

Smart buildings: How IoT technology aims to add value for real estate companies

The Internet of Things in
the CRE industry

A research report
from the Deloitte
Center for
Financial Services

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Deloitte's Internet of Things practice enables organizations to identify where the IoT can potentially create value in their industry and develop strategies to capture that value, utilizing the IoT for operational benefit.

To learn more about Deloitte's IoT practice, visit <http://www2.deloitte.com/us/en/pages/technology-media-and-telecommunications/topics/the-internet-of-things.html>.

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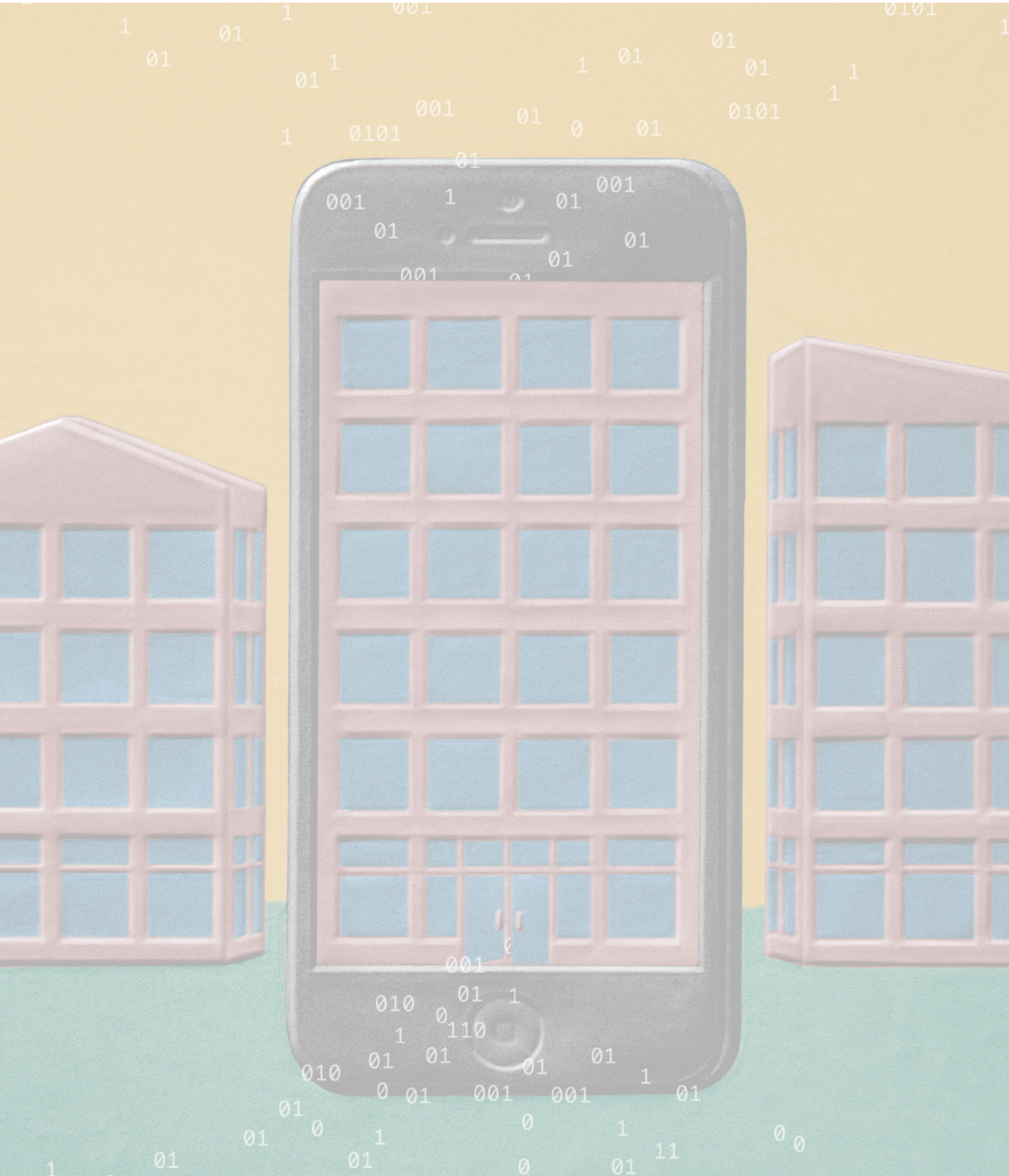
Enhancing performance and reimagining tenant experience

TECHNOLOGY is changing the most fundamental truth about commercial real estate (CRE)—that value is based solely on location, location, location. While it still matters, of course, that a space be close to customers, employees, and/or suppliers, information-based applications have the potential to add new ways for the CRE sector to create value for customers, differentiate from competitors, and even find new sources of revenue.

Specifically, the Internet of Things (IoT) is already having a significant impact on the CRE industry, helping companies move beyond a focus on cost reduction. IoT applications aim to grow margins and enable features such as dramatically more efficient building operations, enhanced tenant relationships, and new revenue generation opportunities. Consider the increasingly popular smart thermostats that intuitively adjust the temperature, humidity, and light based on residents' preferences and climatic conditions.

While consumer IoT devices have drawn most press attention, it is enterprise-level

adoption of the technology that will likely have the bigger impact on industry. Indeed, the CRE industry is perhaps uniquely positioned to implement the technology, using IoT-enabled building management systems (BMS) to make building performance more efficient and also use sensor-generated data to enhance building user experience. Gartner's recent smart-city forecasts highlight the potential: "Smart commercial buildings will be the highest user of Internet of Things (IoT) until 2017, after which smart homes will take the lead with just over 1 billion connected things in 2018."¹ This not only allows CRE to expose wide segments of the population to IoT technology—it provides owners an opportunity to have direct conversations and relationships with building users rather than only with their tenants. For instance, sensors in shopping malls can help owners connect directly and offer services to end customers. This would lead to building relationships with customers as well as strengthening tenant engagement.



What is the IoT?

