General Session Special Presentation

INTELLIGENT BUILDINGS AND THE IMPACT OF THE INTERNET OF THINGS

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INTRODUCTION

This report has been created by IHS, a leading analyst research firm, for the Continental Automated Buildings Association (CABA). CABA is a leader in initiating and developing cross-industry collaborative research, under the CABA Research Program.

About CABA

CABA has two councils, the Connected Home Council (CHC) focusing on residential homes and the Intelligent Buildings Council (IBC) focusing on larger commercial buildings. Each council produces one collaborative Landmark Research project per year which is fully funded by CABA member sponsors. Each Landmark Research project is directed by a Steering Committee made up of project sponsors. The Steering Committee provides feedback and input throughout the course of the research to help define the scope, direction, and methodology. CABA and the project Steering Committee commission a research firm to conduct the research while CABA provides project management.

The Intelligent Buildings Market is a rapidly evolving segment that is being influenced by a number of emerging trends. CABA's IBC participated in several research ideation sessions to generate topics and select the IBC Landmark Research project for 2016. Several excellent ideas were generated, the top three topics were voted on, and "Intelligent Buildings and the Impact of the Internet of Things (IoT)" was selected as the Landmark Research Project for 2016.

Following selection of the topic for the Landmark Research Project for 2016, CABA released a formal Request for Proposal (RFP). The CABA selection team narrowed down candidates who responded to the RFP to the top two finalists. Along with initial funders of this research, CABA commissioned the research to IHS Markit.

INTRODUCTION

About IHS Markit

IHS Markit (NASDAQ: INFO) is a world leader in critical information, analytics and expertise to forge solutions for the major industries and markets that drive economies worldwide. The company delivers next-generation information, analytics and solutions to customers in business, finance and government, improving their operational efficiency and providing deep insights that lead to well-informed, confident decisions. IHS Markit has more than 50,000 key business and government customers, including 85 percent of the Fortune Global 500 and the world's leading financial institutions. Headquartered in London, IHS Markit is committed to sustainable, profitable growth.

IHS Markit

REPORT FUNDERS

IHS Markit and CABA would like to acknowledge the CABA member funders listed in Figure ES1, and the respondents who helped make this research possible. We would also like to take this opportunity to thank the CABA member funders and CABA, as well as all those organizations that contributed their valuable time and information. In particular, we appreciate the trust and transparency shown by respondents willing to share confidential information. Without the help of all these organizations it would not have been possible to produce such an in depth and detailed study.

THE ROLE OF THE STEERING COMMITTEE

The Steering Committee represented a cross-section of solution providers in the Intelligent Buildings marketplace. Representatives from each organization joined IHS Markit and CABA on regular collaboration calls to ensure the research scope met the project objectives. The Steering Committee played a vital role in outlining the research product in terms of defining the required content on the research approach including the development of the interview scripts and survey guides. In addition, the Steering Committee received a draft of the research and their review and feedback was valuable in creating the final product.

REPORT METHODOLOGY

Two main primary research processes were used for this report: extensive interviews with industry participants (ecosystem interviews) and an on-line decision-maker survey of businesses in Canada and the United States.

Ecosystem interviews

A series of detailed interviews were conducted by telephone with key decision-makers at a number of different types of organizations, across the following organization types. The percentages provide an approximate guide only:

- 30 percent were leading building supply-side solution providers.
- 20 percent were from large North American facility management service providers and large owners.
- 30 percent were from organizations specializing in IoT solutions for enterprises and industry, 50 percent of them were from established suppliers, 50% from disruptors.
- 20 percent were from other players on the supply side of the building automation industry, such as system integrators, connectivity solution providers, etc.

The names of the companies interviewed cannot be revealed. Interviewees were assured confidentiality, as they were often discussing product or service plans and detailed strategic information.

IHS Markit conducted 20 in-depth interviews for this study. These interviews were informed by the extensive knowledge of IHS Markit of conducting research in this information technology (IT) area.

REPORT METHODOLOGY

North American decision-maker survey

IHS Markit, in conjunction with the CABA project Steering Committee members, developed an an on-line decision-maker survey to assess attitudes towards intelligent buildings and the impact of IoT.

The survey targeted 150 building, facility and IT managers and owners/operators from a broad sample of building sizes, types, and geographies in both the United States and Canada.

The aim of this survey was to understand decision-maker views on the impact of a range of IoT topics on intelligent buildings. These topics ranged from real-time monitoring and control of building systems to the role of data analytics in building management. The topics were framed within the context of the five main themes outlined in section 2.

The survey consisted of 20 questions, two open-response, and the balance being closed-response. It was intended that the survey took 15–20 minutes to complete. For these >150 responses, the project steering group decided that:

- An artificial skew was to be created in the sample in order that approximately 33 percent of responses were from Canada, allowing for greater statistical analysis of the results by country than a purely population-driven sample frame would give.
- As well as traditional building or facilities managers, the survey was also to target responses from IT managers within enterprises or buildings and from building owners to reflect the trends in convergence between them. 25 percent of responses were proposed to be from IT managers, 25 percent from building owners
- The remainder of the survey targeted a representative sample by vertical industry (sector), facility size, and sub-region in Canada and the United States.

It should be noted that the Steering Committee was split on whether to include the industrial/manufacturing sector within the survey. By a narrow margin, it was decided to include this sector; however, IHS Markit has endeavored to analyze the results with and without industrial/manufacturing included, to assess whether the inclusion affected the general picture presented by the responses.

SUMMARY OF KEY FINDINGS

The Value of IoT Drives Adoption in Intelligent Buildings

It is important to note that the IoT is not a specific device or technology – it is a conceptual framework, driven by the idea of embedding connectivity and intelligence in a wide range of devices. IHS defines an IoT device as one with some form of embedded connectivity that allows it to be directly connected to the Internet (that is, it is IP-addressable) or allows it to connect (be tethered) to an IP-addressable device. This connection can be wired or wireless. These devices can include a range of sensors as well as some type of user interface (UI); but neither a sensor nor a user interface is required under this definition.

The overall Ecosystem of IoT is reviewed in ES.1, where the ability to collect vast amounts of data in near real-time from this broad range of intelligent connected devices is the foundation of the IoT. This data can then be accessed directly, or via the cloud; and unique value propositions can be created through the application of complex analytics and big data techniques. In this way, the IoT can, and will, be used to provide unique value propositions and create complex information systems which are greater than the sum of the individual components.

KEY TRENDS IN IOT AND COMMERCIAL BUILDING TECHNOLOGY MARKETS

Internet of Things Overview

Although there are many factors that will influence the pace of IoT adoption in commercial buildings, several key themes revolve around defining a high value of the IoT in the intelligent building. However, value is relative especially since there are many stakeholders in the intelligent building ecosystem, and different IoT implementations have the ability to create value for each of them.

- Access to data continually drives technology innovation within the intelligent building: Historically the collected data has only been viewed/utilized by a select group of individuals, usually on-site, via specialized equipment. As we move to IoT standardized devices, a whole range of individuals can access building data, for a variety of purposes; ultimately driving a wide range of new technology solutions for the intelligent building.
- Overarching trends will impact the development of the commercial market ultimately determining levels of investment available to support IoT adoption including governments or regulatory bodies placing value on IoT technology solutions that can have a measurable impact on their cause, such as energy performance or the health of building occupants.
- A fundamental shift in business strategies from both building operators and suppliers to better support the adoption of IoT solutions signals the value both put on IoT in the intelligent building.

