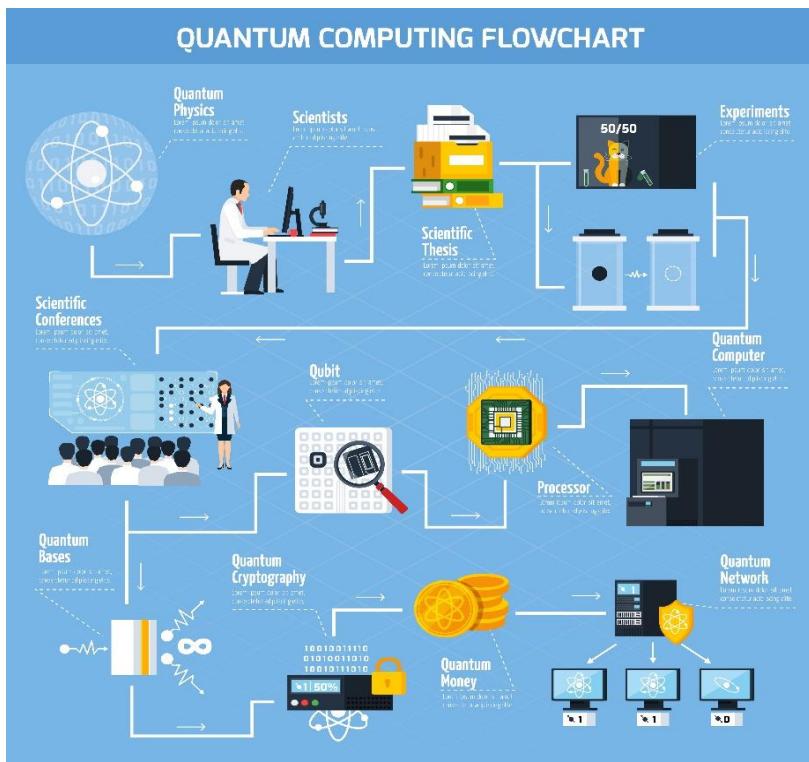


2018-2024

Quantum Computing Market & Technologies



Industry 4.0 Research

Quantum Computing Market & Technologies

2018-2024

Volume 1

Industry 4.0 Research (division of **HSRC**) is an international market and technology research publisher specializing in premium Industry 4.0 and Quantum Technologies market. With an extensive portfolio of Industry 4.0 and Quantum Computing reports, **Industry 4.0 Research** has been recognized as the global leader in the Forth Industrial Revolution market research.

601 Pennsylvania Ave., NW Suite 900. Washington DC 20004
Tel: (202) 740-9606, info@i40research.com

Table of Contents

1	Executive Summary	24
1.1	Findings & Conclusions	24
1.2	Global Quantum Computing Market – 2018-2024	38
1.2.1	Government-Funded RDT&E Vs. Products & Services Market	38
1.2.2	Global Quantum Computing Market by Sector	39
1.2.3	Global Quantum Computing Vertical Markets	40
1.2.4	Global Quantum Computing Market by Revenue Source	41
1.2.5	Global Quantum Computing Market by Region	42
1.2.6	Global Quantum Computing Market by Country	43
 MARKET BACKGROUND		44
2	Quantum Computing Market Background.....	44
2.1	The Global Information Technology (IT) Market.....	44
2.2	Quantum Computing.....	45
2.3	Why Are Quantum Computers Attractive?	48
2.4	Quantum Computing Outlook	49
2.5	Quantum Supremacy	50
2.6	Quantum Technologies Timeline	51
2.7	Investments in Quantum Computing	59
2.8	Quantum Computing Technology Roadmap	60
2.9	Topological Quantum Computers	60
2.10	The 2 nd Quantum Revolution	61
2.11	Applications of Quantum Computing.....	61
2.12	The Private Sector Quantum Computing R&D Activities.....	62
2.13	The Global Quantum Computing Race	65
2.14	China – U.S. Quantum Information Leadership Race	65
3	Quantum Information Bids, Tenders and Projects Data	67
4	Quantum Computing Value Chain	73
 GLOBAL MARKET		74
5	SWOT Analysis	74
5.1	Strengths	74
5.2	Weaknesses	74
5.3	Opportunities	75
5.4	Threats.....	76
6	Global Quantum Computing Market – 2018-2024	78
6.1	Global Quantum Computing Market by Sector	78
6.1.1	Market Forecast – 2016-2024	78

6.1.2	Market Dynamics – 2016-2024.....	79
6.1.3	Market Breakdown – 2016-2024	80
6.2	Global Quantum Computing Market by Revenue Source	80
6.2.1	Quantum Computing Systems Market.....	80
6.2.2	Quantum Computing Software Market	80
6.2.3	Quantum Computing as a Service Market.....	82
6.2.4	Quantum Computing Government Financed R&D Market	83
6.2.5	Global Market Forecast – 2016-2024	83
6.2.6	Market Dynamics – 2016-2024.....	84
6.2.7	Market Breakdown – 2016-2024	85
6.3	Global Quantum Computing Market by Region	86
6.3.1	Market Forecast by Region – 2016-2024	86
6.3.2	Market Dynamics – 2016-2024.....	87
6.3.3	Market Breakdown by Region – 2016-2024	87
7	Quantum Computing by Sector – 2018-2024.....	88
7.1	National Security Quantum Computing Market	88
7.1.1	Market Forecast by Region – 2016-2024	88
7.1.2	Market Dynamics – 2016-2024.....	89
7.1.3	Market Breakdown by Region – 2016-2024	90
7.2	Government Quantum Computing Market	90
7.2.1	Market Forecast by Region – 2016-2024	91
7.2.2	Market Dynamics – 2016-2024.....	92
7.2.3	Market Breakdown by Region – 2016-2024	92
7.3	Government-Funded RDT&E Quantum Computing Market	93
7.3.1	Market Forecast by Region – 2016-2024	93
7.3.2	Market Dynamics – 2016-2024.....	94
7.3.3	Market Breakdown by Region – 2016-2024	95
7.4	Industry & Business Sectors Quantum Computing Market	95
7.4.1	Market Forecast by Region – 2016-2024	96
7.4.2	Market Dynamics – 2016-2024.....	97
7.4.3	Market Breakdown by Region – 2016-2024	97
8	Quantum Computing Vertical Markets – 2018-2024	98
8.1	Defense & Intelligence Quantum Computing Market	98
8.1.1	National Security Intelligence	98
8.1.2	Defense	99
8.1.3	Global Defense & Intelligence Quantum Computing Market – 2016-2024	100
8.1.3.1	Market Forecast.....	100
8.1.3.2	Market Dynamics	101
8.2	Homeland Security & Public Safety Quantum Computing Market.....	102
8.2.1	Public Safety	102
8.2.2	Homeland Security	102

8.2.3	Global Homeland Security & Public Safety Quantum Computing Market – 2016-2024	103
8.2.3.1	Market Forecast.....	103
8.2.3.2	Market Dynamics	104
8.3	Government & Public Services Quantum Computing Market	105
8.3.1	Market Background	105
8.3.2	Global Government & Public Services Quantum Computing Market – 2016-2024	105
8.3.2.1	Market Forecast.....	105
8.3.2.2	Market Dynamics	106
8.4	Gov.-Funded RDT&E Quantum Computing Market	107
8.4.1	Gov.-Funded RDT&E Quantum Computing by Country - 2016	107
8.4.2	Global Government-Funded RDT&E Quantum Computing Market – 2016-2024	108
8.4.2.1	Market Forecast.....	108
8.4.2.2	Market Dynamics	109
8.5	Banking & Securities Quantum Computing Market	109
8.5.1	Market Background	109
8.5.2	Global Banking & Securities Quantum Computing Market – 2016-2024	110
8.5.2.1	Market Forecast.....	110
8.5.2.2	Market Dynamics	111
8.6	Manufacturing & Logistics Quantum Computing Market	112
8.6.1	Mission Planning/Scheduling and Logistics.....	112
8.6.2	Global Manufacturing & Logistics Quantum Computing Market – 2016-2024	114
8.6.2.1	Market Forecast.....	114
8.6.2.2	Market Dynamics	115
8.7	Insurance Quantum Computing Market	115
8.7.1	Market Background	115
8.7.2	Global Insurance Quantum Computing Market – 2016-2024	116
8.7.2.1	Market Forecast.....	116
8.7.2.2	Market Dynamics	117
8.8	Healthcare & Pharmaceutical Quantum Computing Market.....	117
8.8.1	Overview	117
8.8.2	Medical Diagnostics Quantum Computing Market Background	118
8.8.3	Medical Treatments Quantum Computing Market Background	118
8.8.4	Example: Combating Cancer.....	119
8.8.5	The Folding@home Project.....	119
8.8.6	Pharmacology Quantum Computing	119
8.8.7	Protein Folding Quantum Computing Market Background	120

