

Europe's Terror & Migration Crisis Series

2016-2022

European Explosives & Weapons Detection Technologies Market



Homeland Security Research Corp.

Europe's Terror & Migration Crisis Series

***European Explosives &
Weapons Detection Technologies
Market
2016-2022***

May 2016

Homeland Security Research Corp. (HSRC) is an international market and technology research firm specializing in the Counter Terror & Public Safety (PS) Industry. HSRC provides premium market reports on present and emerging technologies and industry expertise, enabling global clients to gain time-critical insight into business opportunities. HSRC's clients include the EU, NATO U.S. Congress, DHS, U.S. Army, U.S. Navy, DOD, DOT, and US Congress GAO among others; as well as Counter Terror & PS government agencies in Japan, Korea, Taiwan, Israel, Canada, UK, Germany, Australia, Sweden, Finland, Singapore. With over 950 private sector clients (72% repeat customers), including major defense and security vendors, and Fortune 500 companies. HSRC earned the reputation as the industry's Gold Standard for Counter Terror & Public Safety market reports.

**Washington D.C. 20004, 601 Pennsylvania Ave., NW Suite 900,
Tel: 202-455-0966, info@hsrc.biz, www.homelandsecurityresearch.com**

Acknowledgements

The authors of this report wish to convey their sincere thanks to all of the Counter Terror & Public Safety planners, engineers, scientists, security personnel, government officials, vendors, distributors and users, who granted us interviews, sent us their publications, provided us with non-published presentations, reviewed and commented on our drafts - giving us an invaluable insight into the working of technologies markets and trends. The list below contains the names of some of the people who have helped us directly or indirectly in the preparation of this report. We thank them and many others.

Jorge Domecq, Chief Executive of the European Defence Agency (EDA). **Carl Bildt**, Former Swedish Prime Minister and Minister of Foreign Affairs and Trustee of Friends of Europe. **Ana Gomes**, Member of the European Parliament, Committee on Civil Liberties, Justice and Home Affairs and on the Subcommittee on Security and Defence. **Ian Bremmer**, President and Founder of Eurasia Group. **Elisabeth Guigou**, President of the Foreign Affairs Commission of the French National Assembly, President of Anna Lindh Foundation and Trustee of Friends of Europe. **Lock Pin Chew**, Director of the Risk Assessment and Horizon Scanning Programme Office of Singapore's National Security Coordinating Secretariat. **Peter Hultqvist**, Swedish Minister of Defence. **Luis De Almeida Sampaio**, Portuguese Permanent Representative of Portugal to NATO. **Wolfgang Ischinger**, Chairman of the Munich Security Conference and former German Ambassador to the U.S. **Jaap De Hoop Scheffer**, Former NATO Secretary General and Trustee of Friends of Europe. **Elizabeth Johnston**, Executive Director of the European Forum for Urban Security. **Marina Kaljurand**, Estonian Minister of Foreign Affairs. **Joanne Liu**, International President of Medecins sans Frontieres (MSF). **Mara E. Karlin**, U.S. Deputy Assistant Secretary of Defense for Strategy and Force Development. **Frederica Mogherini**, High Representative of the Union for Foreign Affairs and Security Policy and Vice-President of the European Commission. **Irene Khan**, Director General of the International Development Law Organization and Former Secretary General of Amnesty International. **Bert Koenders**, Dutch Minister of Foreign Affairs. **General Mikhail Kostarakos**, Chairman of the European Union Military Committee (CEUMC). **Baroness Pauline Neville-Jones**, Member of the UK House of Lords and former Minister of State for Security and Counter-Terrorism. **Thomas Gottschild**, Director for EU & NATO Policies, Cassidian. **Colonel Henry Neumann**, Group Leader of CBRN Protection, Fire and Self Protection, German Armed Forces. **Lieutenant Colonel Brian Clesham**, HQ Land Command, Ministry of Defence, UK. **Pentti Partanen**, Director General, Finnish Department of Rescue Services. **John Conaghan**, Police Inspector, British Transport Police. **Colonel Frank Kämper**, Project Officer Protection, Capability Directorate, European Defence Agency. **Gayle Gorman and Jamie Campbell**, Eclipse Ventures. **Lars Kjaer**, World Shipping Council. **John Avolio**, Director, Security & Detection Systems, L3 Communications. **Ted Strancyek**, President, Aircraftsmen & Associates. **Dore S. Perler**, President & CEO, Sense Holding Inc. **James T. Ryan**, General Manager, Cantronic Ethnologies. **M. Peretz**, Executive Vice President, Integrated Detection Systems. **Richard Doubrava**, Managing Director of Security, Air Transport Association. **Marian Terlecki**, Manager, Cargo Security and ULD Industry Distribution & Financial Services, International Air Transport Association (IATA). **Raphael Kahn**, Director Secure, Marine. **Tony Magnusson**, Acting Head of Anti-Smuggling Division, National CSI coordinator, Swedish Customs. **Nadège Grard**, Assistant European Organisation for Security (EOS). **Pavel Adam**, Institute of Photonics and Electronics,