KEY TRENDS IN IOT AND COMMERCIAL BUILDING TECHNOLOGY MARKETS

Figure ES2 Overall IoT Opportunity and Drivers

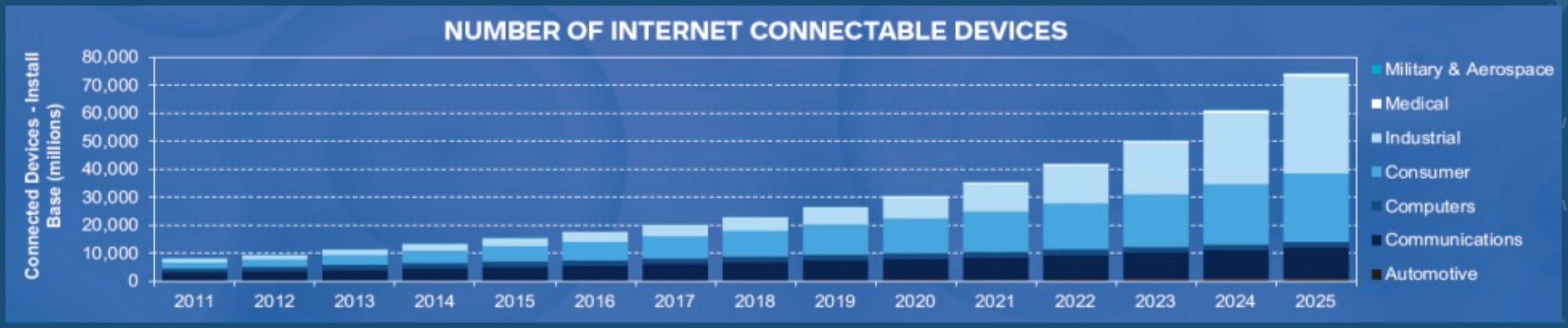
Source: IHS Markit

KEY TRENDS IN IOT AND COMMERCIAL BUILDING TECHNOLOGY MARKETS

Figure ES.2 illustrates the size of the IoT market opportunity. It is projected that by the end of 2025, there will be around 70 billion IoT-connected devices and that annual shipments will have reached 18 billion devices per annum. There are several factors that IHS considered in the development of these projections, including:

- Near-term effects of the sluggish global macroeconomic environment due to a slow housing market and constrained CapEx
- Development of appropriate business models (for each market subsector)
- Consumer acceptance and decreasing costs of connected devices
- IPV6 implementation
- Long-term evolution (LTE network upgrades)
- Advances in processor technologies.

Figure ES.3 Overall Development of IoT Devices



Source: IHS Markit

KEY TRENDS IN IOT AND COMMERCIAL BUILDING TECHNOLOGY MARKETS

Introduction to the Development of the Intelligent Buildings Market

A number of overarching trends will impact the development of the commercial building automation market over the next five years as well as the adoption of IoT to move to an intelligent building:

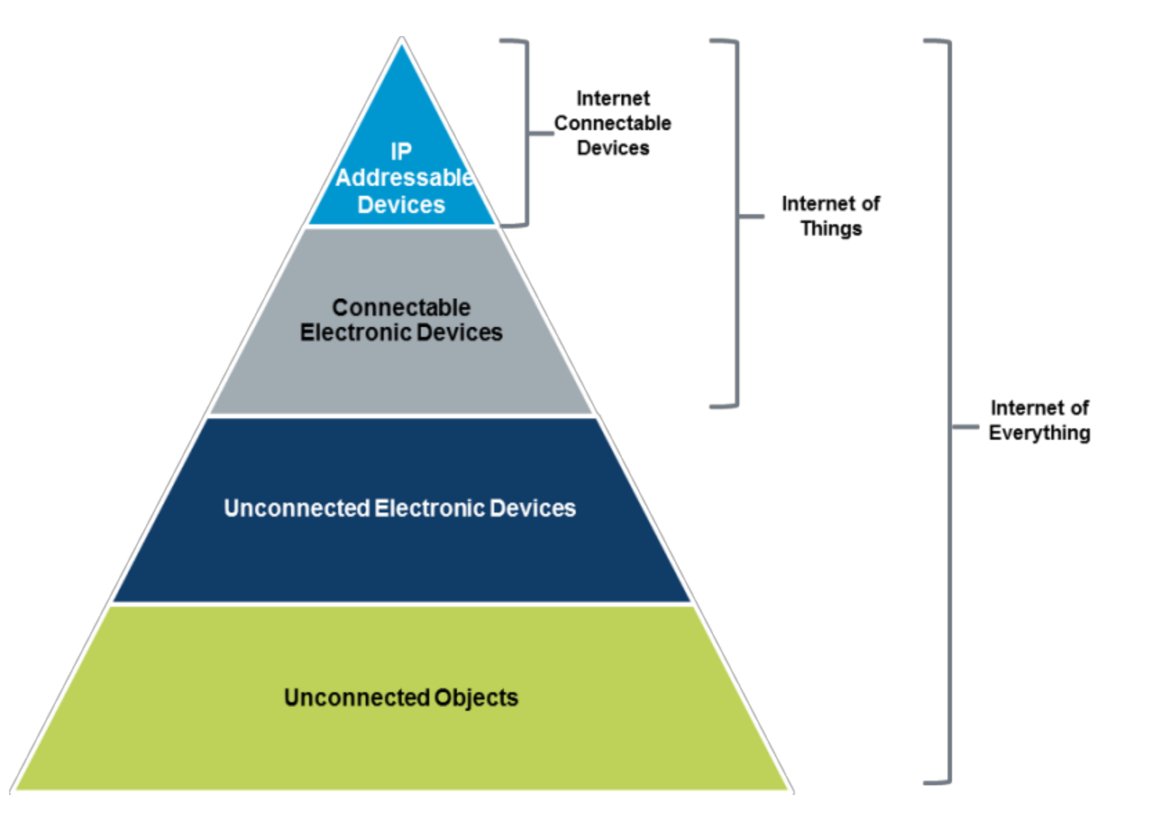
- Commercial construction spending growth
- Policies, legislation and regulation
- Building certification programs and organizations
- Refurbishments of existing buildings
- Building owner and facility manager requirements
- Education and industry knowledge

More interesting, is to look at the key developments of technology being deployed within intelligent buildings and map these developments against the overall IoT Ecosystem map as presented on the next slide. It is important to highlight that innovation is driving every layer of the ecosystem at the same time, although there are interoperability and standardization are trends continually highlighted.

INTERNET OF THINGS OVERVIEW

- IoT is a conceptual framework.
- It's about enabling connectivity and embedded intelligence in devices.
- Some of these devices are connected today, but MANY are not…
- Not strictly machine-to-machine (M2M) – also machine-to-people, people-to-machine, machine-to-objects, people-to-objects
- Creates the ability to collect data from a broad range of devices
- Data can be accessed via the cloud and analyzed using "big data" techniques

Figure 1.1- Internet of Things Hierarchy

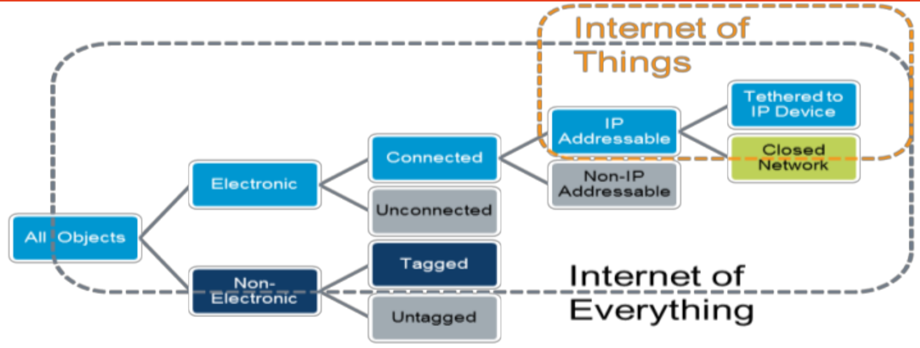


Source: IHS Markit © 2016 IHS Markit

HIERARCHY OF CONNECTED DEVICES

- Unconnected Objects: Desk, chair, soda can, fire hydrant, animal collar, shipping pallet, buildings, etc.
- Unconnected Electronic Devices: Calculator, streetlight, vending machine, coffee maker, blood pressure monitor, etc.
- Connected/Tethered Electronic Devices: Audio headset, printer, computer monitor, DVD player, licensed mobile radio unit, etc.
- IP-addressable Devices: Tablet PC, smartphone, Infotainment head unit, smart meter, EV charging station, home health hub, etc.