8.8.8	Global Healthcare & Pharmaceutical Quantum Computing Market – 2016-2024	121
8.8.8.1	Market Forecast.....	121
8.8.8.2	Market Dynamics	122
8.9	Retail & Wholesale Quantum Computing Market.....	122
8.9.1	Market Background	122
8.9.2	Global Retail & Wholesale Quantum Computing Market – 2016-2024	123
8.9.2.1	Market Forecast.....	123
8.9.2.2	Market Dynamics	124
8.10	Information Technology Industry Quantum Computing Market.....	124
8.10.1	Software Verification & Validation	124
8.10.2	Global Information Technology Industry Quantum Computing Market – 2016-2024	125
8.10.2.1	Market Forecast.....	125
8.10.2.2	Market Dynamics	126
8.11	Telecommunications Quantum Computing Market	126
8.11.1	Global Telecommunications Quantum Computing Market – 2016-2024	128
8.11.1.1	Market Forecast.....	128
8.11.1.2	Market Dynamics	129
8.12	Automotive, Aerospace & Transportation Quantum Computing Market.....	129
8.12.1	Market Background	129
8.12.2	Global Automotive, Aerospace & Transportation Quantum Computing Market – 2016-2024	130
8.12.2.1	Market Forecast.....	130
8.12.2.2	Market Dynamics	131
8.13	Energy & Utilities Quantum Computing Market.....	132
8.13.1	Market Background	132
8.13.2	Global Energy & Utilities Quantum Computing Market – 2016-2024	132
8.13.2.1	Market Forecast.....	132
8.13.2.2	Market Dynamics	133
8.14	Web, Media & Entertainment Quantum Computing Market	134
8.14.1	Market Background	134
8.14.2	Global Web, Media & Entertainment Quantum Computing Market – 2016-2024	134
8.14.2.1	Market Forecast.....	134
8.14.2.2	Market Dynamics	135
8.15	Smart Cities Quantum Computing Market	136
8.15.1	Market Background	136
8.15.2	Global Smart Cities Quantum Computing Market – 2016-2024	136
8.15.2.1	Market Forecast.....	136

8.15.2.2	Market Dynamics	137
8.16	Cybersecurity Quantum Computing Market	137
8.16.1	Market Background	137
8.16.2	Global Cybersecurity Quantum Computing Market – 2016-2024	141
8.16.2.1	Market Forecast.....	141
8.16.2.2	Market Dynamics	142
8.17	Other Vertical Markets Quantum Computing Market	143
8.17.1	Market Forecast	143
8.17.2	Market Dynamics.....	144
REGIONAL MARKETS		145
9	Global Quantum Computing Market by Region	145
9.1	North America Quantum Computing Markets – 2018-2024	145
9.1.1	North America Quantum Computing Market by Sector	145
9.1.1.1	Market Forecast – 2016-2024.....	145
9.1.1.2	Market Dynamics – 2016-2024	146
9.1.1.3	Market Breakdown – 2016-2024.....	147
9.1.2	North America Quantum Computing Market by Revenue Source.....	148
9.1.2.1	Market Forecast – 2016-2024.....	148
9.1.2.2	Market Dynamics – 2016-2024	149
9.1.2.3	Market Breakdown – 2016-2024.....	149
9.2	Europe Quantum Computing Markets – 2018-2024.....	150
9.2.1	Europe Quantum Computing Market by Sector	150
9.2.1.1	Market Forecast – 2016-2024.....	150
9.2.1.2	Market Dynamics – 2016-2024	151
9.2.1.3	Market Breakdown – 2016-2024.....	152
9.2.2	Europe Quantum Computing Market by Revenue Source	153
9.2.2.1	Market Forecast – 2016-2024.....	153
9.2.2.2	Market Dynamics – 2016-2024	154
9.2.2.3	Market Breakdown – 2016-2024.....	154
9.3	Asia-Pacific Quantum Computing Markets – 2018-2024	155
9.3.1	Asia-Pacific Quantum Computing Market by Sector.....	155
9.3.1.1	Market Forecast – 2016-2024.....	155
9.3.1.2	Market Dynamics – 2016-2024	156
9.3.1.3	Market Breakdown – 2016-2024.....	157
9.3.2	Asia-Pacific Quantum Computing Market by Revenue Source	158
9.3.2.1	Market Forecast – 2016-2024.....	158
9.3.2.2	Market Dynamics – 2016-2024	159
9.3.2.3	Market Breakdown – 2016-2024.....	159
9.4	ROW Quantum Computing Markets – 2018-2024	160
9.4.1	ROW Quantum Computing Market by Sector.....	160

9.4.1.1	Market Forecast – 2016-2024.....	160
9.4.1.2	Market Dynamics – 2016-2024	161
9.4.1.3	Market Breakdown – 2016-2024.....	162
9.4.2	ROW Quantum Computing Market by Revenue Source	163
9.4.2.1	Market Forecast – 2016-2024.....	163
9.4.2.2	Market Dynamics – 2016-2024	164
9.4.2.3	Market Breakdown – 2016-2024.....	164
NATIONAL MARKETS.....		165
North America		165
10 U.S. Quantum Computing Market – 2018-2024		165
10.1	U.S. Market Background.....	165
10.2	U.S. Quantum Computing Market Background	165
10.2.1	U.S. Government Quantum Computing.....	165
10.2.2	U.S. Government Investment in Quantum Computing: Introduction.....	166
10.2.3	DOD: Quantum Computing Activities, Projects & Funding	166
10.2.4	DOE: Quantum Computing Activities, Projects & Funding	167
10.2.5	NSA: Quantum Computing Activities, Projects & Funding	168
10.2.6	IARPA: Quantum Computing Activities, Projects & Funding	168
10.2.7	NIST: Quantum Computing Activities, Projects & Funding	169
10.2.8	NSF: Quantum Computing Activities, Projects & Funding	170
10.2.9	U.S.A. Supercomputing Race.....	170
10.2.10	Federal Quantum Computing Outlook - 2018-2024.....	171
10.2.11	U.S. Private Sector Quantum Computing Market Background	172
10.2.12	U.S. Quantum Computing RDT&E	173
10.3	The U.S.-Chinese, Quantum Technology Race	174
10.3.1	Scope	174
10.3.2	U.S. Strategic Considerations	175
10.3.3	Quantum Encryption and Communication Race.....	176
10.3.4	The Quantum Sensing Race	177
10.4	U.S. Quantum Computing Market - 2018-2024.....	179
10.4.1	Market Forecast – 2016-2024	179
10.4.2	Market Dynamics – 2016-2024.....	180
11 Canada Quantum Computing Market – 2018-2024		181
11.1	Canada Market Background	181
11.2	Canada Quantum Computing Market Background	181

11.3 Canada Quantum Computing Market - 2018-2024	182
11.3.1 Market Forecast – 2016-2024	182
11.3.2 Market Dynamics – 2016-2024.....	183
Europe	184
12 The EU Quantum Computing Activities.....	184
12.1 Introduction	184
12.2 EU Research Frameworks	185
12.3 European Commission Future & Emerging Technologies Program QC Activities.....	186
12.3.1 Funding	186
12.3.2 The EU Cloud Initiative.....	187
12.3.3 The EU Quantum Technology Flagship.....	187
12.3.4 The EU Quantum Technology Program	187
12.4 The EU Quantum Computing Industry Program	188
13 UK Quantum Computing Market – 2018-2024	190
13.1 UK Market Background.....	190
13.2 UK Quantum Computing Market Background	190
13.3 UK Quantum Computing Market - 2018-2024.....	192
13.3.1 Market Forecast – 2016-2024	192
13.3.2 Market Dynamics – 2016-2024.....	193
14 France Quantum Computing Market – 2018-2024.....	194
14.1 France Market Background.....	194
14.2 France Quantum Computing Activities.....	194
14.2.1 The France QC National Network	194
14.2.2 Quantum Computation in France	195
14.2.3 Quantum Group.....	195
14.2.4 Atos SE	196
14.2.5 IBM France	196
14.2.6 Paris Centre for Quantum Computing	197
14.3 France Quantum Computing Market - 2018-2024.....	197
14.3.1 Market Forecast – 2016-2024	197
14.3.2 Market Dynamics – 2016-2024.....	198
15 The Netherlands Quantum Computing Market – 2018-2024	199
15.1 Netherlands Market Background.....	199
15.2 Netherlands Quantum Computing Activities	199
15.3 Netherlands Quantum Computing Market - 2018-2024	201
15.3.1 Market Forecast – 2016-2024	201
15.3.2 Market Dynamics – 2016-2024.....	202
16 Denmark, Sweden, Norway, Finland Quantum Computing Market – 2018-2024.....	203
16.1 Market Background	203
16.2 Denmark, Sweden, Norway and Finland Quantum Computing Market – 2018-2024	204
16.2.1 Market Forecast – 2016-2024	204