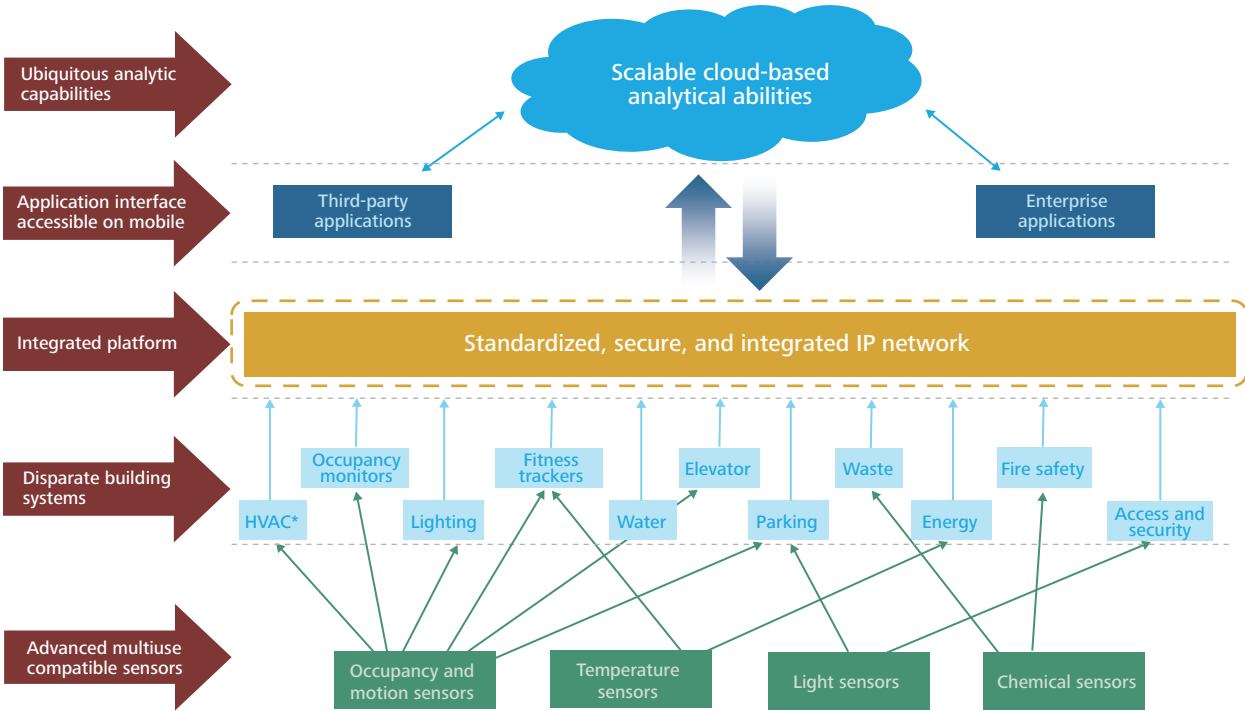
THE IoT is a suite of technologies and applications that equip devices and locations to generate all kinds of information—and to connect those devices and locations for instant data analysis and, ideally, “smart” action. Conceptually, the IoT implies physical objects being able to utilize the Internet backbone to communicate data about their condition, position, or other attributes.² (For more information on the technologies that power the IoT, see our primer, [Inside the Internet of Things](#).)³ CRE companies may find it most relevant to understand how various types of sensors can track features such as motion, air pressure, light, temperature, and water flow and then—with the Internet backbone—enable the BMS to autonomously sense, communicate, analyze, and act or react to people or other machines in a nonintrusive manner (see figure 1).

With the cost of sensors, data storage, and connectivity all falling,⁴ we expect more CRE firms to move forward in adopting IoT applications. A recent Deloitte Center for Financial Services [study](#) suggests that IoT technology

has huge potential in CRE: In fact, sensor deployment in the sector is likely to grow at a compound annual growth rate of 78.8 percent between 2015 and 2020 (see figure 2 and appendix 1–2) to nearly 1.3 billion.

Using such sensors, the IoT promises to turn any object into a source of information about that object and its environment. This creates both a new way to differentiate products and services and a new source of value that can be managed in its own right. Realizing the IoT’s full potential motivates a framework that captures the series and sequence of activities by which organizations create value from information: the Information Value Loop (see figure 3). In the CRE context, the value created from the information generated by IoT-enabled buildings has the potential to widen the lens on value creation beyond location through a level of efficiency and effectiveness that could distinguish buildings within a marketplace from a desirability and profitability standpoint.

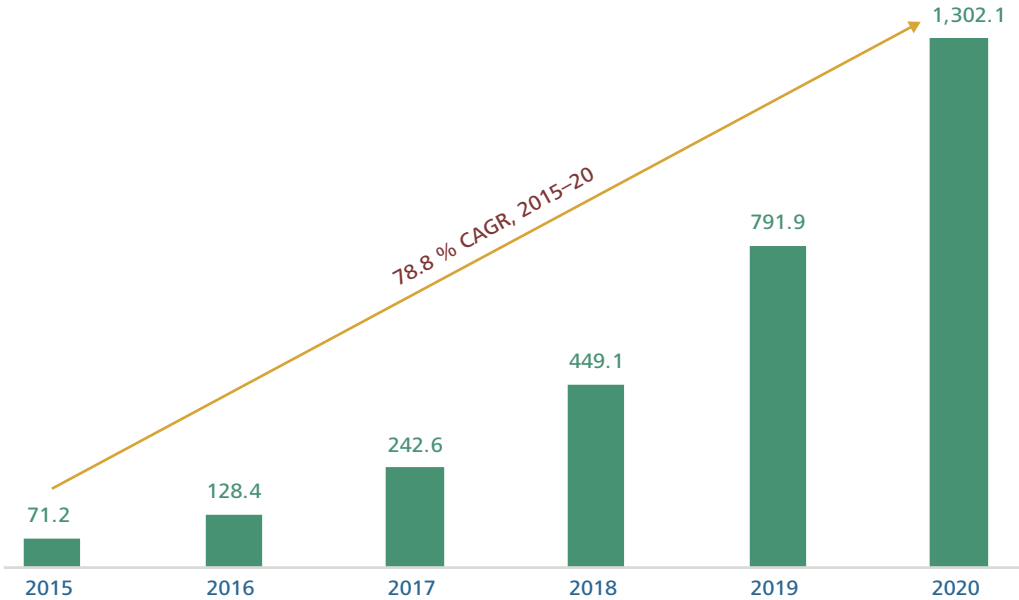
Figure 1. IoT information value stack for CRE buildings



Source: Jim Young, “BioT—BUILDING Internet of Things™,” Realcomm, January 23, 2014; Deloitte Center for Financial Services analysis. *HVAC refers to heating, ventilation, and air-conditioning.