Figure 1.2 - Connected Devices Hierarchy



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Source: IHS Markit

APPROACH TO CATEGORIZING THE INTERNET OF THINGS

The IoT ecosystem can be categorized into seven main industry sub-segments.

These are outlined in Figure 2.3. This report focuses on the connected consumer roadmap and the part that IoT has to play in it. Although IHS has defined a specific segment as ‘consumer’, in reality consumers will own devices that interact with the IoT ecosystem from a range of these sub-segments, including automotive, communications, IT and consumer medical.

Therefore it is important that the reader understands the market drivers in each part of this ecosystem; and how the ecosystem interacts with the connected consumer.

Figure 1.3 - IHS Approach to Categorizing IoT Market Segments

Source: IHS Markit

ECOSYSTEM DEVELOPMENT AND MARKET OPPORTUNITY

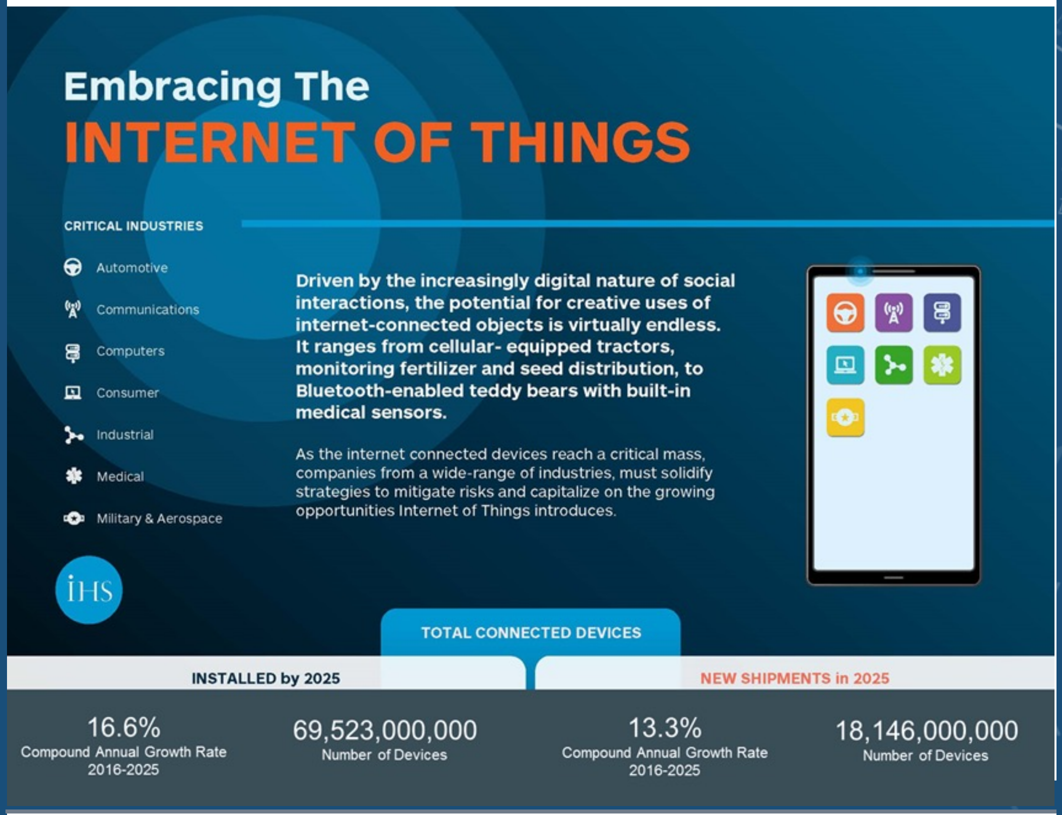
Figure 1.4 illustrates the size of the IoT market opportunity. It is projected that by the end of 2025, there will be around 70 billion IoT-connected devices and that annual shipments will have reached 18 billion devices per annum.
There are several factors that IHS considered in the development of these projections. These include:

- Near-term effects of the global macroeconomic environment
- Development of appropriate business models (for each market subsector)
- Consumer acceptance
- IPV6 implementation
- LTE network upgrades
- Advances in processor technologies.

Although the first three factors represent potential barriers, the last three are seen more as enablers of a broader ecosystem of internet-connectable devices.

The following slides provide some additional discussion for each of these factors and gives some context for how they affect the internet-connectable device market overall.

Figure 14 - Overall IoT Opportunity and Drivers



Source: IHS Markit

VERTICAL IOT ECOSYSTEM DEVELOPMENT

Figure 1.5 - IoT in Industrial Applications

Source: IHS Markit

The industrial sub-sector is the part of the IoT ecosystem projected to offer the largest market opportunity, with a projected 28 billion IoT connections by the end of 2025. It is also the sector most relevant to this report as it includes many of the device types affected by IoT in intelligent buildings, such as in building automation, power and energy, commercial security, and industrial automation. The following parts of the IoT ecosystem are captured in this sub-slides and discussed further in Figure 1.5:

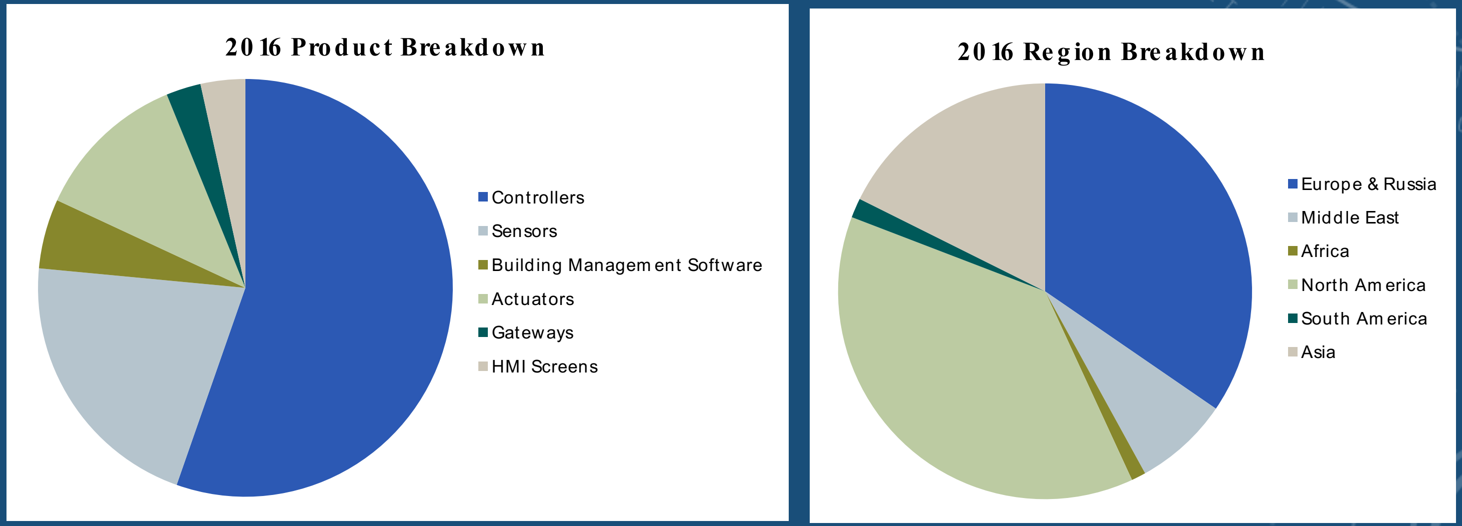
- **Building automation.**
- **Commercial transport.**
- **Retail electronics.**
- **Industrial automation.**
- **Commercial and street lighting.**
- **Power and energy.**
- **Commercial security.**
- **Test and measurement.**
- **Other industrial**