16.2.2	Market Dynamics – 2016-2024.....	206
17	Germany Quantum Computing Market – 2018-2024.....	207
17.1	Germany Market Background	207
17.2	Germany Quantum Computing Activities	207
17.3	Germany Quantum Computing Market - 2018-2024	208
17.3.1	Market Forecast – 2016-2024	208
17.3.2	Market Dynamics – 2016-2024.....	209
18	Switzerland Quantum Computing Market – 2018-2024	210
18.1	Switzerland Market Background	210
18.2	Switzerland Quantum Computing Market – 2018-2024	210
18.2.1	Market Forecast – 2016-2024	210
18.2.2	Market Dynamics – 2016-2024.....	211
19	Russia Quantum Computing Market – 2018-2024.....	212
19.1	Russia Market Background.....	212
19.2	Russia Quantum Computing Activities.....	212
19.3	Russia Quantum Computing Market - 2018-2024.....	213
19.3.1	Market Forecast – 2016-2024	213
19.3.2	Market Dynamics – 2016-2024.....	214
20	Rest of Europe Quantum Computing Market – 2016-2024.....	215
20.1	Market Forecast – 2018-2024	215
20.2	Market Dynamics – 2018-2024	216
Asia-Pacific		217
21	India Quantum Computing Market – 2018-2024.....	217
21.1	India Market Background	217
21.2	India Quantum Computing Market Background	217
21.3	India Quantum Computing Market - 2018-2024	217
21.3.1	Market Forecast – 2016-2024	217
21.3.2	Market Dynamics – 2016-2024.....	218
22	China Quantum Computing Market – 2018-2024	219
22.1	.China Market Background	219
22.2	China Quantum Computing Market Background	219
22.2.1	Quantum Information in China.....	219
22.2.2	Government-Funded RDT&E	221
22.2.3	Made in China 2025 Program.....	222
22.2.4	Chinese Quantum Computing Advances.....	222
22.2.5	PRC's Quantum Cryptography and Communications	223
22.2.6	PRC Quantum Sensing Programs.....	224
22.2.7	China-U.S. Quantum Information Race	225
22.2.8	Limitations of the U.S. Quantum Information Programs	226
22.2.9	U.S. Vs. Chinese Intellectual property (IP) Race	227
22.2.10	China Supercomputing Lead	229
22.3	China Quantum Computing Market - 2018-2024	231
22.3.1	Market Forecast – 2016-2024	231

22.3.2	Market Dynamics – 2016-2024.....	232
23	Japan Quantum Computing Market – 2018-2024	233
23.1	Japan Market Background	233
23.2	Japan Quantum Computing Activities	233
23.3	Japan Quantum Computing Market - 2018-2024	234
23.3.1	Market Forecast – 2016-2024	234
23.3.2	Market Dynamics – 2016-2024.....	235
24	Singapore Quantum Computing Market – 2018-2024.....	236
24.1	Singapore Market Background.....	236
24.2	Singapore Quantum Computing Activities	236
24.3	Singapore Quantum Computing Market - 2018-2024	237
24.3.1	Market Forecast – 2016-2024	237
24.3.2	Market Dynamics – 2016-2024.....	238
25	Australia Quantum Computing Market – 2018-2024	239
25.1	Australia Market Background.....	239
25.2	Australia Quantum Computing Activities	239
25.3	Australia Quantum Computing Market - 2018-2024	240
25.3.1	Market Forecast – 2016-2024	240
25.3.2	Market Dynamics – 2016-2024.....	241
26	Rest of Asia Pacific Quantum Computing Market – 2018-2024	242
26.1	Market Forecast – 2018-2024.....	242
26.2	Market Dynamics – 2018-2024	243
Latin America		244
27	Mexico Quantum Computing Market – 2018-2024	244
27.1	Mexico Market Background	244
27.2	Mexico Quantum Computing Market - 2018-2024	244
27.2.1	Market Forecast – 2016-2024	244
27.2.2	Market Dynamics – 2016-2024.....	245
28	Brazil Quantum Computing Market – 2018-2024.....	246
28.1	Brazil Market Background.....	246
28.2	Brazil Quantum Computing Activities	246
28.3	Brazil Quantum Computing Market - 2018-2024	246
28.3.1	Market Forecast – 2016-2024	246
28.3.2	Market Dynamics – 2016-2024.....	247
29	Rest of Latin America Quantum Computing Market – 2018-2024	248
29.1	Market Forecast – 2018-2024.....	248
29.2	Market Dynamics – 2018-2024	249
ME&A		250
30	Saudi Arabia Quantum Computing Market – 2018-2024	250
30.1	Saudi Arabia Market Background	250

30.2	Saudi Arabia Quantum Computing Market - 2018-2024	250
30.2.1	Market Forecast – 2016-2024	250
30.2.2	Market Dynamics – 2016-2024.....	251
31	Other GCC Quantum Computing Market – 2018-2024.....	252
31.1	Market Background.....	252
31.1.1	UAE Market Background	252
31.1.2	Qatar Market Background	252
31.1.3	Kuwait Market Background.....	252
31.2	Quantum Computing Activities.....	252
31.3	Other GCC Quantum Computing Market - 2018-2024.....	252
31.3.1	Market Forecast – 2016-2024	252
31.3.2	Market Dynamics – 2016-2024.....	253
32	Israel Quantum Computing Market – 2018-2024.....	254
32.1	Israel Market Background	254
32.2	Israel Quantum Computing Activities	254
32.3	Israel Quantum Computing Market - 2018-2024	254
32.3.1	Market Forecast – 2016-2024	254
32.3.2	Market Dynamics – 2016-2024.....	255
33	South Africa Quantum Computing Market – 2018-2024	256
33.1	Market Background.....	256
33.2	South Africa Quantum Computing Market - 2018-2024	256
33.2.1	Market Forecast – 2016-2024	256
33.2.2	Market Dynamics – 2016-2024.....	257
34	Rest of ME&A Quantum Computing Market – 2018-2024.....	258
34.1	Market Forecast – 2018-2024.....	258
34.2	Market Dynamics – 2018-2024	259

List of Tables

Table 1 – Global Quantum Computing Market [\$M] – 2016-2024: Government-Funded RDT&E vs. Products & Services Market	38
Table 2 – Global Quantum Computing Market [\$M] by Sector – 2016-2024.....	39
Table 3 – Global Quantum Computing Vertical Markets [\$M] – 2016-2024	40
Table 4 – Global Quantum Computing Market* [\$M] by Revenue Source – 2016-2024.....	41
Table 5 – Global Quantum Computing Market* [\$M] by Region – 2016- 2024.....	42
Table 6 – Global Quantum Computing Market* AGRs [%] by Region – 2016-2024.....	42
Table 7 – Global Quantum Computing Market* [\$M] by Country – 2016- 2024.....	43
Table 8 – The Global IT Market [\$B] & Market Share [%] By Revenue Source – 2017	44
Table 9 – Global IT Market Share [%] By Region – 2016	44
Table 10 – Global IT Market [\$B] By Industry – 2016	44
Table 11 – Quantum Computing Investment by Investor	59
Table 12 – Quantum Information 2014-2017 Bids, Tenders and Projects	67
Table 13 – Global Quantum Computing Market* [\$M] by Sector – 2016- 2024.....	78
Table 14 – Global Quantum Computing Market* AGRs [%] by Sector – 2016-2024.....	79
Table 15 – Global Quantum Computing Market* [\$M] by Revenue Source – 2016-2024.....	83
Table 16 – Global Quantum Computing Market AGRs [%] by Revenue Source – 2016-2024	84
Table 17 – Global Quantum Computing Market* [\$M] by Region – 2016- 2024.....	86
Table 18 – Global Quantum Computing Market* AGRs [%] by Region – 2016-2024.....	87
Table 19 – Global National Security Quantum Computing Market* [\$M] by Region – 2016-2024	88
Table 20 – Global National Security Quantum Computing Market* AGRs [%] by Region – 2016-2024	89
Table 21 – Global Government Quantum Computing Market* [\$M] by Region – 2016-2024	91
Table 22 – Global Government Quantum Computing Market* AGRs [%] by Region – 2016-2024	92
Table 23 – Global Government-Funded RDT&E Quantum Computing Market* [\$M] by Region – 2016-2024	93
Table 24 – Global Government-funded RDT&E Quantum Computing Market* AGRs [%] by Region – 2016-2024.....	94
Table 25 – Global Industry & Business Sectors Quantum Computing Market* [\$M] by Region – 2016-2024	96

