

CHAPTER ONE: INTRODUCTION.....	1
STUDY GOALS AND OBJECTIVES.....	1
REASONS FOR DOING THE STUDY	1
SCOPE OF REPORT	2
INTENDED AUDIENCE.....	3
ANALYST CREDENTIALS.....	3
METHODOLOGY AND INFORMATION SOURCES.....	4
RELATED REPORTS.....	4
BCC ONLINE SERVICES.....	4
DISCLAIMER	5
 CHAPTER TWO: SUMMARY.....	 6
SUMMARY.....	6
<i>SUMMARY TABLE GLOBAL MARKET FOR COMMERCIAL BIOTECH SEPARATION SYSTEMS BY METHOD OF SEPARATION, THROUGH 2016 (\$ MILLIONS)</i>	 7
<i>SUMMARY FIGURE GLOBAL MARKET FOR COMMERCIAL BIOTECH SEPARATION SYSTEMS BY METHOD OF SEPARATION, 2011 AND 2016 (\$ MILLIONS)</i>	 8
 CHAPTER THREE: OVERVIEW	 9
BIOMOLECULAR SEPARATION SYSTEMS	9
<i>TABLE 1 GLOBAL MARKET RANKING FOR COMMERCIAL BIOTECH SEPARATION SYSTEMS, 2011 AND 2016 (%)</i>	 10
RED BIOTECHNOLOGY.....	10
WHITE BIOTECHNOLOGY.....	10
GREEN BIOTECHNOLOGY.....	11
BLUE BIOTECHNOLOGY	11
ANALYTICAL, PREPARATIVE, AND PRODUCTION SCALE PROCESSES.....	12
ANALYTICAL SCALE SEPARATION PROCESSES	12
PREPARATIVE SCALE SEPARATIONS.....	12
PRODUCTION SCALE SEPARATION	13
SCOPE	13
BIOMOLECULAR SEPARATIONS AND PURIFICATION.....	14
BIOMOLECULAR SEPARATIONS AND PURIFICATION (CONTINUED).....	15
BIOMOLECULAR SEPARATIONS AND PURIFICATION (CONTINUED).....	16
BIOMOLECULAR SEPARATIONS AND PURIFICATION (CONTINUED).....	17
Biomolecular Separations and Purification (Continued).....	18
SEPARATION TECHNOLOGY: CURRENT TRENDS	19
SEPARATION TECHNOLOGY.....	19

<i>TABLE 2 MAJOR COMPANIES IN THE BIOMOLECULAR SEPARATION MARKET AND MAJOR PRODUCT AREAS, 2011</i>	20
<i>TABLE 2 (CONTINUED)</i>	21
DRIVERS AND RESISTORS FOR BIOMOLECULAR SEPARATION MARKET	
MARKET.....	21
DRIVERS.....	21
RESISTORS.....	22
COMMERCIAL BIOMOLECULAR SEPARATION MARKET	22
PROTEINS	22
Proteins (Continued)	23
ANTIBODIES.....	24
ENZYMES	25
NUCLEIC ACIDS.....	25
Nucleic Acids (Continued)	26
HORMONES	27
CELLS	27
BLOOD AND SERUM PRODUCTS.....	28
ORGANIC PRODUCTS	29
<i>TABLE 3 GLOBAL MANUFACTURE OF BULK CHEMICAL SUBSTANCE BY BIOCATALYSIS, 2010 (METRIC TONS)</i>	29
COMMERCIAL SEPARATION SYSTEMS END-USE MARKETS	30
END USERS OF BIOTECHNOLOGY SEPARATION SYSTEMS	30
Pharmaceuticals	30
Food, Cosmetics, and Agriculture	31
Energy	32
COMMERCIAL BIOTECHNOLOGY SEPARATION SYSTEMS END-USER DISTRIBUTION WITHIN THE U.S. MARKET.....	32
BIOTECHNOLOGY ACTIVITY IN THE U.S.....	32
<i>TABLE 4 DISTRIBUTION OF U.S. BIOTECHNOLOGY AND BIOPHARMA COMPANIES BY REGION, 2008 (%)</i>	33
DISTRIBUTION OF SEPARATIONS SYSTEMS BY END USERS	34
DISTRIBUTION OF SEPARATIONS ... (CONTINUED).....	35
DISTRIBUTION OF SEPARATIONS ... (CONTINUED).....	36
OVERVIEW OF THE GLOBAL COMMERCIAL BIOMOLECULAR SEPARATIONS MARKET	37
<i>TABLE 5 GLOBAL MARKET FOR BIOMOLECULAR SEPARATIONS SYSTEMS INDUSTRY BY REGION, THROUGH 2016 (\$ MILLIONS)</i>	37
OVERVIEW OF GLOBAL MARKET SEPARATION SYSTEMS GROWTH BY SEPARATION METHOD.....	38
<i>TABLE 6 GLOBAL MARKET FOR SEPARATION SYSTEMS BY SEPARATION METHOD, THROUGH 2016 (\$ MILLIONS)</i>	38
SEPARATION SYSTEMS MARKET: COMPETITIVE STRUCTURE	39
<i>TABLE 7 COMPETITIVE STRUCTURE, 2010</i>	39
DISTRIBUTION STRUCTURE.....	40