Czech Republic. **Ralph Hammer**, Expert, National and European Security Research, Ministry of Transport, Innovation and Technology, Austria. **Charles Elsen**, Former Council of the European Union. **Jean-Louis de Brouwer**, European Commission. **Audrey Baneyx**, Sciences-Po Paris Médialab. **Benoit Verjat**, Sciences-Po Paris Médialab. **Peter Jozsef Csonka**, European Commission. **Wencelas de Lobkowicz**, Former European Commission, Sciences Po Paris. **Médéric Martin-Mazé**, King's College, London. **Tony Venables**, Former European Citizen Action Service. **Kees Groenendijk**, University of Nijmegen. **Beate Winkler**, Author, former Director of the EU Agency in Vienna, now FRA. **Fabrice Leggeri**, Frontex. **Elsbeth Guild**, University of Nijmegen, CEPS. **Wouter Van De Rijt**, Council of the European Union. **Emilio de Capitani**, Former European Parliament. **Michael Kennedy**, Eurojust. **Petra Bard**, Central European University. **Willy Bruggeman**, Europol. **Monica den Boer**, SeQure Research and Consultancy, Vrije Universiteit, Amsterdam. **Johannes Vos**, Former Council of the European Union. **Peter Hustinx**, Former European Data Protection Supervisor. **Julien Jeandesboz**, Université Libre de Bruxelles. **Sandra Nunes**, eu-LISA. **Sharon Abbas**, Business Development Manager Raytheon International, Europe. **Nicolas D. Loannidis**, Managing Director, Patras Port Authority, S.A. **Anthony Comber**, Sales and Marketing Manager, Thales Navigation Limited. **Steven D. Botello** – Director, Cargo Sales, Rapiscan Security Products. **Jiří Homola**, Institute of Photonics and Electronics, Czech Republic. **Marek Piliarik**, Institute of Photonics and Electronics, Czech Republic, Prague. **Jianping Yao**, Microwave Photonics Research Laboratory, Canada. **Philip Anderson**, Senior Fellow Homeland Security Initiatives, CSIS Center For Strategic & International Studies. **Dale K. Kotter**, Scientist, National Security - INEEL. **Jerry Peck**, Global Trade Management Solutions. **Mike Bohlman**, Horizon Lines and ISO TC 104. **Charlie Piersall**, ISO TC. **Daniel Colonel Fred Hilpert**, Director, Transformation Support, Joint CBRN Defence Centre of Excellence, Czech Republic. **Bill DeWitt**, SSA. **Susan F. Hallowell, Ph.D.**, Director of Technology. **Jerry W. McElwee**, Vice President, Joint Programs, Boeing. **Eric R. Schwartz**, Director, Advanced Systems Technology Phantom Works, Boeing. **Patrick OSZCZEDA**, VP Counter Terror, Thales Group. **Bruce Aitken**, President, Homeland Security Industries Association (HSIA). **R. Barry Ashby**, President, Ashby & Associates. **Rodney E. Thomas**, CEO, Thomas & Herbert Consulting LTC. **John C. Carrano, Ph.D.**, Program Manager Microsystems Technology Office, Defense Advanced Research Projects Agency. **Mark J. Rosker, Ph.D.**, Program Manager, DARPA. **John M. Libert**, Physical Scientist, Display Metrology, Forensic Imaging, Department of Commerce National Institute of Standards and Technology Electronics and Electrical Engineering Laboratory of NIST. **Tomáš Špringer**, Institute of Photonics and Electronics, Czech Republic. **Milan Vala**, Institute of Photonics and Electronics, Academy of Sciences of the Czech Republic, Prague. **Benjamin R. Watts**, Department of Engineering Physics, McMaster University. **Tomasz Wolinski**, Faculty of Physics, Warsaw University of Technology. **Chang-Qing Xu**, Department of Engineering Physics, McMaster University. **Brig. Gen (Res.) Dani Arditi**, Fmr. Director Israel National Security Council. **Giorgio Abrate**, Senior Vice President. **Avio Olav Adami**, Strategic Relations Luciad Col (GS). **Thomas Ahammer**, Deputy Military Representative Permanent Representation of Austria to the EU. **Frank Amedick**, Global Account Manager, NATO Siemens Belgium. **Paul Ames**, Freelance Journalist. **Jacqueline Argence**, Solution Portfolio Management Director, Cassidian. **Aviel Atias**, Consultant Mind-Alliance Systems, LLC. **Fabio Bagnoli**, Division Manager, D'appolonia. **Paul Baker**, Director/Associate Consultant Baker, R&C/Ecorys. **Gary Bamford**, Director, Arcadis Vectra. **Alain Barbier**, Deputy Special Representative to the European Union, International Criminal Police Organization (INTERPOL). **Dan Baxter**, Senior Vice-President and Director, Fleishman-Hillard. **Jacquelyn Bednarz**, Attaché, Department of Homeland Security Mission of the United States of America to the EU. **Emanuela Bellan**, Head of Unit, Crisis Management European Commission General