BUILDING AUTOMATION MARKET SIZE

Figure 1.6 presents an overview of the world market for building automation equipment. Key points:

- IHS estimates that the world market for building automation equipment is forecast to be worth $5.9 billion in 2016 and controllers were the largest market, accounting for $3.1 billion.
- EMEA remained the largest market for building automation equipment in 2015, Asia was estimated to be the smallest market; however, it is forecast to be the fastest growing of any region.
- Revenues from retrofit and refurbishment projects driven by the American and EMEA markets are forecast to be surpassed by revenues from new in 2018.

Figure 16   2016 Building Automation Equipment Market Size - Millions of USD



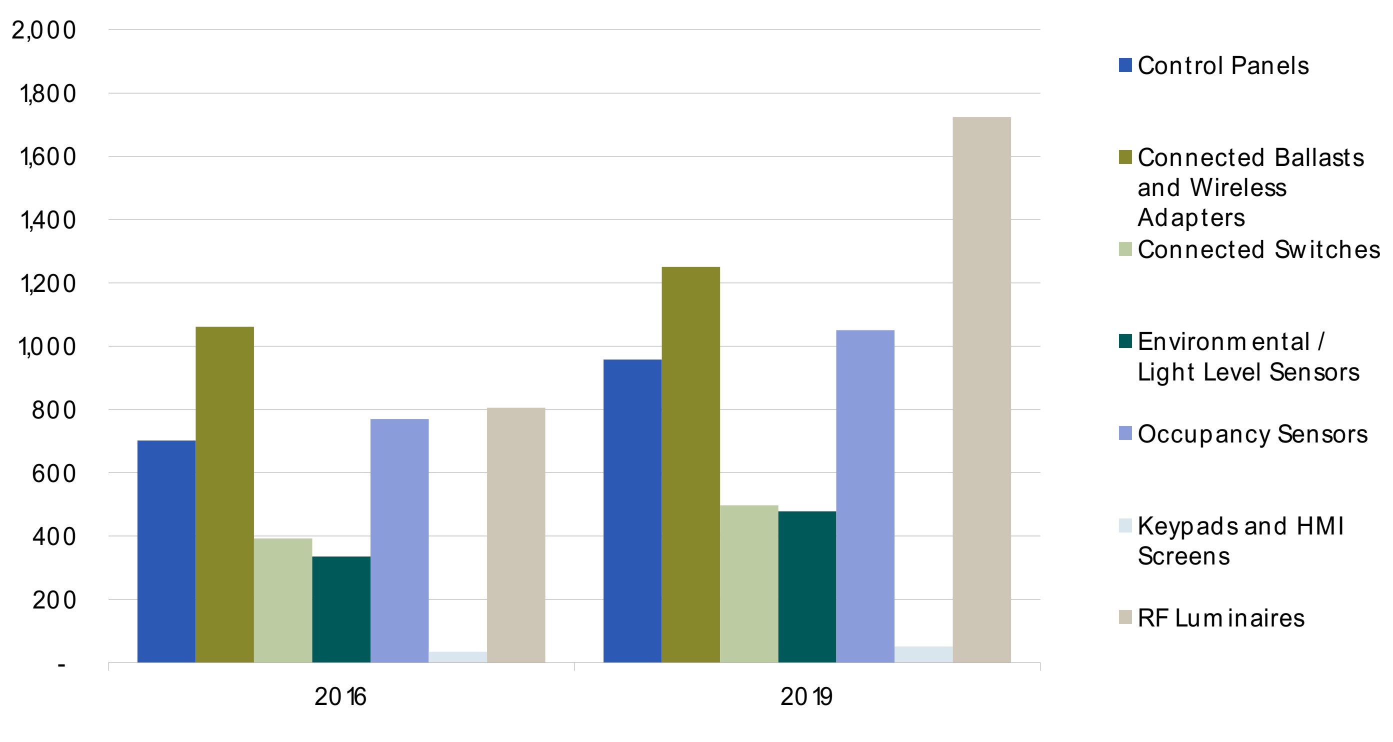
Source: IHS Markit

WORLD MARKET FOR CONNECTED LIGHTING

Figure 1.7 presents an overview of the world market for connected lighting in commercial applications. The key points to note are:

- IHS estimates that the world market for connected lighting in commercial applications is forecast to be worth $4.1 billion in 2016. This figure excludes central controllers and gateways as gateways help "bridge" desperate systems or communication protocols but typically do not control a system.
- The construction market and economic conditions are perhaps the two most important factors for the market for smart lighting and lighting controls, particularly in commercial applications.
- EMEA leads the world in the deployment of connected street lights, with nearly half of the global spending, with Americas trailing slighting and Asia lagging current spending, although it is expected to make significant investments in the future.

Figure 1.7   Global Market for Connected Lighting in Commercial Applications - Millions of USD



