



### Read This and SAVE!

- Check [www.eogogics.com/store](http://www.eogogics.com/store) for current list price (may be lower)
- **Get 5% off** NOW and ALL FUTURE PURCHASES by becoming a member (it's FREE!). Click blue 'Join/Log in' button on top of our website to join
- Call for **additional discounts** that may be available
- After purchase, ask for **free consultation** to help you relate the report findings to your company
- Ask for **discounts on related courses and more consultation** as needed

## Urban ICT: Smart Cities, 5G, Industrial IoT, and Big Data in Manufacturing Analysis Market Analysis and Forecasts 2015 - 2020

Published: **December 2015**

Pages: **401**

### Overview

Information and Communications Technologies (ICT) are transforming at a rapid rate, driven by urbanization, industrialization of emerging economies, smart city initiatives, and certain key technologies including Big Data and broadband wireless; 5G in particular will drive massive innovation, particularly in an urban environment.

Smart City development is emerging as a focal point for growth drivers in several key ICT areas including: M2M/IoT, Connected Devices, Broadband Wireless, Cloud Computing, Big Data and Analytics. The manufacturing industry is rapidly transforming as technology, competition, and the evolving demands of global consumers dictate the need for continuously improving efficiencies and flexibility. Significant impact from ICT include machine communications, teleoperation, and integration with IoT.

This Mind Commerce report, ***Urban ICT: Smart Cities, 5G, Industrial IoT, and Big Data in Manufacturing Market Analysis and Forecasts 2015 – 2020***, provides insights, analysis, and forecasts for 2015 to 2020 for 5G, Smart Cities, Industrial IoT (IIoT), and Big Data in Manufacturing. The research includes evaluation of companies, solutions, and assessment for the future prospects and market impact of each technology. All purchases of our reports include time with

an expert analyst who will help you link key findings in the report to the business issues you're addressing. This needs to be used within three months of purchasing the report.

## Target Audience

---

- Manufacturing companies
- Communication service providers
- Broadband infrastructure companies
- Big Data and Analytics services companies
- Industrial Internet product and services vendors
- Governments of countries focused on Smart Cities

## Table of Contents

---

### **Smart City Business Drivers, Technologies, Companies, and Solutions: Global Outlook and Forecasts 2015 - 2020**

- 1.0 INTRODUCTION
- 1.1 EXECUTIVE SUMMARY
- 1.2 TARGET AUDIENCE
- 1.3 COMPANIES IN REPORT
- 2.0 OVERVIEW OF SMART CITY AND MARKETPLACE
- 2.1 WHAT DEFINES A SMART CITY?
- 2.1.1 SMART CITY VS. INTELLIGENT /CONNECTED / DIGITAL CITY
- 2.1.2 FEATURES OF SMART CITY
- 2.2 SMART CITY VS. SMART COMMUNITY
- 2.3 SMART CITY APPROACH
- 2.4 EXISTING CITY VS. NEW CITY TREND
- 2.5 SMART CITY COMPONENTS
- 2.6 LIFE-CYCLE MODEL FOR SMART CITY SERVICES
- 2.7 SMART CITY MARKET SEGMENT
- 3.0 SMART CITY BUSINESS MODEL
- 3.1 BUILD OWN OPERATE (BOO)
- 3.2 BUILD OPERATE TRANSFER (BOT)
- 3.3 BUILD OPERATE MANAGE (BOM)
- 3.4 OPEN BUSINESS MODEL (OBM)
- 4.0 SMART CITY MARKET: SWOT ANALYSIS
- 4.1 MARKET TRENDS
- 4.1.1 SERVICES IN THE AGE OF DIGITAL TECHNOLOGIES
- 4.1.2 SOFTWARE TO BIG DATA
- 4.1.3 SMART FORECAST TO ENHANCED SERVICES
- 4.1.4 WORKPLACE TRANSFORMATION
- 4.2 GROWTH DRIVERS: STRENGTH & OPPORTUNITIES
- 4.2.1 CONTINUAL ECONOMIC DEVELOPMENT
- 4.2.2 INCREASING URBAN POPULATION DEMANDS BETTER INFRASTRUCTURE

- 4.2.3 NEED FOR ENERGY EFFICIENT CITIES
- 4.2.4 NEW CHANNELS FOR SERVICE DELIVERY
- 4.3 MARKET CHALLENGES: WEAKNESS AND THREATS
- 5.0 SMART CITY PLANNING
- 5.1 URBAN DEVELOPMENT
- 5.2 UTILITIES AND SMART GRIDS
- 5.3 TELECOM INFRASTRUCTURE
- 5.4 SMART COMMUNITY MODEL
  - 5.4.1 SMART COMMUNITY PLANNING
  - 5.4.2 SMART COMMUNITY GOVERNANCE
  - 5.4.3 SMART COMMUNITY HEALTH
  - 5.4.4 SMART COMMUNITY CITIZENSHIP
  - 5.4.5 SMART COMMUNITY INFRASTRUCTURE
  - 5.4.6 SMART COMMUNITY RESOURCES
  - 5.4.7 SMART COMMUNITY DWELLINGS
- 5.5 CIVIC GAMIFICATION
- 6.0 SMART CITY TECHNOLOGIES, SOLUTIONS, AND IMPACT
- 6.1 MACHINE-TO-MACHINE (M2M)
- 6.2 INTERNET OF THINGS (IOT)
  - 6.2.1 IOT AND ADDRESSING
  - 6.2.2 IOT AND COMMUNICATIONS
  - 6.2.3 IOT AND SMART CITY APPLICATIONS
  - 6.2.4 IOT CHALLENGES FOR SMART CITY
  - 6.2.5 IOT AND USE CASE SCENERIO
- 6.3 WIDE AREA COMMUNICATIONS VIA CELLULAR
- 6.4 METROPOLITAN AREA COMMUNICATIONS VIA WIMAX
- 6.5 SHORT-RANGE COMMUNICATIONS
  - 6.5.1 WIFI
  - 6.5.2 RADIO FREQUENCY IDENTIFICATION (RFID)
- 6.6 TECHNOLOGY SOLUTIONS AND IMPACT
- 6.7 BIG DATA TO CREATE SMART CITY
- 6.8 SMAC STACK
- 7.0 SMART CITY IMPACT ON INDUSTRY VERTICALS
- 7.1 TELECOM SERVICES
  - 7.1.1 SMART CITY SERVICES
  - 7.1.2 BENEFITS TO TELECOM OPERATORS
  - 7.1.3 CHALLENGES FOR TELECOM OPERATORS
- 7.2 ENERGY MANAGEMENT
- 7.3 INDUSTRIAL AUTOMATION
- 7.4 TRANSPORTATION
- 7.5 SECURITY
- 7.6 EDUCATION
- 8.0 SMART CITY VENDOR AND SOLUTION ANALYSIS
- 8.1 ABB
  - 8.1.1 INTELLIGENT TECHNOLOGY FOR SMART CITIES
  - 8.1.2 CITY COMMUNICATIONS PLATFORM
  - 8.1.3 ELECTRICITY GRIDS
  - 8.1.4 IMPROVING THE PERFORMANCE OF WATER PLANTS AND NETWORKS
  - 8.1.5 ENERGY MANAGEMENT
  - 8.1.6 DISTRICT HEATING AND COOLING