Secretariat. **Juliette Bird**, First Secretary, Security and Terrorism Permanent Representation of the United Kingdom to the EU. **Ivan Bizjak**, Director General for Justice and Home Affairs Council of the European Union. **David Blackwell**, Director for Cybersecurity DETICA (BAE Systems). **Christian Blobner**, Project Manager, Logistics and Factory Systems, Fraunhofer Institute for Factory Operation and Automation IFF. **Agnes Borg**, Assistant, Weber. **Shandwick Martin Borrett**, Director, IBM Institute for Advanced Security. **John Brading**, Deputy BD Director, National Security, Raytheon, UK. **Simon Busuttil**, European Parliament. **Geert Cami**, Co-Founder & Director, Security & Defence Agenda (SDA). **Genserik Cantournet**, Vice President, Security Cross-Processes and Projects Telecom Italia. **Patrice Cardot**, Conseiller, Ministry of Defence, France, Direction Générale de l'Armement (DGA). **Valentina Carletti**, Advisor for EU, EDA and NATO affairs, Selex Sistemi Integrati. **Albert Caruana**, Information Assurance Officer, Council of the European Union. **Claudio Catalano**, Analyst, Studies Division, Finmeccanica, UK. **Marc Cathelineau**, Vice President, European Union & NATO Affairs, Thales. **Inge Ceuppens**, Project Officer, European Commission, DG for Information Society & Media. **Jacques Cipriano**, Vice President, European Affairs, Safran Group. **Michael Clarke**, Public Affairs Director, G4S. **Robert Cox**, Trustee, Friends of Europe. **Eugenio Creso**, Institutional Relations Director, Selex Sistemi Integrati S.p.A. **Vincenzo Cuomo**, Professor, Italian National Research Council (CNR). **Charles de Couessin** General Manager, ID Partners. **Dennis Davis**, Vice President, International Association of Fire and Rescue Services (CTIF). **Jean-Louis de Brouwer**, Director for Migration and Borders, European Commission, DG for Home Affairs. **Gilles de Kerchove**, European Counter-Terrorism Coordinator, Council of the European Union. **Kirsten de Haan**, Research Assistant, Fleishman-Hillard. **Stanislas de Maupeou**, Director for Cyber-Defence, Thales. **Eva Diaz Perez**, EADS Key Account NATO/EU, European Aeronautic Defence and Space Company (EADS). **Anatoly Didenko**, Counsellor, Mission of the Russian Federation to the EU. **Claes Dorien**, Office Manager, European Corporate Security Association (ECSA). **Michael T. Dougherty**, Director of Immigration Control, Raytheon. **Jonathan Dowdall**, Policy Analyst & Market Development, Security Europe. **David Henry Doyle**, Security & Defence Advisor, YPFP Brussels. **Anna Katarzyna Dubowik**, Secretary, Permanent Representation of Poland to the EU. **H.E. Mr. Dumitru Sorin Ducaru**, Ambassador, Delegation of Romania to NATO. **Krzysztof Durczak**, Key Account Manager, Defence & Security Sector, Thales. **Eeva Eek-Pajuste**, Counsellor, Political Affairs, Permanent Representation of Estonia to the EU. **Sabine Ehmke-Gendron**, Director for Civil Protection and Disaster Management, Council of the European Union. **Ludwig Eickemeyer**, Corporate Sales Executive, European Voice. **Gamze Erdem**, Advisor, Turkish Industry and Business Association, (TÜSIAD). **Anu Esilas**, Programmes Coordinator, Estonian Atlantic Treaty Association. **Henning Faltin**, Deputy Branch Head, European Union Military Staff (EUMS). **David Fairnie**, Director of Global Port Solution, G4S. **Patsy Faynsztein**, Manager, EU Business Development, Raytheon International, Europe. **Maria Fialho**, Special Advisor, Transatlantic Relations, European Parliament. **Ulrich Fikar**, Assistant to Zoltán Martinusz, European Council Cabinet of President Herman Van Rompuy. **Theodor Fokken**, Director, Business Development EU-NATO, Rohde & Schwarz. **Pierre-Alain Fonteyne**, Chairman of the IMG-S Security Research Roadmap (SRR), Catholic University of Louvain. **Roger Forsberg**, Chief Information Security Officer, Swedish Fortifications Agency. **Ulrike Freyert**, Policy Officer, Justice and Interior Representation of Brandenburg to the EU. **Octávia Frota**, Senior Advisor, Conrad International. **Marino Gallego**, Innovation Business Director, Everis. **Hugo Ganet-Sénoko**, Senior Manager, Indra. **Jim Gaudoin**, Managing Director, L-3 Communication Systems Security & Detection Systems Division. **Antoine Gérard**, Head of the Brussels Liaison Office, United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA). **Andrea Ghianda**, Project Manager, Security & Defence Agenda (SDA). **Pierluigi Massimo Giansanti**, Director, NATO/EU Sales Department,

