CABA™

Monetization of Intelligent Buildings

LANDMARK RESEARCH PROJECT

EXECUTIVE SUMMARY

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MONETIZATION OF INTELLIGENT BUILDINGS

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Harbor Research

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ES.1 RESEARCH BACKGROUND & INTRODUCTION

The Continental Automated Buildings Association (CABA) commissioned Harbor Research to study how new Internet of Things (IoT) technologies are changing or evolving traditional monetization models in intelligent buildings. This report seeks to understand how use cases, customer environments and buying behaviors, and evolving business models all impact the way products and solutions are monetized in intelligent buildings.

Harbor Research and the Steering Committee first convened via a webinar in April 2018, and established a regular schedule of discussion and collaboration for the duration of the project. The findings presented in this report showcase the results of primary and secondary research, including in-depth executive interviews and a broad stakeholder online survey.

The outcomes of this collaborative research project will provide a clear understanding of the monetization opportunities that can be derived from intelligent building technologies and services. Harbor Research and CABA would like to acknowledge and sincerely thank the following organizations for funding, guiding and participating in this research:

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Role of the Steering Committee

The Steering Committee represents a cross-section of solution providers in the intelligent buildings marketplace. Representatives from each company joined Harbor Research and CABA on regular collaboration calls to ensure the research scope met the project objectives. The Steering Committee plays a vital role in outlining the research product in terms of defining the required content as well in collaboration on the research approach including the development of the interview scripts and survey guides.

Each CABA Landmark Research project is directed by a Steering Committee made up of the Silver and Gold level project funders. 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's Steering Committee commission a research firm to conduct the research, while CABA provides project management and leadership.

About CABA

The Continental Automated Buildings Association (CABA) is an international not-for-profit industry association, founded in 1988, composed of over 390 major private and public technology organizations dedicated to the advancement of connected home and building technologies. These organizations include private firms involved in the design, manufacture, installation and retailing of products, as well as public utilities and governments responsible for regulations and incentives that affect home and building automation. CABA is a leader in developing collaborative research across buildings stakeholder types and encourages the development of standards that accelerate market development.

Please visit http://www.caba.org for more information.

About Harbor Research

Founded in 1984, Harbor Research Inc. has more than 30 years of experience in providing strategic consulting and research services that enable our clients to understand and capitalize on emergent and disruptive opportunities driven by information and communications technology.

Harbor Research has been involved in the development of the smart systems and IoT market opportunity since 1998. The firm has established a unique competence in developing business models and strategy for the convergence of pervasive computing, global networking and smart systems. Harbor Research's extensive involvement in developing this market opportunity, through research and consulting, has allowed the firm to engage with clients in the technology supplier community – both large and emergent players – as well as a diverse spectrum of device OEMs and services providers as well as broad end customer interactions.

Please visit http://harborresearch.com for more information.

Research Goals

The goal of this research is to examine in depth the impact that IoT technologies and the services that these technologies enable will have in the intelligent buildings market. This report will provide actionable insights and data as it relates to new and emerging monetization models and business strategies for intelligent buildings. Harbor Research has examined the opportunities provided by IoT for intelligent building stakeholders, including: building occupants; owner/operators and property managers; builders and developers; integrators and installers; technology manufacturers; equipment manufacturers; and service providers, including insurance companies, network service providers and utility companies.

To meet these goals, Harbor Research has conducted a detailed analysis about the future state of the building marketplace, including key trends, buying behaviors, technology challenges and opportunities. Case studies of IoT technologies and applications that highlight current adoption patterns in the building marketplace have been identified and the innovative players driving successful solutions have been highlighted. Top applications for IoT technologies in buildings have been examined in business cases, identifying the technical makeup of solutions and value propositions for various market participants. Within each business case, go-to-market/channel requirements are developed to highlight the role of different stakeholders in these solutions and recommendations are made for how firms should structure their organization and offerings to capture new value from smart, connected offerings.

Research Methods

The methodology for defining, identifying, and analyzing IoT technical and business opportunities followed the procedures below:

- **Review Existing Intelligent Building and IoT Research:** Review and analyze existing CABA and industry research on the intelligent building market as it relates to design and implementation, cost structure and pricing models, impacts of Big Data, technology and market development roadmaps and North America intelligent building market sizing.
- **Review Previous Harbor Research Analyses:** Review and analyze previous Harbor research on connected buildings, monetization models, building automation systems, IoT platforms, data management and analytics, and security.
- **Conduct Interviews with Thought Leaders:** Identify and organize a list of key stakeholders and conduct interviews with industry thought leaders and steering committee members.
- **Create A Foundational Framework for Intelligent Building Monetization:** Develop a framework from which the CABA steering committee and Harbor Research can collaborate.

Having identified and framed the opportunities via the above detailed process, Harbor Research performed this research by conducting parallel quantitative and qualitative primary analysis along with supplementary market research and analysis. A market survey was developed and administered with over 1,500 respondents, representing all identified stakeholder segments from the United States and Canada, including; building tenants and occupants, intelligent building operators, intelligent building owners, intelligent building developers and other key intelligent building decision makers.

The results of this survey were utilized to identify the current state of the market from an adoption standpoint, uncover the most prevalent technical barriers, adoption challenges and opportunities, reveal which IoT use cases are driving the most adoption today, and learn about each stakeholder groups' view on needs and requirements such as analytics and physical security.

Harbor Research meanwhile conducted in-depth expert interviews with 30 marketplace stakeholders to understand how technical requirements and user needs are shifting, along with how these marketplace stakeholders see product and service monetization models evolving in intelligent buildings, including differences across segments, applications, stakeholders and regions. Additional interviews (10-15) with recognized thought leaders, experts, industry associations and other sources were then conducted to verify, balance coverage and test findings in a Delphi-style approach.

Harbor Research forecasts the Intelligent Building opportunity by conducting a combination of primary and secondary research, as well as analyzing key players' financials and marketplace adoption. The 2018 addressable market of connected devices shipped and installed, and their relative annual service charge is sized based on a series of indices and metrics from market reports, industry data, company analysis and primary research. Companies' financial statements, earnings reports, subscription and licensing prices, and other metrics are used to determine revenues across revenue categories and device segments for system integrators, leading vendors and vertical specialists.