- 8.2 ACCENTURE
  - 8.2.1 SMART GRID
  - 8.2.2 SMART BUILDING SOLUTIONS
  - 8.2.3 INTELLIGENT TRANSPORT
  - 8.2.4 INFRASTRUCTURE ANALYTICS
  - 8.2.5 INTELLIGENT CITY STRATEGY
- 8.3 ALCATEL LUCENT
  - 8.3.1 SOLUTIONS
- 8.4 CISCO SYSTEMS
  - 8.4.1 SMART PARKING
  - 8.4.2 SMART BUILDINGS
  - 8.4.3 REMOTE EXPERT
  - 8.4.4 CONNECTED LEARNING
  - 8.4.5 SMART WORK SPACES
- 8.5 CUBIC
  - 8.5.1 NEXTCITY
  - 8.5.2 NEXT CONTACT
  - 8.5.3 NEXTINFO
- 8.6 HONEYWELL
  - 8.6.1 ECC
  - 8.6.2 SMART GRID
  - 8.6.3 AUTO DEMAND RESPONSE (AUTO DR)
- 8.7 IBM
  - 8.7.1 PUBLIC SAFETY SOLUTIONS
  - 8.7.2 SMARTER BUILDINGS AND URBAN PLANNING SOLUTIONS
  - 8.7.3 GOVERNMENT AND AGENCY ADMINISTRATION SOLUTIONS
  - 8.7.4 ENERGY AND WATER SOLUTIONS
  - 8.7.5 ENVIRONMENTAL SOLUTIONS
  - 8.7.6 TRANSPORTATION SOLUTIONS
- 8.8 INTEL
  - 8.8.1 INTEL ARCHITECTURE
  - 8.8.2 IOT AND CYBER-PHYSICAL SYSTEM
  - 8.8.3 SUSTAINABILITY LENS
- 8.9 ORACLE
  - 8.9.1 SMART INNOVATION
  - 8.9.2 SMART PROCESSES
  - 8.9.3 SMART INFRASTRUCTURE
- 8.10 SIEMENS AG
  - 8.10.1 DESIGO
  - 8.10.2 SMART GRID SUITE
  - 8.10.3 SIVEILLANCE
  - 8.10.4 RAILBAM
  - 8.10.5 TRAIINGUARD
  - 8.10.6 SITRAFFIC
- 8.11 HUAWEI
  - 8.11.1 SMART GOVERNMENT
  - 8.11.2 SAFE CITY SOLUTION
  - 8.11.3 SMART HOSPITAL SOLUTION
  - 8.11.4 SMART EDUCATION SOLUTION
  - 8.11.5 SMART TRANSPORT SOLUTION

- 8.12 CYAN TECHNOLOGY
- 9.0 SMART CITY PROJECT AND REGIONAL ANALYSIS
- 9.1 EUROPE
  - 9.1.1 SMART CITY PROJECTS
  - 9.1.2 SPAIN
  - 9.1.3 UK
- 9.2 ASIA PACIFIC (APAC)
  - 9.2.1 SMART CITY PROJECTS
  - 9.2.2 INDIA
  - 9.2.3 CHINA
  - 9.2.4 SOUTH KOREA
- 9.3 NORTH AMERICA
  - 9.3.1 SMART CITY PROJECTS
- 9.4 LATIN AMERICA
- 9.5 MIDDLE EAST
  - 9.5.1 UNITED ARAB EMIRATES
  - 9.5.2 SAUDI ARABIA
  - 9.5.3 QATAR
- 9.6 AFRICA
- 10.0 SMART CITY MARKET FORECASTS 2015 - 2020
- 10.1 GLOBAL SMART CITY CUMULATIVE MARKET 2015 - 2020
- 10.2 GLOBAL SMART CITY MARKET BY SEGMENT 2015 - 2020
  - 10.2.1 GLOBAL SMART CITY MARKET SHARE BY SEGMENT 2015 AND 2020
  - 10.2.2 GLOBAL SMART HOME MARKET 2015 - 2020
  - 10.2.3 GLOBAL SMART GRID MARKET 2015 - 2020
  - 10.2.4 GLOBAL SMART BUILDING MARKET 2015 - 2020
  - 10.2.5 GLOBAL SMART INDUSTRIAL AUTOMATION MARKET 2015 - 2020
  - 10.2.6 GLOBAL SMART ENERGY MANAGEMENT MARKET 2015 - 2020
  - 10.2.7 GLOBAL SMART GOVERNANCE MARKET 2015 - 2020
  - 10.2.8 GLOBAL SMART HEALTHCARE MARKET 2015 - 2020
  - 10.2.9 GLOBAL SMART EDUCATION MARKET 2015 - 2020
  - 10.2.10 GLOBAL SMART WATER MANAGEMENT MARKET 2015 - 2020
  - 10.2.11 GLOBAL SMART WASTE MANAGEMENT MARKET 2015 - 2020
  - 10.2.12 GLOBAL SMART TRANSPORTATION MARKET 2015 - 2020
  - 10.2.13 GLOBAL SMART SECURITY MARKET 2015 - 2020
- 10.3 REGIONAL SMART CITY MARKET 2015 - 2020
  - 10.3.1 SMART CITY MARKET SHARE BY REGION DURING 2015 - 2020
  - 10.3.2 EUROPE SMART CITY MARKET 2015 - 2020
  - 10.3.3 ASIA PACIFIC SMART CITY MARKET 2015 - 2020
  - 10.3.4 NORTH AMERICA SMART CITY MARKET 2015 - 2020
  - 10.3.5 LATIN AMERICA SMART CITY MARKET 2015 - 2020
  - 10.3.6 MIDDLE EAST & AFRICA SMART CITY MARKET 2015 - 2020
- 10.4 URBANIZATION AND SMART CITY INVESTMENT PROJECTION
- 10.5 CONNECTED OBJECT & SERVICE PROJECTION 2015 - 2020
  - 10.5.1 WORLD POPULATION VS. CONNECTED DEVICE PER PERSON 2003 - 2020
  - 10.5.2 TOTAL CONNECTED DEVICE PROJECTION 2015 - 2020
  - 10.5.3 CONNECTED DEVICES BY OBJECT & SERVICE SEGMENTS 2015 - 2020
- 11.0 OPPORTUNITY ANALYSIS FOR TELECOM OPERATORS
- 11.1 SMART CITY AS A SERVICE
- 11.2 CENTRALIZED PLATFORM

