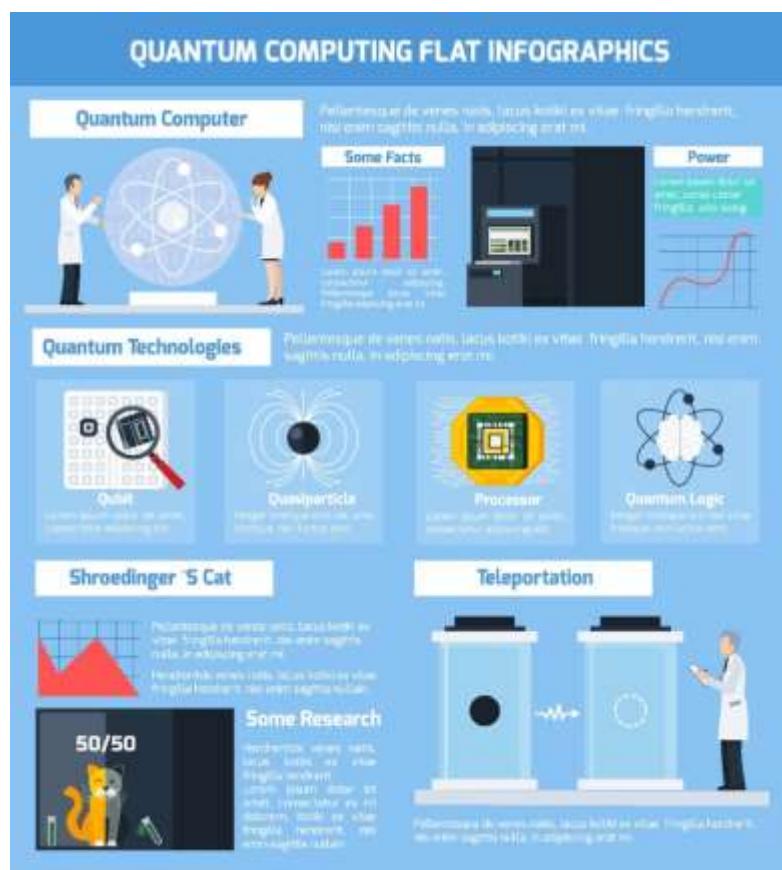


2017-2024

Global Quantum Computing Market



Industry 4.0 Research

Global Quantum Computing Market

2017-2024

Vol.1

Industry 4.0 Research (A division of HSRC)
601 Pennsylvania Ave. Washington D.C., U.S.A
www.Industry40marketresearch.com

Table of Contents

| | | |
|----------------------------|--|-----------|
| 1 | Executive Summary | 22 |
| 1.1 | Major Findings | 22 |
| 1.2 | Global Quantum Computing Market – 2016-2024 | 32 |
| GLOBAL MARKET | | 39 |
| 2 | Quantum Computing Market Background..... | 39 |
| 2.1 | Quantum Technologies Timeline | 39 |
| 2.2 | Quantum Supremacy | 44 |
| 2.3 | Investments in Quantum Computing | 46 |
| 2.4 | Quantum Computing Technology Roadmap..... | 47 |
| 2.5 | Topological Quantum Computers | 47 |
| 2.6 | The 2 nd Quantum Revolution | 48 |
| 2.7 | Applications of Quantum Computing..... | 48 |
| 2.8 | The Private Sector Quantum Computing R&D Activities..... | 49 |
| 2.9 | The Global Quantum Computing Race | 52 |
| 2.10 | China – U.S. Quantum Information Leadership Race | 52 |
| 3 | Quantum Information Bids, Tenders and Projects Data | 54 |
| 4 | SWOT Analysis | 61 |
| 4.1 | Strengths | 61 |
| 4.2 | Weaknesses | 61 |
| 4.3 | Opportunities | 62 |
| 4.4 | Threats..... | 63 |
| 5 | Global Quantum Computing Market – 2017-2024 | 64 |
| 5.1 | Global Quantum Computing Market by Sector | 64 |
| 5.1.1 | Market Forecast – 2016-2024 | 64 |
| 5.1.2 | Market Dynamics – 2016-2024..... | 65 |
| 5.1.3 | Market Breakdown – 2016-2024 | 66 |
| 5.2 | Global Quantum Computing Market by Revenue Source | 66 |
| 5.2.1 | Quantum Computing Systems Market..... | 66 |
| 5.2.2 | Quantum Computing Software Market | 66 |
| 5.2.3 | Quantum Computing as a Service Market..... | 68 |
| 5.2.4 | Quantum Computing Government Financed R&D Market | 69 |
| 5.2.5 | Global Market Forecast – 2016-2024 | 69 |
| 5.2.6 | Market Dynamics – 2016-2024..... | 70 |
| 5.2.7 | Market Breakdown – 2016-2024 | 71 |
| 5.3 | Global Quantum Computing Market by Region | 72 |
| 5.3.1 | Market Forecast by Region – 2016-2024 | 72 |
| 5.3.2 | Market Dynamics – 2016-2024..... | 73 |
| 5.3.3 | Market Breakdown by Region – 2016-2024 | 73 |

| | | |
|----------|---|-----------|
| 6 | Quantum Computing by Sector – 2017-2024..... | 74 |
| 6.1 | National Security Quantum Computing Market | 74 |
| 6.1.1 | Market Forecast by Region – 2016-2024 | 74 |
| 6.1.2 | Market Dynamics – 2016-2024..... | 75 |
| 6.1.3 | Market Breakdown by Region – 2016-2024 | 76 |
| 6.2 | Government Quantum Computing Market | 76 |
| 6.2.1 | Market Forecast by Region – 2016-2024 | 77 |
| 6.2.2 | Market Dynamics – 2016-2024..... | 78 |
| 6.2.3 | Market Breakdown by Region – 2016-2024 | 78 |
| 6.3 | Government-Funded RDT&E Quantum Computing Market | 79 |
| 6.3.1 | Market Forecast by Region – 2016-2024 | 79 |
| 6.3.2 | Market Dynamics – 2016-2024..... | 80 |
| 6.3.3 | Market Breakdown by Region – 2016-2024 | 81 |
| 6.4 | Industry & Business Sectors Quantum Computing Market | 81 |
| 6.4.1 | Market Forecast by Region – 2016-2024 | 82 |
| 6.4.2 | Market Dynamics – 2016-2024..... | 83 |
| 6.4.3 | Market Breakdown by Region – 2016-2024 | 83 |
| 7 | Quantum Computing Vertical Markets – 2017-2024 | 84 |
| 7.1 | Defense & Intelligence Quantum Computing Market | 84 |
| 7.1.1 | National Security Intelligence | 84 |
| 7.1.2 | Defense | 85 |
| 7.1.3 | Global Defense & Intelligence Quantum Computing Market – 2016-2024 | 86 |
| 7.1.3.1 | Market Forecast..... | 86 |
| 7.1.3.2 | Market Dynamics | 87 |
| 7.2 | Homeland Security & Public Safety Quantum Computing Market..... | 88 |
| 7.2.1 | Public Safety | 88 |
| 7.2.2 | Homeland Security | 88 |
| 7.2.3 | Global Homeland Security & Public Safety Quantum Computing Market – 2016-2024 | 89 |
| 7.2.3.1 | Market Forecast..... | 89 |
| 7.2.3.2 | Market Dynamics | 90 |
| 7.3 | Government & Public Services Quantum Computing Market | 91 |
| 7.3.1 | Market Background | 91 |
| 7.3.2 | Global Government & Public Services Quantum Computing Market – 2016-2024 | 91 |
| 7.3.2.1 | Market Forecast..... | 91 |
| 7.3.2.2 | Market Dynamics | 92 |
| 7.4 | Gov.-Funded RDT&E Quantum Computing Market | 93 |
| 7.4.1 | Gov.-Funded RDT&E Quantum Computing by Country - 2016 | 93 |
| 7.4.2 | Global Government-Funded RDT&E Quantum Computing Market – 2016-2024 | 94 |
| 7.4.2.1 | Market Forecast..... | 94 |
| 7.4.2.2 | Market Dynamics | 95 |

| | | |
|----------|--|-----|
| 7.5 | Banking & Securities Quantum Computing Market..... | 95 |
| 7.5.1 | Market Background | 95 |
| 7.5.2 | Global Banking & Securities Quantum Computing Market – 2016-2024 | 96 |
| 7.5.2.1 | Market Forecast..... | 96 |
| 7.5.2.2 | Market Dynamics | 97 |
| 7.6 | Manufacturing & Logistics Quantum Computing Market..... | 98 |
| 7.6.1 | Mission Planning/Scheduling and Logistics..... | 98 |
| 7.6.2 | Global Manufacturing & Logistics Quantum Computing Market – 2016-2024 | 100 |
| 7.6.2.1 | Market Forecast..... | 100 |
| 7.6.2.2 | Market Dynamics | 101 |
| 7.7 | Insurance Quantum Computing Market | 101 |
| 7.7.1 | Market Background | 101 |
| 7.7.2 | Global Insurance Quantum Computing Market – 2016- 2024 | 102 |
| 7.7.2.1 | Market Forecast..... | 102 |
| 7.7.2.2 | Market Dynamics | 103 |
| 7.8 | Healthcare & Pharmaceutical Quantum Computing Market..... | 103 |
| 7.8.1 | Overview | 103 |
| 7.8.2 | Medical Diagnostics Quantum Computing Market Background | 104 |
| 7.8.3 | Medical Treatments Quantum Computing Market Background | 104 |
| 7.8.4 | Example: Combating Cancer..... | 105 |
| 7.8.5 | The Folding@home Project..... | 105 |
| 7.8.6 | Pharmacology Quantum Computing | 105 |
| 7.8.7 | Protein Folding Quantum Computing Market Background | 106 |
| 7.8.8 | Global Healthcare & Pharmaceutical Quantum Computing Market – 2016-2024 | 107 |
| 7.8.8.1 | Market Forecast..... | 107 |
| 7.8.8.2 | Market Dynamics | 108 |
| 7.9 | Retail & Wholesale Quantum Computing Market..... | 108 |
| 7.9.1 | Market Background | 108 |
| 7.9.2 | Global Retail & Wholesale Quantum Computing Market – 2016-2024 | 109 |
| 7.9.2.1 | Market Forecast..... | 109 |
| 7.9.2.2 | Market Dynamics | 110 |
| 7.10 | Information Technology Industry Quantum Computing Market..... | 110 |
| 7.10.1 | Software Verification & Validation | 110 |
| 7.10.2 | Global Information Technology Industry Quantum Computing Market – 2016-2024 | 111 |
| 7.10.2.1 | Market Forecast..... | 111 |
| 7.10.2.2 | Market Dynamics | 112 |