In addition, Harbor Research leveraged previous work the firm has conducted, as well as CABA research, to identify key trends, players, IoT application evolution and requirements for IoT platform architecture for commercial and institutional buildings. Case studies from real-world implementations were developed to address market direction and provide quantitative opportunity sizing for the identified applications and segments.

Report Structure

The report begins by providing a base understanding of the trends and forces driving the development of smart systems and the adoption of IoT technology across a range of building markets. The opportunities for smart systems are then examined across the buildings venue, with the variability of needs across the venue highlighted.

We then examine in-depth the intelligent buildings market, including how to frame opportunities based on building segment requirements, stakeholder and occupant personas, key enabling technologies shifting competitive dynamics and evolving buying behaviors. Trends and forces shaping the development and adoption of connected devices and services in this market are examined across technology,

competitor, customer, and socioeconomic realms. Here we also highlight the underlying elements common to all IoT solutions and point to the overall scale of smart systems opportunities within the intelligent buildings market.

Having identified the opportunity in intelligent buildings, we then discuss frameworks for intelligent building monetization and the implications for stakeholder business models, including ecosystem and technology requirements, as well as product and services positioning and messaging. These are broken down by stakeholders involved, trends and forces affecting monetization, identified success factors, and case studies of real-world implementations. Finally, the study arrives at channels to market, conclusions and implications for various monetization methods and strategies, and recommendations by stakeholder type are presented.

ES.2 SUMMARY OF FINDINGS

Introduction to Smart Systems

Peer-to-peer information, social networking and pervasive computing are combining to create new modes of collaboration and decision making. People, information, and technology are becoming more connected, distributed and pervasive, enabling the convergence of physical and virtual worlds. Social networking technologies are moving to the enterprise and will be embraced and experienced differently than in the consumer space. Network awareness will include knowledge, people and things.

These forces are forming a new trend we call "smart systems." In its simplest form, smart systems is a new generation of computing systems and information architecture that — when combined with artificial intelligence, machine learning and IoT technologies — are breaking away from today's information, computing and telecom paradigms. These new smart systems enable intelligent real-world physical systems that can be integrated onto networks, and the data from machines, sensors, video streams, maps, people, newsfeeds and much more become an integral part of all information systems. This new paradigm is driving all information systems and, more importantly, their interactions towards real-time, state-based, context-sensitive capabilities that integrate people, processes, physical equipment and knowledge to enable collective awareness and better decision-making.

The foundation of smart systems is based on leveraging embedded computing, software and networking technology to deliver smart, remotely monitored goods that will support entirely new modes of customer-device interaction and service delivery. The core platforms that inform smart systems combine new innovations in software and information architectures with data collection, aggregation, integration and management tools. These data technologies will work together in unprecedented ways to solve more complex business problems than previous generations of computing.

There are broader functional needs that are driving several important development requirements in smart systems, including:

- The rapidly rising key need for smart products to be interoperable with a growing array of applications, systems and people.
- The need for new development protocols and what we call information automation to address the growing complexity of new device data driven systems and the sheer scale of development required to bring these systems to market.
- The ability to aggregate, fuse and manage structured, semi-structured, unstructured and time series data as well as an understanding of the maturation of radically new information models and architectures that can more readily integrate classical IT capabilities with real-time, state-based devices and systems.
- Traditional buildings technology generally outlives software and information automation systems, thereby creating friction in product life-cycles. Given the steep costs of infrastructure investments and retrofitting buildings with technology, careful consideration must be paid to ensure the longevity and usefulness of intelligent building systems.

These challenges are present and take unique forms within the intelligent buildings space. For example, in the challenge of interoperability between applications, systems and people, users consist of tenants, consumers and operators, each of which have their own requirements. Applications will be designed to optimize existing systems as operators need to meet new operator efficiency protocols. Some forward-looking and well-funded operators and some commercial building segments will be more advanced than simply retrofitting existing systems and provide their end-users with immense upgrades. Smart systems in intelligent buildings are entering a dynamic period with emerging solutions across all segments that will result in OEMs, technology suppliers, third-party value adders, and users needing to react, and monetize, emerging technologies in different ways.

Intelligent Buildings Market Overview

The intelligent building systems market is poised to enter a new period of transformation based on the availability of low-cost, wireless IoT technologies and new services offered through innovative business and monetization models. This market is experiencing a confluence of IoT data platforms, and a range of market players are trying to determine how to capture these emerging revenue streams and drive monetization from new services. The combination of available technology with business architectures designed to support these new offerings has the potential to unleash a significant wave of disruption and new value in this evolving arena.

The nearest steps towards enabling intelligent buildings is integrating connectivity and sensor networks across systems and assets such that stakeholders achieve greater operations visibility and control. The subsequent hurdle and area of opportunity is integrating disparate assets and systems through a unified platform solution. The confluence of connectivity, sensing and software will create a holistic view of physical intelligent buildings systems, in which the next phase of complex applications can evolve. Each step in the evolution of building intelligence implies certain business models and ecosystem strategies that will facilitate monetization of smart building products and services.

Emerging intelligent buildings provide a distributed control and information system that enables networks of intelligent devices to monitor and control the mechanical systems in a building, while integrating data from existing building systems. These solutions are enabled by a new class of software tools and data frameworks that allow data to be aggregated from across the fractured vendor ecosystem. Advanced data management, analytics, AI and machine learning algorithms applied to integrated datasets are identifying and capturing new efficiency gains from building systems. These new technologies and use cases are not only changing the way that buildings stakeholders operate, but also how they co-operate.

This technology shift has fundamentally changed how intelligent buildings solution providers must address the market from a holistic product and solution standpoint. Despite all the excitement and hype created around IoT and intelligent buildings, service providers have to overcome a range of challenges to realize the full value of IoT in the near to medium term. Some of the major challenges include: the development of new growth opportunities that leverage data from IoT-enabled buildings; interoperability; cybersecurity; data ownership; customer needs; building a portfolio of IoT products and services for vertical markets; and monetization models for these products and services.