Selex Sistemi Integrati, S.p.A. **Bill Giles**, Director General Europe, BAE Systems. **Laurent Giquello**, French National Expert, NATO Air Command and Control System Management Agency (NACMA). **Lt. Gen. Jo Godderij**, Director, NATO International Military Staff (IMS). **Timo Harkonen**, Director of Government Security, Office of the Prime Minister, Finland. **Michael Hartinger**, Project Officer, Capability Development Planning, European Defence Agency (EDA). **Robert Havas**, Chairman, Board of Directors, European Organization for Security (EOS). **Rear Admiral Giorgio Lazio**, Chief of Staff Maritime Command, NATO. **James A. Lewis**, Director and Senior Fellow of the Strategic Technologies Program of the Center for Strategic and International Studies (CSIS). **Michael Printzos**, Programme Director of The Hellenic Initiative. **Lee Litzenberger**, U.S. Deputy Permanent Representative to NATO. **Didier Reynders**, Belgian Deputy Prime Minister and Minister of Foreign Affairs and European Affairs. **Katrin Suder**, German Secretary of State at the Ministry of Defence. **Carne Ross**, Executive Director of Independent Diplomat. **Sir Adam Thomson**, UK Permanent Representative to NATO. **Michael Roth**, German Minister of State for Europe. **Marietje Schaake**, Member of the European Parliament, Vice-Chair of the Delegation for Relations with the United States, Member of the Committee on International Trade. **Waldemar Very**, Deputy Special Representative for the Rule of Law at the United Nations Mission in Liberia (UNMIL). **Marriet Schuurman**, NATO Special Representative. **Catherine Woollard**, Secretary General of the European Council on Refugees and Exiles (ECRE). **Jamie Shea**, NATO Deputy Assistant Secretary General for Emerging Security Challenges. **Maria zakharova**, Spokesperson of the Russian Ministry of Foreign Affairs. **Julianne smith**, Senior Fellow and Director of the Strategy and Statecraft Program at the Center for a New American Security (CNAS). **Lamberto Zannier**, Secretary General of the Organization for Security and Co-operation in Europe (OSCE). **Javier Solana**, Former NATO Secretary General and EU High Representative for CSDP and Trustee of Friends of Europe.

Table of Contents

1	Europe's Terror & Migration Crisis: Key Findings	18
2	Europe's Terror & Migration Crisis: Key Conclusions	33
3	European Explosives Trace Detection (ETD) Market – 2016-2022.....	45
3.1	European Explosives Trace Detection: Major Findings	45
3.2	European Explosives Trace Detection: Major Conclusions	47
3.3	ETD Technologies and Market Background	48
3.3.1	ETD Background	48
3.3.2	Ion Mobility Spectroscopy (IMS)	52
3.3.3	Current Explosives & Narcotics Detection Technologies Map	53
3.3.4	ETD vs. Bulk Explosives & Narcotics Detection: Pros & Cons.....	54
3.3.5	Handheld and Desktop ETD	54
3.3.6	Airport Boarding Gate Explosives Scanners	56
3.3.7	Vehicle Screening ETD Systems	58
3.4	Pipeline ETD Technologies	59
3.4.1	Nanotechnology Explosives and Narcotics Trace Detection: Challenges.....	59
3.4.2	Receptor-based ETD	60
3.4.3	Molecularly Imprinted Polymers Based ETD.....	60
3.4.4	Nano-mechanical Sensor Based ETD	60
3.4.5	Electronic Nose Based ETD	60
3.4.6	Silica Micro-cantilever Based ETD.....	61
3.4.7	Surface Enhanced Raman Scattering Based ETD	61
3.4.8	Hybrid Nano-sensor Based ETD.....	62
3.4.9	Protein Coated Carbon Nanotubes, Nano Based ETD	62
3.4.10	Piezo-resistive Polymer Cantilever Nano Based ETD	62
3.4.11	Inkjet Based Wireless Sensor ETD Technology	63
3.4.12	Amino-silane Coated Nanowires Arrays Based ETD	63
3.4.13	Free-surface Microfluidic Control of Surface-Enhanced Raman Spectroscopy Based ETD.....	64
3.4.14	Trace Chemical Vapor Detection Cartridge	64
3.4.15	Free Surface Microfluidic Chip.....	65
3.4.16	Continuous Pre-concentrator	66
3.4.17	Raman Chemical Specific Signatures.....	66
3.4.18	Molecularly Imprinted Polymers Explosives and Narcotics Detection Kit	67
3.4.19	Quantum Sniffer™ Portable ETD.....	68
3.4.20	Cantilever Nano-Mechanical Sensors.....	69
3.4.21	Sensor Array and Neural Network Based ETD	70
3.4.22	Temperature-stepped Desorption Based ETD.....	71
3.4.23	Trace Detection of Nitrogen-Based Explosives with UV-PLF.....	71
3.4.24	Non-Contact Explosives and Narcotics Harvesting ETD	72