Table 26 – Global Industry & Business Sectors Quantum Computing Market* AGRs [%] by Region – 2016-2024.....	97
Table 27 – Global Defense & Intelligence Quantum Computing Market* [\$M] – 2016-2024.....	100
Table 28 – Global Defense & Intelligence Quantum Computing Market* AGRs [%] – 2016-2024.....	101
Table 29 – Global Homeland Security & Public Safety Quantum Computing Market* [\$M] – 2016-2024	103
Table 30 – Global Homeland Security & Public Safety Quantum Computing Market* AGRs [%] – 2016-2024.....	104
Table 31 – Global Government & Public Services Quantum Computing Market* [\$M] – 2016-2024	106
Table 32 – Global Government & Public Services Quantum Computing Market* AGRs [%] – 2016-2024.....	106
Table 33 – Government-Funded RDT&E by Country – 2016.....	107
Table 34 – Global Gov.-Funded RDT&E Quantum Computing Market [\$M] – 2016-2024.....	108
Table 35 – Global Gov.-Funded RDT&E Quantum Computing Market AGRs [%] – 2016-2024.....	109
Table 36 – Global Banking & Securities Quantum Computing Market* [\$M] – 2016-2024.....	111
Table 37 – Global Banking & Securities Quantum Computing Market* AGRs [%] – 2016-2024.....	111
Table 38 – Global Manufacturing & Logistics Quantum Computing Market* [\$M] – 2016-2024.....	114
Table 39 – Global Manufacturing & Logistics Quantum Computing Market* AGRs [%] – 2016-2024.....	115
Table 40 – Global Insurance Quantum Computing Market* [\$M] – 2016-2024.....	116
Table 41 – Global Insurance Quantum Computing Market* AGRs [%] – 2016-2024.....	117
Table 42 – Global Healthcare & Pharmaceutical Quantum Computing Market* [\$M] – 2016-2024	121
Table 43 – Global Healthcare & Pharmaceutical Quantum Computing Market* AGRs [%] – 2016-2024.....	122
Table 44 – Global Retail & Wholesale Quantum Computing Market* [\$M] – 2016-2024.....	123
Table 45 – Global Retail & Wholesale Quantum Computing Market* AGRs [%] – 2016-2024	124
Table 46 – Global Information Technology Industry Quantum Computing Market* [\$M] – 2016-2024	125
Table 47 – Global Information Technology Industry Quantum Computing Market* AGRs [%] – 2016-2024.....	126
Table 48 – Global Telecommunications Quantum Computing Market* [\$M] – 2016-2024.....	128

Table 49 – Global Telecommunications Quantum Computing Market* AGRs [%] – 2016-2024	129
Table 50 – Global Automotive, Aerospace & Transportation Quantum Computing Market* [\$M] – 2016-2024	131
Table 51 – Global Automotive, Aerospace & Transportation Quantum Computing Market* AGRs [%] – 2016-2024	131
Table 52 – Global Energy & Utilities Quantum Computing Market* [\$M] – 2016-2024	132
Table 53 – Global Energy & Utilities Quantum Computing Market* AGRs [%] – 2016-2024	133
Table 54 – Global Web, Media & Entertainment Quantum Computing Market* [\$M] – 2016-2024	134
Table 55 – Global Web, Media & Entertainment Quantum Computing Market* AGRs [%] – 2016-2024	135
Table 56 – Global Smart Cities Quantum Computing Market* [\$M] – 2016-2024	136
Table 57 – Global Smart Cities Quantum Computing Market* AGRs [%] – 2016-2024	137
Table 58 – Global Cybersecurity Quantum Computing Market* [\$M] – 2016-2024	141
Table 59 – Global Cybersecurity Quantum Computing Market* AGRs [%] – 2016-2024	142
Table 60 – Global Other Vertical Markets Quantum Computing Market* [\$M] – 2016-2024	143
Table 61 – Global Other Vertical Markets Quantum Computing Market* AGRs [%] – 2016-2024	144
Table 62 – North America Quantum Computing Market* [\$M] by Sector – 2016-2024	145
Table 63 – North America Quantum Computing Market* AGRs [%] by Sector – 2016-2024	146
Table 64 – North America Quantum Computing Market [\$M] by Revenue Source – 2016-2024	148
Table 65 – North America Quantum Computing Market AGRs [%] by Revenue Source – 2016-2024	149
Table 66 – Europe Quantum Computing Market* [\$M] by Sector – 2016-2024	150
Table 67 – Europe Quantum Computing Market* AGRs [%] by Sector – 2016-2024	151
Table 68 – Europe Quantum Computing Market [\$M] by Revenue Source – 2016-2024	153
Table 69 – Europe Quantum Computing Market AGRs [%] by Revenue Source – 2016-2024	154
Table 70 – Asia-Pacific Quantum Computing Market* [\$M] by Sector – 2016-2024	155
Table 71 – Asia-Pacific Quantum Computing Market* AGRs [%] by Sector – 2016-2024	156

Table 72 – Asia-Pacific Quantum Computing Market [\$M] by Revenue Source – 2016-2024	158
Table 73 – Asia-Pacific Quantum Computing Market AGRs [%] by Revenue Source – 2016-2024	159
Table 74 – ROW Quantum Computing Market* [\$M] by Sector – 2016-2024 ...	160
Table 75 – ROW Quantum Computing Market* AGRs [%] by Sector – 2016-2024.....	161
Table 76 – ROW Quantum Computing Market [\$M] by Revenue Source – 2016-2024.....	163
Table 77 – ROW Quantum Computing Market AGRs [%] by Revenue Source – 2016-2024	164
Table 78 – U.S. Quantum Computing Market* [\$M] – 2016-2024.....	179
Table 79 – U.S. Quantum Computing Market* AGRs [%] – 2016-2024	180
Table 80 – Canada Quantum Computing Market* [\$M] – 2016-2024	182
Table 81 – Canada Quantum Computing Market* AGRs [%] – 2016-2024	183
Table 82 – European Quantum Technology Program Expected Applications	188
Table 83 – UK Quantum Computing Market* [\$M] – 2016-2024.....	192
Table 84 – UK Quantum Computing Market* AGRs [%] – 2016-2024	193
Table 85 – France Quantum Computing Market* [\$M] – 2016-2024.....	198
Table 86 – France Quantum Computing Market* AGRs [%] – 2016-2024	198
Table 87 – The Netherlands Quantum Computing Market* [\$M] – 2016- 2024.....	201
Table 88 – The Netherlands Quantum Computing Market* AGRs [%] – 2016-2024.....	202
Table 89 – Denmark, Sweden, Norway and Finland Quantum Computing Market* [\$M] – 2016-2024	204
Table 90 – Denmark, Sweden, Norway and Finland Quantum Computing Market* AGRs [%] – 2016-2024.....	206
Table 91 – Germany Quantum Computing Market* [\$M] – 2016-2024	208
Table 92 – Germany Quantum Computing Market* AGRs [%] – 2016-2024	209
Table 93 – Switzerland Quantum Computing Market* [\$M] – 2016-2024	210
Table 94 – Switzerland Quantum Computing Market* AGRs [%] – 2016- 2024.....	211
Table 95 – Russia Quantum Computing Market* [\$M] – 2016-2024.....	213
Table 96 – Russia Quantum Computing Market* AGRs [%] – 2016-2024	214
Table 97 – Rest of Europe Quantum Computing Market* [\$M] – 2016-2024 ...	215
Table 98 – Rest of Europe Quantum Computing Market* AGRs [%] – 2016- 2024.....	216
Table 99 – India Quantum Computing Market* [\$M] – 2016-2024	217
Table 100 – India Quantum Computing Market* AGRs [%] – 2016-2024	218
Table 101 – China Quantum Computing Market* [\$M] – 2016-2024	231
Table 102 – China Quantum Computing Market* AGRs [%] – 2016-2024.....	232
Table 103 – Japan Quantum Computing Market* [\$M] – 2016-2024	234
Table 104 – Japan Quantum Computing Market* AGRs [%] – 2016-2024	235
Table 105 – Singapore Quantum Computing Market* [\$M] – 2016-2024	237