Graphic: Deloitte University Press | DUPress.com

Figure 2. Potential growth in worldwide IoT sensor deployments for CRE (2015–20), millions



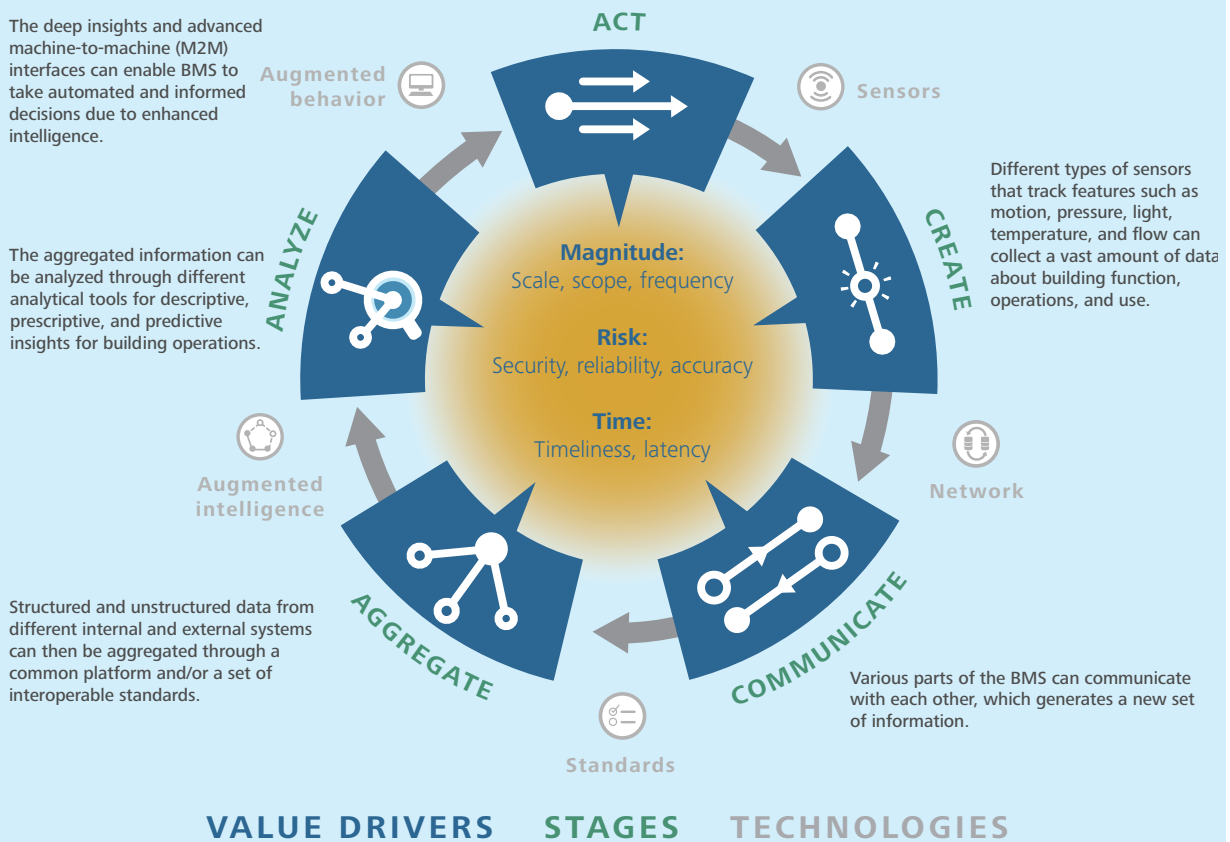
Source: Chart created and analysis performed by the Deloitte Center for Financial Services based on Gartner research: “Forecast: Internet of Things, endpoints and associated services, Worldwide, 2015,” Gartner Inc., October 29, 2015. For more information on categories and sensor types included in the graph, please refer to appendix 1.

Graphic: Deloitte University Press | DUPress.com

THE INFORMATION VALUE LOOP

For information to complete the loop and create value, it passes through the loop's stages, each enabled by specific technologies. An *act* is monitored by a sensor that *creates* information, that information passes through a network so that it can be *communicated*, and *standards*—be they technical, legal, regulatory, or social—allow that information to be *aggregated* across time and space. *Augmented intelligence* is a generic term meant to capture all manner of analytical support, collectively used to *analyze* information. The loop is completed via *augmented behavior* technologies that either enable automated action or shape human decisions in a manner leading to improved action.

Figure 3. CRE Information Value Loop



Source: Deloitte Center for Financial Services.

Graphic: Deloitte University Press | DUPress.com

In the CRE context, different types of sensors that track features such as motion, pressure, light, temperature, and flow *create* a vast amount of data around building operations and the environment. This information passes through a *network* such that various parts of the BMS *communicate* with each other and the vast set of structured and unstructured data can be aggregated on a real-time basis at a building, portfolio, and even metropolitan level. The aggregated information can be analyzed using different tools to develop descriptive, prescriptive, and predictive insights for building operations teams (both landlords and tenants). The loop is completed when the BMS demonstrates *augmented behavior* in the form of increased automated actions related to monitoring and tracking, among other things, or influencing human decisions for both the landlord and tenant.

The amount of value created by information passing through the loop is a function of the value drivers identified in the middle. Falling into three generic categories—magnitude, risk, and time—the specific drivers listed are not exhaustive but only illustrative. Different applications will benefit from an emphasis on different drivers.

The uses of the IoT

Far beyond motion-sensor lighting

FOR CRE executives who have long looked to automate building maintenance activities, all the IoT hype may sound inflated: Is this just a new buzzword for old practices? But it may not be. Yes, CRE companies have been installing sensors and automating activities for some time, primarily aiming to realize the benefits of low-hanging fruit such as cost savings and operational efficiency through improved energy management and reduced personnel costs. Figure 4 depicts approaches to developing a connected BMS, each progressively more connected and integrated than its predecessor.