3.4.24.1	Non-Contact Harvesting.....	72
3.4.24.2	ETD Transport.....	72
3.4.24.3	ETD Analysis.....	73
3.4.24.4	ETD Reporting	73
3.4.25	Check Point Explosives and Narcotics Detection System	73
3.4.26	Trace Detection of Small Molecules by Pulsed-Ultraviolet Laser Raman Spectroscopy.....	73
3.4.27	Sensing Trace Amounts of Nitro-Aromatic Explosives and Narcotics Using Nanowire-Nanocluster Hybrids	74
3.4.28	Detection of Explosives and Narcotics at Trace Levels by Laser-Induced Breakdown Spectroscopy (LIBS)	74
3.4.29	Universal Explosive Detection System	74
3.4.30	MEMS-Based Explosive Particle Detection and Remote Particle Stimulation	75
3.4.31	Laser Vaporization of Trace Explosives and Narcotics for Enhanced Non-Contact Detection	75
3.4.32	Advanced Materials and Sensor Platforms	76
3.5	Explosives Trace Detection (ETD): Business Opportunities & Challenges	77
3.6	Explosives Trace Detection (ETD) Industry: SWOT Analysis.....	78
3.6.1	Strengths	78
3.6.2	Weaknesses	79
3.6.3	Opportunities	79
3.6.4	Threats.....	80
3.7	European Explosives Trace Detection (ETD) Market – 2015-2022.....	81
4	European Metal Detectors Market – 2016-2022	82
4.1	Metal Detectors Technologies and Market Background	82
4.1.1	European Metal Detectors Market Background	82
4.1.2	Hand-Held (HH) Metal Detectors	84
4.1.3	Single Zone Metal Detection Portals.....	87
4.1.4	Multi-Zone Metal Detection Portals.....	87
4.1.5	Enhanced (Matrix) Metal Detection Portals.....	87
4.2	Major Metal Detector Vendors.....	88
4.3	Metal Detectors: Business Opportunities & Challenges	88
4.4	Metal Detectors Market: SWOT Analysis	89
4.4.1	Strengths	89
4.4.2	Weaknesses	90
4.4.3	Opportunities	90
4.4.4	Threats.....	90
4.5	European Metal Detectors Market – 2015-2022.....	91
5	European Standoff Explosives & Weapon Detection Market – 2016- 2022.....	93
5.1	Market & Technology Background	93
5.1.1	Suicide Bombers & Vehicle Borne IEDs	99

5.2	Standoff Explosives & Weapon Detection: Business Opportunities & Challenges	101
5.2.1	Business Opportunities	101
5.2.2	PBIED & VBIED Detection: Technological Challenges	103
5.3	Standoff Person-Borne and Vehicle-Borne Explosives & Weapon Detection SWOT Analysis	104
5.3.1	Strengths	104
5.3.2	Weaknesses	105
5.3.3	Opportunities	106
5.3.4	Threats.....	106
5.4	European Standoff Explosives & Weapon Detection Market – 2015-2022	106
6	European Tomographic Explosive Detection Systems (EDS) & BHS Market – 2016-2022	108
6.1	Explosive Detection Systems: Technology Background.....	108
6.1.1	Explosive Detection Systems: Throughput	108
6.1.2	EDS Principle of Operation	109
6.1.3	Hybrid Tomographic EDS & 2D X-Ray Screening	110
6.1.4	EDS EU Standard-3 Certification.....	110
6.1.5	EDS Throughput vs. Price	111
6.1.6	Aviation Security: EDS Checked Luggage Screening.....	111
6.2	Security-related Airport Baggage Handling Systems (BHS).....	112
6.3	Baggage Handling Systems	113
6.3.1	High-Volume In-Line Checked Luggage BHS Systems	113
6.3.2	Checked Luggage BHS: Mini In-Line Checked Luggage Screening System.....	115
6.3.3	Stand-alone EDS	116
6.4	EDS Market Background.....	118
6.5	Aviation Security Explosive Detection Systems (EDS) and BHS Industry: SWOT Analysis	119
6.5.1	Strengths	119
6.5.2	Weaknesses	119
6.5.3	Opportunities	121
6.5.4	Threats.....	122
6.6	European Tomographic Explosive Detection Systems & BHS Market – 2015-2022	123
7	European Vehicle & Container Screening Systems Market – 2016-2022 ...	125
7.1	Vehicle & Container Screening Portals Technologies	125
7.1.1	Comparison of Container-Vehicle Screening Technologies.....	125
7.1.2	X-Ray Container-Vehicle Screening Systems.....	127
7.1.3	Dual Energy X-Ray Container-Vehicle Screening.....	130
7.1.4	Dual-View X-Ray Container-Vehicle Screening	131
7.1.5	Backscatter X-Ray Container-Vehicle Screening.....	132
7.1.6	Gamma Ray Systems Container-Vehicle Screening	132