Ultimately, the common denominator across the adopter base is the desire to maximize both end-user satisfaction and efficiency of building system operations and management. Building managers and tenants alike stand to benefit greatly from increased building system networking and have traditionally applied automated systems to HVAC, lighting, power devices, security and fire and life safety systems. Forward-looking building managers are seeking cost-effective means for better coordination of traditional systems while linking to other systems, such as external lighting or parking systems that have historically been operated in a stand-alone mode.

Finally, the inherent nature of networked intelligent building products and services is unlocking a multitude of new ways for suppliers to design business models and more effectively monetize the solutions that they are providing. As these intelligent and networked devices create and share data,

numerous new business models emerge that involve partnerships and other ecosystem maneuvers that would not be possible in previous building technology generations.

Creating diverse ecosystems is just one of several trends impacting the intelligent buildings space. Below we highlight the four types of trends and forces that impact smart systems in intelligent buildings, each necessary to understanding the evolution of the space and the future of its solutions, pain points and monetization strategies across different user bases.

Overarching Forces & Impacts

Today's building managers, operators and owners are seeking cost-effective and easy-to-use tools that coordinate the operation of traditional building systems with newly connected IoT systems. As these end-customers mature, they are increasingly asking what value-added services they can enable with their IoT data. Gathering data and storing it in the cloud is not enough; new use cases such as predictive maintenance and operations visibility require tightly integrated systems that look nothing like the disparate building spaces that they manage and occupy today.

Monetization models in particular present a challenge for intelligent building stakeholders. Traditionally, bundled equipment, software and services contracts have been sold to major buildings customers via a largely unchanged model. This has been the case since automation reached the buildings venue. Now, everything is changing. IoT technologies have created the opportunity for new services and products to be deployed in intelligent buildings, but ensuring that these solutions address customer needs, while also opening new revenue streams for solution providers is a challenge that has not yet been properly addressed across the market.

Most solution providers today do not know how monetization models should integrate with their overarching IoT business model, or how to properly position monetization models in the context of customer buying behaviors, top use cases, or unique market sub-segment requirements. There are also major challenges associated with finding the appropriate solution packaging, pricing and selling models that will bring new IoT-enabled solutions to the intelligent buildings market. This has resulted in market confusion; end-customers do not know what they are getting for their money, solution providers do not know what end-customers are willing to pay for or how offerings should be priced, packaged and deployed. Just as IoT technologies have led to a fundamentally new approach for how buildings are monitored and managed, a new approach to monetize IoT products, software and services is now required.

Figure ES 1 Overarching Forces & Impacts

Source: Harbor Research

Vendors that have been targeting these market sub-segments with BMS offerings for decades are transitioning beyond a focus on HVAC, energy systems and lighting control and into broader IoT integration. This transition has been driven by a wide range of trends and forces that are impacting the intelligent buildings market. Whenever Harbor Research considers the trends and forces having an impact on any market, four types of trends are taken into account: Technology, Customer (technology adopter), Competitive (technology supplier), and Socioeconomic. These four trend types help to paint a picture of the market that includes all relevant dimensions.

Technology Forces & Impacts

Technological advances have been key in enabling the shift from basic building automation and management systems to integrated intelligent building systems. Chief among these are processing and data management innovations, which are accelerating development of distributed computing architectures. While standard communication protocols, such as BACnet and LonWorks have gained significant traction, organizing around standardized data formats has been less successful and remains an impediment to enabling complex applications without unduly burdening users with complicated device interactions. Innovators seek to address the challenges posed by the fragmented equipment supplier market with software advances across the tech stack, from networking and application deployment to device communications and application enablement.

Competitive Forces & Impacts

Evolving customer expectations are reshaping the competitive landscape, forcing suppliers to prioritize user-centric design with open, end-to-end systems and services. This shift is challenging not only technical solution design but legacy business models and channel structures as well. Incumbent firms seeking to innovate have pursued both organic developments and external maneuvers, especially flexible and open-ended collaborations with start-ups. The shift towards collaborative development, however, is met with new challenges that require companies to fundamentally rewire foundational elements of their organization.

The slow pace of change by entrenched vendors has invited a range of new market entrants into the buildings venue, including utilities and energy management players, carriers and cable providers, security and insurance providers, and consumer electronics and specialized connectivity hardware providers. Successful vendors are adopting start-up mindsets, prioritizing agility and process differentiation rather than relying on differentiation of static products.

Customer Forces & Impacts

Although customers are increasingly interested in what intelligent buildings offer, buying behaviors are strongly influenced by the mission-critical nature of the building and has resulted in uneven adoption across verticals. As building systems become cheaper and easier to integrate, end-users in both mission-critical and non-mission-critical segments are pursuing new and expanded applications rather than focusing solely on HVAC, energy management, or fire and security.

Across verticals, building operators and end-users are seeking the highly-personalized level of services that they have come to expect from tightly integrated consumer electronics offerings, challenging vendors of point solutions to expand the scope and capabilities of their offerings.

Socioeconomic Forces & Impacts

Increased government activity and the variable cost of energy both have significant impact on the intelligent buildings market. Energy trends and regulatory standards can support or constrain demand across the entire market. For instance, the European Union, where many are deeply concerned about energy security and climate change, has set the bar very high for member countries. By 2020, member states must have building codes in place requiring that all newly constructed buildings consume roughly 30-40 percent net renewable energy. This is a significant driver in building automation adoption.

These types of trends and forces impact certain segments of the market differently than others. For example, customer comfort and highly personalized levels of comfort will impact segments such as retail much more than it will impact commercial buildings, as many of these operators are simply seeking efficiencies in existing systems. A combined understanding of general trends and forces, as well as each segment of the intelligent commercial buildings space, allows us to piece together a picture of the future of smart systems in buildings.