| | | |
|----------|--|------------|
| 7.11 | Telecommunications Quantum Computing Market | 112 |
| 7.11.1 | Global Telecommunications Quantum Computing Market – 2016-2024 | 114 |
| 7.11.1.1 | Market Forecast..... | 114 |
| 7.11.1.2 | Market Dynamics | 115 |
| 7.12 | Automotive, Aerospace & Transportation Quantum Computing Market..... | 115 |
| 7.12.1 | Market Background | 115 |
| 7.12.2 | Global Automotive, Aerospace & Transportation Quantum Computing Market – 2016-2024 | 116 |
| 7.12.2.1 | Market Forecast..... | 116 |
| 7.12.2.2 | Market Dynamics | 117 |
| 7.13 | Energy & Utilities Quantum Computing Market..... | 118 |
| 7.13.1 | Market Background | 118 |
| 7.13.2 | Global Energy & Utilities Quantum Computing Market – 2016-2024 | 118 |
| 7.13.2.1 | Market Forecast..... | 118 |
| 7.13.2.2 | Market Dynamics | 119 |
| 7.14 | Web, Media & Entertainment Quantum Computing Market | 120 |
| 7.14.1 | Market Background | 120 |
| 7.14.2 | Global Web, Media & Entertainment Quantum Computing Market – 2016-2024 | 120 |
| 7.14.2.1 | Market Forecast..... | 120 |
| 7.14.2.2 | Market Dynamics | 121 |
| 7.15 | Smart Cities Quantum Computing Market | 122 |
| 7.15.1 | Market Background | 122 |
| 7.15.2 | Global Smart Cities Quantum Computing Market – 2016-2024 | 122 |
| 7.15.2.1 | Market Forecast..... | 122 |
| 7.15.2.2 | Market Dynamics | 123 |
| 7.16 | Cybersecurity Quantum Computing Market | 123 |
| 7.16.1 | Market Background | 123 |
| 7.16.2 | Global Cybersecurity Quantum Computing Market – 2016-2024 | 127 |
| 7.16.2.1 | Market Forecast..... | 127 |
| 7.16.2.2 | Market Dynamics | 128 |
| 7.17 | Other Vertical Markets Quantum Computing Market | 129 |
| 7.17.1 | Market Forecast | 129 |
| 7.17.2 | Market Dynamics..... | 130 |
| | REGIONAL MARKETS | 131 |
| 8 | Global Quantum Computing Market by Region | 131 |
| 8.1 | North America Quantum Computing Markets – 2017-2024 | 131 |
| 8.1.1 | North America Quantum Computing Market by Sector | 131 |
| 8.1.1.1 | Market Forecast – 2016-2024..... | 131 |

| | | |
|--|---|------------|
| 8.1.1.2 | Market Dynamics – 2016-2024 | 132 |
| 8.1.1.3 | Market Breakdown – 2016-2024..... | 133 |
| 8.1.2 | North America Quantum Computing Market by Revenue Source..... | 134 |
| 8.1.2.1 | Market Forecast – 2016-2024..... | 134 |
| 8.1.2.2 | Market Dynamics – 2016-2024 | 135 |
| 8.1.2.3 | Market Breakdown – 2016-2024..... | 135 |
| 8.2 | Europe Quantum Computing Markets – 2017-2024..... | 136 |
| 8.2.1 | Europe Quantum Computing Market by Sector | 136 |
| 8.2.1.1 | Market Forecast – 2016-2024..... | 136 |
| 8.2.1.2 | Market Dynamics – 2016-2024 | 137 |
| 8.2.1.3 | Market Breakdown – 2016-2024..... | 138 |
| 8.2.2 | Europe Quantum Computing Market by Revenue Source | 139 |
| 8.2.2.1 | Market Forecast – 2016-2024..... | 139 |
| 8.2.2.2 | Market Dynamics – 2016-2024 | 140 |
| 8.2.2.3 | Market Breakdown – 2016-2024..... | 140 |
| 8.3 | Asia-Pacific Quantum Computing Markets – 2017-2024 | 141 |
| 8.3.1 | Asia-Pacific Quantum Computing Market by Sector..... | 141 |
| 8.3.1.1 | Market Forecast – 2016-2024..... | 141 |
| 8.3.1.2 | Market Dynamics – 2016-2024 | 142 |
| 8.3.1.3 | Market Breakdown – 2016-2024..... | 143 |
| 8.3.2 | Asia-Pacific Quantum Computing Market by Revenue Source | 144 |
| 8.3.2.1 | Market Forecast – 2016-2024..... | 144 |
| 8.3.2.2 | Market Dynamics – 2016-2024 | 145 |
| 8.3.2.3 | Market Breakdown – 2016-2024..... | 145 |
| 8.4 | ROW Quantum Computing Markets – 2017-2024 | 146 |
| 8.4.1 | ROW Quantum Computing Market by Sector..... | 146 |
| 8.4.1.1 | Market Forecast – 2016-2024..... | 146 |
| 8.4.1.2 | Market Dynamics – 2016-2024 | 147 |
| 8.4.1.3 | Market Breakdown – 2016-2024..... | 148 |
| 8.4.2 | ROW Quantum Computing Market by Revenue Source | 149 |
| 8.4.2.1 | Market Forecast – 2016-2024..... | 149 |
| 8.4.2.2 | Market Dynamics – 2016-2024 | 150 |
| 8.4.2.3 | Market Breakdown – 2016-2024..... | 150 |
| NATIONAL MARKETS..... | | 151 |
| North America | | 151 |
| 9 U.S. Quantum Computing Market – 2017-2024 | | 151 |
| 9.1 | U.S. Market Background..... | 151 |
| 9.2 | U.S. Quantum Computing Market Background | 151 |
| 9.2.1 | U.S. Government Quantum Computing..... | 151 |

| | | |
|---------------------|---|------------|
| 9.2.2 | U.S. Government Investment in Quantum Computing: Introduction..... | 152 |
| 9.2.3 | DOD: Quantum Computing Activities, Projects & Funding | 152 |
| 9.2.4 | DOE: Quantum Computing Activities, Projects & Funding | 153 |
| 9.2.5 | NSA: Quantum Computing Activities, Projects & Funding | 154 |
| 9.2.6 | IARPA: Quantum Computing Activities, Projects & Funding | 154 |
| 9.2.7 | NIST: Quantum Computing Activities, Projects & Funding | 155 |
| 9.2.8 | NSF: Quantum Computing Activities, Projects & Funding | 156 |
| 9.2.9 | U.S.A. Supercomputing Race..... | 156 |
| 9.2.10 | Federal Quantum Computing Outlook - 2018-2024..... | 157 |
| 9.2.11 | U.S. Private Sector Quantum Computing Market Background | 158 |
| 9.2.12 | U.S. Quantum Computing RDT&E | 159 |
| 9.3 | The U.S.-Chinese, Quantum Technology Race | 160 |
| 9.3.1 | Scope | 160 |
| 9.3.2 | U.S. Strategic Considerations | 161 |
| 9.3.3 | Quantum Encryption and Communication Race..... | 162 |
| 9.3.4 | The Quantum Sensing Race | 163 |
| 9.4 | U.S. Quantum Computing Market - 2016-2024..... | 165 |
| 9.4.1 | Market Forecast – 2016-2024 | 165 |
| 9.4.2 | Market Dynamics – 2016-2024..... | 166 |
| 10 | Canada Quantum Computing Market – 2017-2024 | 167 |
| 10.1 | Canada Market Background | 167 |
| 10.2 | Canada Quantum Computing Market Background | 167 |
| 10.3 | Canada Quantum Computing Market - 2016-2024 | 168 |
| 10.3.1 | Market Forecast – 2016-2024 | 168 |
| 10.3.2 | Market Dynamics – 2016-2024..... | 169 |
| Europe | 170 | |
| 11 | The EU Quantum Computing Activities | 170 |
| 11.1 | Introduction | 170 |
| 11.2 | EU Research Frameworks | 171 |
| 11.3 | European Commission Future & Emerging Technologies Program QC Activities..... | 172 |
| 11.3.1 | Funding | 172 |
| 11.3.2 | The EU Cloud Initiative | 173 |
| 11.3.3 | The EU Quantum Technology Flagship..... | 173 |
| 11.3.4 | The EU Quantum Technology Program | 173 |
| 11.4 | The EU Quantum Computing Industry Program | 174 |

