING DSPS.....	53
<i>TABLE 12 WORLDWIDE SALES OF IMAGING DSPS, THROUGH 2012 (\$ MILLIONS)</i>	53

Introduction and History.....	53
Implementation Methodologies.....	54
Applications and Innovations	55
<i>TABLE 13 WORLDWIDE SALES OF IMAGING DSP TO APPLICATIONS, THROUGH 2012 (\$ MILLIONS)</i>	56
<i>FIGURE 7 COMPARISON OF SHARES OF IMAGING APPLICATIONS, 2007 AND 2012: IMAGING DSP (%)</i>	56
Medical Imaging	57
Kodak.....	57
Zoran.....	58
ST Microelectronics.....	58
Benefits and Limitations.....	59
IMAGING FPGAS	60
<i>TABLE 14 WORLDWIDE SALES OF IMAGING FPGAS, THROUGH 2012 (\$ MILLIONS)</i>	60
Introduction and History.....	60
Implementation Methodologies.....	61
Applications and Innovations	62
<i>TABLE 15 WORLDWIDE SALES OF IMAGING FPGA TO APPLICATIONS, THROUGH 2012 (\$ MILLIONS)</i>	62
<i>FIGURE 8 COMPARISON OF SHARES OF IMAGING APPLICATIONS, 2007 AND 2012: IMAGING FPGA (%)</i>	63
Altera.....	64
Heron Modular Systems	65
Celoxica and GiDEL	66
Mistral Solutions.....	66
Benefits and Limitations.....	66
Benefits ... (Continued)	67
IMAGING MEMORY	68
<i>TABLE 16 WORLDWIDE SALES OF IMAGING MEMORY, THROUGH 2012 (\$ MILLIONS)</i>	68
Implementation Methodologies.....	68
Applications and Innovations	68
<i>TABLE 17 WORLDWIDE SALES OF IMAGING MEMORY TO APPLICATIONS, THROUGH 2012 (\$ MILLIONS)</i>	69
<i>FIGURE 9 COMPARISON OF SHARES OF IMAGING APPLICATIONS, 2007 AND 2012: IMAGING MEMORY (%)</i>	69
Curtiss-Wright Controls	70
MoSys	70
Mayo Clinic and IBM.....	71
Laser printer	71
IMAGING SOCS	71
<i>TABLE 18 WORLDWIDE SALES OF IMAGING SOC, THROUGH 2012 (\$ MILLIONS)</i>	71

Introduction and History.....	72
Implementation Methodologies.....	72
Applications and Innovations	73
<i>TABLE 19 WORLDWIDE SALES OF IMAGING SOC TO APPLICATIONS, THROUGH 2012 (\$ MILLIONS)</i>	74
<i>FIGURE 10 COMPARISON OF SHARES OF IMAGING APPLICATIONS, 2007 AND 2012: IMAGING SOC (%)</i>	74
<i>FIGURE 10 (CONTINUED)</i>	75
TAK Imaging.....	75
LASMEA	75
Altasens.....	76
Connexant	76
SigmaTel	77
Pixelplus and Sharp Corporation.....	77
Agilent	77
Benefits and Limitations.....	78
IMAGING TRANSCEIVERS	78
<i>TABLE 20 WORLDWIDE SALES OF IMAGING TRANSCEIVER, THROUGH 2012 (\$ MILLIONS)</i>	78
Introduction and History.....	78
Applications and Innovations	79
<i>TABLE 21 WORLDWIDE SALES OF IMAGING TRANSCEIVER TO APPLICATIONS, THROUGH 2012 (\$ MILLIONS)</i>	79
<i>FIGURE 11 COMPARISON OF SHARES OF IMAGING APPLICATIONS, 2007 AND 2012: IMAGING TRANSCEIVER (%)</i>	79
<i>FIGURE 11 (CONTINUED)</i>	80
University of Massachusetts Lowell	80
Time Reversal (TR).....	81
Texas A&M University (TAMU)	81
Zarlink.....	82
IMAGE DISPLAY	82
PRINTING INKS	82
<i>TABLE 22 WORLDWIDE SALES OF PRINTING INK, THROUGH 2012 (\$ MILLIONS)</i>	83
Introduction and History.....	83
Implementation Methodologies.....	83
Applications and Innovations	83
<i>TABLE 23 WORLDWIDE SALES OF PRINTING INK TO APPLICATIONS, THROUGH 2012 (\$ MILLIONS)</i>	84
<i>FIGURE 12 COMPARISON OF SHARES OF IMAGING APPLICATIONS, 2007 AND 2012: PRINTING INK (%)</i>	84
Microtek	85
Ink Technology.....	85
HP	86