- 11.3 SMAC STACK
- 11.4 REGULATORY FRAMEWORK
- 12.0 SMART CITY CASE STUDY
- 12.1 SMART LIAOYUAN: THE FIRST SMART CITY IN NORTHEAST CHINA
- 12.2 BEIJING SMART GOVERNMENT: THE LUCKY CLOUD PROJECT
- 12.3 LONGYAN SMART HOSPITAL: SECURE, EFFICIENT AND GREEN
- 12.4 KARAMAY: BUILDING THE SAFEST CITY
- 12.5 SMART EDUCATION FOR EAST CHINA NORMAL UNIVERSITY (ECNU)
- 13.0 CONCLUSIONS AND RECOMMENDATIONS
- 13.1 RECOMMENDED STRATEGY FOR SMART CITY
- 13.1.1 CONSIDER CITY ECOSYSTEM
- 13.1.2 ENGAGE CITIZEN AND COLLABORATION WITH TECHNOLOGY
- 13.1.3 CONSTITUENT COLLABORATION

## Figures

- Figure 1: Smart City Framework
- Figure 2: Smart City Participants and Role in Ecosystem
- Figure 3: Smart City Wheel: Components and Key Indicators
- Figure 4: Smart City Services Life-cycle Model
- Figure 5: Smart City Market Segments
- Figure 6: Smart City Infrastructure
- Figure 7: HetNet Network Topology
- Figure 8: WiMAX Point to Point Communications
- Figure 9: ABB Smart City Offerings
- Figure 10: Accenture Smart City Offerings
- Figure 11: Huawei Smart City Solutions
- Figure 12: Global Smart City Cumulative Market \$ Billion 2015 - 2020
- Figure 13: Global Smart City Market Share Percent by Segment 2015
- Figure 14: Global Smart City Market Share Percent by Segment 2020
- Figure 15: Global Smart Home Market \$ Billion 2015 - 2020
- Figure 16: Global Smart Grid Market \$ Billion 2015 - 2020
- Figure 17: Global Smart Building Market \$ Billion 2015 - 2020
- Figure 18: Global Smart Industrial Automation Market \$ Billion 2015 - 2020
- Figure 19: Global Smart Energy Management Market \$ Billion 2015 - 2020
- Figure 20: Global Smart Governance Market \$ Billion 2015 - 2020
- Figure 21: Global Smart Healthcare Market \$ Billion 2015 - 2020
- Figure 22: Global Smart Education Market \$ Billion 2015 - 2020
- Figure 23: Global Smart Water Management Market \$ Billion 2015 - 2020
- Figure 24: Global Smart Waste Management Market \$ Billion 2015 - 2020
- Figure 25: Global Smart Transportation Market \$ Billion 2015 - 2020
- Figure 26: Global Smart Security Market \$ Billion 2015 - 2020
- Figure 27: Smart City Market Share Europe, Americas, APAC MEA 2015 - 2020
- Figure 28: Europe Smart City Market \$ Billion 2015 - 2020
- Figure 29: Asia Pacific Smart City Market \$ Billion 2015 - 2020
- Figure 30: North America Smart City Market \$ Billion 2015 - 2020
- Figure 31: Latin America Smart City Market \$ Billion 2015 - 2020
- Figure 32: Middle East & Africa Smart City Market \$ Billion 2015 - 2020
- Figure 33: World Population vs. Connected Device per Person 2003 - 2020
- Figure 34: Total Connected Device Projections Billion 2015 - 2020