Individual BMS: Typically, CRE owners install BMS on a piecemeal basis to automate individual tasks such as elevator or lighting control;⁵ not surprisingly, owners then must collect and aggregate data from various places (see figure 4).

Partially integrated BMS: Realizing the limitations of individual BMS, more mature CRE companies have begun using partially integrated BMS,⁶ combining automation of a few activities with a common focus, such as energy management systems. Compared

with individual BMS, these systems are more integrated, require less manual intervention, and enable faster decision making. More importantly, CRE owners use these systems to enhance tenant and end-client experience through sustainability initiatives (including to support LEED and other green building certification standards), open Wi-Fi access, and so forth.

Fully integrated, IoT-enabled BMS: In sharp contrast, a CRE company's IoT-enabled systems can be fully integrated BMS, allowing higher-order cost, productivity, and revenue benefits with a deep customer and data focus. It can leverage one infrastructure to operate all building management solutions and require minimal to no manual involvement. Internet protocol or IP-enabled devices can facilitate intelligent decision making by automating point decisions and enhancing strategic insights; this allows data to automatically flow all the way around the Information Value Loop without manual interaction, enabling quick action on the data and creating new value for CRE companies.

The way in which IoT-generated information creates value represents a fundamental shift for CRE companies. In creating value through information generated by connected systems, IoT applications can not only improve efficiency but provide new opportunities for differentiation and even new revenue. CRE companies can do this by implementing full sustainability programs with supportive analytics, a deeper focus on tenant and end-client relationships and experiences (footpath

technologies that assess shoppers' movement patterns in a mall through signals from their cellphones), or even enhanced revenue-generating services to tenants (infrastructure, analytics, and so forth).

With so many options, determining which is right for a particular CRE company requires understanding exactly how IoT technology can create value for them and their tenants as well as the latter's end users.

Figure 4. Difference between building automation and IoT applications



Source: "Building automation prepares for the Building Internet of Things (BioT)," Memoori, May 1, 2014; Deloitte Center for Financial Services analysis.

Graphic: Deloitte University Press | DUPress.com

Where the value is

Leveraging IoT data

GIVEN the current focus on costs and margins, CRE companies may be predisposed to seek to improve margins first through tried-and-true methods of cost savings and operational efficiency, rather than connectivity. But IoT applications offer more possibilities to build upon those efficiencies, enabling CRE companies to use data generated through connected systems to differentiate their services and identify new revenue opportunities.

Creating value through efficiency

With BMS already firmly established in the CRE sector, it is perhaps no surprise that many of the initial uses of IoT technology help CRE companies by increasing efficiency through enhanced building performance and better portfolio and liquidity management.

Enhanced building performance

IoT-enabled BMS can be used to reduce energy use, repair and maintenance, and administrative costs. For instance, property owners can use the data collected by motion and occupancy sensors at a building level to regulate air-conditioning and lighting in real time, thereby reducing energy costs and optimizing the internal environment for its

intended purpose. CRE companies can also offer clear value to tenants, since the system could lead to lower energy bills. According to Bettina Tratz-Ryan, research vice president at Gartner Inc., “Especially in large sites, such as industrial zones, office parks, shopping malls, airports or seaports, IoT can help reduce the cost of energy, spatial management and building maintenance by up to 30 percent.”⁷

The continuous monitoring and predictive capability of IoT-enabled buildings can also preempt a repair or maintenance issue by enabling a building manager to take appropriate corrective action before tenants even notice a problem. According to a Johnson Controls survey of the company’s Building Efficiency Panel, 70 percent of respondents believe that the ability to predict and diagnose problems and provide or propose solutions will be a “game changer.”⁸

IoT-enabled buildings can alleviate security concerns for both owners and tenants. Real-time monitoring can bolster internal security, and specialized weather sensors provide advance warnings of adverse weather events.⁹ As the frequency and severity of hurricanes, floods, and tornadoes increase under a changing climate, so too does the value of disaster preparedness and resilience.

Better portfolio risk management and liquidity

Enhanced tracking and monitoring at a building and portfolio level, along with use of portfolio analytics, can result in lower asset risk, more granular valuations, and enhanced portfolio management capabilities. For example, tracking the flow of people can enable CRE owners to analyze occupant behavior and space usage patterns, while acknowledging privacy limitations. This information may help them identify excess capacity and develop action plans for peak hours, ultimately resulting in more efficient portfolio management.¹⁰

In a crowdsourced simulation exercise conducted by Wikistrat on behalf of the Deloitte Center for Financial Services, one of the scenarios suggested that CRE valuations can factor granular and secure information about which buildings contribute to tenants' employee productivity (see appendix 3). This can be done through data from IoT devices such as smart electric boxes, plumbing and water usage sensors, thermal efficiency recorded by smart thermostats, maintenance and usage information from common areas and elevators, and measurements of human "collisions per hour per square meter." Combining such information with data related to the surrounding environment can result in more accurate and dynamic valuations.

Separately, the same technology can also boost customers' ability to find and choose CRE properties. Several tech startups are automating brokerage and leasing tasks and activities, openly sharing CRE pricing and valuation information, lowering barriers between potential tenants and CRE owners.¹¹ Now, brokers can add information generated and analyzed through IoT sensors, opening up new possibilities. Wikistrat's crowdsourced simulation exercise suggests that if such information is exposed to a public marketplace, it will likely enhance transparency, create a liquid trading

market, and reduce friction in the leasing and buying processes. Potential buyers could see not only static data about price and valuation but also real-time area data about traffic, crime, or other real-world factors that impact property values. For real estate investment trusts (REITs) in particular, this development would improve their ability to understand and profile risks on an individual asset basis, opening the opportunity to sell or swap assets to rebalance portfolios. Conversely, it may also empower tenants to have more informed negotiations at rent review. Some panelists from our crowdsourcing simulation also highlighted the creation of a new generation of REITs based on standardized risk profiles of a REIT's underlying assets or sophisticated arbitrage operations as other future scenarios.