KEY END USERS.....	40
MERGERS AND ACQUISITIONS.....	40
<i>TABLE 8 ACQUIRED BIOTECHNOLOGY AND BIOPHARMACEUTICAL COMPANIES, 2008–2010 (\$ MILLIONS)</i>	41
<i>TABLE 8 (CONTINUED)</i>	42
<i>TABLE 8 (CONTINUED)</i>	43
<i>TABLE 8 (CONTINUED)</i>	44
<i>TABLE 8 (CONTINUED)</i>	45
<i>TABLE 8 (CONTINUED)</i>	46
<i>TABLE 8 (CONTINUED)</i>	47
<i>TABLE 8 (CONTINUED)</i>	48
<i>TABLE 8 (CONTINUED)</i>	49
CHAPTER FOUR: CENTRIFUGATION SYSTEMS IN BIOTECHNOLOGY	50
CENTRIFUGATION SYSTEMS IN BIOTECHNOLOGY	50
<i>TABLE 9 CENTRIFUGATION PROCESSES AND CHEMICALS USED</i>	51
TYPES OF CENTRIFUGATION PROCEDURES	51
APPLICATIONS OF CENTRIFUGATION IN SEPARATION.....	52
APPLICATIONS OF CENTRIFUGATION SYSTEMS IN THE BIOTECH INDUSTRY	52
Applications of Centrifugation ... (Continued).....	53
DRIVERS FOR CENTRIFUGATION SYSTEMS IN THE BIOTECH INDUSTRY	54
<i>TABLE 10 GLOBAL MARKET FOR CENTRIFUGATION SEPARATION SYSTEMS BY REGION, THROUGH 2016 (\$ MILLIONS)</i>	55
<i>TABLE 11 CENTRIFUGATION SEPARATION SYSTEMS MARKET, THROUGH 2016 (\$ MILLIONS)</i>	55
DRIVERS FOR CENTRIFUGATION ... (CONTINUED)	56
<i>TABLE 12 PRODUCT TECHNOLOGY IN ULTRACENTRIFUGATION BY COMPANY, 2011</i>	56
<i>TABLE 12 (CONTINUED)</i>	57
KEY PLAYERS IN THE CENTRIFUGATION SEPARATION SYSTEMS GLOBAL MARKET.....	57
CHAPTER FIVE: LIQUID CHROMATOGRAPHY IN BIOMOLECULAR SEPARATIONS IN BIOTECHNOLOGY	58
LIQUID CHROMATOGRAPHY... ..	58
LIQUID CHROMATOGRAPHY...(CONTINUED).....	59
<i>TABLE 13 PRODUCT TECHNOLOGY IN CHROMATOGRAPHY BY COMPANY, 2011</i>	60
<i>TABLE 13 (CONTINUED)</i>	61
ION EXCHANGE CHROMATOGRAPHY	61
GEL FILTRATION CHROMATOGRAPHY.....	62
AFFINITY CHROMATOGRAPHY	62
THIN-LAYER CHROMATOGRAPHY.....	63