Figure 35: Connected Devices by Service Segments 2015 - 2020

## 5G Technology Assessment, Market Outlook, and Forecasts 2015 - 2030

- 1.0 EXECUTIVE SUMMARY
- 2.0 INTRODUCTION TO 5G TECHNOLOGY
  - 2.1 5G TECHNOLOGY AND FUNCTIONALITY
    - 2.1.1 DIFFERENCES BETWEEN 5G AND 4G
  - 2.2 WHAT 5G TECHNOLOGY CAN OFFER?
  - 2.3 OSI LAYERS IN 5G
    - 2.3.1 PHYSICAL AND MEDIUM ACCESS CONTROL LAYER
    - 2.3.2 NETWORK LAYER
    - 2.3.3 OPEN TRANSPORT PROTOCOL (OTA) LAYER
    - 2.3.4 APPLICATION LAYER
  - 2.4 5G MOTIVATION AND TIMELINE
  - 2.5 5G SPECTRUM OPTIONS AND UTILIZATION
  - 2.6 ELEMENTS OF 5G
  - 2.7 5G CHALLENGES
    - 2.7.1 TECHNOLOGY REQUIREMENTS AND SERVICE CHARACTERISTICS
    - 2.7.2 STANDARDIZATION
    - 2.7.3 NETWORK CHALLENGES
    - 2.7.4 MOBILE DEVICE CHALLENGES
    - 2.7.5 APPLICATION CHALLENGES
  - 2.8 TECHNOLOGICAL REQUIREMENTS OF 5G
- 3.0 5G ENABLING TECHNOLOGIES
  - 3.1 MASSIVE MIMO
  - 3.2 NETWORK FUNCTIONS VIRTUALIZATION (NFV)
  - 3.3 SDN AND VIRTUALIZATION
  - 3.4 COGNITIVE RADIOS (CRS) AND TRANSMISSION TECHNOLOGIES
  - 3.5 SELF-ORGANIZING NETWORKS (SONS)
  - 3.6 COMMUNICATION, NAVIGATION, SENSING AND SERVICES
  - 3.7 COOPERATIVE COMMUNICATION FUNCTIONS
    - 3.7.1 MULTI-HOP
    - 3.7.2 CACHING
  - 3.8 AUTOMATED NETWORK ORGANIZATION 2
    - 3.8.1 SELF-CONFIGURATION
    - 3.8.2 AUTOMATIC NEIGHBOUR RELATION (ANR)
    - 3.8.3 SELF-HEALING
    - 3.8.4 SELF-ORGANIZATION
  - 3.9 ADVANCED TRAFFIC MANAGEMENT
  - 3.10 VISIBLE LIGHT COMMUNICATIONS (VLCS) 30
  - 3.11 ENERGY EFFICIENCY
  - 3.12 MILLIMETER WAVE (MMWAVE)
  - 3.13 MASSIVE M2M COMMUNICATIONS
  - 3.14 C-RAN ARCHITECTURE
  - 3.15 HETNET SOLUTION
  - 3.16 H-CRAN SOLUTION
  - 3.17 LARGE-SCALE COOPERATIVE SPATIAL SIGNAL PROCESSING (LS-CSSP)
  - 3.18 SDR
  - 3.19 SPECTRUM AND SATELLITE

- 3.20 DRONES, ROBOTS, AND HIGH-ALTITUDE BALLOONS
- 3.21 NEXT GEN TECHNOLOGY
  - 3.21.1 CROSS LAYER CONTROLLER
  - 3.21.2 ENERGY AWARE
  - 3.21.3 SECURITY
- 4.0 5G REGULATORY CONTRIBUTOR
- 4.1 5G ROADMAP
  - 4.1.1 5G REQUIREMENTS 2015 - 2020
  - 4.1.2 5G WIRELESS SUBSYSTEM 2015 - 2020
  - 4.1.3 NETWORK VIRTUALISATION & SOFTWARE NETWORKS 2015 - 2020
  - 4.1.4 CONVERGED CONNECTIVITY
- 4.2 GSMA
- 4.3 OFCOM UK
- 4.4 METIS
- 4.5 5G PPP
- 4.6 NGMN
- 4.7 4G AMERICAS
- 5.0 5G SERVICE APPLICATIONS IN M2M AND IOT ENVIRONMENT
- 5.1 5G BUSINESS CASE
  - 5.1.1 SHARING SPECTRUM AND SERVICE SPECTRUM
- 5.2 POTENTIAL 5G APPLICATION USE CASES
  - 5.2.1 VIRTUAL REALITY OR TACTILE INTERNET
  - 5.2.2 AUTONOMOUS DRIVING AND CONNECTED CARS
  - 5.2.3 WIRELESS CLOUD-BASED OFFICE AND MULTI-PERSON VIDEOCONFERENCING
  - 5.2.4 M2M CONNECTIVITY
  - 5.2.5 50+ MBPS EVERYWHERE
  - 5.2.6 HIGH SPEED TRAIN
  - 5.2.7 REMOTE COMPUTING
  - 5.2.8 NON-STATIONARY HOT SPOTS
  - 5.2.9 3D CONNECTIVITY: AIRCRAFT
  - 5.2.10 SMART CLOTHING
  - 5.2.11 SENSOR NETWORKS
  - 5.2.12 NATURAL DISASTER
  - 5.2.13 CONTROL NETWORK FOR ROBOTS
  - 5.2.14 EHEALTH
  - 5.2.15 3D CONNECTIVITY: DRONES
  - 5.2.16 PUBLIC SAFETY
  - 5.2.17 CONTEXT AWARE SERVICE
- 5.3 BRAND NEW SERVICES CAPABILITY
- 6.0 5G ECOSYSTEM
  - 6.1 5G REQUIREMENT
    - 6.1.1 USER DRIVEN REQUIREMENT
    - 6.1.2 NETWORK DRIVEN REQUIREMENT
  - 6.2 STAKEHOLDER ANALYSIS
  - 6.3 STAKEHOLDER EXPECTATION: KPI'S OF 5G TECHNOLOGY
    - 6.3.1 PERFORMANCE CHALLENGES
    - 6.3.2 SYSTEM LEVEL CHALLENGES
  - 6.4 5G CHANNEL MODEL
  - 6.5 APIS AND SLAS TO EXTERNAL ACTORS
  - 6.6 KEY DRIVERS