| | | |
|-----------|---|------------|
| 12 | UK Quantum Computing Market – 2017-2024 | 176 |
| 12.1 | UK Market Background..... | 176 |
| 12.2 | UK Quantum Computing Market Background | 176 |
| 12.3 | UK Quantum Computing Market - 2016-2024..... | 178 |
| 12.3.1 | Market Forecast – 2016-2024 | 178 |
| 12.3.2 | Market Dynamics – 2016-2024..... | 179 |
| 13 | France Quantum Computing Market – 2017-2024..... | 180 |
| 13.1 | France Market Background..... | 180 |
| 13.2 | France Quantum Computing Activities..... | 180 |
| 13.2.1 | The France QC National Network | 180 |
| 13.2.2 | Quantum Computation in France | 181 |
| 13.2.3 | Quantum Group..... | 181 |
| 13.2.4 | Atos SE | 182 |
| 13.2.5 | IBM France | 182 |
| 13.2.6 | Paris Centre for Quantum Computing | 183 |
| 13.3 | France Quantum Computing Market - 2016-2024..... | 183 |
| 13.3.1 | Market Forecast – 2016-2024 | 183 |
| 13.3.2 | Market Dynamics – 2016-2024..... | 184 |
| 14 | The Netherlands Quantum Computing Market – 2017-2024 | 185 |
| 14.1 | Netherlands Market Background..... | 185 |
| 14.2 | Netherlands Quantum Computing Activities | 185 |
| 14.3 | Netherlands Quantum Computing Market - 2016-2024 | 187 |
| 14.3.1 | Market Forecast – 2016-2024 | 187 |
| 14.3.2 | Market Dynamics – 2016-2024..... | 188 |
| 15 | Denmark, Sweden, Norway, Finland Quantum Computing Market – 2017-2024..... | 189 |
| 15.1 | Market Background | 189 |
| 15.2 | Denmark, Sweden, Norway and Finland Quantum Computing Market – 2016-2024 | 190 |
| 15.2.1 | Market Forecast – 2016-2024 | 190 |
| 15.2.2 | Market Dynamics – 2016-2024..... | 192 |
| 16 | Germany Quantum Computing Market – 2017-2024 | 193 |
| 16.1 | Germany Market Background | 193 |
| 16.2 | Germany Quantum Computing Activities | 193 |
| 16.3 | Germany Quantum Computing Market - 2016-2024 | 194 |
| 16.3.1 | Market Forecast – 2016-2024 | 194 |
| 16.3.2 | Market Dynamics – 2016-2024..... | 195 |
| 17 | Switzerland Quantum Computing Market – 2017-2024 | 196 |
| 17.1 | Switzerland Market Background | 196 |
| 17.2 | Switzerland Quantum Computing Market – 2016-2024 | 196 |
| 17.2.1 | Market Forecast – 2016-2024 | 196 |
| 17.2.2 | Market Dynamics – 2016-2024..... | 197 |
| 18 | Russia Quantum Computing Market – 2017-2024..... | 198 |
| 18.1 | Russia Market Background..... | 198 |

| | | |
|---------------------------|---|------------|
| 18.2 | Russia Quantum Computing Activities | 198 |
| 18.3 | Russia Quantum Computing Market - 2016-2024..... | 199 |
| 18.3.1 | Market Forecast – 2016-2024 | 199 |
| 18.3.2 | Market Dynamics – 2016-2024..... | 200 |
| 19 | Rest of Europe Quantum Computing Market – 2016-2024..... | 201 |
| 19.1 | Market Forecast – 2016-2024..... | 201 |
| 19.2 | Market Dynamics – 2016-2024 | 202 |
| Asia-Pacific | | 203 |
| 20 | India Quantum Computing Market – 2017-2024..... | 203 |
| 20.1 | India Market Background | 203 |
| 20.2 | India Quantum Computing Market Background | 203 |
| 20.3 | India Quantum Computing Market - 2016-2024..... | 203 |
| 20.3.1 | Market Forecast – 2016-2024 | 203 |
| 20.3.2 | Market Dynamics – 2016-2024..... | 204 |
| 21 | China Quantum Computing Market – 2017-2024 | 205 |
| 21.1 | .China Market Background | 205 |
| 21.2 | China Quantum Computing Market Background | 205 |
| 21.2.1 | Quantum Information in China..... | 205 |
| 21.2.2 | Government-Funded RDT&E | 207 |
| 21.2.3 | Made in China 2025 Program..... | 208 |
| 21.2.4 | Chinese Quantum Computing Advances..... | 208 |
| 21.2.5 | PRC's Quantum Cryptography and Communications | 209 |
| 21.2.6 | PRC Quantum Sensing Programs..... | 210 |
| 21.2.7 | China-U.S. Quantum Information Race | 211 |
| 21.2.8 | Limitations of the U.S. Quantum Information Programs | 212 |
| 21.2.9 | U.S. Vs. Chinese Intellectual property (IP) Race | 213 |
| 21.2.10 | China Supercomputing Lead | 215 |
| 21.3 | China Quantum Computing Market - 2016-2024 | 217 |
| 21.3.1 | Market Forecast – 2016-2024 | 217 |
| 21.3.2 | Market Dynamics – 2016-2024..... | 218 |
| 22 | Japan Quantum Computing Market – 2017-2024 | 219 |
| 22.1 | Japan Market Background | 219 |
| 22.2 | Japan Quantum Computing Activities | 219 |
| 22.3 | Japan Quantum Computing Market - 2016-2024 | 220 |
| 22.3.1 | Market Forecast – 2016-2024 | 220 |
| 22.3.2 | Market Dynamics – 2016-2024..... | 221 |
| 23 | Singapore Quantum Computing Market – 2017-2024..... | 222 |
| 23.1 | Singapore Market Background..... | 222 |
| 23.2 | Singapore Quantum Computing Activities | 222 |
| 23.3 | Singapore Quantum Computing Market - 2016-2024 | 223 |
| 23.3.1 | Market Forecast – 2016-2024 | 223 |
| 23.3.2 | Market Dynamics – 2016-2024..... | 224 |
| 24 | Australia Quantum Computing Market – 2017-2024 | 225 |

| | | |
|----------------------------|---|------------|
| 24.1 | Australia Market Background | 225 |
| 24.2 | Australia Quantum Computing Activities | 225 |
| 24.3 | Australia Quantum Computing Market - 2016-2024 | 226 |
| 24.3.1 | Market Forecast – 2016-2024 | 226 |
| 24.3.2 | Market Dynamics – 2016-2024 | 227 |
| 25 | Rest of Asia Pacific Quantum Computing Market – 2017-2024 | 228 |
| 25.1 | Market Forecast – 2016-2024 | 228 |
| 25.2 | Market Dynamics – 2016-2024 | 229 |
| Latin America | 230 | |
| 26 | Mexico Quantum Computing Market – 2017-2024 | 230 |
| 26.1 | Mexico Market Background | 230 |
| 26.2 | Mexico Quantum Computing Market - 2016-2024 | 230 |
| 26.2.1 | Market Forecast – 2016-2024 | 230 |
| 26.2.2 | Market Dynamics – 2016-2024 | 231 |
| 27 | Brazil Quantum Computing Market – 2017-2024..... | 232 |
| 27.1 | Brazil Market Background | 232 |
| 27.2 | Brazil Quantum Computing Activities | 232 |
| 27.3 | Brazil Quantum Computing Market - 2016-2024 | 232 |
| 27.3.1 | Market Forecast – 2016-2024 | 232 |
| 27.3.2 | Market Dynamics – 2016-2024 | 233 |
| 28 | Rest of Latin America Quantum Computing Market – 2017-2024 | 234 |
| 28.1 | Market Forecast – 2016-2024 | 234 |
| 28.2 | Market Dynamics – 2016-2024 | 235 |
| ME&A | 236 | |
| 29 | Saudi Arabia Quantum Computing Market – 2017-2024 | 236 |
| 29.1 | Saudi Arabia Market Background | 236 |
| 29.2 | Saudi Arabia Quantum Computing Market - 2016-2024 | 236 |
| 29.2.1 | Market Forecast – 2016-2024 | 236 |
| 29.2.2 | Market Dynamics – 2016-2024 | 237 |
| 30 | Other GCC Quantum Computing Market – 2017-2024..... | 238 |
| 30.1 | Market Background | 238 |
| 30.1.1 | UAE Market Background | 238 |
| 30.1.2 | Qatar Market Background | 238 |
| 30.1.3 | Kuwait Market Background | 238 |
| 30.2 | Quantum Computing Activities | 238 |
| 30.3 | Other GCC Quantum Computing Market - 2016-2024 | 238 |
| 30.3.1 | Market Forecast – 2016-2024 | 238 |
| 30.3.2 | Market Dynamics – 2016-2024 | 239 |
| 31 | Israel Quantum Computing Market – 2017-2024..... | 240 |
| 31.1 | Israel Market Background | 240 |

| | | |
|-----------|---|------------|
| 31.2 | Israel Quantum Computing Activities | 240 |
| 31.3 | Israel Quantum Computing Market - 2016-2024 | 240 |
| 31.3.1 | Market Forecast – 2016-2024 | 240 |
| 31.3.2 | Market Dynamics – 2016-2024..... | 241 |
| 32 | South Africa Quantum Computing Market – 2017-2024 | 242 |
| 32.1 | Market Background..... | 242 |
| 32.2 | South Africa Quantum Computing Market - 2016-2024 | 242 |
| 32.2.1 | Market Forecast – 2016-2024 | 242 |
| 32.2.2 | Market Dynamics – 2016-2024..... | 243 |
| 33 | Rest of ME&A Quantum Computing Market – 2017-2024..... | 244 |
| 33.1 | Market Forecast – 2016-2024..... | 244 |
| 33.2 | Market Dynamics – 2016-2024 | 245 |

List of Tables

| | |
|--|----|
| Table 1 – Global Quantum Computing Market [\$M] – 2016-2024: Government-Funded RDT&E vs. Products & Services Market | 33 |
| Table 2 – Global Quantum Computing Market [\$M] by Sector – 2016-2024..... | 34 |
| Table 3 – Global Quantum Computing Vertical Markets [\$M] – 2016-2024 | 35 |
| Table 4 – Global Quantum Computing Market [\$M] by Revenue Source – 2016-2024..... | 36 |
| Table 5 – Global Quantum Computing Market [\$M] by Region – 2016-2024..... | 37 |
| Table 6 – Global Quantum Computing Market AGRs [%] by Region – 2016- 2024..... | 37 |
| Table 7 – Global Quantum Computing Market [\$M] by Country – 2016- 2024..... | 38 |
| Table 8 – Quantum Computing Investment by Investor..... | 46 |
| Table 9 – Quantum Information 2014-2017 Bids, Tenders and Projects | 54 |
| Table 10 – Global Quantum Computing Market [\$M] by Sector – 2016-2024.... | 64 |
| Table 11 – Global Quantum Computing Market AGRs [%] by Sector – 2016-2024..... | 65 |
| Table 12 – Global Quantum Computing Market [\$M] by Revenue Source – 2016-2024..... | 69 |
| Table 13 – Global Quantum Computing Market AGRs [%] by Revenue Source – 2016-2024 | 70 |
| Table 14 – Global Quantum Computing Market [\$M] by Region – 2016- 2024..... | 72 |
| Table 15 – Global Quantum Computing Market AGRs [%] by Region – 2016-2024..... | 73 |
| Table 16 – Global National Security Quantum Computing Market [\$M] by Region – 2016-2024 | 74 |
| Table 17 – Global National Security Quantum Computing Market AGRs [%] by Region – 2016-2024 | 75 |
| Table 18 – Global Government Quantum Computing Market [\$M] by Region – 2016-2024 | 77 |
| Table 19 – Global Government Quantum Computing Market AGRs [%] by Region – 2016-2024 | 78 |
| Table 20 – Global Government-Funded RDT&E Quantum Computing Market [\$M] by Region – 2016-2024..... | 79 |
| Table 21 – Global Government-funded RDT&E Quantum Computing Market AGRs [%] by Region – 2016-2024..... | 80 |
| Table 22 – Global Industry & Business Sectors Quantum Computing Market [\$M] by Region – 2016-2024..... | 82 |
| Table 23 – Global Industry & Business Sectors Quantum Computing Market AGRs [%] by Region – 2016-2024..... | 83 |
| Table 24 – Global Defense & Intelligence Quantum Computing Market [\$M] – 2016-2024..... | 86 |
| Table 25 – Global Defense & Intelligence Quantum Computing Market AGRs [%] – 2016-2024 | 87 |