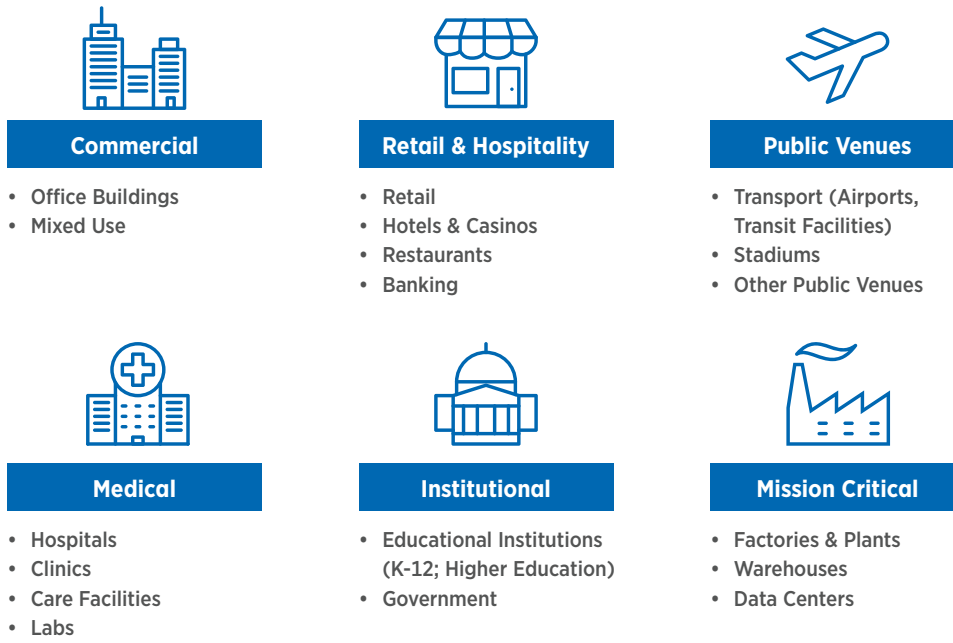
Intelligent Buildings Market Segments

While building management systems have traditionally been limited to large commercial buildings, the falling costs of networks and associated monitoring and control systems continue to drop, creating a potential market in smaller buildings. The requirements for open standards to foster integration, the promise of lower operating costs and higher customer service levels, and the necessity of integrating disparate legacy systems are attracting adopters to Internet-enabled applications in the smart buildings arena. A current snapshot of the buildings sector reveals that progress towards these goals will likely be uneven and "bumpy" because of the diverse range of suppliers and players. Across the smart buildings market, our previous research has highlighted diverse challenges in realizing such growth, including:

- Difficulty adopting new business models and justifying the business case.
- Complex services and solution-delivery ecosystems that require businesses to relate in new and different ways.
- Anticipation of new product, service and systems innovation modes that are not widely adopted today.
- A fragmented IoT and smart systems vendor landscape that is not yet well aligned with the larger IT infrastructure and carrier players.
- Requirements for vertically-focused solutions from a supply-side world that has historically been far more horizontally driven.

For the purposes of this report, the intelligent buildings market focuses on a variety of commercial building sub-segments, including commercial office, retail and hospitality, public venues, medical, institutional, and a range of 'mission-critical' buildings. Additional granularity within these sub-segments is detailed in the figure below.

Figure ES 2 Building Types Segmentation



Source: Harbor Research

Each of these segments has unique requirements from an operations perspective, as well as from a consumer's perspective. The nature of each building type creates unique pain points that need creative solutions across the technology stack; enablement, networks, system applications and value-added applications, which will be further discussed below. For example, public venues contain many people

in flux, making reliable connectivity a difficult task. This necessitates a focus on networks and the players that can supply pervasive connectivity in typically large, study buildings with many people wanting network access. For example, a segment such as retail has shifted its focus towards system and value-added applications, including technology such as interactive digital signage software, that provides information to customers to help inform their purchase.

Intelligent Building Systems Technology Enablers

Intelligent building technologies have been in place for decades, and while they are not pervasive across all buildings, they are a sign of what's to come: interconnected and automated building processes that improve operational productivity, efficiency, and tenant comfort and satisfaction. At the core of this new age of intelligent building products and devices sit four key enablers through which the value of intelligent building systems will be realized:

- **Enablement & Security:** Encompasses the hardware and software that enables secure device connectivity. Board and silicon connectivity componentry, from suppliers such as ARM or Intel, provide the foundation for communicating with local or wide area networks.
- **Networks:** Includes wireline networks like Ethernet, Wireless Personal Area Networks (WPAN) like Bluetooth, Wireless Local Area Networks (WLAN) like Wi-Fi and Wireless Wide Area Networks (WWAN) like cellular and satellite.
- **System Applications:** Consists of software platforms and services for provisioning, certification, and integration of devices, as well as device and data management functions such as: location and tracking, monitoring and state, diagnostics and prognostics, device management and connectivity, and automation and analytics.
- **Value Added Applications:** Leverage a set of system applications to integrate people, business processes and assets into a managed service. VAAs are the primary driver of smart systems revenue over the long-term.

The combination of the sale and services of the complete technology stack results in a complete opportunity for the intelligent commercial buildings space. Historically, connectivity hardware has driven the market, as it is a catalyst towards creating new connected buildings. However, as connectivity becomes more common and hardware competition increases, prices for connectivity have decreased and the opportunities in software and services have increased immensely. By understanding which elements of the tech stack are most valuable in certain building segments (as a result of trends and forces in the space), the top targets of solutions and segments as well as the corresponding monetization models become elevated.

Scale of Intelligent Building Opportunity

Within Harbor Research's smart systems forecast model, the buildings venue represents a large and growing opportunity. The commercial building customer segment includes 54 distinct device types within 13 device segments and is forecasted across five distinct regions, including North America. Using public government data, OEM data, and the survey and interviews completed for this research, Harbor Research updated and validated its device and revenue forecasts across the commercial building segment.

Across the forecasted device segments, there are over 651 million installed connected devices in North America in 2018. This installed base is forecasted to grow at a rate of 9.5 percent over the forecast period, resulting in 1.03 billion installed devices in 2023.

In parallel, 124 million connected devices will ship in North America in 2018. The number of shipped devices is forecasted to grow at a rate of 10.9 percent over the forecast period, resulting in 209 million devices shipped in 2023. The largest building segment by number of devices installed is retail & hospitality, with 126 million devices installed in 2018, growing at a rate of 10.5 percent over the forecast period resulting in 208 million devices installed in 2023.

In the context of newer smart systems and IoT technology in buildings, connectivity hardware has historically driven the market. Now, hardware prices are falling across the board and the basic enablement opportunity is decreasing as a percentage of the total smart systems opportunity. Today, the most substantial revenue opportunities can be found in applications and managed services. As technology stabilizes, it becomes more valuable to focus on service opportunities to drive future growth.