- 6.7 DISRUPTIVE CAPABILITIES
- 6.8 DESIGN PRINCIPLES
- 6.9 5G BUSINESS MODEL
- 6.10 5G VALUE PROPOSITION
- 7.0 5G STANDARDIZATION AND RESEARCH
- 7.1 MAJOR EVENT
- 7.2 RESEARCH, DEVELOPMENT AND INNOVATION
- 7.3 STANDARDIZATION ACTIVITIES
- 7.4 ITU RADIO COMMUNICATION SECTOR (ITU-R)
- 7.5 3GPP
  - 7.5.1 IMT 2020
  - 7.5.2 RAN STUDY
- 7.6 GSMA
- 7.7 NGMN ALLIANCE
- 7.8 TIA
- 7.9 EUROPEAN COMMISSION (EC)
  - 7.9.1 METIS
  - 7.9.2 5G PPP
  - 7.9.3 5G PPP PROJECTS
  - 7.9.4 5GNOW
- 7.10 NATIONAL GOVERNMENTS IN EASTERN ASIA
  - 7.10.1 CHINA IMT-2020
  - 7.10.2 JAPAN ARIB 20B AH
  - 7.10.3 KOREA 5G FORUM
  - 7.10.4 CHINA'S 863-5G PROJECT
- 7.11 MOBILE OPERATOR AND VENDORS
  - 7.11.1 SK TELECOM AND ERICSSON
  - 7.11.2 HUAWEI AND SAMSUNG
  - 7.11.3 NTT DOCOMO AND MULTIPLE VENDORS
  - 7.11.4 TURKCELL AND ERICSSON
  - 7.11.5 5G NORMA (NOKIA AND SK TELECOM)
  - 7.11.6 HUAWEI AND ERICSSON
- 7.12 FANTASTIC-5G
- 7.13 5GIC
- 7.14 NYU WIRELESS
- 8.0 5G VENDORS AND COMPANY ANALYSIS
- 8.1 ERICSSON
  - 8.1.1 5G COLLABORATION AND COMMITMENT
  - 8.1.2 5G STRATEGY AND USE CASES
  - 8.1.3 5G TRIAL COMMITMENT
- 8.2 ALCATEL-LUCENT
  - 8.2.1 5G RESEARCH AND CONTRIBUTIONS
  - 8.2.2 5G STRATEGY
  - 8.2.3 5G SOLUTIONS
- 8.3 FUJITSU
  - 8.3.1 5G STRATEGY AND SOLUTIONS
  - 8.3.2 5G CONTRIBUTION
  - 8.3.3 5G TRIAL COMMITMENT
- 8.4 HUAWEI
  - 8.4.1 5G VISION

- 8.4.2 5G STRATEGY
- 8.4.3 5G COLLABORATION AND CONTRIBUTION
- 8.5 INTEL
  - 8.5.1 5G STRATEGY
  - 8.5.2 5G COLLABORATION AND CONTRIBUTION
- 8.6 NEC
  - 8.6.1 5G STRATEGY
  - 8.6.2 5G CONTRIBUTION
  - 8.6.3 5G TRIAL COMMITMENT
- 8.7 SAMSUNG
  - 8.7.1 5G STRATEGY AND VISION
  - 8.7.2 5G CONTRIBUTION
  - 8.7.3 5G COLLABORATION
  - 8.7.4 5G TRIAL COMMITMENT
- 8.8 ZTE
  - 8.8.1 5G STRATEGY
  - 8.8.2 5G CONTRIBUTION
  - 8.8.3 5G TRIAL COMMITMENT
- 8.9 QUALCOMM
  - 8.9.1 5G STRATEGY
  - 8.9.2 5G CONTRIBUTION
- 8.10 NOKIA NETWORKS
  - 8.10.1 5G VISION
  - 8.10.2 5G STRATEGY
  - 8.10.3 5G CONTRIBUTION AND COLLABORATION
  - 8.10.4 5G TRIAL COMMITMENT
- 8.11 CHINA MOBILE
  - 8.11.1 5G CONTRIBUTION
- 8.12 DEUTSCHE TELEKOM
  - 8.12.1 5G CONTRIBUTION
- 8.13 NTT DOCOMO
  - 8.13.1 5G CONTRIBUTION
- 8.14 SK TELECOM
  - 8.14.1 5G CONTRIBUTION
- 8.15 BROADCOM
  - 8.15.1 5G CONTRIBUTION
- 8.16 LG U+
- 8.17 SINGTEL
- 9.0 5G INVESTMENT AND SUBSCRIPTION FORECAST
- 9.1 GLOBAL 5G R&D AND TRIAL INVESTMENTS 2015 - 2030
  - 9.1.1 5G INVESTMENT BY CATEGORY 2015 - 2020 VS. 2020 - 2030
- 9.2 LTE ADVANCE AND 5G SUBSCRIPTION 2020 - 2030
- 9.3 5G ONLY SUBSCRIPTION 2022 - 2030
  - 9.3.1 5G ONLY SUBSCRIPTIONS BY REGIONS 2022 - 2030
- 9.4 MOBILE OPERATORS' 5G EXPECTATION 2015
  - 9.4.1 NETWORK LEVEL EXPECTATION
  - 9.4.2 SPECTRUM USAGE EXPECTATION
  - 9.4.3 SERVICE LEVEL EXPECTATION
  - 9.4.4 5G DEVELOPMENT BY REGIONS
  - 9.4.5 5G COMMERCIAL LAUNCHING