Creating value through differentiation

With the amount of connectivity and data generated by IoT-enabled buildings, CRE owners have an opportunity to differentiate themselves by using the information to identify unmet consumer demands, provide more sophisticated services to their tenants and transform tenant and user experience, and contribute to the broader ecosystem. By offering services their competitors as yet lack, CRE companies using IoT applications in this way could charge premium prices and improve margins. In fact, tenants will likely soon come to expect IoT features, meaning that a building lacking them may trade at a discount. Some of these opportunities include:

- Focus on employee and occupant health and productivity
- Service innovation to tenants
- Benefits to the broader ecosystem

Focus on employee and occupant health and productivity

The potential impact of IoT applications is hardly limited to machines—it can also track and help to improve employee and occupant health and productivity. In addition to enabling predictive maintenance, wearables such as smart glasses can combine IoT technology with augmented reality to provide prompt information and guidance to workers in the field, particularly during the construction stage.¹² Further, as the technology advances, sensors will likely be able to help CRE companies capture data on occupant health—assuming the occupants are amenable.

Combining BMS-captured environmental data (temperature and air quality) with movement data from motion sensors and other sources could allow CRE companies to understand the optimal ventilation and temperature levels for a specific day. The buildings' HVAC and lighting systems can make necessary adjustments in ventilation and space conditioning and provide a healthier environment for occupants.¹³ And data about the movement of individuals through open spaces can help tenants boost the productivity of workers by better designing tasks and breaks to facilitate collaboration and even socializing between employees.

Service innovation to tenants

Fierce competition and changing patterns in consumption and work are forcing companies in many sectors to reevaluate their CRE space usage as they look for innovative ways to cut costs and derive value. Many companies now continuously resize their CRE requirements to adapt to lower demand for physical space. The retail sector is a classic example of

this trend, as online sales growth is eroding demand for physical stores: Analysts expect 50 percent of American malls to close by 2030.¹⁴

The strategic importance of CRE space in a company's business plan and the resultant shrinkage in demand are pushing CRE owners to think harder about predicting demand and using newer ways to attract and retain tenants.

CRE owners can use IoT data to create differentiation right from the development stage. Developers can adapt design and construction of CRE buildings to the changing consumption patterns such as combined “live/work/play” by using tenants' and end-users' behavioral data.¹⁵

Further, information from IoT-enabled buildings will potentially enable existing and potential tenants to make smarter site location decisions and differentiate themselves. For example, AirSage, a location-based service provider, collects real-time location data for billions of mobile devices each day.¹⁶ The company aggregates and analyzes anonymous wireless signaling data to provide insights on movement and flow of traffic and consumer behavior.¹⁷ This information, combined with socio-demographic information on population and job growth, crime, pollution, noise, and climate patterns, should result in better-informed decision making.

These are just a few examples. Since IoT-generated information varies with physical location, the technology's uses can similarly change by type of property. To help illustrate the wide variety of possible IoT uses in differentiating CRE companies, the graphic on the following pages shows a number of examples broken down by property type.

IoT service innovation for tenants and their customers

COMMON BENEFITS TO ALL PROPERTY TYPES



Lower operating costs such as lower energy bills



Improved health and productivity benefits for occupiers



Tighter security due to real-time surveillance and faster emergency response systems



RETAIL

MULTIFAMILY

OFFICE

INDUSTRIAL

RETAIL

Service innovation opportunities through IoT

- Draw key insights around preferences and decision-making behaviors of end consumers, such as identifying 'buyers' and 'browsers' by using footpath technologies.
- Provide smart offers and enhanced information on parking availability using mobile phones and beacons based on knowledge about end-customer location and condition.

Use case

- Simon Property Group is investing in iBeacon™ location and proximity detection technology to help retailers enhance the in-store shopping experience and take personalized shopping to the next level. Using location data, iBeacon™ enables personalized marketing, indoor navigation, automatic check-in, and contactless payment.

Illustrative usage view



MULTIFAMILY

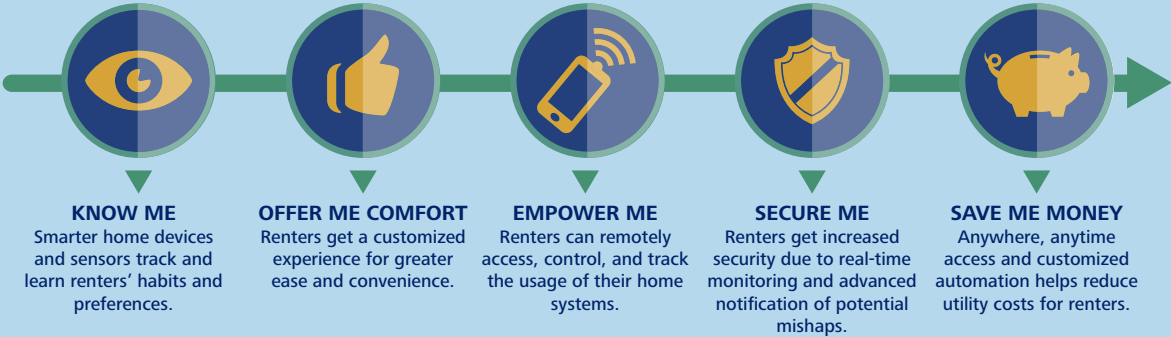
Service innovation opportunities through IoT

- Improve space design and tenant experience by using insights captured through smart devices and sensors on personal habits such as consumption, health stats, movement, etc.
- Provide preemptive maintenance and automated maintenance request management and enable renters to remotely customize and personalize their home environment through IoT-enabled appliances.

Use case

- Real estate developer Capstone Partners has teamed up with IoT startup IOTAS to offer smart home environment for renters at Grant Park Village apartments in Portland, OR. Apartments have installed different sensors, smart outlets, and switches in every room to be able to monitor different aspects such as temperature, humidity, lights, motion, and water flow. Systems track the habits and preferences of the dwellers and enable renters to create rules to customize their home environment from anywhere and at anytime through a mobile app, thereby increasing convenience and lowering energy bills

Illustrative usage view



OFFICE

Service innovation opportunities through IoT

- Increase staff convenience by designing more comfortable and customizable workspaces, backed by insights on staff interaction and movement, captured through sensors.
- Help improve workplace efficiency and employee productivity by automating redundant tasks, such as swiping access cards at several places, and providing a healthier work environment, respectively.