HP (Continued).....	87
INDUSTRY ANALYSIS	88
TABLE 24 WORLDWIDE SALES OF IMAGING COMPONENTS TO VARIOUS GEOGRAPHICAL REGIONS, THROUGH 2012 (\$ MILLIONS).....	88
FIGURE 13 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012 (%)......	89
MARKET DYNAMICS: IMAGE CAPTURE COMPONENTS	89
TABLE 25 WORLDWIDE SALE OF IMAGE CAPTURE COMPONENTS, THROUGH 2012 (\$MILLIONS).....	90
FIGURE 14 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: IMAGE CAPTURE COMPONENTS (%)......	90
TABLE 26 WORLDWIDE SALES OF IMAGING LASER COMPONENTS TO GEOGRAPHICAL REGIONS, THROUGH 2012 (\$ MILLIONS)	91
FIGURE 15 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: IMAGING LASER COMPONENTS (%)......	92
IMAGING LENS	93
TABLE 27 WORLDWIDE SALES OF IMAGING LENS TO GEOGRAPHICAL REGIONS, THROUGH 2012 (\$ MILLIONS).....	93
FIGURE 16 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: IMAGING LENS (%)......	94
IMAGE SENSORS	95
TABLE 28 WORLDWIDE SALES OF IMAGING SENSORS TO GEOGRAPHICAL REGIONS, THROUGH 2012 (\$ MILLIONS).....	96
FIGURE 17 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: IMAGING SENSORS (%)......	96
FIGURE 17 (CONTINUED)	97
SUPERCONDUCTING WIRES.....	97
TABLE 29 WORLDWIDE SALES OF SUPERCONDUCTING WIRES TO GEOGRAPHICAL REGIONS, THROUGH 2012 (\$ MILLIONS).....	98
FIGURE 18 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: SUPERCONDUCTING WIRES (%)......	99
MARKET DYNAMICS: IMAGE ANALYSIS	100
TABLE 30 WORLDWIDE SALE OF IMAGE ANALYSIS COMPONENTS, THROUGH 2012 (\$ MILLIONS).....	100
FIGURE 19 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: IMAGE ANALYSIS COMPONENTS (%)......	100
FIGURE 19 (CONTINUED)	101
IMAGING ASICS	101
TABLE 31 WORLDWIDE SALES OF IMAGING ASICS TO GEOGRAPHICAL REGIONS (\$ MILLIONS).....	102
FIGURE 20 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: IMAGING ASICS (%)......	102
FIGURE 20 (CONTINUED)	103