- 9.5 DATA TRAFFIC, VIDEO, AND DOWNLOAD SPEED PROJECTION 2020 - 2030
- 9.6 5G INVESTMENT CASE ANALYSIS
  - 9.6.1 EUROPEAN COMMISSION
  - 9.6.2 HUAWEI
  - 9.6.3 SOUTH KOREA
  - 9.6.4 ZTE
  - 9.6.5 HORIZON 2020
- 9.7 QUANTUM TECHNOLOGY AND 6G INVESTMENT ANALYSIS
- 10.0 5G IMPLICATION FOR TELECOM INDUSTRY
- 10.1 SPECTRUM AND COVERAGE IMPLICATIONS
- 10.2 ONE MILLISECOND LATENCY
- 10.3 BUSINESS OPPORTUNITIES
- 11.0 CONCLUSIONS AND RECOMMENDATIONS
  - 11.1 END-TO-END ECOSYSTEM
  - 11.2 5G CONSIDERATIONS
    - 11.2.1 5G ARRIVAL DEPENDS ON SPECIFICATIONS AND ADOPTION
    - 11.2.2 NEW RAN WILL IMPROVE MOBILE NETWORKS
    - 11.2.3 IMMEDIATE TECHNOLOGICAL DEVELOPMENTS
    - 11.2.4 LTE MAY SLOW DOWN 5G GROWTH
    - 11.2.5 USE OF GOVERNMENTAL INTEREST AND RESOURCES
    - 11.2.6 MORE SUSTAINABLE OPERATOR INVESTMENT MODEL IN TERMS OF CAPACITY
  - 11.3 5G VALUE CREATION
    - 11.3.1 FOR CONSUMERS
    - 11.3.2 FOR ENTERPRISES
    - 11.3.3 FOR VERTICALS
    - 11.3.4 FOR 3RD PARTY PARTNERS
  - 11.4 RECOMMENDATION FOR VALUE CHAIN PARTNERS
    - 11.4.1 DISRUPTIVE NETWORK ARCHITECTURE
    - 11.4.2 ACCESS
    - 11.4.3 SYSTEM LEVEL PRINCIPLES
    - 11.4.4 RIGHT BUSINESS MODEL
    - 11.4.5 STAKEHOLDER COMMUNITY
    - 11.4.6 POLICY AND STANDARDIZATION FRAMEWORK

## Figures

- Figure 1: Core Differences between 5G and 4G
- Figure 2: Sample Specifications for 5G
- Figure 3: Conceptual 5G Mobile Device
- Figure 4: Mobile Terminal Network Layer in 5G Networks
- Figure 5: 5G Timeline 2008 - 2021
- Figure 6: 5G Challenges: Mobile SoC Performance vs. Energy Efficiency
- Figure 7: 5G Technological Components
- Figure 8: Massive MIMO Concept
- Figure 9: NFV in H-RAN Solution
- Figure 10: SDN Architecture
- Figure 11: SDN Supporting Layers
- Figure 12 Self-Organizing Networks (SONs) in H-RAN
- Figure 13: H-RAN Application of 5G Systems
- Figure 14: Centralized and Distribution LS-CSSP in H-CRANs

Figure 15: Software Defined Radio Network  
Figure 16: Hybrid Architecture of SDN & SDR in 5G Network  
Figure 17: Role of Satellite in 5G Communication System  
Figure 18: METIS Regulatory Consortium  
Figure 19: METIS Regulatory Framework  
Figure 20: 5G Service Application Areas  
Figure 21: Potential 5G Service Chart and Bandwidth & Latency Requirement  
Figure 22: New Service Capabilities in 5G Environment  
Figure 23: 5G Disruptive Capabilities  
Figure 24: Performance Indicators of Disruptive Capabilities in 5G Network  
Figure 25: 5G Network Design Architecture and Service Division  
Figure 26: 5G Business Models  
Figure 27: Key 5G Initiatives and Development Timeline 2012 - 2020  
Figure 28: 5G Exploration to Development Phases 2014 - 2020  
Figure 29: 5G Standardization Roadmap 2014 - 2024  
Figure 30: 3GPP 5G Timeline  
Figure 31: METIS HTs Structure  
Figure 32: METIS WPs Structure  
Figure 33: National 863 5G Project Phases 2013 - 2015  
Figure 34: 863 5G Project Promotional Framework  
Figure 35: Ericsson 5G Collaboration and Work 2013 - 2021  
Figure 36: Ericsson 5G Strategy Chart  
Figure 37: Ericsson 5G Vision for Broadband  
Figure 38: Ericsson 5G Vision for Smart Transport and Infrastructure  
Figure 39: Ericsson 5G Vision for Media  
Figure 40: Ericsson 5G Vision for Remote Devices  
Figure 41: Ericsson 5G Vision for IoT  
Figure 42: Alcatel-Lucent 5G Timeline  
Figure 43: Alcatel-Lucent 5G Programmable Networking Framework  
Figure 44: Alcatel-Lucent 5G Solutions  
Figure 45: Fujitsu 5G Network Configurations and WLAN  
Figure 46: Huawei 5G Service and Scenario Vision  
Figure 47: Huawei 5G All-spectrum access RAN  
Figure 48: Intel 5G Vision  
Figure 49: NEC 5G Vision  
Figure 50: NEC's Virtualization of Cell Concept  
Figure 51: Architecture of Massive-Element Antenna  
Figure 52: Samsung's 5G Service Vision  
Figure 53: Samsung Rainbow Requirements  
Figure 54: Samsung's FD-MIMO Concept  
Figure 55: Samsung's Reconfigurable 5G Phased-array Antenna  
Figure 56: Samsung's 5G Timeline  
Figure 57: Samsung's 5G Trial Drive 2014  
Figure 58: ZTE's Three Dimensional 5G Vision  
Figure 59: Qualcomm 5G Scalability Chart  
Figure 60: Qualcomm 5G Connectivity Design  
Figure 61: Qualcomm Unified Platform Dimensions  
Figure 62: Qualcomm 5G Timeline 2015 - 2022  
Figure 63: Qualcomm 5G Business Model  
Figure 64: Qualcomm Model to Leverage 4G Investment