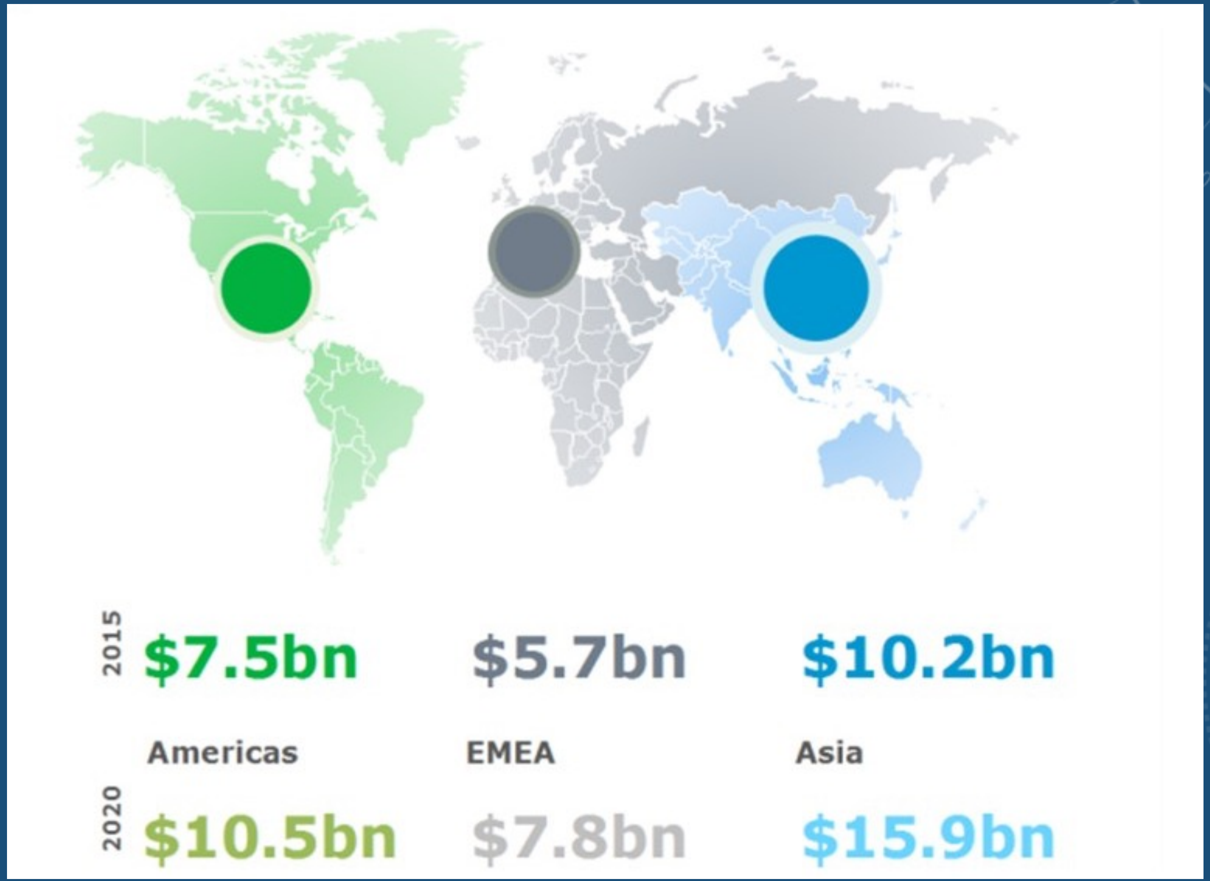
Source: IHS Markit

PHYSICAL SECURITY EQUIPMENT

Within the definition of physical security equipment and services, IHS Markit includes the following equipment types:

- Video surveillance: For professional video surveillance, analogue security cameras, DVRs, NVRs, network security cameras, video encoders, video management software (VMS), CS-mount lenses, camera housings, CCTV controllers/keyboards and motorized camera positioning mounts.
- Access control: Readers, control panels, credentials, software and electronic locks.
- Intruder alarms: Intrusion sensors, control panels, keypads and accessories.
- Entrance control (vehicle): Gate operators, rising bollards, road blockers, barriers, garage door operators, and parking systems.
- Entrance control (pedestrian): Entrance gates, full-height turnstiles, optical turnstiles, interlocking doors, revolving security doors, security booths, speed gates, and tripod barriers.
- Enterprise storage: External DAS, internal DAS, SAN, and NAS storage device hardware which are used for video surveillance applications. This category does not include DVRs or NVRs and VMS software.

Figure 1.8 Physical Security Equipment Market Size



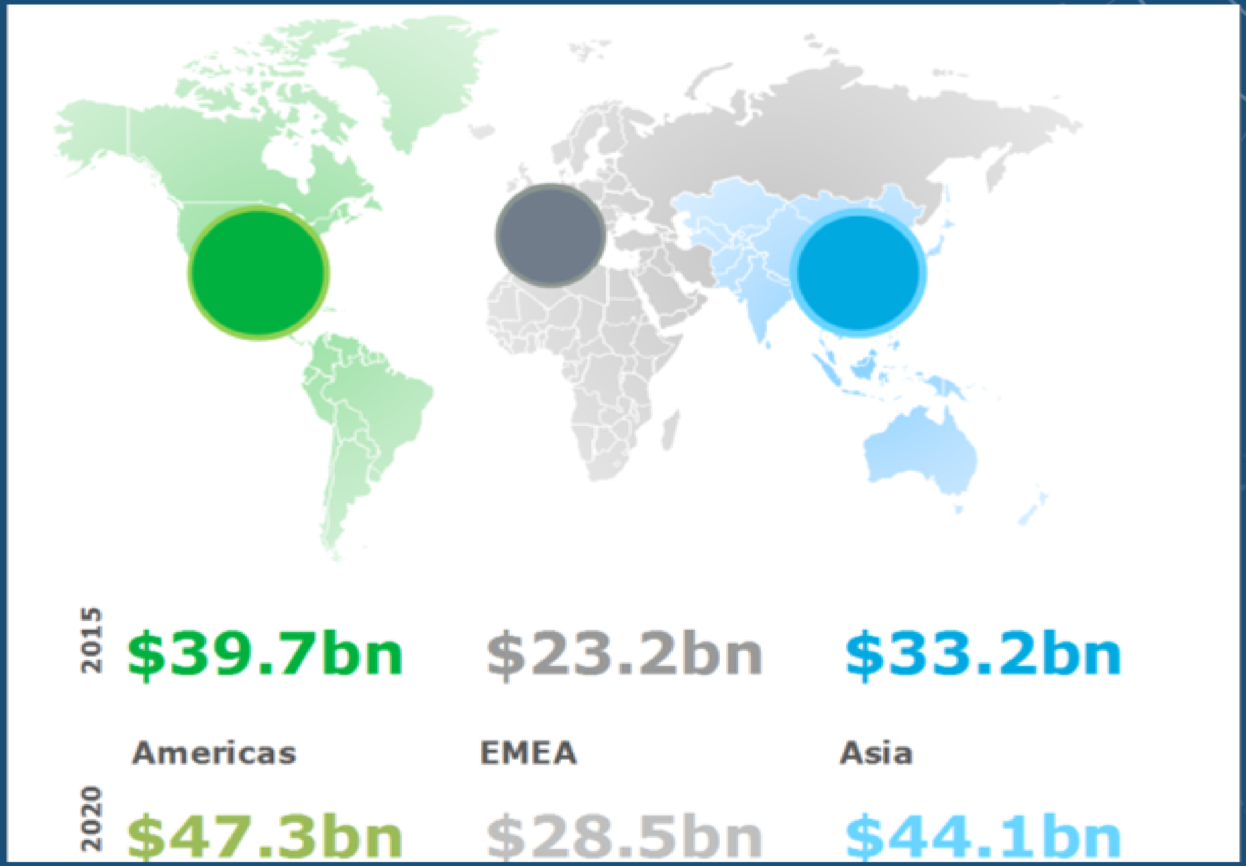
Source: IHS Markit

PHYSICAL SECURITY SERVICES MARKET

Within the definition of physical security equipment and services, IHS Markit includes the following services:

- Video surveillance as a service (VSaaS): A customer pays on a yearly, quarterly, or monthly basis to view live or recorded video surveillance data off-site to the location of the security camera; and the video is used for self-monitoring surveillance and business applications.
- Access control as a service (ACaaS): A customer pays on a yearly, quarterly, or monthly basis to have a server managing the access control system, at a third-party location. There is no software or server located on the customer’s premises.
- Remote monitoring services: Professional alarm monitoring, connected alarm monitoring services, video monitoring for large commercial businesses, and personal emergency response systems (PERS) monitoring.
- Security systems integration: Design and consultancy, installation, service and maintenance, and equipment (intruder alarms, physical access control and video surveillance).