7.1.7	Linac Based X-Ray Container-Vehicle Screening systems	134
7.1.8	Neutron Activation Container-Vehicle Screening Systems	135
7.2	Vehicle & Container Screening Portals: Market Background	137
7.3	Vehicle & Container Screening Portals Industry: SWOT Analysis.....	139
7.3.1	Strengths	139
7.3.2	Weaknesses	140
7.3.3	Opportunities	141
7.3.4	Threats.....	142
7.4	European Vehicle & Container Screening Systems Market – 2015-2022	143
8	European X-Ray Scanners Market – 2016-2022.....	144
8.1	X-Ray Screening Technology Background.....	144
8.1.1	2D X-Ray, EDS & ETD Explosives Detection Technologies - Pros & Cons.....	145
8.1.2	X-Ray Systems - Characteristics	145
8.2	X-Ray Screening Technologies.....	146
8.2.1	Luggage, Baggage & Other Items Screening Technologies	146
8.2.2	People Screening X-Ray Backscatter (AIT) Technology	148
8.2.3	Coherent Scatter 2D X-ray.....	151
8.2.4	Cast and Artificial Limbs X-ray Backscatter Screening Technologies	152
8.2.5	Transportable X-RAY Screening Checkpoints	153
8.2.6	X-ray Technologies: Performance Comparison	154
8.3	X-Ray Screening Market Background	154
8.3.1	Airports and Secured Facilities	154
8.3.2	Europe's Rail Stations X-Ray Screening	156
8.3.3	The European Air Cargo Explosive Screening.....	157
8.3.3.1	ACES: The European Air Cargo Explosive Screening	157
8.3.3.2	The European RA3 and ACC3 Regulations	158
8.4	X-Ray Screening: Business Opportunities & Challenges	159
8.5	X-Ray Security Industry: SWOT Analysis.....	160
8.5.1	Strengths	160
8.5.2	Weaknesses	161
8.5.3	Opportunities	162
8.5.4	Threats.....	163
8.6	European X-Ray Scanners Market – 2015-2022.....	164
9	European Explosives & Weapons Detection Technologies Market – 2015-2022.....	165
9.1	European Explosives & Weapons Detection Technologies Market by Country – 2015-2022.....	165
9.1.1	2015 National Markets & 2016-2022 Forecast.....	165
9.1.2	Market Dynamics by Country – 2016-2022.....	167
9.1.3	Market Breakdown by Country – 2015-2022.....	168
9.2	Market by Revenue Source – 2015-2022.....	170

9.2.1	2015 Market & 2016-2022 Forecast	170
9.2.2	Market Dynamics by Revenue Source – 2016-2022.....	171
9.2.3	Market Breakdown by Revenue Source – 2015-2022	171
9.3	UK Explosives & Weapons Detection Technologies Market – 2016-2022	173
9.4	France Explosives & Weapons Detection Technologies Market – 2016-2022	173
9.5	Belgium Explosives & Weapons Detection Technologies Market – 2016-2022	174
9.6	Sweden, Norway, Finland & Denmark: Explosives & Weapons Detection Technologies Market – 2016-2022.....	174
9.7	Germany Explosives & Weapons Detection Technologies Market – 2016-2022	175
9.8	Austria & Switzerland: Explosives & Weapons Detection Technologies Market – 2016-2022	175
9.9	Italy Explosives & Weapons Detection Technologies Market – 2016-2022	176
9.10	Spain Explosives & Weapons Detection Technologies Market – 2016-2022	176
9.11	Poland Explosives & Weapons Detection Technologies Market – 2016-2022	177
9.12	Hungary & Czech Republic: Explosives & Weapons Detection Technologies Market – 2016-2022	177
9.13	Russia Explosives & Weapons Detection Technologies Market – 2016-2022	178
9.14	Rest of Europe: Explosives & Weapons Detection Technologies Market – 2016-2022	178
10	Appendix A: European Homeland Security & Public Safety Related Product Standards.....	179
10.1	European Committee for Standardization (CEN)	179
10.2	European Homeland Security and Public Safety Standards	179
10.3	EU Buildings & Perimeter Security Standards & Specifications	202
11	Appendix B: The European Union Challenges and Outlook.....	204
11.1	Summary.....	204
11.2	The EU Economy	207
11.3	Anti-EU Trends.....	209
11.4	The EU Frail Leadership and Poor Strategic Vision	210
11.5	Migration and Refugee Crisis	211
11.6	European Security Worries	213
11.7	Terrorism.....	214
11.8	EU Future Scenarios	215

12	Appendix C: Europe Migration Crisis & Border Security	216
12.1	Introduction	216
12.2	EU Migration: Background	216
12.3	The European Borders Security	227
12.3.1	Introduction	227
12.3.2	The Schengen Area	227
12.3.3	The European Integrated Border Management System (IBM)	230
12.3.4	The EU Smart Borders Initiative	231
12.3.5	The Schengen Zone: Passenger Name Record (PNR) System Outlook	232
12.3.6	Temporary Reintroduction of Border Control	237
12.4	European Smart & Secure Border Market	239
13	Appendix D: Abbreviations	242
14	Scope, Methodology & Disclaimer	254
14.1	Research Scope	254
14.2	Research Methodology	254
15	Disclaimer & Copyright	256