Table 106 – Singapore Quantum Computing Market* AGRs [%] – 2016-2024.....	238
Table 107 – Australia Quantum Computing Market* [\$M] – 2016-2024.....	240
Table 108 – Australia Quantum Computing Market* AGRs [%] – 2016-2024	241
Table 109 – Rest of Asia Pacific Quantum Computing Market* [\$M] – 2016-2024.....	242
Table 110 – Rest of Asia Pacific Quantum Computing Market* AGRs [%] – 2016-2024.....	243
Table 111 – Mexico Quantum Computing Market* [\$M] – 2016-2024	245
Table 112 – Mexico Quantum Computing Market* AGRs [%] – 2016-2024.....	245
Table 113 – Brazil Quantum Computing Market* [\$M] – 2016-2024.....	247
Table 114 – Brazil Quantum Computing Market* AGRs [%] – 2016-2024	247
Table 115 – Rest of Latin America Quantum Computing Market* [\$M] – 2016-2024.....	248
Table 116 – Rest of Latin America Quantum Computing Market* AGRs [%] – 2016-2024.....	249
Table 117 – Saudi Arabia Quantum Computing Market* [\$M] – 2016-2024	250
Table 118 – Saudi Arabia Quantum Computing Market* AGRs [%] – 2016-2024.....	251
Table 119 – Other GCC Quantum Computing Market* [\$M] – 2016-2024	253
Table 120 – Other GCC Quantum Computing Market* AGRs [%] – 2016-2024.....	253
Table 121 – Israel Quantum Computing Market* [\$M] – 2016-2024	255
Table 122 – Israel Quantum Computing Market* AGRs [%] – 2016-2024	255
Table 123 – South Africa Quantum Computing Market* [\$M] – 2016-2024	257
Table 124 – South Africa Quantum Computing Market* AGRs [%] – 2016-2024.....	257
Table 125 – Rest of ME&A Quantum Computing Market* [\$M] – 2016-2024	258
Table 126 – Rest of ME&A Quantum Computing Market* AGRs [%] – 2016-2024.....	259

List of Figures

Figure 1 – Quantum Computing Race Corporations	32
Figure 2 – IBM – Google Quantum Computing Race.....	33
Figure 3 – Quantum Computing Market* - 2018 & 2024	34
Figure 4 – Quantum Computing Applications Organogram	37
Figure 5 – Global Quantum Computing Market [\$M] – 2016-2024: Government-Funded RDT&E vs. Products & Services Market	38
Figure 6 – Global Quantum Computing Market Shares [%] by Sector – 2016-2024.....	39
Figure 7 – Global Quantum Computing Market Shares [%] by Revenue Source – 2016-2024	41
Figure 8 – Three Types of Quantum Computing and Applications	46
Figure 9 – IBM – Google Quantum Computing Race.....	57
Figure 10 – TNO Quantum Technologies Timeline Outlook – 2015-2035	58
Figure 11 – Quantum Computing Technology Roadmap	60
Figure 12 – Applications of Quantum Computing	62
Figure 13 – Leading IT Companies and Defense Contractors Investing in Quantum Computing.....	63
Figure 14 – Leading Quantum Computing Companies Technology Approaches.....	64
Figure 15 – Quantum Computing, Patent Applications by Country to 2015	65
Figure 16 – Quantum Patent Applications Timeline 2000-2015.....	66
Figure 17 – Global Quantum Computing Market* [\$M] by Sector – 2016- 2024.....	79
Figure 18 – Global Quantum Computing Market Shares [%] by Sector – 2016-2024.....	80
Figure 19 – Global Quantum Computing Market [\$M] by Revenue Source – 2016-2024.....	84
Figure 20 – Global Quantum Computing Market Shares [%] by Revenue Source – 2016-2024	85
Figure 21 – Global Quantum Computing Market* [\$M] by Region – 2016- 2024.....	86
Figure 22 – Regional Quantum Computing Market* Shares [%] – 2016- 2024.....	87
Figure 23 – Global National Security Quantum Computing Market* [\$M] by Region – 2016-2024	89
Figure 24 – Regional National Security Quantum Computing Market* Shares [%] – 2016-2024	90
Figure 25 – Global Government Quantum Computing Market* [\$M] by Region – 2016-2024	91
Figure 26 – Regional Government Quantum Computing Market* Shares [%] – 2016-2024	92
Figure 27 – Global Government-Funded RDT&E Quantum Computing Market* [\$M] by Region – 2016-2024	94

Figure 28 – Regional Government-Funded RDT&E Quantum Computing Market* Shares [%] – 2016-2024.....	95
Figure 29 – Global Industry & Business Sectors Quantum Computing Market* [\$M] by Region – 2016-2024	96
Figure 30 – Regional Industry & Business Sectors Quantum Computing Market* Shares [%] – 2016-2024.....	97
Figure 31 – Global Defense & Intelligence Quantum Computing Market* [\$M] – 2016-2024.....	101
Figure 32 – Global Homeland Security & Public Safety Quantum Computing Market* [\$M] – 2016-2024	104
Figure 33 – Global Government & Public Services Quantum Computing Market* [\$M] – 2016-2024	106
Figure 34 – Global Gov.-Funded RDT&E Quantum Computing Market [\$M] – 2016-2024.....	108
Figure 35 – Global Banking & Securities Quantum Computing Market* [\$M] – 2016-2024.....	111
Figure 36 – Global Manufacturing & Logistics Quantum Computing Market* [\$M] – 2016-2024.....	114
Figure 37 – Global Insurance Quantum Computing Market* [\$M] – 2016-2024.....	116
Figure 38 – Global Healthcare & Pharmaceutical Quantum Computing Market* [\$M] – 2016-2024	121
Figure 39 – Global Retail & Wholesale Quantum Computing Market* [\$M] – 2016-2024.....	123
Figure 40 – Global Information Technology Industry Quantum Computing Market* [\$M] – 2016-2024	126
Figure 41 – Global Telecommunications Quantum Computing Market* [\$M] – 2016-2024.....	128
Figure 42 – QC Promises to Aerospace Activities	130
Figure 43 – Global Automotive, Aerospace & Transportation Quantum Computing Market* [\$M] – 2016-2024	131
Figure 44 – Global Energy & Utilities Quantum Computing Market* [\$M] – 2016-2024.....	133
Figure 45 – Global Web, Media & Entertainment Quantum Computing Market* [\$M] – 2016-2024	135
Figure 46 – Global Smart Cities Quantum Computing Market* [\$M] – 2016-2024.....	137
Figure 47 – Global Cybersecurity Quantum Computing Market* [\$M] – 2016-2024.....	142
Figure 48 – Global Other Vertical Markets Quantum Computing Market* [\$M] – 2016-2024.....	143
Figure 49 – North America Quantum Computing Market* [\$M] by Sector – 2016-2024.....	146
Figure 50 – North America Quantum Computing Market Shares [%] by Sector – 2016-2024	147

Figure 51 – North America Quantum Computing Market [\$M] by Revenue Source – 2016-2024	148
Figure 52 – North America Quantum Computing Market Shares [%] by Revenue Source – 2016-2024	149
Figure 53 – Europe Quantum Computing Market* [\$M] by Sector – 2016- 2024.....	151
Figure 54 – Europe Quantum Computing Market Shares [%] by Sector – 2016-2024.....	152
Figure 55 – Europe Quantum Computing Market [\$M] by Revenue Source – 2016-2024.....	153
Figure 56 – Europe Quantum Computing Market Shares [%] by Revenue Source – 2016-2024	154
Figure 57 – Asia-Pacific Quantum Computing Market* [\$M] by Sector – 2016-2024.....	156
Figure 58 – Asia-Pacific Quantum Computing Market Shares [%] by Sector – 2016-2024.....	157
Figure 59 – Asia-Pacific Quantum Computing Market [\$M] by Revenue Source – 2016-2024	158
Figure 60 – Asia-Pacific Quantum Computing Market Shares [%] by Revenue Source – 2016-2024	159
Figure 61 – ROW Quantum Computing Market* [\$M] by Sector – 2016- 2024.....	161
Figure 62 – ROW Quantum Computing Market Shares [%] by Sector – 2016-2024.....	162
Figure 63 – ROW Quantum Computing Market [\$M] by Revenue Source – 2016-2024.....	163
Figure 64 – ROW Quantum Computing Market Shares [%] by Revenue Source – 2016-2024	164
Figure 65 – U.S. Quantum Computing Market* [\$M] – 2016-2024	179
Figure 66 – Canada Quantum Computing Market* [\$M] – 2016-2024	182
Figure 67 –The UK QC Research Hubs.....	191
Figure 68 – UK Quantum Computing Market* [\$M] – 2016-2024	192
Figure 69 – France Quantum Computing Market* [\$M] – 2016-2024	198
Figure 70 – QuTech Focus Areas	199
Figure 71 – Dutch Quantum Computing Research Centers.....	200
Figure 72 –The Dutch 2016-2022 H2020 QC Research Program	201
Figure 73 – The Netherlands Quantum Computing Market* [\$M] – 2016- 2024.....	202
Figure 74 – Denmark, Sweden, Norway and Finland Quantum Computing Market* [\$M] – 2016-2024	205
Figure 75 – Germany Quantum Computing Market* [\$M] – 2016-2024.....	208
Figure 76 – Switzerland Quantum Computing Market* [\$M] – 2016-2024	211
Figure 77 – Russia Quantum Computing Market* [\$M] – 2016-2024.....	214
Figure 78 – Rest of Europe Quantum Computing Market* [\$M] – 2016-2024...215	215
Figure 79 – India Quantum Computing Market* [\$M] – 2016-2024.....	218
Figure 80 – China Quantum Computing, Patent Applications Status.....	227