Figure 1.9 Physical Security Services Market Size



Source: IHS Markit

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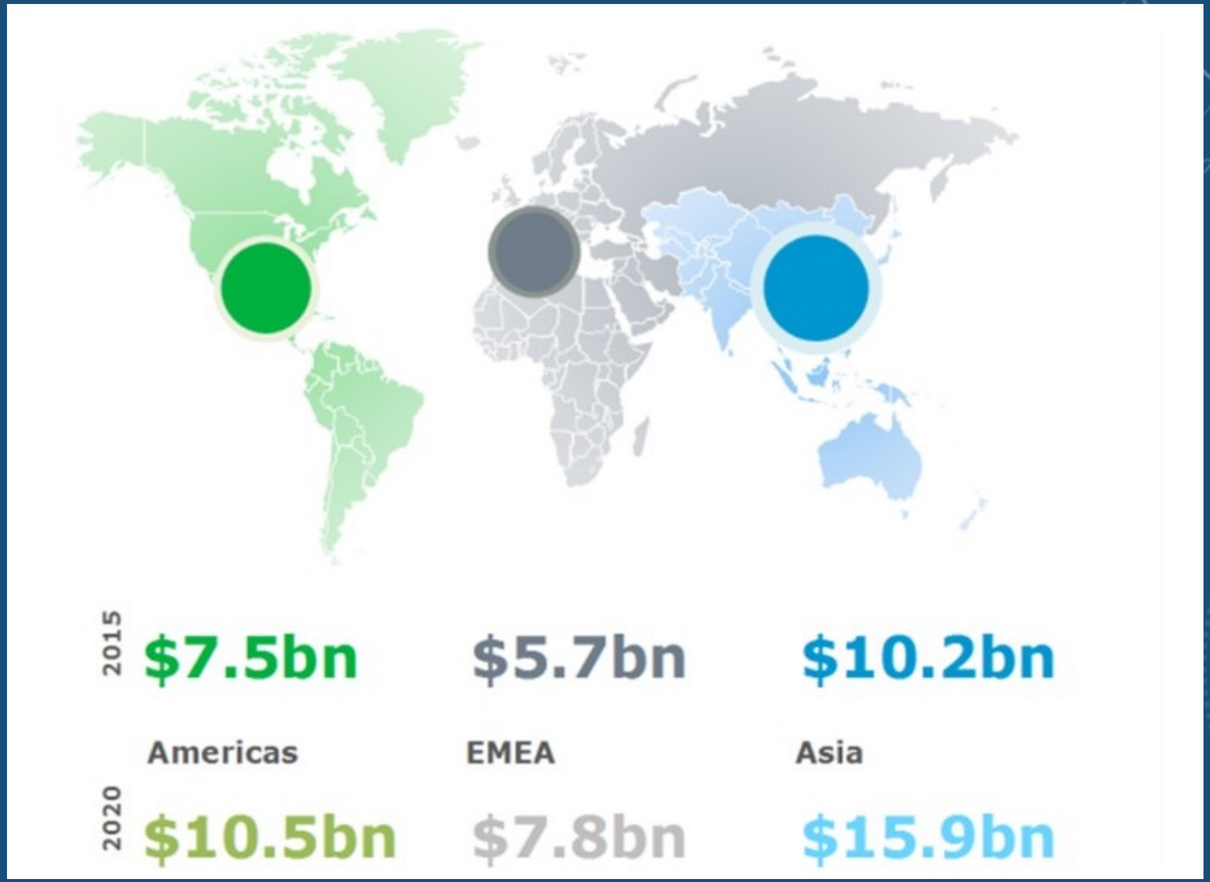
Figure 18 Physical Security Equipment Market Size



Source: IHS Markit

WHERE TECHNOLOGY DEVELOPMENT MEETS THE INTELLIGENT BUILDINGS IOT ECOSYSTEM

IoT Ecosystem	Technology Development	Resulting Industry Technical Challenges
Connecting Devices	Wireless- Wireless transmission will play an increasingly important role in the specification of building automation systems. However, this will mainly take the form of field level devices, such as sensors, actuators, and thermostats. The management level of building automation systems will remain wired, because of high bandwidth requirements and the frequent transmission of data within the management level. Protocols used for building automation systems: • EnOcean, ZigBee, Z-Wave • BACnet, LonTalk, KNX technology, Modbus	• Network security • Cybersecurity Concerns
Collect Data	Open Protocols: There is a steady move in the building automation industry towards more open products; however, there is a need for these protocols to be Internet Protocol (IP) compatible. This is achieved through vendors using common communication protocols, such as, BACnet, LonWorks, KNX or Modbus. This enables end-users and system integrators to select best-of-breed equipment and solutions without having to be tied to one vendor for the sake of ensuring compatibility.	• Interoperability Challenges • Interoperability moves beyond connectivity and through to analytics.
Access Data	This study would suggest that middleware was a solution to overcoming compatibility issues in the past - The connection between the sensors and the software and different building systems is starting to be taken for granted. A future trend could be towards eliminating the middleware and creating a direct connection between the field devices and the enterprise level. The current connection based on middleware will no longer be necessary as the edge devices and nodes become IP compatible, as we will not need the translation of data from field devices to IP standardized enterprise software and hardware. The main difference between collecting and accessing data is the range of users that can access the data. As the industry moves to IoT standardized devices, a whole range of individuals can access building data, for a variety of purposes, i.e., building owners, facilities managers, utilities, insurance companies, employers, etc.	• Driving Cloud Computing • Mobile Applications • Dashboards • Visualization
Complex Analytics	Building analytics used in intelligent building is defined as software that provides diagnostics to evaluate the performance of a building. The diagnostics are based on data that has been collected from building sensors and utility meters. Includes both building optimization and fault detection analytics. Developing the edge control layer in the intelligent building could be viewed as another initiative that could be used as a tool to allow for complex analytics at the edge of the network, which would help alleviate data storage problems as well.	• Supporting Demand Response • Intelligent Buildings Platform Need to interact with BMS
Source: IHS Markit		@2016 IHS Markit

THEME 1 – REALIZING THE VALUE OF IOT

Summary of key message:

As technology developments throughout the IoT Ecosystem have come to fruition and continual innovation drives solutions, adoption of IoT solutions in intelligent buildings remains dependent on proving the value of IoT. Although the ecosystem interviews gave perspective on what the suppliers to the industry believed would be of value, the decision-maker survey illustrated if this was not always in line with what the customer was actually looking for.

Suppliers often referred to the new and innovative functions that IoT could bring, such as location-based services, pervasive sensing, scenario creation, etc. However, the results from the decision-maker survey illustrated that often the most important developments were to enhance the more traditional building system functions.

It should be noted that the survey only captured a snapshot of viewpoints related to the value add of IoT, but there are many stakeholders in the ecosystem, and different IoT implementations have the ability to create value for each of them. For instance, there is value in upgrading and enhancing existing building automation systems with retrofits, although the full functionality and benefit will not always be realized, for that particular project the value in upgrading may be high. Obviously going all in with construction of a new building is the best approach, but this is not always practical.

Impact of IoT as key issue for the industry to address:

Analytics, Dashboards, Real-time Monitoring and Control, Centralized Management, Convergence of Systems, Adaptive Automation, User Interface, Business Case and Economies of Scale, Stakeholder Analysis

THEME 2 – DATA SECURITY & STORAGE

Summary of key message:

Concerns remain over attacks, which is currently a limiting factor to the types of technologies chosen to support with data privacy and storage challenges. IoT and the development of cloud services have opened up new opportunities and business models for ecosystem suppliers to the commercial building systems market. However, many of these new services and business models are predicated on the data generated by the building systems being stored remotely and potentially analyzed by third parties.

Suppliers interviewed indicated they were rolling out or had rolled out cloud-based services for their customers. The decision maker survey shows that for the majority of the sample respondents (68 percent) were not willing to store their building systems' data on third-party systems. Of those that were willing, 11 percent of the total respondents restricted the types of data the third parties could store.