| | |
|---|-----|
| Table 26 – Global Homeland Security & Public Safety Quantum Computing Market [\$M] – 2016-2024..... | 89 |
| Table 27 – Global Homeland Security & Public Safety Quantum Computing Market AGRs [%] – 2016-2024 | 90 |
| Table 28 – Global Government & Public Services Quantum Computing Market [\$M] – 2016-2024..... | 92 |
| Table 29 – Global Government & Public Services Quantum Computing Market AGRs [%] – 2016-2024 | 92 |
| Table 30 – Government-Funded RDT&E by Country – 2016..... | 93 |
| Table 31 – Global Gov.-Funded RDT&E Quantum Computing Market [\$M] – 2016-2024..... | 94 |
| Table 32 – Global Gov.-Funded RDT&E Quantum Computing Market AGRs [%] – 2016-2024 | 95 |
| Table 33 – Global Banking & Securities Quantum Computing Market [\$M] – 2016-2024..... | 97 |
| Table 34 – Global Banking & Securities Quantum Computing Market AGRs [%] – 2016-2024 | 97 |
| Table 35 – Global Manufacturing & Logistics Quantum Computing Market [\$M] – 2016-2024..... | 100 |
| Table 36 – Global Manufacturing & Logistics Quantum Computing Market AGRs [%] – 2016-2024 | 101 |
| Table 37 – Global Insurance Quantum Computing Market [\$M] – 2016-2024..... | 102 |
| Table 38 – Global Insurance Quantum Computing Market AGRs [%] – 2016-2024..... | 103 |
| Table 39 – Global Healthcare & Pharmaceutical Quantum Computing Market [\$M] – 2016-2024..... | 107 |
| Table 40 – Global Healthcare & Pharmaceutical Quantum Computing Market AGRs [%] – 2016-2024 | 108 |
| Table 41 – Global Retail & Wholesale Quantum Computing Market [\$M] – 2016-2024..... | 109 |
| Table 42 – Global Retail & Wholesale Quantum Computing Market AGRs [%] – 2016-2024 | 110 |
| Table 43 – Global Information Technology Industry Quantum Computing Market [\$M] – 2016-2024..... | 111 |
| Table 44 – Global Information Technology Industry Quantum Computing Market AGRs [%] – 2016-2024 | 112 |
| Table 45 – Global Telecommunications Quantum Computing Market [\$M] – 2016-2024..... | 114 |
| Table 46 – Global Telecommunications Quantum Computing Market AGRs [%] – 2016-2024 | 115 |
| Table 47 – Global Automotive, Aerospace & Transportation Quantum Computing Market [\$M] – 2016-2024 | 117 |
| Table 48 – Global Automotive, Aerospace & Transportation Quantum Computing Market AGRs [%] – 2016-2024..... | 117 |

| | |
|--|-----|
| Table 49 – Global Energy & Utilities Quantum Computing Market [\$M] – 2016-2024..... | 118 |
| Table 50 – Global Energy & Utilities Quantum Computing Market AGRs [%] – 2016-2024..... | 119 |
| Table 51 – Global Web, Media & Entertainment Quantum Computing Market [\$M] – 2016-2024..... | 120 |
| Table 52 – Global Web, Media & Entertainment Quantum Computing Market AGRs [%] – 2016-2024 | 121 |
| Table 53 – Global Smart Cities Quantum Computing Market [\$M] – 2016-2024..... | 122 |
| Table 54 – Global Smart Cities Quantum Computing Market AGRs [%] – 2016-2024..... | 123 |
| Table 55 – Global Cybersecurity Quantum Computing Market [\$M] – 2016-2024..... | 127 |
| Table 56 – Global Cybersecurity Quantum Computing Market AGRs [%] – 2016-2024..... | 128 |
| Table 57 – Global Other Vertical Markets Quantum Computing Market [\$M] – 2016-2024..... | 129 |
| Table 58 – Global Other Vertical Markets Quantum Computing Market AGRs [%] – 2016-2024 | 130 |
| Table 59 – North America Quantum Computing Market [\$M] by Sector – 2016-2024..... | 131 |
| Table 60 – North America Quantum Computing Market AGRs [%] by Sector – 2016-2024 | 132 |
| Table 61 – North America Quantum Computing Market [\$M] by Revenue Source – 2016-2024 | 134 |
| Table 62 – North America Quantum Computing Market AGRs [%] by Revenue Source – 2016-2024 | 135 |
| Table 63 – Europe Quantum Computing Market [\$M] by Sector – 2016-2024..... | 136 |
| Table 64 – Europe Quantum Computing Market AGRs [%] by Sector – 2016-2024..... | 137 |
| Table 65 – Europe Quantum Computing Market [\$M] by Revenue Source – 2016-2024 | 139 |
| Table 66 – Europe Quantum Computing Market AGRs [%] by Revenue Source – 2016-2024 | 140 |
| Table 67 – Asia-Pacific Quantum Computing Market [\$M] by Sector – 2016-2024..... | 141 |
| Table 68 – Asia-Pacific Quantum Computing Market AGRs [%] by Sector – 2016-2024 | 142 |
| Table 69 – Asia-Pacific Quantum Computing Market [\$M] by Revenue Source – 2016-2024 | 144 |
| Table 70 – Asia-Pacific Quantum Computing Market AGRs [%] by Revenue Source – 2016-2024 | 145 |
| Table 71 – ROW Quantum Computing Market [\$M] by Sector – 2016-2024 | 146 |

| | |
|---|-----|
| Table 72 – ROW Quantum Computing Market AGRs [%] by Sector – 2016-2024..... | 147 |
| Table 73 – ROW Quantum Computing Market [\$M] by Revenue Source – 2016-2024..... | 149 |
| Table 74 – ROW Quantum Computing Market AGRs [%] by Revenue Source – 2016-2024 | 150 |
| Table 75 – U.S. Quantum Computing Market [\$M] – 2016-2024 | 165 |
| Table 76 – U.S. Quantum Computing Market AGRs [%] – 2016-2024 | 166 |
| Table 77 – Canada Quantum Computing Market [\$M] – 2016-2024..... | 168 |
| Table 78 – Canada Quantum Computing Market AGRs [%] – 2016-2024..... | 169 |
| Table 79 – European Quantum Technology Program Expected Applications | 174 |
| Table 80 – UK Quantum Computing Market [\$M] – 2016-2024 | 178 |
| Table 81 – UK Quantum Computing Market AGRs [%] – 2016-2024 | 179 |
| Table 82 – France Quantum Computing Market [\$M] – 2016-2024 | 184 |
| Table 83 – France Quantum Computing Market AGRs [%] – 2016-2024 | 184 |
| Table 84 – The Netherlands Quantum Computing Market [\$M] – 2016-2024... 187 | |
| Table 85 – The Netherlands Quantum Computing Market AGRs [%] – 2016-2024..... | 188 |
| Table 86 – Denmark, Sweden, Norway and Finland Quantum Computing Market [\$M] – 2016-2024..... | 190 |
| Table 87 – Denmark, Sweden, Norway and Finland Quantum Computing Market AGRs [%] – 2016-2024..... | 192 |
| Table 88 – Germany Quantum Computing Market [\$M] – 2016-2024 | 194 |
| Table 89 – Germany Quantum Computing Market AGRs [%] – 2016-2024..... | 195 |
| Table 90 – Switzerland Quantum Computing Market [\$M] – 2016-2024..... | 196 |
| Table 91 – Switzerland Quantum Computing Market AGRs [%] – 2016-2024..... | 197 |
| Table 92 – Russia Quantum Computing Market [\$M] – 2016-2024 | 199 |
| Table 93 – Russia Quantum Computing Market AGRs [%] – 2016-2024 | 200 |
| Table 94 – Rest of Europe Quantum Computing Market [\$M] – 2016-2024 | 201 |
| Table 95 – Rest of Europe Quantum Computing Market AGRs [%] – 2016-2024..... | 202 |
| Table 96 – India Quantum Computing Market [\$M] – 2016-2024 | 203 |
| Table 97 – India Quantum Computing Market AGRs [%] – 2016-2024..... | 204 |
| Table 98 – China Quantum Computing Market [\$M] – 2016-2024..... | 217 |
| Table 99 – China Quantum Computing Market AGRs [%] – 2016-2024 | 218 |
| Table 100 – Japan Quantum Computing Market [\$M] – 2016-2024 | 220 |
| Table 101 – Japan Quantum Computing Market AGRs [%] – 2016-2024..... | 221 |
| Table 102 – Singapore Quantum Computing Market [\$M] – 2016-2024..... | 223 |
| Table 103 – Singapore Quantum Computing Market AGRs [%] – 2016-2024..... | 224 |
| Table 104 – Australia Quantum Computing Market [\$M] – 2016-2024 | 226 |
| Table 105 – Australia Quantum Computing Market AGRs [%] – 2016-2024 | 227 |
| Table 106 – Rest of Asia Pacific Quantum Computing Market [\$M] – 2016-2024..... | 228 |