Figure 81 – China Quantum Patent Applications Timeline Vs. The U.S. Japan, Europe & Korea	228
Figure 82 – China Quantum Computing Market* [\$M] – 2016-2024	231
Figure 83 – Japan Quantum Computing Market* [\$M] – 2016-2024.....	234
Figure 84 – Singapore Quantum Computing Market* [\$M] – 2016-2024	237
Figure 85 – Australia Quantum Computing Market* [\$M] – 2016-2024.....	240
Figure 86 – Rest of Asia Pacific Quantum Computing Market* [\$M] – 2016- 2024.....	242
Figure 87 – Mexico Quantum Computing Market* [\$M] – 2016-2024	245
Figure 88 – Brazil Quantum Computing Market* [\$M] – 2016-2024	247
Figure 89 – Rest of Latin America Quantum Computing Market* [\$M] – 2016-2024.....	248
Figure 90 – Saudi Arabia Quantum Computing Market* [\$M] – 2016-2024	251
Figure 91 – Other GCC Quantum Computing Market* [\$M] – 2016-2024.....	253
Figure 92 – Israel Quantum Computing Market* [\$M] – 2016-2024.....	255
Figure 93 – South Africa Quantum Computing Market* [\$M] – 2016-2024	257

Quantum Computing Market & Technologies

2018-2024

Volume 2

Table of Contents

BUSINESS OPPORTUNITIES	17
1 Quantum Computing Business Opportunities.....	17
1.1 Business Opportunities Roadmap.....	17
1.2 Machine Learning	18
1.3 Search Engines.....	19
1.4 Business Intelligence	20
1.5 Software/Hardware Validation and Verification	20
1.6 Image and Pattern Recognition.....	21
1.7 National Security Intelligence.....	21
1.8 Defense	21
1.9 Public Safety	21
1.10 Homeland Security.....	21
1.11 Government & Public Services	21
1.12 Banking & Financial Services	22
1.13 Financial Electronic Trading & Trading Strategies	22
1.14 Smart Manufacturing & Logistics	24
1.15 Mission Planning/Scheduling and Logistics	24
1.16 Insurance	24
1.17 Medical Diagnostics	24
1.18 Medical Treatments	24
1.19 Pharmacology	24
1.20 Protein Folding.....	24
1.21 Retail & Wholesale.....	24
1.22 Information Technology Industry.....	25
1.23 Telecommunication.....	25
1.24 Automotive & Transportation	25
1.25 Aerospace.....	25
1.26 Energy & Utilities.....	26
1.27 Energy Systems & Photovoltaics	26
1.28 Energy Exploration.....	26
1.29 Web, Media & Entertainment	26
1.30 Smart Cities	26
1.31 Cybersecurity	26
1.32 Quantum Computing Systems	26
1.33 Quantum Computing Software.....	26
1.34 Quantum Computing as a Service on the Cloud	27
1.35 Academia & National Labs.....	27
1.36 Graph Theory Problems.....	27
1.37 Material Science	28
1.38 Marine Science	28
1.39 Bioinformatics	29
1.40 Climate Modeling & Weather Predictions.....	29
1.41 Seismic Survey	30
1.42 Risk Management.....	31

1.43	Simulation	32
1.44	Video Compression.....	32
1.45	Cryptography	33
1.45.1	Quantum Cryptography	33
1.45.2	Post-quantum Cryptography.....	33
1.46	QC Based Optimization Problems	34
1.46.1	Optimization Problems	34
1.46.2	Quantum-Assisted Optimization	34
1.46.3	Reservoir Optimization Applications	35
1.46.4	Utilities Management Optimization	35
1.47	Quantum Computing Based Machine Learning	35
1.47.1	Quantum Machine Learning	35
1.47.2	Quantum Reinforcement Learning	36
1.48	Big Data & Predictive Analytics.....	36
1.49	Material Science	37
1.50	Quantum Sampling	38
1.51	Quantum Chemistry	38
1.52	Monte Carlo Simulation.....	39
2	Moore's Law Outlook	41
LEADING VENDORS		44
3	Quantum Computing Companies.....	44
3.1	1Qbit	44
3.1.1	Company Profile	44
3.1.2	Quantum Computing Activities	44
3.2	Agilent Technologies.....	45
3.2.1	Company Profile	45
3.2.2	Quantum Computing Activities	45
3.3	Aifotec AG.....	45
3.3.1	Company Profile	45
3.3.2	Quantum Computing Activities	46
3.4	Airbus Group.....	46
3.4.1	Company Profile	46
3.4.2	Quantum Computing Activities	46
3.5	Alcatel-Lucent	47
3.5.1	Company Profile	47
3.5.2	Quantum Computing Activities	47
3.6	Alibaba Group Holding Limited	47
3.6.1	Company Profile	47
3.6.2	Quantum Computing Activities	48
3.7	Anyon Systems, Inc	48
3.7.1	Company Profile	48
3.7.2	Quantum Computing Activities	48
3.8	Artiste-qb.net	49
3.8.1	Company Profile	49

3.8.2	Quantum Computing Activities	49
3.9	Avago Technologies	49
3.10	Booz Allen Hamilton.....	49
3.10.1	Company Profile	49
3.10.2	Quantum Computing Activities	50
3.11	British Telecommunications (BT)	50
3.11.1	Company Profile	50
3.11.2	Quantum Computing Activities	51
3.12	Cambridge Quantum Computing Limited.....	51
3.12.1	Company Profile	51
3.12.2	Quantum Computing Activities	52
3.13	Ciena Corporation.....	52
3.13.1	Company Profile	52
3.13.2	Quantum Computing Activities	52
3.14	Cyoptics	53
3.14.1	Company Profile	53
3.14.2	Quantum Computing Activities	53
3.15	D-Wave Systems Inc	53
3.15.1	Company Overview	53
3.15.2	Quantum Computing Activities	54
3.16	Eagle Power Technologies, Inc.....	54
3.16.1	Company Profile	54
3.16.2	Quantum Computing Activities	55
3.17	Emcore Corporation.....	55
3.17.1	Company Profile	55
3.17.2	Quantum Computing Activities	55
3.18	Enablence Technologies.....	55
3.18.1	Company Profile	55
3.18.2	Quantum Computing Activities	55
3.19	Entanglement Partners	56
3.20	Fathom Computing	56
3.20.1	Company Profile	56
3.20.2	Quantum Computing Activities	56
3.21	Finisar Corporation	56
3.22	Fujitsu Limited.....	57
3.22.1	Company Profile	57
3.22.2	Quantum Computing Activities	57
3.23	Google Quantum AI Lab	59
3.23.1	Company Profile	59
3.23.2	Quantum Computing Activities	59
3.24	H-Bar Quantum Consultants	60
3.25	Hewlett Packard Enterprise Company	61
3.25.1	Company Profile	61
3.25.2	Quantum Computing Activities	61
3.26	IBM	62
3.26.1	Company Profile	62