Impact of IoT as key issue for the industry to address:

Cybersecurity, Privacy, Data Storage, Data Sovereignty, Gateways and Data Centers, Edge to Cloud Services, Remote Accessibility, Ability to gather and normalize data from disparate systems

THEME 3 – STANDARDIZATION

Summary of key message:

A consistent issue that affects IoT in all application areas is interoperability, and the vast array of standards and technologies that are used to connect devices. Connectivity is at the core of IoT; however, the lack of common standards is also one of its greatest barriers. Interoperability is a concern for both wired and wireless, but it is becoming more of an issue as more wireless retrofit solutions are being introduced to the market, adding to the existing mix of wired protocols. This is the key reason driving the critical need for both wired and wireless solutions to be IP compatible.

Based on results from the survey depending on system type, between 18 percent and 27 percent of respondents used only wireless solutions for individual systems. Physical access control was the system type where wireless only was most prevalent. Lighting was the system type where wireless only was least prevalent.

Impact of IoT as key issue for the industry to address:

Interoperability and Open Standards, Cover connectivity, middleware platforms, APIs, etc.

THEME 4 – ECOSYSTEM

Summary of key message:

Open ecosystems and cross-vertical, cross-value chain collaboration are crucial in the IoT because much of the proposed innovation and value is due to “mash ups” (e.g., integration) of data from diverse sources, ranging from connected machine and sensor data and traditional ERP/CRM systems, amongst others.

Despite companies reporting they would like a more centralized control of systems, results from the decision maker survey indicate there are still a number of barriers to achieving this: there are multiple routes to market and the numerous types of customers are buying in different ways.

Impact of IoT as key issue for the industry to address:

Existing Players, Emerging IoT Suppliers, Channels to Market, Development of overall supplier ecosystem and the disruption from IoT, Education and Engagement, Emerging revenue models for services

THEME 5 – BUSINESS PROCESSES

Summary of key message:

At the moment, there are two clear examples of changes in the current business practice of many companies in the intelligent building market in direct response to this increase in control of a building; they are the changing roles of facility managers and a focus on service instead of hardware from suppliers.

The facility manager's role is transitioning to more of a cooperative partnership with IT in the near-to-midterm, with the facility manager taking on more and more IT responsibility, knowledge and domain expertise as the market matures and the lines between the roles continue to blur in the long-term.

Impact of IoT as key issue for the industry to address:

Role of facility managers versus IT managers, Changes in training, roles, processes

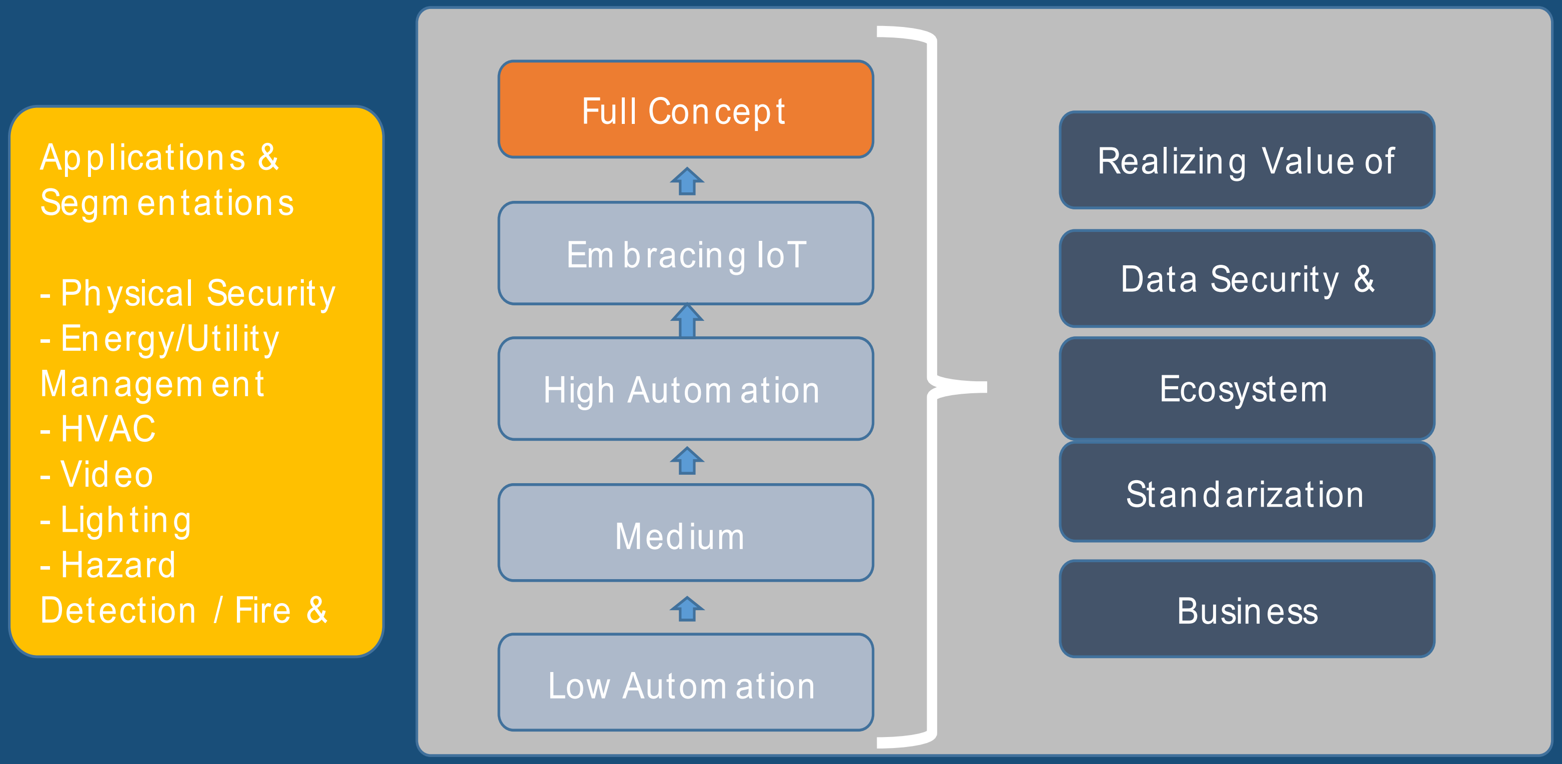
INTELLIGENT BUILDING ROADMAP & RECOMMENDATIONS

Achieving a full concept intelligent building is a significant step; one which few organizations can claim as investment is high to adopt both the leading edge solutions and centrally controlled solutions. Key attributes for organizations to target adopting a full concept intelligent building include:

- **Target companies having nearly all main building functions automated – HVAC, energy management, hazard detection, physical security, lighting and CCTV.**
- **The systems would also employ leading-edge features, with high levels of systems performing based on building occupancy, location-based set points, external inputs (weather forecasts and energy pricing), integration with A/V equipment, analytics, predictive maintenance, etc.**
- **It is expected that a mix of solutions for data storage and analysis will be used. Some organizations are expected to have embraced cloud computing using third-party infrastructure to store and analyze data. However, the high level of negative feeling about this means that on-premises or company-owned infrastructure will still be a likely chosen solution.**
- **Most advanced users have current frustration about interoperability problems and the lack of standardization. Pushing features that demonstrate how these problems can be overcome and that show compliance to industry standards, such as Haystack, will help.**

INTELLIGENT BUILDING ROADMAP & RECOMMENDATIONS

Figure ES.5 Intelligent Building Roadmap - Embracing IoT in Intelligent Buildings



Source: IHS Markit

DECISION MAKER SURVEY SUMMARY ANALYSIS

The conclusion is that some of the potential of IoT is seen as merely 'nice to have'. The most important things that suppliers need to communicate in their marketing are: exactly how IoT will impact the bottom line; how it will reduce the energy consumption of buildings; and how it will allow building owners to improve overall financial planning. Table ES.1 highlights the advantages with clear ties to ROI are currently the most attractive to users. Once these points have been made, they can be supplemented by stating other, less obvious advantages that are of interest, but just viewed as 'nice to have'.