| | |
|--|-----|
| Table 107 – Rest of Asia Pacific Quantum Computing Market AGRs [%] – 2016-2024..... | 229 |
| Table 108 – Mexico Quantum Computing Market [\$M] – 2016-2024..... | 231 |
| Table 109 – Mexico Quantum Computing Market AGRs [%] – 2016-2024 | 231 |
| Table 110 – Brazil Quantum Computing Market [\$M] – 2016-2024 | 233 |
| Table 111 – Brazil Quantum Computing Market AGRs [%] – 2016-2024 | 233 |
| Table 112 – Rest of Latin America Quantum Computing Market [\$M] – 2016-2024..... | 234 |
| Table 113 – Rest of Latin America Quantum Computing Market AGRs [%] – 2016-2024..... | 235 |
| Table 114 – Saudi Arabia Quantum Computing Market [\$M] – 2016-2024..... | 236 |
| Table 115 – Saudi Arabia Quantum Computing Market AGRs [%] – 2016-2024..... | 237 |
| Table 116 – Other GCC Quantum Computing Market [\$M] – 2016-2024 | 239 |
| Table 117 – Other GCC Quantum Computing Market AGRs [%] – 2016-2024..... | 239 |
| Table 118 – Israel Quantum Computing Market [\$M] – 2016-2024 | 241 |
| Table 119 – Israel Quantum Computing Market AGRs [%] – 2016-2024..... | 241 |
| Table 120 – South Africa Quantum Computing Market [\$M] – 2016-2024..... | 243 |
| Table 121 – South Africa Quantum Computing Market AGRs [%] – 2016-2024..... | 243 |
| Table 122 – Rest of ME&A Quantum Computing Market [\$M] – 2016-2024..... | 244 |
| Table 123 – Rest of ME&A Quantum Computing Market AGRs [%] – 2016-2024..... | 245 |

List of Figures

| | |
|---|----|
| Figure 1 – Global Quantum Computing Market [\$M] – 2016-2024: Government-Funded RDT&E vs. Products & Services Market | 33 |
| Figure 2 – Global Quantum Computing Market Shares [%] by Sector – 2016-2024..... | 34 |
| Figure 3 – Global Quantum Computing Market Shares [%] by Revenue Source – 2016-2024 | 36 |
| Figure 4 – Quantum Computing Technology Roadmap | 47 |
| Figure 5 – Applications of Quantum Computing | 49 |
| Figure 6 – Leading IT Companies and Defense Contractors Investing in Quantum Computing..... | 50 |
| Figure 7 - Leading Quantum Computing Companies Technology Approaches..... | 51 |
| Figure 8 – Quantum Computing, Patent Applications by Country to 2015 | 52 |
| Figure 9 – Quantum Patent Applications Timeline 2000-2015..... | 53 |
| Figure 10 – Global Quantum Computing Market [\$M] by Sector – 2016- 2024..... | 65 |
| Figure 11 – Global Quantum Computing Market Shares [%] by Sector – 2016-2024..... | 66 |
| Figure 12 – Global Quantum Computing Market [\$M] by Revenue Source – 2016-2024..... | 70 |
| Figure 13 – Global Quantum Computing Market Shares [%] by Revenue Source – 2016-2024 | 71 |
| Figure 14 – Global Quantum Computing Market [\$M] by Region – 2016- 2024..... | 72 |
| Figure 15 – Regional Quantum Computing Market Shares [%] – 2016-2024 | 73 |
| Figure 16 – Global National Security Quantum Computing Market [\$M] by Region – 2016-2024 | 75 |
| Figure 17 – Regional National Security Quantum Computing Market Shares [%] – 2016-2024 | 76 |
| Figure 18 – Global Government Quantum Computing Market [\$M] by Region – 2016-2024 | 77 |
| Figure 19 – Regional Government Quantum Computing Market Shares [%] – 2016-2024..... | 78 |
| Figure 20 – Global Government-Funded RDT&E Quantum Computing Market [\$M] by Region – 2016-2024..... | 80 |
| Figure 21 – Regional Government-Funded RDT&E Quantum Computing Market Shares [%] – 2016-2024 | 81 |
| Figure 22 – Global Industry & Business Sectors Quantum Computing Market [\$M] by Region – 2016-2024..... | 82 |
| Figure 23 – Regional Industry & Business Sectors Quantum Computing Market Shares [%] – 2016-2024 | 83 |
| Figure 24 – Global Defense & Intelligence Quantum Computing Market [\$M] – 2016-2024..... | 87 |

| | |
|--|-----|
| Figure 25 – Global Homeland Security & Public Safety Quantum Computing Market [\$M] – 2016-2024 | 90 |
| Figure 26 – Global Government & Public Services Quantum Computing Market [\$M] – 2016-2024..... | 92 |
| Figure 27 – Global Gov.-Funded RDT&E Quantum Computing Market [\$M] – 2016-2024..... | 94 |
| Figure 28 – Global Banking & Securities Quantum Computing Market [\$M] – 2016-2024..... | 97 |
| Figure 29 – Global Manufacturing & Logistics Quantum Computing Market [\$M] – 2016-2024..... | 100 |
| Figure 30 – Global Insurance Quantum Computing Market [\$M] – 2016-2024..... | 102 |
| Figure 31 – Global Healthcare & Pharmaceutical Quantum Computing Market [\$M] – 2016-2024..... | 107 |
| Figure 32 – Global Retail & Wholesale Quantum Computing Market [\$M] – 2016-2024..... | 109 |
| Figure 33 – Global Information Technology Industry Quantum Computing Market [\$M] – 2016-2024..... | 112 |
| Figure 34 – Global Telecommunications Quantum Computing Market [\$M] – 2016-2024..... | 114 |
| Figure 35 – QC Promises to Aerospace Activities | 116 |
| Figure 36 – Global Automotive, Aerospace & Transportation Quantum Computing Market [\$M] – 2016-2024 | 117 |
| Figure 37 – Global Energy & Utilities Quantum Computing Market [\$M] – 2016-2024..... | 119 |
| Figure 38 – Global Web, Media & Entertainment Quantum Computing Market [\$M] – 2016-2024..... | 121 |
| Figure 39 – Global Smart Cities Quantum Computing Market [\$M] – 2016-2024..... | 123 |
| Figure 40 – Global Cybersecurity Quantum Computing Market [\$M] – 2016-2024..... | 128 |
| Figure 41 – Global Other Vertical Markets Quantum Computing Market [\$M] – 2016-2024..... | 129 |
| Figure 42 – North America Quantum Computing Market [\$M] by Sector – 2016-2024..... | 132 |
| Figure 43 – North America Quantum Computing Market Shares [%] by Sector – 2016-2024 | 133 |
| Figure 44 – North America Quantum Computing Market [\$M] by Revenue Source – 2016-2024 | 134 |
| Figure 45 – North America Quantum Computing Market Shares [%] by Revenue Source – 2016-2024 | 135 |
| Figure 46 – Europe Quantum Computing Market [\$M] by Sector – 2016-2024..... | 137 |
| Figure 47 – Europe Quantum Computing Market Shares [%] by Sector – 2016-2024..... | 138 |

| | |
|--|-----|
| Figure 48 – Europe Quantum Computing Market [\$M] by Revenue Source – 2016-2024..... | 139 |
| Figure 49 – Europe Quantum Computing Market Shares [%] by Revenue Source – 2016-2024 | 140 |
| Figure 50 – Asia-Pacific Quantum Computing Market [\$M] by Sector – 2016-2024..... | 142 |
| Figure 51 – Asia-Pacific Quantum Computing Market Shares [%] by Sector – 2016-2024..... | 143 |
| Figure 52 – Asia-Pacific Quantum Computing Market [\$M] by Revenue Source – 2016-2024 | 144 |
| Figure 53 – Asia-Pacific Quantum Computing Market Shares [%] by Revenue Source – 2016-2024 | 145 |
| Figure 54 – ROW Quantum Computing Market [\$M] by Sector – 2016-2024 ... | 147 |
| Figure 55 – ROW Quantum Computing Market Shares [%] by Sector – 2016-2024..... | 148 |
| Figure 56 – ROW Quantum Computing Market [\$M] by Revenue Source – 2016-2024..... | 149 |
| Figure 57 – ROW Quantum Computing Market Shares [%] by Revenue Source – 2016-2024 | 150 |
| Figure 58 – U.S. Quantum Computing Market [\$M] – 2016-2024..... | 165 |
| Figure 59 – Canada Quantum Computing Market [\$M] – 2016-2024 | 168 |
| Figure 60 –The UK QC Research Hubs..... | 177 |
| Figure 61 – UK Quantum Computing Market [\$M] – 2016-2024 | 178 |
| Figure 62 – France Quantum Computing Market [\$M] – 2016-2024..... | 184 |
| Figure 63 – QuTech Focus Areas | 185 |
| Figure 64 – Dutch Quantum Computing Research Centers..... | 186 |
| Figure 65 –The Dutch 2016-2022 H2020 QC Research Program | 187 |
| Figure 66 – The Netherlands Quantum Computing Market [\$M] – 2016-2024..... | 188 |
| Figure 67 – Denmark, Sweden, Norway and Finland Quantum Computing Market [\$M] – 2016-2024..... | 191 |
| Figure 68 – Germany Quantum Computing Market [\$M] – 2016-2024 | 194 |
| Figure 69 – Switzerland Quantum Computing Market [\$M] – 2016-2024 | 197 |
| Figure 70 – Russia Quantum Computing Market [\$M] – 2016-2024 | 200 |
| Figure 71 – Rest of Europe Quantum Computing Market [\$M] – 2016-2024 | 201 |
| Figure 72 – India Quantum Computing Market [\$M] – 2016-2024 | 204 |
| Figure 73 – China Quantum Computing, Patent Applications Status..... | 213 |
| Figure 74 – China Quantum Patent Applications Timeline Vs. The U.S., Japan, Europe & Korea | 214 |
| Figure 75 – China Quantum Computing Market [\$M] – 2016-2024 | 217 |
| Figure 76 – Japan Quantum Computing Market [\$M] – 2016-2024 | 220 |
| Figure 77 – Singapore Quantum Computing Market [\$M] – 2016-2024..... | 223 |
| Figure 78 – Australia Quantum Computing Market [\$M] – 2016-2024 | 226 |
| Figure 79 – Rest of Asia Pacific Quantum Computing Market [\$M] – 2016-2024..... | 228 |

| | |
|--|-----|
| Figure 80 – Mexico Quantum Computing Market [\$M] – 2016-2024..... | 231 |
| Figure 81 – Brazil Quantum Computing Market [\$M] – 2016-2024 | 233 |
| Figure 82 – Rest of Latin America Quantum Computing Market [\$M] – 2016-2024..... | 234 |
| Figure 83 – Saudi Arabia Quantum Computing Market [\$M] – 2016-2024 | 237 |
| Figure 84 – Other GCC Quantum Computing Market [\$M] – 2016-2024 | 239 |
| Figure 85 – Israel Quantum Computing Market [\$M] – 2016-2024 | 241 |
| Figure 86 – South Africa Quantum Computing Market [\$M] – 2016-2024 | 243 |