Use case

- Deloitte's Amsterdam office building uses connected lighting systems backed by Power-over-Ethernet technology that allows transmission of data along with power. The smart lighting increases convenience for the staff by enabling them to customize the brightness of surrounding lights through their mobile devices. In addition, sensors embedded in the lights track air quality, temperature, and humidity to help maintain a healthier atmosphere.

Illustrative usage view



INDUSTRIAL

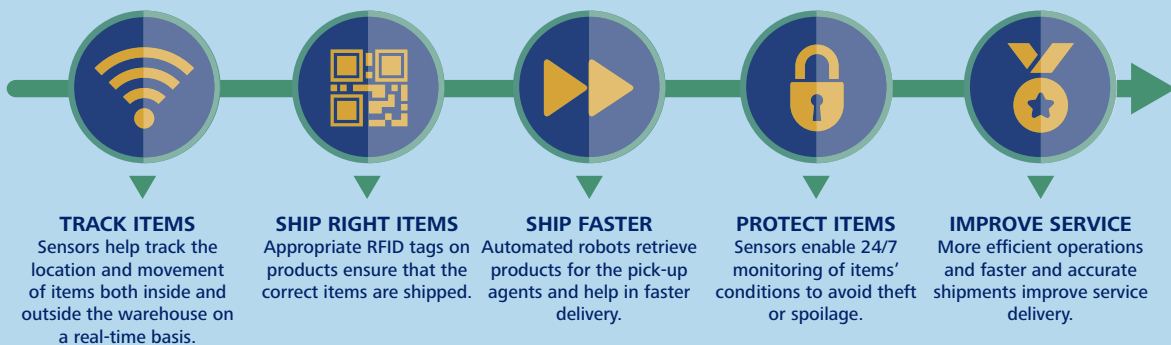
Service innovation opportunities through IoT

- Enable faster shipments by using automated pick-up process through IoT-enabled cart-like robots.
- Ensure accurate shipments by meticulously tracking the complex chain of movements of items across large warehouses.

Use case

- Lids, an Indianapolis-based fashion retailer, uses cart-like robots which wirelessly receive a list of items to be shipped. The robots then fetch the items from the storage racks and help the workers to efficiently manage each shipment. All the details around the movement and condition of items and preparation of shipments are tracked through sensors by a centralized remote monitoring unit. This not only enables the firm to effectively manage the items stored, but ensure accurate and faster shipments from the warehouse.

Illustrative usage view



Source: Deloitte's IoT Reference Architecture; Simon Property Group, "Simon and Mobiquity technologies to expand iBeacon network nationwide, creating opportunity for new level of connection between shoppers and retailers," August 4, 2014; IOTAS company website; Gizmag, "[Deloitte's new Amsterdam HQ has connected sensor-packing LED lighting](#)," July 28, 2014; SupplyChain24/7, "Enter the smart (Internet of Things) warehouse," July 5, 2015; Deloitte Center for Financial Services analysis. Note: *Smart buildings: How IoT technology aims to add value for real estate companies* is an independent publication and has not been authorized, sponsored, or otherwise approved by Apple Inc.; iBeacon is a trademark of Apple Inc.

Benefits to the broader ecosystem

The IoT's interconnected nature means that the value of the collected data is not limited to CRE and tenants—companies can link to the broader ecosystem as well. Connected buildings can drive meticulous tracking of information on sustainability initiatives related to energy, water, and waste management and boost efforts to reduce the impact of climate change. Further, sustainability analytics can help CRE companies decrease their carbon footprint, have more sustainable properties in their portfolio, and eventually differentiate themselves in the marketplace.

In the case of energy, increased IoT adoption can imply more detailed and real-time

monitoring of all devices that consume energy in a building and better connectivity with the smart grids.¹⁸ This would allow power utilities to enhance the efficiency of energy distribution and conservation.¹⁹

Likewise, in the case of water, different sets of information (such as lower rainfall and pipeline burst) can potentially help buildings identify possible supply shortages and better plan their usage and overall water conservation.²⁰ For waste management, sensors in smart trash bins can communicate volumes to help collectors optimize pick-up timings and appropriately plan disposal of different forms of waste.²¹

Creating value through new revenue sources

While creating value through new revenue sources is likely a longer-term prospect, CRE companies can perhaps offer analytics-as-a-service. This essentially means that companies can combine, analyze, and present insights from the large sets of data in a manner that tenants or other stakeholders can purchase and augment their actions and behavior. As

an example, data on people moving within a building can potentially be sold to advertisers or urban planners to help them in their decision making. In another example, retail real estate owners can capture and analyze end-customer demography, purchase, and movement data and sell it to their tenants. CRE companies can likely sell building performance information to institutional investors to allow them to make informed investment decisions.

Companies can combine, analyze, and present insights from the large sets of data in a manner that tenants or other stakeholders can purchase and augment their actions and behavior.

Value capture

How to maximize IoT value?

IoT technology offers many potential benefits, but its implementation largely remains in its infancy. At issue are the bottlenecks that limit the flow of information and therefore reduce the applications' value to CRE companies. A bottleneck is characteristically seen as a bad thing—a limiting factor in an otherwise smooth, even flow²²—but in the value loop, it is also an opportunity for the company that removes that bottleneck, because in creating new value for all, the company can capture a large part of that value for itself.

The bottleneck in any flow is going to depend on what is flowing and under what circumstances. Therefore, much as we see IoT technology creating three categories of new value in CRE, there is a different bottleneck in each case, as well as cybersecurity and privacy issues that cut across all, as table 1 illustrates:

We believe CRE companies will likely have a competitive edge if their IoT strategy ameliorates the bottlenecks and optimizes the use of the large sets of structured and unstructured information that various value loops create.

Technology integration and interoperability

To achieve the fully integrated BMS with all of its promises for increased efficiency, IoT applications must bring together many diverse types of data from many different sources. In terms of the Information Value Loop, the bottleneck exists at the *aggregate* stage.