List of Tables

Table 1 - European Population, Muslim-Population, GDP, GDP/Capita and Defense-Budget 2014 Data by 17 Countries.....	24
Table 2 - European Police Forces, 1 st Responders, Airports & Air-Passengers Statistics by Country	32
Table 3 - ETD vs. Bulk Explosives and Narcotics Detection Technologies	54
Table 4 - Quantum Sniffer: Features & Benefits.....	68
Table 5 - Explosives Trace Detection (ETD) Market: Business Opportunities.....	77
Table 6 - European Explosives Trace Detection (ETD) Market [\$M] and AGR [%] – 2015-2022	81
Table 7 - Metal Detectors Market: Business Opportunities	89
Table 8 - European Metal Detectors Market [\$M] and AGR [%] – 2015-2022.....	91
Table 9 - Comparison of Open Space Explosives & Weapon Detection Technologies.....	100
Table 10 - PBIED & VBIED Detection Technologies: Performance Criteria	102
Table 11 - European Standoff Explosives & Weapon Detection Market [\$M] and AGR [%] – 2015-2022	107
Table 12 - Product Comparison of High-Volume EDS Machines	117
Table 13 - European Tomographic Explosive Detection Systems & BHS Market [\$M] and AGR [%] – 2015-2022	123
Table 14 - Container-Vehicle Screening - Technologies Comparison	126
Table 15 - European Vehicle & Container Screening Systems Market [\$M] and AGR [%] – 2015-2022	143
Table 16 - EDS, ETD and 2D X-Ray Technologies - Pros and Cons	145
Table 17 - Comparison of X-ray Detection Technologies.....	154
Table 18 - X-Ray Screening Market: Business Opportunities	159
Table 19 - European X-Ray Scanners Market [\$M] and AGR [%] – 2015-2022.....	164
Table 20 - European Explosives & Weapons Detection Technologies Security Market* [\$M] by Country – 2015-2022	165
Table 21 - European Explosives & Weapons Detection Technologies Market* AGRs [%] by Country – 2016-2022	167
Table 22 - European Explosives & Weapons Detection Technologies Market* Shares [%] by Country – 2015-2022	168
Table 23 – European Explosives & Weapons Detection Technologies Security Market [\$M] by Revenue Source (Sales, Aftersale and Other Revenues) – 2015-2022.....	170
Table 24 - European Explosives & Weapons Detection Technologies Market AGRs [%] by Revenue Source – 2016-2022	171
Table 25 - European Explosives & Weapons Detection Technologies Security Market Share [%] by Revenue Source – 2015-2022	171
Table 26 - UK Explosives & Weapons Detection Technologies Market [\$M] by Revenue Source – 2015-2022	173

Table 27 - France Explosives & Weapons Detection Technologies Market [\$M] by Revenue Source – 2015-2022.....	173
Table 28 - Belgium Explosives & Weapons Detection Technologies Market [\$M] by Revenue Source – 2015-2022.....	174
Table 29 - Sweden, Norway, Finland & Denmark: Explosives & Weapons Detection Technologies Market [\$M] by Revenue Source – 2015- 2022	174
Table 30 - Germany Explosives & Weapons Detection Technologies Market [\$M] by Revenue Source – 2015-2022.....	175
Table 31 - Austria & Switzerland: Explosives & Weapons Detection Technologies Market [\$M] by Revenue Source – 2015-2022.....	175
Table 32 - Italy Explosives & Weapons Detection Technologies Market [\$M] by Revenue Source – 2015-2022	176
Table 33 - Spain Explosives & Weapons Detection Technologies Market [\$M] by Revenue Source – 2015-2022	176
Table 34 - Poland Explosives & Weapons Detection Technologies Market [\$M] by Revenue Source – 2015-2022.....	177
Table 35 - Hungary & Czech Republic: Explosives & Weapons Detection Technologies Market [\$M] by Revenue Source – 2015-2022	177
Table 36 - Russia Explosives & Weapons Detection Technologies Market [\$M] by Revenue Source – 2015-2022	178
Table 37 - Rest of Europe: Explosives & Weapons Detection Technologies Market [\$M] by Revenue Source – 2015-2022.....	178
Table 38 - European Homeland Security and Public Safety Standards	179
Table 39 - Membership in the EU, Eurozone, and Schengen Area	206

List of Figures

Figure 1 - Europe Three-Key Challenges.....	19
Figure 2 - Number of European ISIS-Da'esh Fighters by Country	20
Figure 3 - 2015 Refugee Applications to Europe by Month	25
Figure 4 - 2015 Migrant Applications to Europe by Country of Origin.....	26
Figure 5 - Main Routes of Migration to Europe.....	26
Figure 6 - European Asylum-Seeker Decisions by Country	27
Figure 7 - Refugee Acceptance by Country 2015	28
Figure 8 - Asylum Claims per 100.000 Local Populations 2015	29
Figure 9 - EU Defense Expenditure [%] Drop- 2007-2014 [Constant 2005 Euros].....	31
Figure 10 - A Multi-lane People Screening Site.....	46
Figure 11 - Explosive Trace Detection: Principle of Operation	48
Figure 12 - ETD Operational Workflow.....	49
Figure 13 - Explosive Materials Classification	50
Figure 14 - The Most Commonly Used Explosives Classification	51
Figure 15 - Explosives Detection Technologies: Bulk vs. Trace Detection.....	53
Figure 16 - Explosives Trace Detection Configuration: Hand Held ETD, & Tabletop ETD,	55
Figure 17 - Stand-Alone Checked Luggage ETD System	56
Figure 18 - Boarding Card ETD Reader	57
Figure 19 - Airport Boarding Gate with Built-in ETD Screening Technology	58
Figure 20 - ETD Based Vehicle Screening System.....	59
Figure 21 - Free-surface Microfluidic Control of Surface-enhanced Raman Spectroscopy Based ETD	64
Figure 22 - Surface Enhanced Raman Spectroscopy System	65
Figure 23 - Microfluidic Control Surface-Enhanced Raman Spectroscopy Based ETD Process	66
Figure 24 - Falcon First Responder Kit.....	67
Figure 25 - Cantilever (a) Without Detection. (b) With Detection of Molecules at its Surface	69
Figure 26 - Schematic of Basic Sensor Design	70
Figure 27 - Schematic Diagram of an ETD Based on a Sensor Array and Neural Network.....	70
Figure 28 - Non-Contact ETD Explosives and Narcotics Harvesting, Transport, Analysis and Reporting Process	72
Figure 29 - European Explosives Trace Detection (ETD) Market [\$M] – 2015- 2022	81
Figure 30 - Passengers Walk through a Metal Detector at the Gare du Nord Train Station in Paris	82
Figure 31 - Metal Detection Portals Technologies.....	83
Figure 32 - Hand-Held Weapon Detector – Proper Scanning Path	86
Figure 33 - Enhanced (Matrix) Metal Detection Portal	88
Figure 34 - European Metal Detectors Market [\$M] – 2015-2022	92