The intelligent building market presents a significant opportunity for smart systems and IoT-based revenues, with a total opportunity of $16.8 billion in 2018, growing at a compound annual growth rate of 14.0 percent to $32.4 billion in 2023. Smart systems revenues for intelligent buildings break down into the following macro categories:

- Enablement revenues, the smallest revenue stream represent an opportunity of $837 million in 2023.
- Network services revenues represent 21 percent of the total opportunity in 2018, with a 2018 value of $3.5 billion, growing to $5.4 billion in 2023, at a CAGR of 9.0 percent.
- System applications revenues are growing at a rate of 14.2 percent over the forecast period, increasing from a $2.6 billion opportunity today to a $5.0 billion opportunity in 2023.
- Value added applications represent the largest revenue opportunity at $10.0 billion in 2018, growing at a CAGR of 16.1 percent to $21.2 billion in 2023.

Players looking to capture part of the intelligent commercial buildings space have historically been large equipment manufacturers, and although these players remain important, new competition between smaller independent technology suppliers has increased with the emergence of new software and corresponding services. However, each of these players are addressing pain points, challenges and requirements of end customers. These challenges, desired use cases and monetization models change across buildings segments and end customer types, as highlighted in the survey results from over 1,500 building operators, tenants, and end customers.

Intelligent Buildings Market Structure

At a high level, the supply side of the building systems market breaks down in two groups:

- Large incumbent equipment and control suppliers.
- A broad array of smaller independent systems, technology and service providers. In attempting to organize more broadly integrated offerings, many supply-side constituents have attempted to expand scope through acquisition.

The slew of acquisitions that the first group has undertaken in the last few years has, rather than allowing delivery of an integrated platform solutions to customers, left the acquiring companies in a relatively disorganized state, with a number of new assets that they must work to incorporate into their own businesses. As customer expectations for the depth and breadth of services offered increase, incumbents will have to look beyond M&A and fundamentally rewire organizational structures to survive. The significant margins that incumbent building systems vendors have captured relied upon proprietary software and systems. The significant capital cost and complexity in operating these systems, particularly as an increasingly number of non-compatible building systems are added to the network, have left operators longing for simpler, more integrated solutions.

IoT service players have emerged to disrupt traditional building system providers by offering more technologically advanced, open solutions that tend to abstract the underlying hardware. These players are all over the market, working with OEMs, service providers, and even directly with end-users to install low-cost sensors across environments or pull data from legacy equipment into advanced analytics packages. Prioritizing open-source data modeling standards, these tools are abstracting the fragmented hardware landscape by bridging proprietary protocols and performing vendor-agnostic data collection, fusion and analytics to derive new levels of insight.

The evolution in competitive structure requires a parallel evolution in business models for suppliers

to remain relevant. Past products, services and successful ways of doing business may not translate into success in this future world. Suppliers need to refocus efforts on what values they are providing to customers in the various markets they are serving and identify areas where partners and other third-parties can support product and service development and delivery.

End Customer Needs and Challenges

To better understand how end customers are leveraging IoT technologies within intelligent buildings, Harbor Research conducted a comprehensive survey across approximately 1,500 building owner/operators, tenants, and customers. In doing so, there are clear insights that can be gleaned from not only what types of applications and use cases respondents are most interested in, but also how respondents prefer to pay for certain services and products that can help inform how suppliers think about their monetization strategies across their product and service portfolio.

In relating end customers to their preferred or necessary means of payment, it is important to understand the top use cases and how they vary from operator, tenant and consumer. Below is a table view of top use cases for consumers, tenants and operators, garnered from our survey.

The top use cases, preferences, pain points and challenges across building end customer stakeholders directly influence the types of monetization models that suppliers should consider when formulating strategies for intelligent building products and services.

Tenant Survey Key Findings

- Pervasive connectivity, or reliable Internet connectivity and cellular reception, offering the best connection to the user as they move throughout the building resonated as a positive impact among 57 percent.
- Automated maintenance, a capability many apartment renters are familiar with, is a top use case for commercial buildings with 54 percent of respondents denoting the capability as a positive impact. This percentage is likely to shift across various commercial building types and commercial building sizes.
- Flexible workstations that cater to several types of meeting sizes and work styles as well as employee wellness reminders, were non-system (lighting, HVAC) oriented use cases that addressed tenant comfort, with 55 percent and 54 percent of respondents noting the positive impact these additions would make in their building.
- Broad stroke “energy usage awareness” reports garnered 51 percent of respondents; however, specific examples such as light optimization, temperature optimization and air-quality monitoring each were believed to be positive impacts by 60 percent or more of respondents.

Consumer Survey Key Findings

Below are the key results from our consumer surveys organized by building segment:

- **Hotel Consumer Survey**
  - 71 percent of casino hotel consumers responded that their current hotel and resorts do not offer smart parking, but that it would enhance their experience significantly. Business or luxury hotels respondents had less of a desire for smart parking at around 52 percent.
  - Smart digital signage that offers real-time information, such as way-finding within hotels, was also a desired capability among 57 percent of casino and business respondents.
  - Occupancy sensors for lighting were more popular in budget hotels, 57 percent of respondents noted.
  - Luxury hotel respondents were the only segment of hotel buildings where over 50 percent of respondents noted that emergency alert systems would enhance their experience.

- **Retail Consumer Survey**
  - Identity management systems that prevent data breaches and financial fraud was the most desired capability across retail with 73 percent of respondents in convenience stores and specialty retailers noting it would improve their experience.
  - Smart digital signage that provides consumers with information on parking and wayfinding capabilities within big-box superstores also ranked high with 68 percent and 62 percent of respondents noting it would enhance their retail experience.
  - 58 percent of convenience store respondents desire reliable cell phone service while in the store.
  - Convenience store and specialty retailer consumers, 58 percent and 57 percent respectively, both responded that smart kiosks that provide information about products would have a positive impact on their experience.
- **Restaurant and Dining Consumer Survey**
  - 66 percent and 75 percent of fast food and fast-casual restaurant consumers noted that virtual reality (VR) or augmented reality (AR) capabilities that allow dish viewing before ordering would be helpful, whereas gourmet or casual dining respondents did not care for VR or AR experiences.
  - Automatic smart payment methods were also popular among fast-food respondents with 60 percent of respondents noting it would enhance their experience.
  - Smart menus that recall previous orders and user preferences were also a desired capability in fast food establishments, 60 percent of respondents noted.
  - Outside of creating a more efficient user experience, respondents across fast food, fast-casual, casual and gourmet dining all noted that building energy efficiency measures are important to them as consumers.