Global Quantum Computing Market

2017-2024

Vol.2

Industry 4.0 Research (A division of HSRC)
601 Pennsylvania Ave. Washington D.C., U.S.A
www.Industry40marketresearch.com

Table of Contents

| | |
|--|-----------|
| COMPANIES & BUSINESS OPPORTUNITIES | 16 |
| 1 Business Opportunities | 16 |
| 1.1 Quantum Computing Business Opportunities Roadmap..... | 16 |
| 1.2 Machine Learning | 17 |
| 1.3 Search Engines..... | 18 |
| 1.4 Business Intelligence | 19 |
| 1.5 Software/Hardware Validation and Verification | 19 |
| 1.6 Image and Pattern Recognition..... | 20 |
| 1.7 National Security Intelligence..... | 20 |
| 1.8 Defense | 20 |
| 1.9 Public Safety..... | 20 |
| 1.10 Homeland Security..... | 20 |
| 1.11 Government & Public Services | 20 |
| 1.12 Banking & Financial Services | 21 |
| 1.13 Financial Electronic Trading & Trading Strategies | 21 |
| 1.14 Smart Manufacturing & Logistics | 23 |
| 1.15 Mission Planning/Scheduling and Logistics | 23 |
| 1.16 Insurance | 23 |
| 1.17 Medical Diagnostics | 23 |
| 1.18 Medical Treatments | 23 |
| 1.19 Pharmacology | 23 |
| 1.20 Protein Folding..... | 23 |
| 1.21 Retail & Wholesale..... | 23 |
| 1.22 Information Technology Industry..... | 24 |
| 1.23 Telecommunication..... | 24 |
| 1.24 Automotive & Transportation | 24 |
| 1.25 Aerospace..... | 24 |
| 1.26 Energy & Utilities..... | 25 |
| 1.27 Energy Systems & Photovoltaics | 25 |
| 1.28 Energy Exploration..... | 25 |
| 1.29 Web, Media & Entertainment | 25 |
| 1.30 Smart Cities | 25 |
| 1.31 Cybersecurity | 25 |
| 1.32 Quantum Computing Systems | 25 |
| 1.33 Quantum Computing Software..... | 25 |
| 1.34 Quantum Computing as a Service on the Cloud | 26 |
| 1.35 Academia & National Labs..... | 26 |
| 1.36 Graph Theory Problems..... | 26 |
| 1.37 Material Science | 27 |
| 1.38 Marine Science | 27 |
| 1.39 Bioinformatics | 28 |
| 1.40 Climate Modeling & Weather Predictions..... | 28 |

| | | |
|----------|--|-----------|
| 1.41 | Seismic Survey | 29 |
| 1.42 | Risk Management..... | 30 |
| 1.43 | Simulation | 31 |
| 1.44 | Video Compression..... | 31 |
| 1.45 | Cryptography | 31 |
| 1.45.1 | Quantum Cryptography | 31 |
| 1.45.2 | Post-quantum Cryptography..... | 32 |
| 1.46 | QC Based Optimization Problems | 32 |
| 1.46.1 | Optimization Problems | 32 |
| 1.46.2 | Quantum-Assisted Optimization | 33 |
| 1.46.3 | Reservoir Optimization Applications | 33 |
| 1.46.4 | Utilities Management Optimization | 34 |
| 1.47 | Quantum Computing Based Machine Learning | 34 |
| 1.47.1 | Quantum Machine Learning | 34 |
| 1.47.2 | Quantum Reinforcement Learning | 35 |
| 1.48 | Big Data & Predictive Analytics..... | 35 |
| 1.49 | Material Science | 35 |
| 1.50 | Quantum Sampling | 36 |
| 1.51 | Quantum Chemistry | 36 |
| 1.52 | Monte Carlo Simulation..... | 37 |
| 2 | Quantum Computing Companies..... | 39 |
| 2.1 | 1Qbit | 39 |
| 2.1.1 | Company Profile | 39 |
| 2.1.2 | Quantum Computing Activities | 39 |
| 2.2 | Agilent Technologies..... | 40 |
| 2.2.1 | Company Profile | 40 |
| 2.2.2 | Quantum Computing Activities | 40 |
| 2.3 | Aifotec AG..... | 40 |
| 2.3.1 | Company Profile | 40 |
| 2.3.2 | Quantum Computing Activities | 41 |
| 2.4 | Airbus Group..... | 41 |
| 2.4.1 | Company Profile | 41 |
| 2.4.2 | Quantum Computing Activities | 41 |
| 2.5 | Alcatel-Lucent | 42 |
| 2.5.1 | Company Profile | 42 |
| 2.5.2 | Quantum Computing Activities | 42 |
| 2.6 | Alibaba Group Holding Limited | 42 |
| 2.6.1 | Company Profile | 42 |
| 2.6.2 | Quantum Computing Activities | 43 |
| 2.7 | Anyon Systems, Inc | 43 |
| 2.7.1 | Company Profile | 43 |
| 2.7.2 | Quantum Computing Activities | 43 |
| 2.8 | Artiste-qb.net | 44 |
| 2.8.1 | Company Profile | 44 |
| 2.8.2 | Quantum Computing Activities | 44 |
| 2.9 | Avago Technologies | 44 |

| | |
|---|----|
| 2.10 Booz Allen Hamilton..... | 44 |
| 2.10.1 Company Profile | 44 |
| 2.10.2 Quantum Computing Activities | 45 |
| 2.11 British Telecommunications (BT) | 45 |
| 2.11.1 Company Profile | 45 |
| 2.11.2 Quantum Computing Activities | 46 |
| 2.12 Cambridge Quantum Computing Limited..... | 46 |
| 2.12.1 Company Profile | 46 |
| 2.12.2 Quantum Computing Activities | 47 |
| 2.13 Ciena Corporation..... | 47 |
| 2.13.1 Company Profile | 47 |
| 2.13.2 Quantum Computing Activities | 47 |
| 2.14 Cyoptics | 48 |
| 2.14.1 Company Profile | 48 |
| 2.14.2 Quantum Computing Activities | 48 |
| 2.15 D-Wave Systems Inc | 48 |
| 2.15.1 Company Overview | 48 |
| 2.15.2 Quantum Computing Activities | 49 |
| 2.16 Eagle Power Technologies, Inc..... | 49 |
| 2.16.1 Company Profile | 49 |
| 2.16.2 Quantum Computing Activities | 50 |
| 2.17 Emcore Corporation | 50 |
| 2.17.1 Company Profile | 50 |
| 2.17.2 Quantum Computing Activities | 50 |
| 2.18 Enablence Technologies..... | 50 |
| 2.18.1 Company Profile | 50 |
| 2.18.2 Quantum Computing Activities | 50 |
| 2.19 Entanglement Partners | 51 |
| 2.20 Fathom Computing | 51 |
| 2.20.1 Company Profile | 51 |
| 2.20.2 Quantum Computing Activities | 51 |
| 2.21 Finisar Corporation | 51 |
| 2.22 Fujitsu Limited..... | 52 |
| 2.22.1 Company Profile | 52 |
| 2.22.2 Quantum Computing Activities | 52 |
| 2.23 Google Quantum AI Lab | 54 |
| 2.23.1 Company Profile | 54 |
| 2.23.2 Quantum Computing Activities | 54 |
| 2.24 H-Bar Quantum Consultants..... | 55 |
| 2.25 Hewlett Packard Enterprise Company | 56 |
| 2.25.1 Company Profile | 56 |
| 2.25.2 Quantum Computing Activities | 56 |
| 2.26 IBM | 57 |
| 2.26.1 Company Profile | 57 |
| 2.26.2 Quantum Computing Activities | 57 |
| 2.27 ID Quantique..... | 58 |

| | | |
|--------|---|----|
| 2.27.1 | Company Profile | 58 |
| 2.27.2 | Quantum Computing Activities | 59 |
| 2.28 | Infinera Corporation | 59 |
| 2.28.1 | Company Profile | 59 |
| 2.28.2 | Quantum Computing Activities | 59 |
| 2.29 | Intel Corp. | 60 |
| 2.29.1 | Company Profile | 60 |
| 2.29.2 | Quantum Computing Activities | 60 |
| 2.30 | IonQ..... | 61 |
| 2.30.1 | Company Profile | 61 |
| 2.30.2 | Quantum Computing Activities | 61 |
| 2.31 | JDS Uniphase Corporation | 61 |
| 2.32 | Kaiam Corporation | 62 |
| 2.32.1 | Company Profile | 62 |
| 2.32.2 | Quantum Computing Activities | 62 |
| 2.33 | Lockheed Martin Corp..... | 62 |
| 2.33.1 | Company Profile | 62 |
| 2.33.2 | Quantum Computing Activities | 63 |
| 2.34 | MagiQ Technologies, Inc. | 63 |
| 2.34.1 | Company Profile | 63 |
| 2.34.2 | Quantum Computing Activities | 64 |
| 2.35 | Microsoft Quantum Architectures and Computation Group (QuArC) | 64 |
| 2.35.1 | Company Profile | 64 |
| 2.35.2 | Quantum Computing Activities | 64 |
| 2.36 | Mitsubishi Electric Corp. | 65 |
| 2.36.1 | Company Profile | 65 |
| 2.36.2 | Quantum Computing Activities | 65 |
| 2.37 | NEC | 66 |
| 2.37.1 | Company Profile | 66 |
| 2.37.2 | Quantum Computing Activities | 67 |
| 2.38 | Nokia Bell Labs | 67 |
| 2.38.1 | Company Profile | 67 |
| 2.38.2 | Quantum Computing Activities | 67 |
| 2.39 | NTT Basic Research Laboratories & NTT Secure Platform Laboratories | 68 |
| 2.39.1 | Company Profile | 68 |
| 2.39.2 | Quantum Computing Activities | 68 |
| 2.40 | Optalysys Ltd. | 68 |
| 2.40.1 | Company Profile | 68 |
| 2.40.2 | Quantum Computing Activities | 69 |
| 2.41 | Post-Quantum..... | 69 |
| 2.41.1 | Company Profile | 69 |
| 2.41.2 | Quantum Computing Activities | 69 |
| 2.42 | QbitLogic..... | 69 |
| 2.42.1 | Company Profile | 69 |