The dynamic and continuously evolving IoT technology presents ongoing challenges. For instance, a lack of industry standards and benchmarks hampers communication among

Table 1. Bottlenecks and key challenges to value capture

Value to CRE	Bottleneck	Key challenges
Efficiency	Aggregate	Technology integration and interoperability
Differentiation	Analyze	Ability to leverage the data created by IoT-enabled buildings
New revenue	Act	Visualize and display data to customers
Cybersecurity & data privacy		

Source: Deloitte Center for Financial Services.

different competing and legacy IT systems. Many of the individual BMS use their own standards leading to multiple protocols; in a 2014 survey, for almost half of respondents, 50 percent of their building retrofit projects involve multiple protocols that do not communicate with each other.²³

Another challenge revolves around sensor owners ceding control to users so different sensors can talk to each other. Also, many times, system integration is a low priority, as companies—particularly at the building design phase—often emphasize lowering initial costs over collaboration.²⁴ CRE companies can consider the below approaches to improve technology integration and interoperability:

- **Develop advanced mobile computing capabilities:** CRE companies will likely benefit from developing a flexible mobile application platform that can integrate new IoT information tracking and capture requirements.
- **Use appropriate integration software and platforms:** Owners of existing buildings can consider buying specialist software solutions that integrate siloed and disparate building systems and improve interoperability. Likewise, owners of new buildings should consider adopting the latest integrated IoT platforms.
- **Use common standards and protocols:** Gradual consolidation of different BMS protocols will help develop benchmarks that facilitate full use of IoT technology. OASIS Open Building Information Exchange is one global industry-wide effort aiming to define standard web protocols for communication between various BMS.²⁵ Ultimately, players must agree on benchmarks to increase interoperability even among systems used by different industries.

Ability to leverage data created by IoT-enabled buildings

If a CRE company wishes to use IoT applications to do more than improve efficiency and offer tenants new products and services, it must overcome a different hurdle: analyzing the vast volumes of data that applications generate and finding insights there. The volume and types of data make this analysis difficult: Most CRE legacy systems can handle structured data, but increasingly, IoT data are unstructured²⁶—indeed, unstructured data are growing at twice the rate of structured data and already account for 90 percent of all enterprise data.²⁷ In addition, data collected from multiple devices come in different formats and at different sampling rates—that is, the frequency at which data are collected.

CRE companies also would need to identify data that are truly useful. According to IDC, machines will produce 10 percent of global data by 2020, with the volume of useful²⁸ data produced increasing to over 35 percent, from 22 percent in 2013.²⁹ CRE companies can use appropriate data structuring and analytics tools to alleviate this bottleneck at the *analyze* stage. This allows CRE companies to differentiate their properties and potentially charge premium prices that can give some breathing space from thin margins.

Beyond this, the transition to using IoT applications to generate entirely new revenue streams comes with its own unique challenges. While advertisers and others may value data illustrating how people move through a space, CRE companies would need to have appropriate data-provisioning capabilities to *act*—that is, offer the data to various stakeholders in the ecosystem.

How can CRE companies leverage the data created by IoT-equipped buildings? CRE companies may want to focus on developing information management and data analytics capabilities, focusing on areas such as:

- **Developing advanced data aggregation and processing capabilities:** CRE companies can consider using advanced big data tools to aggregate large data sets—both structured and unstructured—and process them in multiple ways.
- **Building a flexible platform:** CRE companies should consider building flexibility into the platform that will collect and exchange the building data in the value loop, as the continuous evolution of data standards may render prior platforms obsolete.³⁰
- **Gaining technical skills:** As companies adopt big data tools, their existing talent pool may lack the requisite skills to use them, so they are likely to benefit from retooling existing employees or hiring new specialized talent to aggregate, analyze, and manage the data.

Cybersecurity and data privacy

Increased interconnectivity and data capture enhances cybersecurity and data privacy concerns at every stage of the Information Value Loop. The challenges of cybersecurity and privacy are hardly new, but they are heavily magnified in an IoT-connected world.

The more the number of IoT-enabled devices and the greater the interconnectivity between various building systems, the more detailed and sensitive the data that will be captured. This is likely to broaden the attack surface for hackers,³¹ who would have more avenues to cause financial and reputational damage and even loss of human lives.³² Some recent data breaches show the extent of financial and reputational damage to the tenants from cyber intrusions through building systems, even when buildings are partially integrated. According to IDC forecasts, 40 percent

of the information in the digital universe requires some level of protection, but only half of that data—just 20 percent—is protected.³³

What can CRE companies do to minimize the security and privacy risk that IoT technology presents? They can make several moves to become secure, vigilant, and resilient, as detailed in Deloitte's *Safeguarding the Internet of Things* report, the source of the following steps:³⁴

- **Use purpose-built devices or add-ons, rather than pre-IoT solutions:** Rather than retrofitting or extending functionality of old systems in ways for which they weren't designed, companies should strongly consider wholly new, secure BMS designed specifically for the IoT.
- **Develop clear responsibilities for the players in your ecosystem:** Rather than sharing responsibility across a diffuse ecosystem, players should understand and define where their responsibilities begin and end, and what they are responsible to protect.
- **Establish a baseline of data:** Viewing IoT systems more broadly and monitoring environmental attributes such as usage, location, and access could better enable enterprises to gather a broad enough scope of data to establish a baseline, helping companies to discern what is normal and what constitutes a suspicious aberration.
- **Institute data governance:** Enterprises should consider playing a stronger governance role by defining which data to secure, what it means to be sufficiently secure, and, by extension, which products meet that goal. Guidance around how data can be securely collected, used, and stored can help prevent unwanted breaches.
- **Create loosely coupled systems:** Ensure devices within an ecosystem are loosely coupled and resilient so that the failure of one device does not lead to widespread failure.

Location, information, analytics or location, location, location?