Building Owner/Operator Survey Key Findings

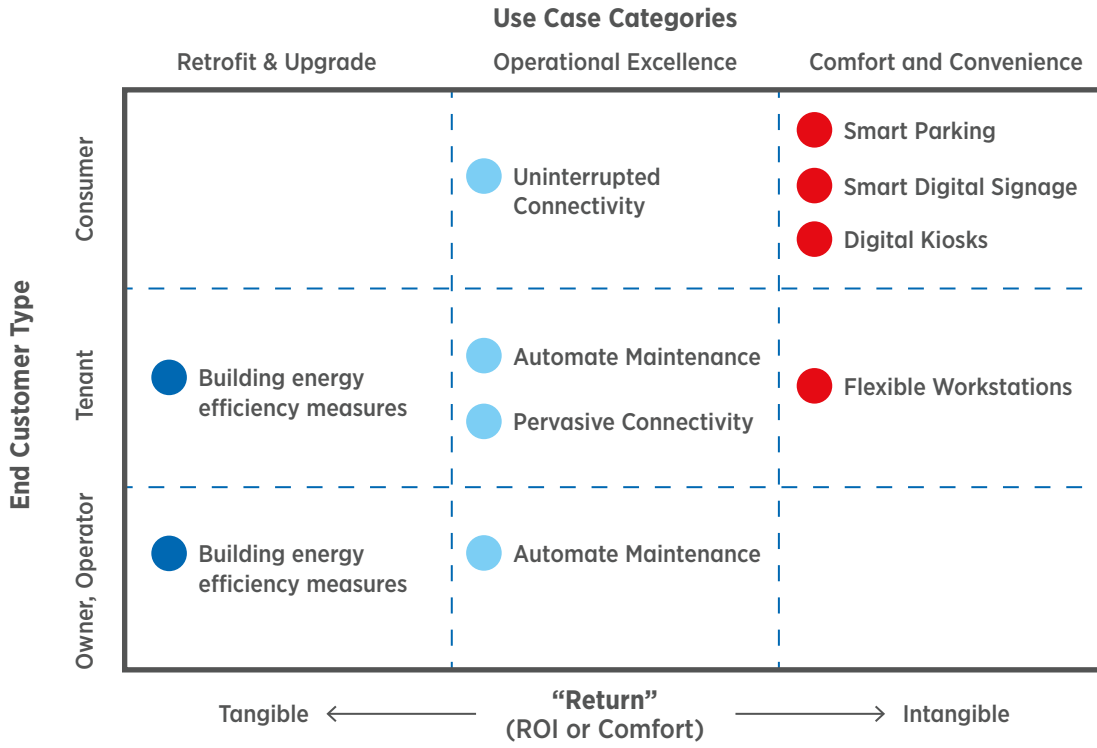
- 25 percent of respondents noted energy efficiency verification and measurement as the number one use case that operators would be most willing to adopt due to the clear and tangible nature of ROI associated with energy related use cases.
- Building occupancy sensing for detecting lighting and other means of converting energy efficiency garnered the vote for top use case from 20 percent of respondents.
- Building asset and predictive maintenance received 19 percent of votes for the top use case among operators.

While the most attractive use cases across customer types may differ, the trajectory of product and service adoption amongst building customers follow a fairly standard path: start with the most tangible, least risky use cases first, such as energy management systems, before moving into less clear and more risky investments in operational or other comfort and convenience use cases.

The relationship between preferred use cases and preferred “return”, combined with an understanding of the pain points and buying behaviors of each end customer reveals the main insights that intelligent building suppliers should consider when determining optimal monetization strategies. For example, for operators it is often a decision of capital expenditures (capex) vs operating expenditures (opex) — capex referencing one-time payments upfront and opex referencing existing and accounted for payments at intervals, generally related to accounting advantages and capital allocation. Traditionally, budgets and purchases are made from a capex perspective as owner/operators have had a more risk-averse attitude in regard to new building technology. Buying new technologies that improve existing systems such as energy management as an upfront cost is the lowest-risk and more familiar payment method for operators. However, for tenants and consumers, it is more of a willingness-to-pay question and also a question of the building type in which the tenant or consumer is in. For example, top use

cases such as digital kiosks/signage are prevalent for fast payment situations such as fast-food restaurants or convenience stores but are not as desired in gourmet restaurants.

Figure ES 3 Survey Respondent and Stakeholder Top Use Case Opportunity Framework



Source: Harbor Research, Survey Data

In the above table of top use cases, there are three broad categories of use cases:

- **Retrofit & Upgrade:** Use cases included in this category include those that are predominately energy management related and that have very tangible metrics for measuring the expected return on investment. For these use cases, end customers are willing to pay for these products and services up front rather than seeking proof of value.
- **Operational Excellence:** Use cases included in this category include those that still have quantifiable returns, but are less tangible than retrofit and upgrade use cases. For these use cases, end customers are likely willing to purchase products in a variety of ways depending on their particular risk profile.
- **Comfort and Convenience:** Use cases in this category include those that don't have objective or clear measures of return for the stakeholder. In these cases, end customers will likely require more flexible payment terms, trial periods, or other ways of experimenting with products and solutions before deciding to spend significant investments.