| | | |
|-------------------|---|-----------|
| 2.42.2 | Quantum Computing Activities | 70 |
| 2.43 | QC Ware Corp. | 70 |
| 2.43.1 | Company Profile | 70 |
| 2.43.2 | Quantum Computing Activities | 70 |
| 2.44 | Quantum Circuits | 70 |
| 2.44.1 | Company Profile | 70 |
| 2.45 | Quantum Hardware Inc | 71 |
| 2.45.1 | Company Profile | 71 |
| 2.45.2 | Quantum Computing Activities | 71 |
| 2.46 | QuantumCTek..... | 71 |
| 2.46.1 | Company Profile | 71 |
| 2.46.2 | Quantum Computing Activities | 71 |
| 2.47 | Qubitekk..... | 71 |
| 2.47.1 | Company Profile | 71 |
| 2.47.2 | Quantum Computing Activities | 72 |
| 2.48 | Quintessence Labs | 72 |
| 2.48.1 | Company Profile | 72 |
| 2.48.2 | Quantum Computing Activities | 72 |
| 2.49 | QxBranch..... | 72 |
| 2.50 | Raytheon BBN | 73 |
| 2.50.1 | Company Profile | 73 |
| 2.50.2 | Quantum Computing Activities | 73 |
| 2.51 | Rigetti Computing | 74 |
| 2.51.1 | Company Profile | 74 |
| 2.51.2 | Quantum Computing Activities | 74 |
| 2.52 | SeQureNet..... | 75 |
| 2.53 | SK Telecom | 75 |
| 2.53.1 | Company Profile | 75 |
| 2.53.2 | Quantum Computing Activities | 75 |
| 2.54 | Sparrow Quantum..... | 76 |
| 2.54.1 | Company Profile | 76 |
| 2.54.2 | Quantum Computing Activities | 76 |
| 2.55 | Toshiba | 77 |
| 2.55.1 | Company Profile | 77 |
| 2.55.2 | Quantum Computing Activities | 77 |
| 2.56 | Xanadu | 77 |
| APPENDICES | | 78 |
| 3 | Appendix A: Introduction to Quantum Computing..... | 78 |
| 3.1.1 | Superposition | 80 |
| 3.1.2 | Entanglement | 80 |
| 3.1.2.1 | Ion-based Qubits | 81 |
| 3.1.2.2 | Superconducting Qubits | 82 |
| 3.1.2.3 | Solid-State Spin Qubits..... | 82 |
| 4 | Appendix B: Quantum Information Technologies | 83 |

| | | |
|-----------|---|------------|
| 4.1 | Quantum information | 83 |
| 4.2 | Shared Principles..... | 83 |
| 4.3 | Quantum Computing..... | 83 |
| 4.4 | Quantum Cryptography:..... | 84 |
| 4.5 | Quantum Sensing | 85 |
| 5 | Appendix C: Quantum Computing Hardware..... | 87 |
| 6 | Appendix D: Quantum Computing Software..... | 88 |
| 6.1 | Introduction to Quantum Algorithms..... | 88 |
| 7 | Appendix E: Quantum Encryption | 89 |
| 7.1 | Background..... | 89 |
| 7.2 | Key Findings | 89 |
| 7.3 | Spooks Reacting at a Distance | 91 |
| 8 | Appendix F: Global 50 Top Supercomputers..... | 93 |
| 9 | Appendix G: Industry Investment in Quantum Computing – 2006-2016 | 98 |
| 10 | Appendix H: NQIT R&D Projects | 102 |
| 10.1 | Background..... | 102 |
| 10.2 | Architectures, Standards and Systems Integration | 102 |
| 10.3 | Ion Trap Node Engineering | 102 |
| 10.4 | Atom-photon Interfaces..... | 103 |
| 10.5 | Photonic Network Engineering..... | 103 |
| 10.6 | Solid State Node Engineering..... | 103 |
| 10.7 | Secure Communications and Verification | 104 |
| 10.8 | Networked Quantum Sensors..... | 104 |
| 10.9 | Quantum Digital Simulation | 104 |
| 10.10 | Hybrid Classical/Quantum Computing | 104 |
| 10.11 | Capabilities and Support..... | 105 |
| 11 | Appendix I: Exascale Computing | 106 |
| 11.1 | Exascale Computing Definition | 106 |
| 11.2 | U.S. Exascale Computing Activities | 106 |
| 11.3 | China Exascale Computing Activities..... | 106 |
| 11.4 | EU Exascale Computing Activities | 106 |
| 11.5 | Japan Exascale Computing Activities | 107 |
| 11.6 | India Exascale Computing Activities | 107 |
| 11.7 | Exascale Computing Challenges | 107 |
| 12 | Appendix J: Market Background by Country | 108 |
| 12.1 | U.S. Market Background..... | 108 |
| 12.1.1 | Facts & Figures | 108 |
| 12.1.2 | U.S. Economy | 108 |
| 12.1.3 | Department of Homeland Security | 108 |
| 12.1.3.1 | Department of Homeland Security: Agencies and Units | 110 |
| 12.1.4 | Department of Defense (DOD) | 112 |

| | | |
|----------|--|-----|
| 12.1.5 | Department of Justice (DOJ) | 112 |
| 12.1.6 | Federal Bureau of Investigation (FBI)..... | 115 |
| 12.1.7 | Department of State (DOS) | 116 |
| 12.1.8 | National Aeronautic & Space Administration (NASA) | 117 |
| 12.1.9 | Department of Transportation (DOT)..... | 117 |
| 12.1.9.1 | Department of Commerce (DOC) | 118 |
| 12.1.10 | U.S. Police Forces..... | 119 |
| 12.2 | Canada Market Background | 120 |
| 12.2.1 | Facts & Figures | 120 |
| 12.2.2 | Canada Geopolitical Overview | 120 |
| 12.2.3 | Canada Economy | 121 |
| 12.2.4 | Canada Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 122 |
| 12.2.5 | Canadian Police Forces | 123 |
| 12.2.6 | Canada Intelligent Services..... | 123 |
| 12.2.7 | Canada Defense Forces..... | 124 |
| 12.3 | Mexico Market Background | 124 |
| 12.3.1 | Facts & Figures | 124 |
| 12.3.2 | Mexico Geopolitical Overview | 124 |
| 12.3.3 | Mexico Economy | 125 |
| 12.3.4 | Mexico Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 126 |
| 12.3.5 | Mexican Police Forces | 127 |
| 12.4 | Brazil Market Background..... | 128 |
| 12.4.1 | Facts & Figures | 128 |
| 12.4.2 | Brazil Geopolitical Overview | 128 |
| 12.4.3 | Brazil Economy | 130 |
| 12.4.4 | Brazil Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 131 |
| 12.4.5 | Brazil Police Forces..... | 132 |
| 12.4.6 | Brazil Defense Forces | 132 |
| 12.5 | UK Market Background | 133 |
| 12.5.1 | Facts & Figures | 133 |
| 12.5.2 | UK Geopolitical Overview | 133 |
| 12.5.3 | UK Economy | 134 |
| 12.5.4 | The Brexit Effects | 134 |
| 12.5.5 | UK Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 137 |
| 12.5.6 | UK Police Forces..... | 137 |
| 12.5.7 | UK Police Forces Statistics | 139 |
| 12.5.8 | UK Intelligent Services | 140 |
| 12.5.8.1 | Security Service – MI5 | 140 |
| 12.5.8.2 | National Domestic Extremism & Disorder Intelligence Unit (NDEDIU) | 141 |
| 12.5.8.3 | National Crime Agency (NCA) | 141 |
| 12.5.8.4 | National Ballistics Intelligence Service (NBIS) | 141 |

| | | |
|-----------|---|-----|
| 12.5.8.5 | National Fraud Intelligence Bureau (NFIB) | 141 |
| 12.5.8.6 | MI6, Secret Intelligence Service | 141 |
| 12.5.8.7 | Defense Intelligence (DI) | 142 |
| 12.5.8.8 | Communications Headquarters (GCHQ) | 142 |
| 12.5.8.9 | The Joint Intelligence Organization..... | 143 |
| 12.5.8.10 | The Parliament Intelligence and Security Committee | 143 |
| 12.5.8.11 | UK Intelligence Agencies Budgets | 144 |
| 12.5.9 | UK Defense Forces | 144 |
| 12.6 | France Market Background..... | 145 |
| 12.6.1 | Facts & Figures | 145 |
| 12.6.2 | France Geopolitical Overview..... | 145 |
| 12.6.3 | France Economy Overview | 145 |
| 12.6.4 | France Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 147 |
| 12.6.5 | French Police Forces..... | 148 |
| 12.6.5.1 | The National Police..... | 148 |
| 12.6.5.2 | Research, Assistance, Intervention, Deterrence (RAID)..... | 149 |
| 12.6.5.3 | National Police Intervention Groups (GIPN) | 149 |
| 12.6.5.4 | The National Gendarmerie | 149 |
| 12.6.5.5 | National Gendarmerie Intervention Group | 149 |
| 12.6.5.6 | Paris Police Prefecture | 150 |
| 12.6.5.7 | Police Forces Statistics..... | 151 |
| 12.6.6 | France Intelligent Services | 151 |
| 12.6.6.1 | Domestic Counter-terrorism & Counter-espionage Intelligence (DGSI) | 151 |
| 12.6.6.2 | Central Directorate of the Judicial Police (DCPJ) | 152 |
| 12.6.6.3 | General Directorate for External Security (DGSE)..... | 152 |
| 12.6.6.4 | Directorate of Protection and Defense Security (DPSD) | 153 |
| 12.6.6.5 | Directorate of Military Intelligence (DRM) | 153 |
| 12.6.6.6 | Anti-Terrorist Bureau (BLAT) | 153 |
| 12.6.6.7 | Inter-Departmental Coordination on Terrorism Matters | 154 |
| 12.6.7 | France Defense Forces | 154 |
| 12.7 | Russia Market Background..... | 155 |
| 12.7.1 | Facts & Figures | 155 |
| 12.7.2 | Russia Geopolitical Overview..... | 155 |
| 12.7.3 | Russia Economy | 156 |
| 12.8 | Germany Market Background | 157 |
| 12.8.1 | Facts & Figures | 157 |
| 12.8.2 | Germany Geopolitical Overview | 157 |
| 12.8.3 | Germany Economy..... | 158 |
| 12.8.4 | Germany Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 159 |
| 12.8.5 | The German Police Forces..... | 160 |
| 12.8.5.1 | BPOL - Federal Police | 160 |