Figure 65: Nokia 5G Vision and Requirements  
Figure 66: Nokia 5G Network Design of Functional Requirement  
Figure 67: NTT DoCoMo 5G Experimental Trial  
Figure 68: Global 5G Investment (R&D and Trial) in \$billion 2015 - 2030  
Figure 69: 5G Investments (Large Scale, Lab R&D, Test Bed) 2015/2020/2030  
Figure 70: Global LTE Advance and 5G Subscription in Billion 2020 - 2030  
Figure 71: Global 5G Only Subscription in Billion 2022 - 2030  
Figure 72: Latency Comparison between LTE and 5G  
Figure 73: End to End 5G Ecosystem  
Figure 74: Total Global Mobile Operator 4G CAPEX Forecast 2009 - 2020  
Figure 75: 5G Value Creation Capabilities

## **Tables**

Table 1: OSI Layers by Category  
Table 2: 5G Spectrum Band Options, Merits and Licenses  
Table 3: MTC features in 3GPP Standard  
Table 4: Roadmap for 5G Requirements 2015 - 2020  
Table 5 Roadmap for 5G Wireless Subsystem 2015 - 2020  
Table 6: Roadmap for Virtualization and Software Networks 2015 - 2020  
Table 7: Roadmap for Converged Connectivity 2015 - 2020  
Table 8: 5G PPP 19 Projects  
Table 9: 5G Only Subscription APAC vs. NA vs. Europe vs. Others 2022 - 2030  
Table 10: Mobile Operators' 5G Expectations  
Table 11: Mobile Operators' Expectations of 5G Spectrum  
Table 12: Mobile Operators' Expectation of 5G Service Levels  
Table 13: Mobile Operators' Expectations of 5G Deployment by Region  
Table 14 Mobile Operators' 5G Commercial Launch Expectations

## **Industrial Internet of Things (IIoT): Key Trends, Opportunities and Market Forecasts 2015 - 2020**

1 Introduction 6  
1.1 Scope of the Study 6  
1.2 Intended Audience 7  
1.3 Companies Covered in Report 7  
2 Executive Summary 10  
3 Industrial Internet of Things (IIoT) 12  
3.1 IIoT: The Fourth Industry Revolution 12  
3.1.1 IIoT is a Change Agent in Transforming Ordinary Factory to Smart Factory 13  
3.1.2 Connected Factory 14  
3.1.3 Industry (Industrie) 4.0 - Smart Factory 15  
3.2 Main Objective of IIoT is an Integration of Connected Things 16  
3.3 Opportunity to Develop Agile and Flexible Production Processes 16  
3.4 IIoT Market Overview 2014 - 2015 17  
3.4.1 GE, Cisco, Intel, AT&T and IBM Founded Industrial Internet Consortium (IIC) 17  
3.4.2 Cisco hosted The Second Annual Internet of Things World Forum (IoTWF) 19  
3.4.3 IIC launched Test-beds 20  
3.4.4 IIC to on Broad Reference Architecture for IoT soon in 2015 22  
3.5 IIoT will Enhance, Integrate and Scale existing Corporate IT Systems 23

- 3.6 IIoT will Leverage Potential of Existing Infrastructure based on Extracted Data 24
- 4 Key IIoT Solutions 25
  - 4.1 AT&T Inc. 25
    - 4.1.1 AT&T Machine to Machine Solutions 26
    - 4.1.2 AT&T M2X 29
  - 4.2 Bosch 30
    - 4.2.1 Bosch Connected Devices and Solutions GmbH (BCDS) 31
    - 4.2.2 Bosch Software innovations: Bosch IoT Suite 31
  - 4.3 Cisco System Inc. 36
    - 4.3.1 Cisco Industrial Networks 37
    - 4.3.2 Cisco Embedded Networks 38
    - 4.3.3 Management and Application Enablement 40
    - 4.3.4 Physical and Cyber Security 41
    - 4.3.5 Cisco IIoT Solutions 41
  - 4.4 Echelon Corporation 43
    - 4.4.1 Echelon's IzoT platform 44
  - 4.5 GE Software 48
    - 4.5.1 GE Predicitvity Solution 49
    - 4.5.2 GE Predix Platform 51
  - 4.6 Object Management Group (OMG) 51
    - 4.6.1 Data Distribution Service (DDS) 52
    - 4.6.2 Dependability Assurance Framework for Safety-Sensitive Consumer Devices 53
    - 4.6.3 Threat Modelling 53
    - 4.6.4 Structured Assurance Case Meta-model (SACM) 54
    - 4.6.5 Unified Component Model for Distributed, Real-Time and Embedded Systems (UCM) 55
    - 4.6.6 Automated Source Code CWE-SANS Top 25-Based Security Measure 55
    - 4.6.7 Oil and Gas Risk Management 56
  - 4.7 Real Time Innovation (RTI) 56
    - 4.7.1 RTI Connex DDS 57
    - 4.7.2 RTI Industrial IoT FastTrax Program 59
- 5 IIoT: Global Market Analysis and Forecasts 2015 - 2020 61
  - 5.1 IIoT is different from Consumer IoT 61
    - 5.1.1 Brownfield vs. Greenfield Deployment 62
  - 5.2 IIoT has to work in Consortium to achieve Success 62
  - 5.3 Global IIoT Markets 2015 - 2020 63
  - 5.4 IIoT Global Markets by Industry Segment 2015 - 2020 65
  - 5.5 IIoT Markets by Region 2015 - 2020 70
  - 5.6 Global Markets by Deployment Vertical 2015 - 2020 73
- 6 Company Profiles 77
  - 6.1 ABB Ltd. 77
  - 6.2 Adaptiv.io 78
  - 6.3 AT&T 78
  - 6.4 Bayshore Networks 79
  - 6.5 Bedrock Automation 81
  - 6.6 Blackberry 81
    - 6.6.1 BlackBerry Corporation - U.S. 82
    - 6.6.2 BlackBerry - Europe 82
  - 6.7 Bosch Connected Devices and Solutions GmbH (BCDS) 83
    - 6.7.1 Head Office- Germany 83
    - 6.7.2 Robert Bosch Engineering and Business Solutions Limited- India 83