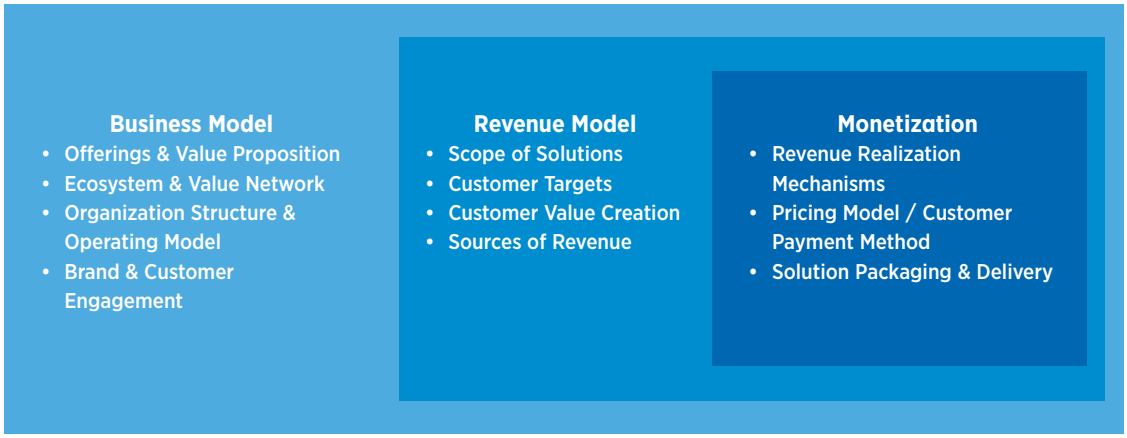
Through this analysis, end customers' willingness to pay and risk sensitivity directly feeds how suppliers should think about the monetization models they choose for a particular product or service. For more tactile, tangible use cases, customers prefer to pay in capex, one-time methods because they know with a fair level of certainty that the risk will be well worth the investment. For less proven or more opaque use cases where return is less known or quantifiable, customers will likely prefer to defer as much of the payment as possible in order to assess how well or not well the solution or product meets their needs.

In the following sections, we will discuss in more detail the relationships between customers' willingness to pay and risk profile to the potential monetization models that best suit the customers' needs.

Monetization in Intelligent Buildings

Our definition of monetization within the evolving smart buildings arena, and for the purposes of this report, focuses on identifying new or novel revenue models enabled by connected products and services within which suppliers will develop pricing strategies and monetization approaches for tangible configurations of products, services and value added capabilities (whether provided directly by the supplier or indirectly through partners). Our definition, as well, includes monetization for adapting non-revenue-generating assets to generate revenue including, for example, a building owner/operator that sells data they collect from systems to a supplier of similar systems, such that they can utilize the data to analyze and better understand system usage and performance. Included in monetization of these products and services is the pricing models—or how the price of a product, service, system or solution is determined. The lines between business and revenue models and between the models and monetization are not exact nor consistent, however, the distinction between the three concepts is important to framing the conclusions from this report.

Figure ES 4 Defining Monetization in the Context of Business & Revenue Models



Source: Harbor Research

Many companies will be hampered in their thinking about monetization by a tendency to assume that the company, after adopting smart systems and services, will be the same company and in the same business as before. This is not a safe assumption.

Simply put, the overarching business models that will inform new solutions in the smart buildings arena can be classified into three broad categories: a "solo" opportunity, one a company can seize alone; a partner-driven opportunity, which will in one way or another be an opportunity that is shared with others; and collaboration-driven opportunities that will be increasingly dependent on data and information-driven values, as well as complex ecosystem and partner development. Within each category of opportunities, solo, partner-driven and collaboration-driven, there are two business models each. Within each category, what business model a company selects itself depends on criteria that relate to and are specific to each opportunity:

- **Solo:** Where most of the elements of the opportunity are attached directly to a product's lifecycle such that they are designed to be deployed by the product player alone.
- **Partner-Driven:** Where the opportunities lie mainly in the adjacencies such that they are designed with partnerships in mind.

- **Collaboration-Driven:** Collaboration-driven opportunities take the previous models one step further to applications that drive diverse interactions between and among devices, sub-systems, people and systems across enterprises, and across multiple business entities, often including public sector systems. Collaboration-driven models are very much defined by the nature of fluid interactions between multiple parallel parties.

We have discussed what we call business models. This context allows us to discuss actual monetization opportunities and resulting pricing considerations for smart building systems and solution providers.

For the purposes of this report, we have identified four categories of monetization models: product-based models; "product-bound" smart services-based models; "unbound" smart services-based models; and solution-based models. Each of these categories implies a supplier providing smart, connected products and/or services. Across the four categories, there are 12 distinct monetization models.

Product-Based Monetization Model

- **Sell the Product:** For many companies, even with their products connected, the only option will be to remain a pure product company. The embedding of connectivity into the product does not open a great opportunity for selling value-adding services. For these companies, the only revenue model is the same old one, the "one-time transaction" model. That is to sell the product once with little additional value-addition or obligation. This is the "traditional" device OEM business model.

"Product-Bound" Smart Services-Based Monetization Models

In many cases, ongoing use of the product is itself quite valuable, or the activity chain extends far beyond the simple use of the product, and/or there are opportunities to use the product to gain access to adjacent activity chains. In these cases, revenue is collected not simply for the product, but, in some way, for the associated service.

In service-based models, the services extend from simple ones performed entirely by the device itself, to human-delivered services that are not even triggered by the device, but which are part of a trusted relationship with the manufacturing company. Let's consider them in that order, starting with services that are entirely product-bound.

- **Pay-Per-Period/Per-Usage Model:** When each use of a product is of considerable value to the customer, the use of the product itself can be sold as a service, with charges being made per instance of use or per time period.
- **Performance-Tied Model:** As with the pay-per-use model, in the performance-tied model, what is sold is a duty performed directly by the device, but a key incentive for the customer is guaranteed levels of service. A utility company will be able to guarantee a certain level of power quality to customers, tracked by Internet-connected devices. Industrial products and services providers will be able to offer guaranteed levels of performance as well. For example, several suppliers of HVAC and power distribution and quality systems already provide their "monitorable" products on a performance-tied basis.
- **Incentives & Rebates Model:** In this model, the product is sold as the gateway to an incentive plan through which sales of other products or services are made attractive. This model will often surface as part of a hybrid approach, rather than in pure form. It is predicated on the fact that the device collects information on the customer's use of the service, and thus can offer various incentives for the customer to use the product or service in ways optimal for the provider.
- **Volume Discount Model:** This is probably the most common form of the incentives model, in which the incentive is simply a volume discount. This model will be employed more

aggressively as device OEMs or service providers become able to monitor the consumption rates and usage patterns of users precisely via networked devices. Users will be offered automatic discounts based upon volume, an incentive for them to come online. And the users in turn will be able to track their own use and cost via services driven by device data.