| | | |
|-----------|---|-----|
| 12.8.5.2 | GSG 9 - Special Operations & Counterterrorism Unit..... | 160 |
| 12.8.5.3 | BFE/BFHU Units - Special Anti-Terrorist Unit of Federal Anti-Riot Police | 161 |
| 12.8.5.4 | ASSIK - Special Task Force Protection in Crisis Areas | 161 |
| 12.8.5.5 | ZKA - Customs Investigation Bureau..... | 161 |
| 12.8.5.6 | ZUZ - Customs SWAT Unit..... | 161 |
| 12.8.5.7 | Military Police..... | 162 |
| 12.8.5.8 | State Police Forces..... | 162 |
| 12.8.5.9 | SEK - State Special Operations Command Part of Uniformed Police | 162 |
| 12.8.5.10 | MEK - Mobile Task Force units, Part of Criminal Police | 163 |
| 12.8.6 | Germany Intelligent Services..... | 163 |
| 12.8.6.1 | Federal Intelligence Service (BND)..... | 163 |
| 12.8.6.2 | Federal Office for the Protection of the Constitution (BfV)..... | 164 |
| 12.8.6.3 | Military Counterintelligence Service (MAD) | 164 |
| 12.8.6.4 | The State Office for the Protection of the Constitution..... | 165 |
| 12.8.7 | Defense Forces | 165 |
| 12.9 | Netherlands Market Background..... | 166 |
| 12.9.1 | Facts & Figures | 166 |
| 12.9.2 | Netherlands Geopolitical Overview | 166 |
| 12.9.3 | Netherlands Economy | 166 |
| 12.9.4 | Netherlands Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 167 |
| 12.9.5 | Netherlands Police | 167 |
| 12.10 | Denmark Market Background | 168 |
| 12.10.1 | Facts & Figures | 168 |
| 12.10.2 | Denmark Geopolitical Overview | 168 |
| 12.10.3 | Denmark Economy | 168 |
| 12.10.4 | Denmark Police Forces | 169 |
| 12.11 | Sweden Market Background | 170 |
| 12.11.1 | Facts & Figures | 170 |
| 12.11.2 | Sweden Geopolitical Overview | 170 |
| 12.11.3 | Sweden Economy | 170 |
| 12.11.4 | Sweden Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 171 |
| 12.11.5 | Swedish Police Forces | 171 |
| 12.12 | Saudi Arabia Market Background | 172 |
| 12.13 | Facts & Figures..... | 172 |
| 12.13.1 | Saudi Arabia Geopolitical Overview | 172 |
| 12.13.2 | Saudi Arabia Economy | 175 |
| 12.13.3 | Saudi Arabia Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 176 |
| 12.13.3.1 | Ministry of Interior | 178 |
| 12.13.3.2 | Saudi National Guard | 178 |

| | | |
|-----------|---|-----|
| 12.13.3.3 | Paramilitary Security Forces | 179 |
| 12.13.4 | Saudi Arabia Police Forces | 180 |
| 12.13.5 | Saudi Arabia Defense Forces..... | 181 |
| 12.13.5.1 | Armed Services | 181 |
| 12.13.5.2 | Independent Forces..... | 182 |
| 12.14 | UAE Market Background | 182 |
| 12.14.1 | Facts & Figures | 182 |
| 12.14.2 | UAE Geopolitical Overview | 182 |
| 12.14.3 | UAE Economy | 183 |
| 12.14.4 | UAE Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 184 |
| 12.14.5 | The UAE Police Forces | 184 |
| 12.14.6 | UAE Defense Forces..... | 185 |
| 12.15 | Qatar Market Background..... | 185 |
| 12.15.1 | Facts & Figures | 185 |
| 12.15.2 | Qatar Geopolitical Overview..... | 185 |
| 12.15.3 | Qatar Economy | 186 |
| 12.15.4 | Qatar Police..... | 186 |
| 12.15.5 | Defense Forces | 188 |
| 12.16 | Kuwait Market Background | 189 |
| 12.16.1 | Facts & Figures | 189 |
| 12.16.2 | Kuwait Geopolitical Overview | 189 |
| 12.16.3 | Kuwait Economy..... | 191 |
| 12.16.4 | Kuwait Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 191 |
| 12.16.5 | Kuwait Police | 191 |
| 12.16.6 | Kuwait Defense Forces | 192 |
| 12.17 | Israel Market Background | 193 |
| 12.17.1 | Facts & Figures | 193 |
| 12.17.2 | Israel Geopolitical Overview | 193 |
| 12.17.3 | Israel Economy..... | 195 |
| 12.17.4 | Israel Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 196 |
| 12.17.5 | The Israeli Police | 196 |
| 12.17.6 | Defense Forces | 197 |
| 12.18 | Australia Market Background | 198 |
| 12.18.1 | Facts & Figures | 198 |
| 12.18.2 | Australia Geopolitical Overview | 198 |
| 12.18.3 | Australia Economy | 198 |
| 12.18.3.1 | External Security..... | 199 |
| 12.18.4 | Australia Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 200 |
| 12.18.5 | Australia - Police Forces..... | 201 |
| 12.18.6 | Australia Intelligent Services | 202 |
| 12.19 | China Market Background | 202 |
| 12.19.1 | Facts & Figures | 202 |

| | | |
|-----------|--|------------|
| 12.19.2 | China Geopolitical Background | 202 |
| 12.19.3 | China Economy | 204 |
| 12.19.4 | China Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 206 |
| 12.19.5 | China Police | 207 |
| 12.19.6 | China Ministry of Public Security | 207 |
| 12.19.7 | Public Security Bureau | 208 |
| 12.19.8 | China Ministry of State Security | 208 |
| 12.19.9 | China Defense Forces..... | 209 |
| 12.20 | Japan Market Background | 214 |
| 12.20.1 | Facts & Figures | 214 |
| 12.20.2 | Japan Geopolitical Background..... | 214 |
| 12.20.3 | Japan Economy..... | 216 |
| 12.20.4 | Japan Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 217 |
| 12.20.5 | Japan Police Forces..... | 218 |
| 12.20.6 | Japan Defense Forces | 218 |
| 12.21 | India Market Background | 219 |
| 12.21.1 | Facts & Figures | 219 |
| 12.21.2 | India Geopolitical Overview | 219 |
| 12.21.3 | India Economy..... | 220 |
| 12.21.4 | India Defense, Intelligence, Law Enforcement & Homeland Security Agencies | 222 |
| 12.21.5 | Indian Police Forces..... | 223 |
| 12.21.6 | India Defense Market | 224 |
| 12.21.7 | India Defense Forces | 227 |
| 12.22 | Singapore Market Background..... | 227 |
| 12.22.1 | Facts & Figures | 227 |
| 12.22.2 | Singapore Geopolitical Overview | 227 |
| 12.22.3 | Singapore Economy | 228 |
| 12.22.4 | Singapore Police | 228 |
| 12.22.5 | Singapore Defense Forces..... | 229 |
| 13 | Appendix K: Key Quantum Computing Patents | 230 |
| 13.1 | Patents List | 230 |
| 13.2 | Quantum Computing Patent Filing by Country..... | 237 |
| 14 | Appendix L: Links to 31 Quantum Computing Academic Research Centers | 238 |
| 15 | Appendix M: 2017 Quantum Conferences Links - | 240 |
| 16 | Appendix N: Glossary | 244 |
| 17 | Appendix O: References | 246 |
| 18 | Scope & Methodology | 263 |
| 18.1 | Research Scope | 263 |
| 18.2 | Research Methodology | 263 |

19 Disclaimer & Copyright.....265

List of Figures

| | |
|--|-----|
| Figure 1 - Quantum Computing Business Opportunities Roadmap | 15 |
| Figure 3 - Qubit Explanation | 79 |
| Figure 4 - Quantum Entanglement..... | 80 |
| Figure 5 - Control Systems for the Ion-Trap System..... | 104 |
| Figure 6 - Department of Homeland Security –Organizational Structure | 109 |
| Figure 7 - Canada Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram | 121 |
| Figure 8 - Mexico Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram | 125 |
| Figure 9 - Brazil Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram | 130 |
| Figure 10 - UK Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram | 136 |
| Figure 11 - France Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram | 146 |
| Figure 12 - Germany Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram | 158 |
| Figure 13 - Netherlands Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram..... | 166 |
| Figure 14 - Saudi Arabia Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram..... | 176 |
| Figure 15 - UAE Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram | 183 |
| Figure 16 - Israel Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram | 195 |
| Figure 17 - Australia Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram | 199 |
| Figure 18 - The IMF 2010-2030 Forecast: China GDP vs. Other Nations GDP | 204 |
| Figure 19 - China Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram | 205 |
| Figure 20 - Japan Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram | 216 |
| Figure 21 - India Defense, Intelligence, Law Enforcement & Homeland Security Agencies Organogram | 221 |
| Figure 22 - Quantum Computing, Quantum Cryptography and Sensors Quantum Patent Applications by Country 2000 to 2015 | 236 |
| Figure 23 - Patent Applications by Country – 2000-2015..... | 236 |