- 6.7.3 Bosch Automotive Products (Suzhou) Co. Ltd. - China 83
- 6.8 Bosch Software Innovations Corp. - U.S. 84
  - 6.8.1 Bosch Software Innovations GmbH- Europe 84
  - 6.8.2 Bosch Software Innovations- Asia pacific 85
- 6.9 Cisco Systems Inc. 86
- 6.10 Ei3 Corporation 87
- 6.11 Elecsys Corporation 87
- 6.12 GE Software 88
  - 6.12.1 GE Global Research 89
  - 6.12.2 GE India Technology Centre Pvt. Ltd. 89
- 6.13 Jasper Technologies Inc. 89
- 6.14 NEC Corporation 90
- 6.15 Object Management Group (OMG) 91
- 6.16 OneM2M Partners 92
- 6.17 Real-Time Innovations (RTI) 93
  - 6.17.1 Real-Time Innovations EU Office 94
- 6.18 Tech Mahindra Ltd. 95
- 6.19 Telstra 95
  - 6.19.1 China Office 96
  - 6.19.2 U.S. Office 96
- 6.20 Unisys Corporation 97

## Figures

- Figure 1: Seven Layer IoT (IoTWF) Framework 20
- Figure 2: Bosch IoT Suite 33
- Figure 3: Anatomy of the IzoT Platform 44
- Figure 4: Global IIoT Market 2015 - 2020 64
- Figure 5: IIoT Global Markets by Industry Segment 67
- Figure 6: IIoT Regional Markets 2015 - 2020 72
- Figure 7: IIoT Global Markets by Deployment Vertical 2015 - 2020 75

## Tables

- Table 1: Global IIoT Market 2015 - 2020 64
- Table 2: IIoT Global Markets for Industry Segment 2015 - 2020 66
- Table 3: IIoT Regional Markets 2015 - 2020 70
- Table 4: IIoT Global Markets by Deployment Vertical 2015 - 2020 75

## Big Data in Manufacturing: Key Trends, Opportunities and Market Forecasts 2015 - 2020

- 1 Introduction
  - 1.1 Research Scope
  - 1.2 Research Methodology
  - 1.3 Target Audience
  - 1.4 Companies Mentioned in this Report
- 2 Summary
- 3 Overview
  - 3.1 Role of Big Data in Modern Manufacturing
  - 3.2 Big Data and Analytics Framework for Manufacturing

- 3.2.1 Big Data Infrastructure
- 3.2.2 Big Data Management
- 3.2.3 Big Data Integration
- 3.2.4 Big Data Analysis
- 3.3 Market Potential for Big Data in Manufacturing will increase through 2020
- 4 Big Data Solutions in Manufacturing
  - 4.1 Hardware Infrastructure
    - 4.1.1 Servers / Data Computing Appliance
    - 4.1.2 Sensors and Actuators
  - 4.2 Software and Platforms
    - 4.2.1 Big Data Integration Platform
    - 4.2.2 Connectors for Hadoop
    - 4.2.3 Big Data Analytics Platforms and Tools
  - 4.3 Big Data Security Software
  - 4.4 Managed Services for Big Data
- 5 Global Markets and Forecasts 2015 - 2020
  - 5.1 Industrial Internet of Things to increase scope for Big Data in Manufacturing
  - 5.2 Connected Factory
  - 5.3 Scope for Big Data in IIoT for Manufacturing
  - 5.4 Manufacturing Sector to Generate 11.3 Zettabytes of Data by 2020
  - 5.5 Big Data Market in Manufacturing 2015 - 2020
    - 5.5.1 Big Data in Manufacturing by Region 2015 - 2020
    - 5.5.2 Big Data in Manufacturing by Products/Service Offering 2015 - 2020
- 6 Company Profiles
  - 6.1 1010Data Inc.
  - 6.2 3Sixty Analytics
  - 6.3 Actian Corporation
  - 6.4 Amazon Web Services
  - 6.5 Bosch Software Innovations GmbH
  - 6.6 Cisco
  - 6.7 Cloudera Inc.
  - 6.8 Cloudwick Inc.
  - 6.9 Computer Sciences Corp. (CSC)
  - 6.10 CRAY Inc.
  - 6.11 Dell Software
  - 6.12 EMC Corporation
  - 6.13 HP
  - 6.14 Hortonworks Inc.
  - 6.15 MongoDB
  - 6.16 Oracle Corporation
  - 6.17 Pivotal Software Inc
  - 6.18 PSSC Labs
  - 6.19 Silicon Graphics International Corp. (SGI)
  - 6.20 Teradata Corporation
  - 6.21 TIBCO JasperSoft

## Figures

- Figure 1: Markets for Big Data in Manufacturing 2015 - 2020
- Figure 2: Big Data and Analytics Framework for Manufacturing



Figure 3: IIoT Deployment in Manufacturing 2015 - 2020  
Figure 4: Data Generation in Manufacturing 2013 - 2020  
Figure 5: Total Big Data Market vs. Big Data in Manufacturing 2015 - 2020  
Figure 6: Regional Markets for Big Data in Manufacturing 2015 - 2020  
Figure 7: Big Data in Manufacturing by Products / Services 2015 - 2020

## **Tables**

Table 1: Market for Big Data in Manufacturing 2015 - 2020  
Table 2: Key Trends in Big Data in Manufacturing  
Table 3: Tips for Manufacturers on Big Data Investments  
Table 4: Servers and Data Computing Appliances offered by various Companies  
Table 5: Data Integration Solutions offered by Various Companies  
Table 6: Data Connectors offered by Various Companies  
Table 7: Analytics Platform offered by Various Companies  
Table 8: Big Data Security Software offered by Various Companies  
Table 9: Big Data Managed Services offered by Various Companies  
Table 10: IIoT Deployment in Manufacturing  
Table 11: Data Generation in Manufacturing 2013 - 2020  
Table 12: Global Markets for Big Data in Manufacturing 2015 - 2020  
Table 13: Regional Markets for Big Data in Manufacturing 2015 - 2020  
Table 14: Big Data in Manufacturing by Products / Services 2015 - 2020