3.26.2	Quantum Computing Activities	62
3.27	ID Quantique.....	63
3.27.1	Company Profile	63
3.27.2	Quantum Computing Activities	64
3.28	Infinera Corporation	64
3.28.1	Company Profile	64
3.28.2	Quantum Computing Activities	64
3.29	Intel Corp.	65
3.29.1	Company Profile	65
3.29.2	Quantum Computing Activities	65
3.30	IonQ	66
3.30.1	Company Profile	66
3.30.2	Quantum Computing Activities	66
3.31	JDS Uniphase Corporation	66
3.32	Kaiam Corporation	67
3.32.1	Company Profile	67
3.32.2	Quantum Computing Activities	67
3.33	Lockheed Martin Corp.....	67
3.33.1	Company Profile	67
3.33.2	Quantum Computing Activities	68
3.34	MagiQ Technologies, Inc.	68
3.34.1	Company Profile	68
3.34.2	Quantum Computing Activities	69
3.35	Microsoft Quantum Architectures and Computation Group (QuArC)	69
3.35.1	Company Profile	69
3.35.2	Quantum Computing Activities	69
3.36	Mitsubishi Electric Corp.	70
3.36.1	Company Profile	70
3.36.2	Quantum Computing Activities	70
3.37	NEC	71
3.37.1	Company Profile	71
3.37.2	Quantum Computing Activities	72
3.38	Nokia Bell Labs	72
3.38.1	Company Profile	72
3.38.2	Quantum Computing Activities	72
3.39	NTT Basic Research Laboratories & NTT Secure Platform Laboratories	73
3.39.1	Company Profile	73
3.39.2	Quantum Computing Activities	73
3.40	Optalysys Ltd.	73
3.40.1	Company Profile	73
3.40.2	Quantum Computing Activities	74
3.41	Post-Quantum.....	74
3.41.1	Company Profile	74
3.41.2	Quantum Computing Activities	74

3.42 QbitLogic.....	74
3.42.1 Company Profile	74
3.42.2 Quantum Computing Activities	75
3.43 QC Ware Corp.	75
3.43.1 Company Profile	75
3.43.2 Quantum Computing Activities	75
3.44 Quantum Circuits	75
3.44.1 Company Profile	75
3.45 Quantum Hardware Inc.....	76
3.45.1 Company Profile	76
3.45.2 Quantum Computing Activities	76
3.46 QuantumCTek.....	76
3.46.1 Company Profile	76
3.46.2 Quantum Computing Activities	76
3.47 Qubitekk.....	76
3.47.1 Company Profile	76
3.47.2 Quantum Computing Activities	77
3.48 Quintessence Labs	77
3.48.1 Company Profile	77
3.48.2 Quantum Computing Activities	77
3.49 QxBranch.....	77
3.50 Raytheon BBN	78
3.50.1 Company Profile	78
3.50.2 Quantum Computing Activities	78
3.51 Rigetti Computing	79
3.51.1 Company Profile	79
3.51.2 Quantum Computing Activities	79
3.52 SeQureNet	80
3.53 SK Telecom	80
3.53.1 Company Profile	80
3.53.2 Quantum Computing Activities	80
3.54 Sparrow Quantum.....	81
3.54.1 Company Profile	81
3.54.2 Quantum Computing Activities	81
3.55 Toshiba	82
3.55.1 Company Profile	82
3.55.2 Quantum Computing Activities	82
3.56 Xanadu	82
4 Quantum Computing Startups	83

APPENDICES.....	86
5 Appendix A: Introduction to Quantum Computing.....	86

5.1.1	Superposition	89
5.1.2	Entanglement	89
5.1.2.1	Ion-based Qubits	89
5.1.2.2	Superconducting Qubits	90
5.1.2.3	Solid-State Spin Qubits.....	90
6	Appendix B: Quantum Information Technologies	91
6.1	Quantum information	91
6.2	Shared Principles.....	91
6.3	Quantum Computing.....	91
6.4	Quantum Cryptography:.....	92
6.5	Quantum Sensing	93
7	Appendix C: Quantum Computing Hardware.....	95
8	Appendix D: Quantum Computing Software.....	96
8.1	Introduction to Quantum Algorithms.....	96
9	Appendix E: Quantum Encryption	97
9.1	Background.....	97
9.2	Key Findings	97
9.3	Spooks Reacting at a Distance	99
10	Appendix F: Global 50 Top Supercomputers.....	101
11	Appendix G: Industry Investment in Quantum Computing.....	106
12	Appendix H: NQIT R&D Projects	110
12.1	Background.....	110
12.2	Architectures, Standards and Systems Integration	110
12.3	Ion Trap Node Engineering	110
12.4	Atom-photon Interfaces.....	111
12.5	Photonic Network Engineering.....	111
12.6	Solid State Node Engineering	111
12.7	Secure Communications and Verification	112
12.8	Networked Quantum Sensors	112
12.9	Quantum Digital Simulation	112
12.10	Hybrid Classical/Quantum Computing	112
12.11	Capabilities and Support.....	113
13	Appendix I: Exascale Computing	114
13.1	Exascale Computing Definition	114
13.2	U.S. Exascale Computing Activities	114
13.3	China Exascale Computing Activities.....	114
13.4	EU Exascale Computing Activities	114
13.5	Japan Exascale Computing Activities	115
13.6	India Exascale Computing Activities	115
13.7	Exascale Computing Challenges	115
14	Appendix J: Market Background by Country.....	116
14.1	U.S. Market Background.....	116

14.1.1	Facts & Figures	116
14.1.2	U.S. Economy	116
14.1.3	Department of Homeland Security	116
14.1.3.1	Department of Homeland Security: Agencies and Units	118
14.1.4	Department of Defense (DOD)	120
14.1.5	Department of Justice (DOJ)	120
14.1.6	Federal Bureau of Investigation (FBI).....	123
14.1.7	Department of State (DOS)	124
14.1.8	National Aeronautic & Space Administration (NASA)	125
14.1.9	Department of Transportation (DOT).....	125
14.1.9.1	Department of Commerce (DOC)	126
14.1.10	U.S. Police Forces.....	127
14.2	Canada Market Background	128
14.2.1	Facts & Figures	128
14.2.2	Canada Geopolitical Overview	128
14.2.3	Canada Economy	129
14.2.4	Canada Defense, Intelligence, Law Enforcement & Homeland Security Agencies	130
14.2.5	Canadian Police Forces	131
14.2.6	Canada Intelligent Services.....	131
14.2.7	Canada Defense Forces.....	132
14.3	Mexico Market Background	132
14.3.1	Facts & Figures	132
14.3.2	Mexico Geopolitical Overview	132
14.3.3	Mexico Economy	133
14.3.4	Mexico Defense, Intelligence, Law Enforcement & Homeland Security Agencies	134
14.3.5	Mexican Police Forces	135
14.4	Brazil Market Background.....	136
14.4.1	Facts & Figures	136
14.4.2	Brazil Geopolitical Overview	136
14.4.3	Brazil Economy	138
14.4.4	Brazil Defense, Intelligence, Law Enforcement & Homeland Security Agencies	139
14.4.5	Brazil Police Forces.....	140
14.4.6	Brazil Defense Forces	140
14.5	UK Market Background.....	141
14.5.1	Facts & Figures	141
14.5.2	UK Geopolitical Overview.....	141
14.5.3	UK Economy	142
14.5.4	The Brexit Effects	142
14.5.5	UK Defense, Intelligence, Law Enforcement & Homeland Security Agencies	145
14.5.6	UK Police Forces.....	145
14.5.7	UK Police Forces Statistics	147

14.5.8	UK Intelligent Services	148
14.5.8.1	Security Service – MI5	148
14.5.8.2	National Domestic Extremism & Disorder Intelligence Unit (NDEDIU)	149
14.5.8.3	National Crime Agency (NCA)	149
14.5.8.4	National Ballistics Intelligence Service (NBIS)	149
14.5.8.5	National Fraud Intelligence Bureau (NFIB)	149
14.5.8.6	MI6, Secret Intelligence Service	149
14.5.8.7	Defense Intelligence (DI)	150
14.5.8.8	Communications Headquarters (GCHQ)	150
14.5.8.9	The Joint Intelligence Organization.....	151
14.5.8.10	The Parliament Intelligence and Security Committee	151
14.5.8.11	UK Intelligence Agencies Budgets	152
14.5.9	UK Defense Forces	152
14.6	France Market Background.....	153
14.6.1	Facts & Figures	153
14.6.2	France Geopolitical Overview.....	153
14.6.3	France Economy Overview	153
14.6.4	France Defense, Intelligence, Law Enforcement & Homeland Security Agencies	155
14.6.5	French Police Forces.....	156
14.6.5.1	The National Police.....	156
14.6.5.2	Research, Assistance, Intervention, Deterrence (RAID).....	157
14.6.5.3	National Police Intervention Groups (GIPN)	157
14.6.5.4	The National Gendarmerie	157
14.6.5.5	National Gendarmerie Intervention Group	157
14.6.5.6	Paris Police Prefecture	158
14.6.5.7	Police Forces Statistics.....	159
14.6.6	France Intelligent Services	159
14.6.6.1	Domestic Counter-terrorism & Counter-espionage Intelligence (DGSI)	159
14.6.6.2	Central Directorate of the Judicial Police (DCPJ)	160
14.6.6.3	General Directorate for External Security (DGSE).....	160
14.6.6.4	Directorate of Protection and Defense Security (DPSD)	161
14.6.6.5	Directorate of Military Intelligence (DRM)	161
14.6.6.6	Anti-Terrorist Bureau (BLAT)	161
14.6.6.7	Inter-Departmental Coordination on Terrorism Matters	162
14.6.7	France Defense Forces	162
14.7	Russia Market Background.....	163
14.7.1	Facts & Figures	163
14.7.2	Russia Geopolitical Overview.....	163
14.7.3	Russia Economy	164
14.8	Germany Market Background	165
14.8.1	Facts & Figures	165