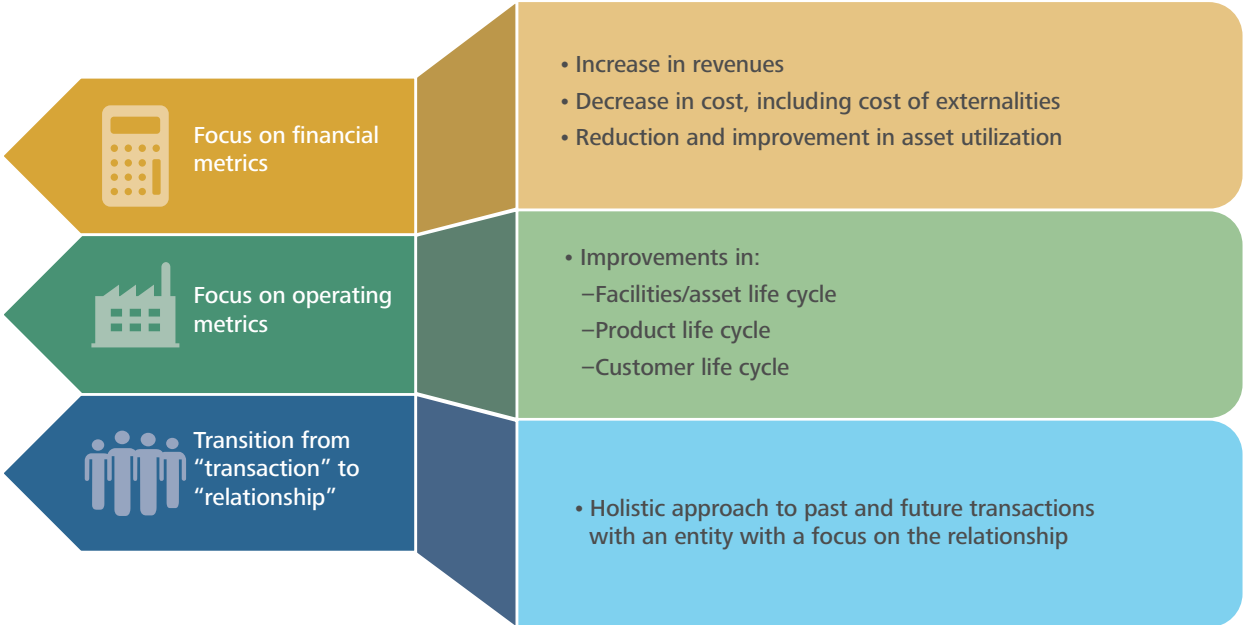
CRE owners should acknowledge that IoT technology is not just another fad. Over time, there is potential for the information generated by IoT-enabled buildings to be as valuable as the location of the physical asset.

However, it is not a question of chasing the technology but, rather, using an existing strategy to determine what a company needs: increased efficiency, greater differentiation, or new sources of revenue. That need, in turn, determines the type of IoT application that

would be most beneficial. To help identify a company’s area of need, CRE owners will benefit from using the Deloitte economic value framework (see figure 5) to help identify the right type of IoT application for them and find ways to monetize their IoT investments.

This apart, from an implementation perspective, our broader FSI paper [*The derivative effect: How financial services can make IoT technology pay off*](#) highlights that early

Figure 5. Economic value framework



Source: Deloitte.

Graphic: Deloitte University Press | DUPress.com

experimentation, building off of existing deployments, will help firms with a “test and learn approach.”³⁵ Beyond that, firms could start with the assumption that every single object in the day-to-day lives of both customers and employees will be able to capture and share data. From that starting point, take an “art of the possible” approach by identifying the potential opportunities these new data streams could create for them. Indeed, they could consider going beyond test-and-learn and instead take an approach that embraces the notion of “learn fast, fail fast.”

To sum it up, as per Industrial Internet Consortium executive director Richard Soley: “Don’t wait. Begin collaborating with others to build prototypes and create standards. And be prepared—your IoT initiatives will likely be tremendously disruptive. We don’t know exactly how, but we do know this: You can’t afford to ignore the Internet of Things.”³⁶ Location is never going away, but with the IoT, the future of CRE just may be in *location, information, analytics*.

Appendices

Appendix 1. Potential use case and IoT sensor types for CRE players

Business use	Sensor category	Sensor types
Building owners and investors	Building management	Smart trashbins, pest control traps, HVAC, thermostats, lighting, smoke/CO sensors, structural health monitoring systems, motion sensors, security gateways, utility meters, and smart building appliances

Source: Deloitte Center for Financial Services analysis.

Appendix 2. Methodology 1

Analyzing a sensor-deployment forecast

In aiming to assess the scope of the IoT's near-term impact on CRE, we used the Gartner forecast as a starting point and took the following steps to generate the numbers used in this section of the report:

- Reviewed more than 200 types of sensors in the forecast and assessed their resulting information's potential value to CRE companies
- Interviewed senior practitioners within Deloitte to gather their views and input on potential use cases
- Categorized the detailed list of sensor types and potential use case for CRE players (see appendix 1)
- Developed sensor deployment numbers and growth rates for these use cases

Our analysis is meant to be illustrative rather than exhaustive, with the goal of exploring the IoT's possibilities and limitations for CRE companies between now and 2020.

Note: The CAGR for CRE installed base used in this report is based on updated estimates and hence differs from our broader FSI report *The derivative effect: How financial services can make IoT technology pay off* published in October 2015.

Appendix 3. Methodology 2

About the crowdsourced simulation exercise Wikistrat conducted on behalf of the Deloitte Center for Financial Services

The project, fielded during July 2015, involved more than 50 analysts across 20 countries. These analysts had varied backgrounds, including technology entrepreneurs; business and technology leaders within the financial services industry; academics with doctorates in economics, business, and technology; analysts in government and research centers; and cybersecurity consultants.

The project was designed to explore the IoT's long-term potential in the financial services industry (FSI), including CRE. Wikistrat tasked analysts with developing a series of use cases within six specific industry sectors, and with forecasting and describing the opportunities and challenges that IoT technology presents.

They followed a structured process that included the following steps:

- Using an online tool, analysts worked collaboratively to develop 44 use-case examples using a wiki-based template designed to identify IoT-related trends and issues, potential opportunities, and risks and challenges.
- They then provided a quantitative assessment of the probability that each use case will emerge and its overall impact or importance to the industry.
- Wikistrat and the Deloitte Center for Financial Services then reviewed all cases and probability assessments to select 10 use cases for further development.
- At a final workshop, participants reviewed and enriched the short list of 10 cases. Enrichment activities included clarification of use cases, provisioning of additional data points, reinforcing potential value for FSI, including CRE, and identification of cross-cutting themes and issues.

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