FLASH CHROMATOGRAPHY.....	63
HIGH-PERFORMANCE, THIN-LAYER CHROMATOGRAPHY.....	63
APPLICATIONS OF LIQUID CHROMATOGRAPHY IN THE	
GLOBAL BIOMOLECULAR SEPARATIONS INDUSTRY.....	64
LIFE SCIENCES.....	64
PHARMACEUTICAL DEVELOPMENT.....	64
CLINICAL.....	65
FOOD AND FLAVOR.....	65
DRIVERS OF LIQUID CHROMATOGRAPHY IN THE	
BIOMOLECULAR SEPARATION INDUSTRY.....	66
MARKET ANALYSIS OF THE GLOBAL LIQUID	
CHROMATOGRAPHY BIOTECH INDUSTRY THROUGH 2011.....	66
<i>TABLE 14 GLOBAL MARKET FOR LIQUID CHROMATOGRAPHY</i>	
<i>SYSTEMS BY REGION, THROUGH 2016 (\$ MILLIONS).....</i>	<i>67</i>
<i>TABLE 15 GLOBAL MARKET FOR CHROMATOGRAPHY SYSTEMS</i>	
<i>BY TECHNOLOGY, THROUGH 2016 (\$ MILLIONS).....</i>	<i>67</i>
<i>TABLE 16 KEY PLAYERS IN THE LIQUID CHROMATOGRAPHY</i>	
<i>SEPARATION SYSTEMS MARKET, 2010.....</i>	<i>68</i>
CHAPTER SIX: ELECTROPHORESIS IN BIOMOLECULAR	
SEPARATIONS.....	69
TYPES OF ELECTROPHORESIS.....	69
GEL ELECTROPHORESIS.....	69
Two-Dimensional Gel Electrophoresis.....	70
CAPILLARY ELECTROPHORESIS.....	71
Capillary Gel Electrophoresis.....	72
Capillary Isoelectric Focusing.....	72
Capillary Electro-Chromatography.....	72
DIELECTROPHORESIS.....	73
FREE-FLOW ELECTROPHORESIS.....	73
APPLICATION OF ELECTROPHORESIS IN THE BIOMOLECULAR	
SEPARATIONS INDUSTRY.....	74
DRIVERS OF ELECTROPHORESIS IN THE BIOMOLECULAR	
SEPARATIONS INDUSTRY.....	75
MARKET ANALYSIS OF GLOBAL ELECTROPHORESIS	
BIOMOLECULAR SEPARATIONS.....	75
<i>TABLE 17 GLOBAL MARKET FOR ELECTROPHORESIS SYSTEMS BY</i>	
<i>REGION, THROUGH 2016 (\$ MILLIONS).....</i>	<i>76</i>
<i>TABLE 18 GLOBAL MARKET FOR ELECTROPHORESIS SYSTEMS BY</i>	
<i>METHOD, THROUGH 2016 (\$ MILLIONS).....</i>	<i>76</i>
KEY PLAYERS IN ELECTROPHORESIS SEPARATION SYSTEMS	
GLOBAL MARKET.....	77
CHAPTER SEVEN: MEMBRANE FILTRATION IN BIOMOLECULAR	
SEPARATIONS.....	78

MATERIAL COMPOSITION OF MEMBRANE FILTERS.....	78
<i>TABLE 19 CLASSES OF FILTRATION BY PORE SIZE AND APPLICATION.....</i>	<i>78</i>
CROSS-FLOW AND TANGENTIAL FLOW FILTRATION	79
BIOMOLECULAR FILTRATION CONFIGURATIONS	79
CERAMIC MEMBRANES	80
PLASTIC-IRRADIATED-ETCHED FILTERS.....	80
ADVANTAGES OF MEMBRANE SYSTEMS	81
DISADVANTAGES OF MEMBRANE SYSTEMS.....	81
APPLICATION OF MEMBRANE FILTRATION TO THE BIOMOLECULAR SEPARATIONS INDUSTRY.....	81
APPLICATIONS IN THE BIOPHARMA INDUSTRY	82
CURRENT TRENDS.....	82
DRIVERS OF MEMBRANE FILTRATION IN THE BIOMOLECULAR SEPARATIONS INDUSTRY.....	83
HIGH DEMAND FOR PROTEIN SEPARATION	83
HIGH QUALITY AND YIELD.....	83
LOW OVERALL COSTS.....	84
MARKET ANALYSIS OF MEMBRANE FILTRATION IN THE BIOMOLECULAR SEPARATIONS INDUSTRY THROUGH 2016	84
<i>TABLE 20 GLOBAL MARKET FOR MEMBRANE FILTRATION SYSTEMS BY REGION, THROUGH 2016 (\$ MILLIONS).....</i>	<i>84</i>
KEY PLAYERS IN THE GLOBAL MARKET FOR MEMBRANE FILTRATION SEPARATION SYSTEMS.....	85
KEY PLAYERS IN THE GLOBAL MARKET (CONTINUED).....	86
CHAPTER EIGHT: NEW METHODS OF BIOMOLECULAR SEPARATION	87
MICROARRAY AND LAB-ON-A-CHIP	87
MICROARRAYS.....	87
Microarrays (Continued)	88
BIOCHIPS	89
LAB-ON-A-CHIP	90
FLOW CYTOMETRY.....	91
CLINICAL APPLICATIONS OF FLOW CYTOMETER	92
MAGNETIC SEPARATION	93
MAGNETIC SEPARATION (CONTINUED).....	94
<i>TABLE 21 GLOBAL MARKET FOR NEW SEPARATION METHODS BY REGION, THROUGH 2016 (\$ MILLIONS).....</i>	<i>95</i>
<i>TABLE 22 MARKET FOR NEW SEPARATIONS METHODS, THROUGH 2016 (\$ MILLIONS).....</i>	<i>96</i>
<i>TABLE 23 KEY PLAYERS IN EACH OF THE NEW SEPARATIONS MARKET SEGMENTS.....</i>	<i>97</i>
MAGNETIC SEPARATION (CONTINUED).....	98
CHAPTER NINE: COMPANY PROFILES	99