14.8.2	Germany Geopolitical Overview	165
14.8.3	Germany Economy.....	166
14.8.4	Germany Defense, Intelligence, Law Enforcement & Homeland Security Agencies	167
14.8.5	The German Police Forces.....	168
14.8.5.1	BPOL - Federal Police	168
14.8.5.2	GSG 9 - Special Operations & Counterterrorism Unit.....	168
14.8.5.3	BFE/BFHu Units - Special Anti-Terrorist Unit of Federal Anti-Riot Police	169
14.8.5.4	ASSIK - Special Task Force Protection in Crisis Areas	169
14.8.5.5	ZKA - Customs Investigation Bureau.....	169
14.8.5.6	ZUZ - Customs SWAT Unit.....	169
14.8.5.7	Military Police.....	170
14.8.5.8	State Police Forces.....	170
14.8.5.9	SEK - State Special Operations Command Part of Uniformed Police	170
14.8.5.10	MEK - Mobile Task Force units, Part of Criminal Police	171
14.8.6	Germany Intelligent Services.....	171
14.8.6.1	Federal Intelligence Service (BND).....	171
14.8.6.2	Federal Office for the Protection of the Constitution (BfV).....	172
14.8.6.3	Military Counterintelligence Service (MAD)	172
14.8.6.4	The State Office for the Protection of the Constitution.....	173
14.8.7	Defense Forces	173
14.9	Netherlands Market Background.....	174
14.9.1	Facts & Figures	174
14.9.2	Netherlands Geopolitical Overview	174
14.9.3	Netherlands Economy	174
14.9.4	Netherlands Defense, Intelligence, Law Enforcement & Homeland Security Agencies	175
14.9.5	Netherlands Police	175
14.10	Denmark Market Background	176
14.10.1	Facts & Figures	176
14.10.2	Denmark Geopolitical Overview	176
14.10.3	Denmark Economy	176
14.10.4	Denmark Police Forces	177
14.11	Sweden Market Background	178
14.11.1	Facts & Figures	178
14.11.2	Sweden Geopolitical Overview	178
14.11.3	Sweden Economy	178
14.11.4	Sweden Defense, Intelligence, Law Enforcement & Homeland Security Agencies	179
14.11.5	Swedish Police Forces	179
14.12	Saudi Arabia Market Background	180
14.13	Facts & Figures.....	180

14.13.1	Saudi Arabia Geopolitical Overview	180
14.13.2	Saudi Arabia Economy	183
14.13.3	Saudi Arabia Defense, Intelligence, Law Enforcement & Homeland Security Agencies	184
14.13.3.1	Ministry of Interior	186
14.13.3.2	Saudi National Guard	186
14.13.3.3	Paramilitary Security Forces	187
14.13.4	Saudi Arabia Police Forces	188
14.13.5	Saudi Arabia Defense Forces.....	189
14.13.5.1	Armed Services	189
14.13.5.2	Independent Forces	190
14.14	UAE Market Background	190
14.14.1	Facts & Figures	190
14.14.2	UAE Geopolitical Overview	190
14.14.3	UAE Economy	191
14.14.4	UAE Defense, Intelligence, Law Enforcement & Homeland Security Agencies	192
14.14.5	The UAE Police Forces	192
14.14.6	UAE Defense Forces.....	193
14.15	Qatar Market Background	193
14.15.1	Facts & Figures	193
14.15.2	Qatar Geopolitical Overview.....	193
14.15.3	Qatar Economy	194
14.15.4	Qatar Police.....	194
14.15.5	Defense Forces	196
14.16	Kuwait Market Background	197
14.16.1	Facts & Figures	197
14.16.2	Kuwait Geopolitical Overview	197
14.16.3	Kuwait Economy.....	199
14.16.4	Kuwait Defense, Intelligence, Law Enforcement & Homeland Security Agencies	199
14.16.5	Kuwait Police.....	199
14.16.6	Kuwait Defense Forces	200
14.17	Israel Market Background	201
14.17.1	Facts & Figures	201
14.17.2	Israel Geopolitical Overview	201
14.17.3	Israel Economy.....	203
14.17.4	Israel Defense, Intelligence, Law Enforcement & Homeland Security Agencies	204
14.17.5	The Israeli Police	204
14.17.6	Defense Forces	205
14.18	Australia Market Background	206
14.18.1	Facts & Figures	206
14.18.2	Australia Geopolitical Overview	206
14.18.3	Australia Economy	206
14.18.3.1	External Security.....	207

14.18.4	Australia Defense, Intelligence, Law Enforcement & Homeland Security Agencies	208
14.18.5	Australia - Police Forces.....	209
14.18.6	Australia Intelligent Services	210
14.19	China Market Background	210
14.19.1	Facts & Figures	210
14.19.2	China Geopolitical Background	210
14.19.3	China Economy	212
14.19.4	China Defense, Intelligence, Law Enforcement & Homeland Security Agencies	214
14.19.5	China Police	215
14.19.6	China Ministry of Public Security	215
14.19.7	Public Security Bureau	216
14.19.8	China Ministry of State Security	216
14.19.9	China Defense Forces.....	217
14.20	Japan Market Background	222
14.20.1	Facts & Figures	222
14.20.2	Japan Geopolitical Background.....	222
14.20.3	Japan Economy.....	224
14.20.4	Japan Defense, Intelligence, Law Enforcement & Homeland Security Agencies	225
14.20.5	Japan Police Forces.....	226
14.20.6	Japan Defense Forces	226
14.21	India Market Background	227
14.21.1	Facts & Figures	227
14.21.2	India Geopolitical Overview	227
14.21.3	India Economy.....	228
14.21.4	India Defense, Intelligence, Law Enforcement & Homeland Security Agencies	230
14.21.5	Indian Police Forces	231
14.21.6	India Defense Market	232
14.21.7	India Defense Forces	235
14.22	Singapore Market Background.....	235
14.22.1	Facts & Figures	235
14.22.2	Singapore Geopolitical Overview	235
14.22.3	Singapore Economy	236
14.22.4	Singapore Police	236
14.22.5	Singapore Defense Forces.....	237
15	Appendix K: Key Quantum Computing Patents	238
15.1	Patents List	238
15.2	Quantum Computing Patent Filing by Country.....	245
16	Appendix L: Links to 31 Quantum Computing Academic Research Centers	246
17	Appendix M: 2017 Quantum Conferences Links -	248
18	Appendix N: Glossary	252

19	Appendix O: References.....	254
20	Scope & Methodology.....	271
20.1	Research Scope	271
20.2	Research Methodology	271
21	Disclaimer & Copyright.....	273

List of Tables

Table 1 - Startup Quantum Computing Companies	83
Table 2 - Commercial Investment in Quantum Computing – 2006-2016	106

List of Figures

Figure 1 - Quantum Computing Business Opportunities Roadmap	17
Figure 2 - Quantum Computing Investor – Company Relationship	84
Figure 3 - Qubit Explanation	89
Figure 4 - Quantum Entanglement.....	89
Figure 5 - Control Systems for the Ion-Trap System.....	113
Figure 6 - Department of Homeland Security –Organizational Structure	118
Figure 7 - Canada Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram	130
Figure 8 - Mexico Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram	134
Figure 9 - Brazil Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram	139
Figure 10 - UK Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram	145
Figure 11 - France Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram	155
Figure 12 - Germany Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram	167
Figure 13 - Netherlands Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram.....	175
Figure 14 - Saudi Arabia Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram.....	185
Figure 15 - UAE Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram	192
Figure 16 - Israel Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram	204
Figure 17 - Australia Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram	208
Figure 18 - The IMF 2010-2030 Forecast: China GDP vs. Other Nations GDP	213
Figure 19 - China Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram	214
Figure 20 - Japan Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram	225
Figure 21 - India Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram	230
Figure 22 - Quantum Computing, Quantum Cryptography and Sensors Quantum Patent Applications by Country 2000 to 2015	245
Figure 23 - Patent Applications by Country – 2000-2015.....	245