IMAGING DSPS.....	103
TABLE 32 WORLDWIDE SALES OF IMAGING DSPS TO GEOGRAPHICAL REGIONS (\$ MILLIONS).....	104
FIGURE 21 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: IMAGING DSPS (%).....	104
FIGURE 21 (CONTINUED).....	105
IMAGING FPGAS.....	105
TABLE 33 WORLDWIDE SALES OF IMAGING FPGAS TO GEOGRAPHICAL REGIONS, THROUGH 2012 (\$ MILLIONS).....	106
FIGURE 22 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: IMAGING FPGAS (%).....	107
IMAGING MEMORY.....	107
Imaging memory (Continued).....	108
TABLE 34 WORLDWIDE SALES OF IMAGING MEMORY TO GEOGRAPHICAL REGIONS, THROUGH 2012 (\$ MILLIONS).....	109
FIGURE 23 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: IMAGING MEMORY (%).....	110
IMAGING SOCS.....	110
TABLE 35 WORLDWIDE SALES OF IMAGING SOCS TO GEOGRAPHICAL REGIONS (\$ MILLIONS).....	111
FIGURE 24 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: IMAGING SOCS (%).....	112
IMAGING TRANSCEIVERS.....	112
TABLE 36 WORLDWIDE SALES OF IMAGING TRANSCEIVERS TO GEOGRAPHICAL REGIONS, THROUGH 2012 (\$ MILLIONS).....	113
FIGURE 25 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: IMAGING TRANSCEIVERS (%).....	114
MARKET DYNAMICS: IMAGE DISPLAY.....	115
PRINTING INKS.....	115
TABLE 37 WORLDWIDE SALES OF PRINTING INK TO GEOGRAPHICAL REGIONS, THROUGH 2012 (\$ MILLIONS).....	115
FIGURE 26 COMPARISON OF SHARES OF GEOGRAPHICAL REGIONS, 2007 AND 2012: PRINTING INK (%).....	116
STAKEHOLDER DETAILS.....	117
STAKEHOLDER CLASSIFICATION SUMMARY.....	117
TABLE 38 SUMMARY OF IMAGING COMPONENT EXPERTISE OF SELECTED STAKEHOLDERS.....	117
TABLE 38 (CONTINUED).....	118
STAKEHOLDER OPERATION DESCRIPTION.....	118
AGILENT.....	118
Agilent (Continued).....	119
ALTERA.....	120
Altera (Continued).....	121
AMKOR.....	122

CANON USA	123
CONEXANT	124
CYPRESS SEMICONDUCTORS	125
DBLUR TECHNOLOGIES	126
HYNIX	127
JASTEC SUPERCONDUCTOR	128
KODAK	129
MICRON	130
Micron (Continued)	131
NAZDAR	132
NIKON IMAGING	133
Nikon Imaging (Continued)	134
OMNIVISION TECHNOLOGIES	135
Omnivision Technologies (Continued)	136
OXFORD INSTRUMENTS	137
PENTAX	138
Pentax (Continued)	139
SAMSUNG ELECTRONICS	140
TELEDYNE SCIENTIFIC AND IMAGING (SI)	141
TESSERA	142
Tessera (Continued)	143
TEXAS INSTRUMENTS (TI)	144
UKAOPTICS	145
UKAoptics (Continued)	146
XEROX	147
XILINX	148
Xilinx (Continued)	149
ZARLINK	150
U.S. PATENT ANALYSIS	151
INTRODUCTION	151
YEAR OF GRANT OF THE PATENT	151
<i>FIGURE 27 IMAGING COMPONENTS: U.S. PATENT TRENDS, 1976–</i>	
<i>2007 (NUMBER OF PATENTS)</i>	<i>152</i>
POSITION OF THE PATENT IN THE IMAGING PROCESS	152
<i>FIGURE 28 CLASSIFICATION OF U.S. PATENTS AWARDED TO</i>	
<i>IMAGING COMPONENTS BY CATEGORY, 1976–2007 (%)</i>	<i>153</i>
POSITION OF THE PATENT IN THE ... (CONTINUED)	154
POSITION OF THE PATENT IN THE ... (CONTINUED)	155
POSITION OF THE PATENT IN THE ... (CONTINUED)	156
APPLICATIONS USING THE PATENT	157
<i>FIGURE 29 CLASSIFICATION OF U.S. PATENTS BY APPLICATION</i>	
<i>AWARDED TO IMAGING COMPONENTS, 1976–2007 (%)</i>	<i>158</i>
COUNTRIES OF THE PATENT ASSIGNEES	158

<i>FIGURE 30 SHARES OF U.S. PATENTS RELATED TO IMAGING COMPONENTS BY COUNTRY, 1976–2007 (%).....</i>	<i>159</i>
<i>PATENT ASSIGNEES.....</i>	<i>160</i>
<i>TABLE 39 ASSIGNEES OF TEN OR MORE U.S. PATENTS RELATED TO IMAGING COMPONENTS, 1976–2007</i>	<i>160</i>