A similar message was given from the results to question 2.3, where 11 applications were presented to respondents and they were asked to rank them all from 1 to 7, where 1 was extremely valuable and 7 not of value at all. The results are shown in Figure ES.6. Again the author concludes that the more traditional, more obvious applications have the greatest value for decision makers. Information on the building system status and the likelihood of failure were the applications that received the highest scores. The more imaginative, less obvious applications, such as "ability to create rules / algorithms based on the needs of your building", "integration with weather systems for historical comparisons as well as future energy & maintenance forecasting" and "use of advanced algorithms to recommend location based set points based on usage and occupancy" were generally viewed as significantly less valuable.

IHS Markit devised a scoring system for each response that allowed the responses to be normalized on a 10-point scale for comparison purposes. To do this, each response was given a score. Four was given for a selection of option 5, three for option 4, two for option 3 and one for option 2, A score of zero was given for option 1. The score was combined for all responses across all building system types. The total was then re-based so that the system type that had the lowest score was set to zero and the system type with the highest score set to 10. The results are displayed in Table 4.10.

DECISION MAKER SURVEY SUMMARY ANALYSIS

Table ES.1 Most attractive advantages that IoT in building automation can bring

	Total	Industrial	Non Industrial	Auto High	Auto Med	Auto Low
Reduce energy consumption	7.9	8.7	7.6	8.8	5.5	10.0
Improve operational efficiency	4.5	4.9	4.4	4.1	3.9	5.4
Enable predictive maintenance	3.7	3.1	4.0	3.1	4.2	3.2
Improve financial planning	10.0	10.0	10.0	10.0	10.0	8.2
Provide remote access	0.4	-	0.6	0.8	0.5	0.7
Future proof	-	0.3	-	0.5	0.1	0.4
Increased use of sensors	0.4	0.3	0.5	3.2	-	-
Open standards	1.7	2.2	1.6	1.0	2.8	0.6
Increase building performance data	3.9	4.5	3.8	6.6	3.7	2.4
Improve occupant comfort	1.0	1.2	1.0	1.0	0.6	2.2
Improve occupant safety	0.1	0.4	0.1	-	0.3	0.9
Improve tenant/employee productivity	2.0	3.7	1.5	1.7	1.7	3.0
Increase building resiliency	2.1	0.9	2.5	4.2	2.1	1.0

All respondents, n=150

Source: IHS Markit

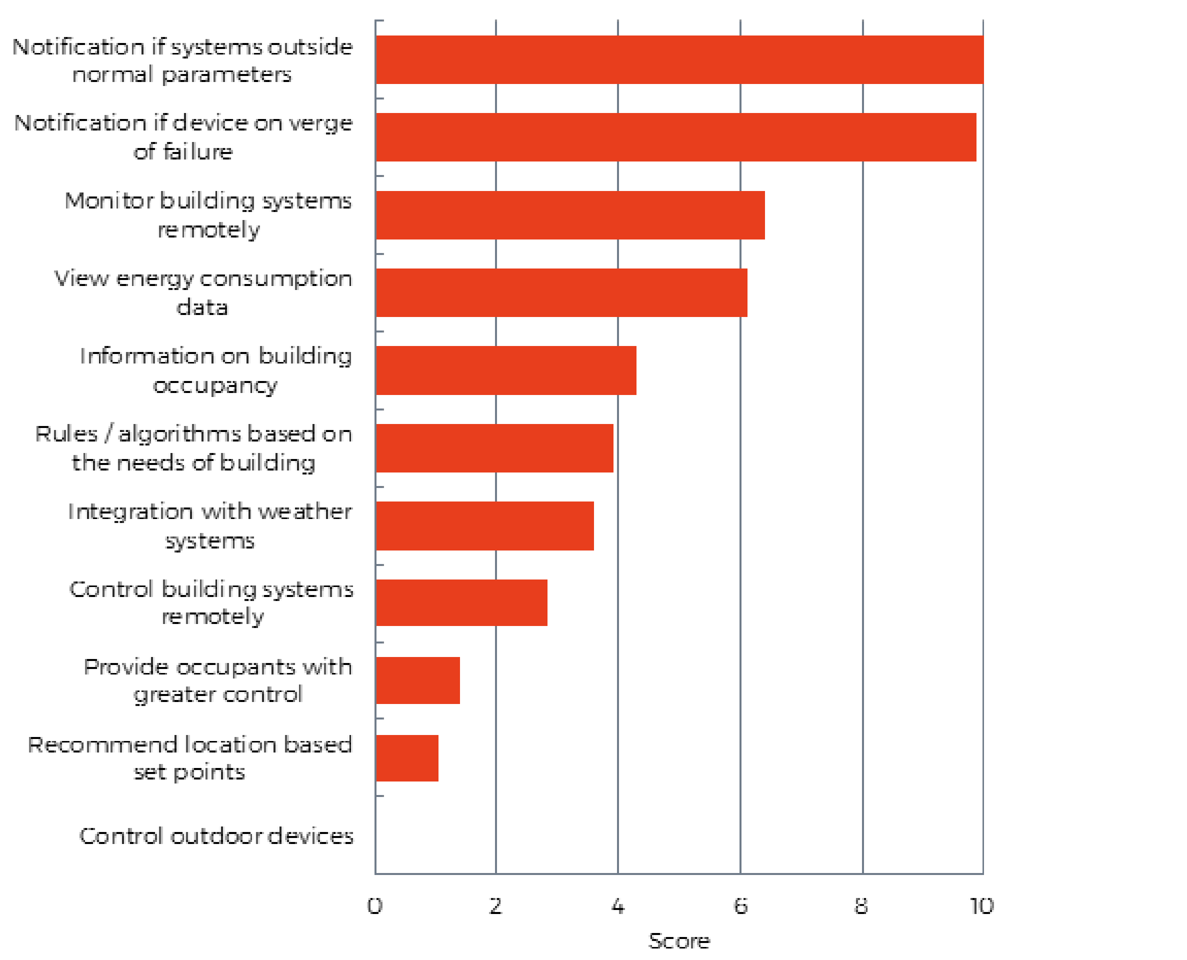
DECISION MAKER SURVEY SUMMARY ANALYSIS

Figure ES.6 focuses mainly on the value off IoT solutions for operations and not for occupants. Several interesting conclusions can be pulled from this one question posed to decision makers:

- The top four applications were all those that are relatively well documented for how intelligent buildings could function. The slightly more out-of-the-box functions such as occupancy information, weather system integration, location based set point recommendations, were scored lower, but did receive more than 30 percent of respondents ranking them within the top three.
- When analyzed by major segment, there was little variation in the profile of those applications that scored higher or lower. One slight difference was those that already fell into the high automation segment did value a little more the newer types of service listed above. Indicating that their attractiveness is perhaps linked to awareness of what they can potentially offer.
- Geolocation in a building is an IoT application and couple possibly enter the "information on building occupancy" category in the below table where there is the ability to do highly accurate indoor location utilizing mobile devices and enterprise WLAN access points. However, the question does not specify this type of use case.
- It is interesting to note that remote monitoring ranks high on the list although remote control is much lower, which may be due to cost and equipment lifecycles instead of a large reaction to cybersecurity measures. Remote monitoring can be relatively easily added with wired or wireless retrofit components (sensors), but remote control generally requires replacing more expensive pieces of equipment with systems that are compatible with remote control.

DECISION MAKER SURVEY SUMMARY ANALYSIS

Figure ES.6 - Application Value - Score



All respondents, n=150

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