Figure 35 - Suicide Attack Sequence	95
Figure 36 - Evacuation Distance by Threat and Explosive Mass	99
Figure 37 - Spectrum of Evolving Standoff People Screening Technologies	101
Figure 38 - European Standoff Explosives & Weapon Detection Market [\$M] – 2015-2022	107
Figure 39 - Whole-Object EDS Scheme	109
Figure 40 - EDS Throughput [BPH] vs. System Price [\$K]	111
Figure 41 - Aviation Security: “100% EDS” Screening Flow Scheme	112
Figure 42 - Checked Luggage ETD, EDS & X-ray Screening	114
Figure 43 - Checked Luggage ETD, EDS & X-ray Screening	114
Figure 44 - Schematic Visualization of a Mini In-Line System	115
Figure 45 - Checked Luggage ETD, EDS & X-ray Screening Mini In-Line System with Light Integration	116
Figure 46 - Checked Luggage ETD, EDS & X-ray Screening Configuration 4 - Stand-alone EDS	117
Figure 47 - European Tomographic Explosive Detection Systems & BHS Market [\$M] – 2015-2022	124
Figure 48 - Container/Vehicle Screening Technologies	125
Figure 49 - X-Ray Screening – Block Diagram	129
Figure 50 - Dual Energy X-Ray	130
Figure 51 - Dual View X-Ray – Principles of Operation	131
Figure 52 - Backscatter X-Ray + Penetrating X-Ray	132
Figure 53 - Gamma Ray Screening - Block Diagram	133
Figure 54 - Linac Screening System Block Diagram	135
Figure 55 - Pulsed Fast Neutron Activation Container/Vehicle Screening System Block Diagram	137
Figure 56 - European Vehicle & Container Screening Systems Market [\$M] – 2015-2022	143
Figure 57 - Major Explosives Detection Technologies: Bulk vs. Trace	144
Figure 58 - X-Ray Conveyor-Based Screening Systems – Principles of Operation ..	147
Figure 59 - Multi-View Dual Energy X-Ray Screening	148
Figure 60 - X-Ray Backscatter (AIT) Principle of Operation	148
Figure 61 - Backscatter People Screening Portal	150
Figure 62 - Coherent X-ray Scheme	151
Figure 63 - Cast and Artificial Limbs Screening System	152
Figure 64 - A Prosthetic Limbs Backscatter Image Showing a Gun Hidden Underneath a Cast	153
Figure 65 - Rapiscan Mobile Check ES002 Contains Two Screening Lanes	153
Figure 66 - X-Ray Screening of Checked Luggage and Cabin Baggage as part of a Layered Aviation Security Infrastructure	155
Figure 67 - European X-Ray Scanners Market [\$M] – 2015-2022	164
Figure 68 - European Explosives & Weapons Detection Technologies Security Market* [\$M] by Country – 2015-2022	166
Figure 69 - European Explosives & Weapons Detection Technologies Security Market* Shares [%] by Country – 2015-2022	169

Figure 70 - European Explosives & Weapons Detection Technologies Security Market [\$M] by Revenue Source (Sales, Aftersale and Other Revenues) – 2015-2022.....	170
Figure 71 - European Explosives & Weapons Detection Technologies Market Share [%] by Revenue Source – 2015-2022.....	172
Figure 72 - The European Union: Member States and Candidate Countries	205
Figure 73 - EU Countries Currency Status- 2016.....	207
Figure 74 - European 2015-2016 GDP Growth Forecast [%] By Country	208
Figure 75 - Europe GDP per Capita By Country	208
Figure 76 - 2015 Refugee Applications to Europe by Month	217
Figure 77 - 2015 Migrant Applications to Europe by Country of Origin.....	218
Figure 78 - Main Routes of Migration	219
Figure 79 - European Asylum-Seeker Decisions by Country	220
Figure 80 - Refugee Acceptance by Country 2015	222
Figure 81 - Asylum Claims per 100.000 Local Populations 2015	223
Figure 82 - Fragility and Instability in Europe Neighborhood MEA Countries.....	225
Figure 83 - Europe Inflows of Threats	226
Figure 84 - European Borders.....	227
Figure 85 - The 2016 Schengen Border Map	228
Figure 86 - The Advanced Passenger Analysis (APA) System	237
Figure 87 - Migrant Arrivals by Sea and Land Borders in 2015.....	239