AFFYMETRIX.....	99
AGILENT TECHNOLOGIES.....	100
ALFA LAVAL GROUP.....	101
ALFA WASSERMANN SEPARATION TECHNOLOGIES.....	102
APPLIED BIOSYSTEMS CORPORATION.....	102
BECKMAN COULTER, INC.....	103
BD BIOSCIENCES (BECTON, DICKINSON, AND COMPANY).....	104
BIO-RAD LABORATORIES, INC.....	105
CALIPER LIFE SCIENCES.....	106
DIONEX.....	107
FLOTTWEG SEPARATIONS TECHNOLOGY.....	108
GE HEALTHCARE LIFE SCIENCES.....	109
HITACHI KOKI CO., LTD.....	109
INVITROGEN.....	110
LIFE TECHNOLOGIES.....	111
MILLIPORE BIOMANUFACTURING AND LIFE SCIENCES (MERCK KGAA).....	111
NOVASEP LIFE SCIENCES MANUFACTURING SOLUTIONS.....	112
PALL CORPORATION.....	113
PERKIN-ELMER.....	113
QIAGEN GMBH.....	114
SEPMAG TECHNOLOGIES.....	115
SARTORIUS STEDMAN BIOTECH CORPORATION.....	115
SHIMADZU SCIENTIFIC INSTRUMENTS.....	116
TECAN GROUP, LTD.....	117
THERMO FISHER SCIENTIFIC.....	117
WATERS CORPORATION.....	118
WHATMAN INTERNATIONAL, LTD.....	119

CHAPTER TEN: PATENTS FOR BIOMOLECULAR SEPARATIONS-

RELATED INSTRUMENTATION AND ACCESSORIES.....	120
<i>TABLE 24 PATENTS ISSUED FOR BIOMOLECULAR SEPARATIONS TECHNOLOGIES, 2005–2010.....</i>	<i>120</i>
<i>TABLE 25 U.S. AND E.U. BIOMOLECULAR SEPARATIONS PATENTS BY AREA (%).....</i>	<i>121</i>
<i>TABLE 26 BIO-RAD LABORATORIES PARTIAL U.S. PATENT LIST.....</i>	<i>121</i>
<i>TABLE 26 (CONTINUED).....</i>	<i>122</i>
<i>TABLE 27 AGILENT TECHNOLOGIES PARTIAL U.S. PATENT LIST.....</i>	<i>122</i>
<i>TABLE 28 GE HEALTHCARE LIFE SCIENCES PARTIAL U.S. PATENT LIST.....</i>	<i>123</i>
<i>TABLE 29 WATERS CORPORATION PARTIAL U.S. PATENT LIST.....</i>	<i>123</i>
<i>TABLE 30 MERCK MILLIPORE CORPORATION PARTIAL U.S. PATENT LIST.....</i>	<i>124</i>
<i>TABLE 31 GLOBAL CHROMATOGRAPHY PATENTS.....</i>	<i>124</i>
<i>TABLE 31 (CONTINUED).....</i>	<i>125</i>

<i>TABLE 31 (CONTINUED)</i>	126
<i>TABLE 32 MEMBRANE FILTRATION PATENTS</i>	126
<i>TABLE 32 (CONTINUED)</i>	127
<i>TABLE 33 ELECTROPHORESIS PATENTS</i>	128
APPENDIX.....	129
<i>TABLE 34 KEY WEBSITES</i>	129
<i>TABLE 35 KEY INDUSTRY AND REGULATORY ASSOCIATIONS</i>	129