- **Membership Club Model:** In the Membership Club model, a product is bundled with a membership for other products or services, and in cases where the membership fees are sufficiently high, the product can be given away as inducement to join the club. As with other revenue models covered here, this one will often show up as a hybrid with one or more others.

"Unbound" Service-Based Monetization Models

So far, we have looked at revenue models characterized by services that are intrinsic to the product or are extrinsic but are so automated that they appear to be intrinsic. Now we move on to a class of revenue models in which the device serves as the point of access to other services which are less automated, or which are not sold directly to the device's end-user. We call these unbound services.

The move towards service-based business models reflects the need for product companies to resist disintermediation by building tighter ongoing relationships with customers. The constant streams of device data enabled by smart and services puts suppliers in a perfect position to support the greater, overall needs of a customer, and to capture more in revenue and profit.

Where unbound services can be sold, the following revenue and monetization models are available:

- **Sale-of-Data Model:** There will be cases in which it is in the customer's interest to allow the device OEM or service provider to share information with third-parties. The customer benefits from the offers these companies can craft using this data, but it is the companies themselves who pay for the sales opportunities.
- **Switchboard Model:** This model is simply the creation of a bazaar, a many-to-many marketplace in which buyers and sellers can find each other, and the owner of the meeting place takes a share of the proceeds.
- **Gateway Model:** The Gateway model is similar to the Switchboard, except that it is a many-to-one marketplace. The device manufacturer has created a deal with a selected service provider, to whom it directs customers in need of the service.

Solutions-Based Monetization Models

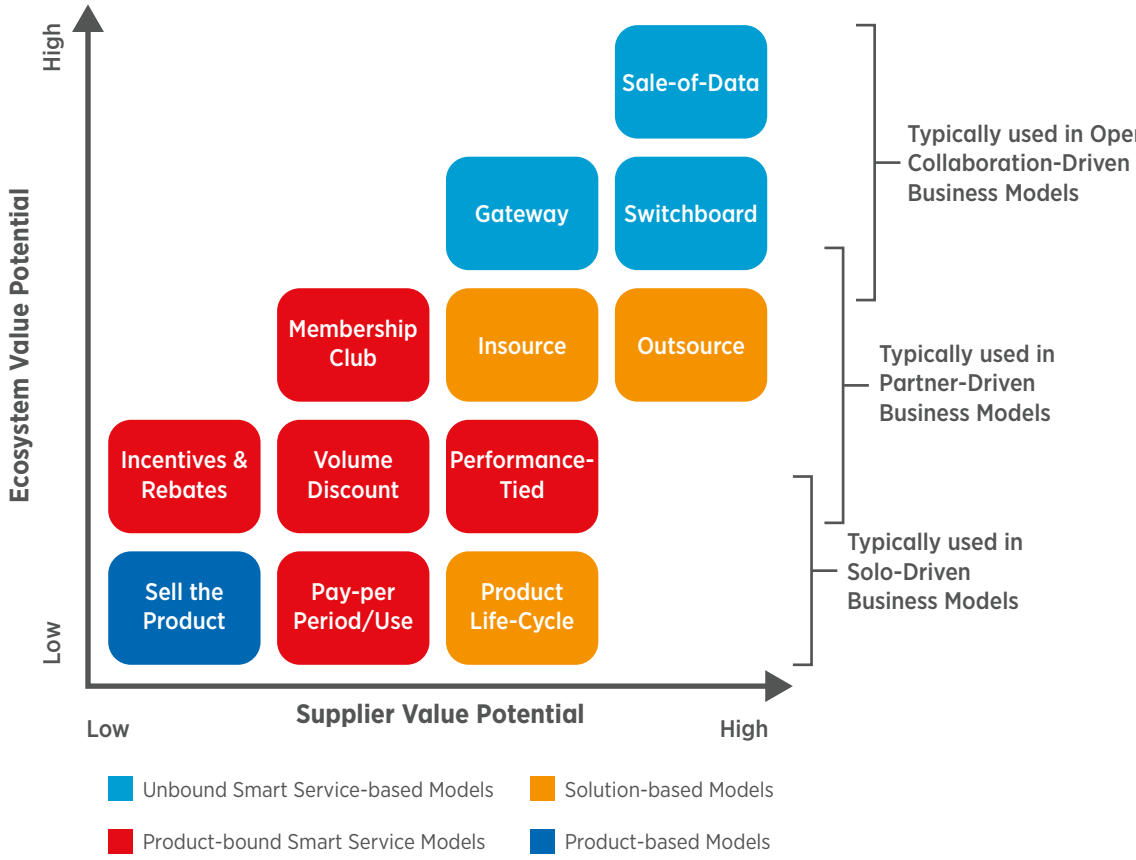
By Internet-enabling their products, companies will be in a unique position to create solutions-based revenue models (combining product-based and service-based offerings). Suppliers will be able to use every device as an anchor within a customer environment, while ensuring that the customer's overall needs are being met. What distinguishes solutionist models from unbound-service models is that the services involved are not only unbound from the device but consist in large part of human-delivered services. The other key distinguisher of solutionist models is that the nature of the services is such that it pays for the device manufacturer to control many of these services directly, because they create close ties to the customer and enormous loyalty.

By sharing risks and rewards, a supplier becomes more involved in the customer environment, which will create even closer ties to the customer. Ultimately, suppliers will be able to support a customer throughout the entire life-cycle of the product and/or customer. The stickiness of this model is enormous. Solution-based models are made possible by customer activity chains that have a total value far in excess of the purchase price of the device. But connectivity makes solutionist models feasible in far more cases and increases the profit potential in every case. Solutions-based models include:

- **Product Life-cycle Model:** This is the simplest solutionist model, in which the device manufacturer comes to understand the activity chain and works to insinuate itself at every possible point.

- **Outsource Model:** There are situations in which a device manufacturer can control not only ancillary service, but can even handle the core service, the use of the device itself. The resulting value is captured in the outsource model.
- **Insource Model:** The insource model is characterized by a supplier going beyond performance guarantees, and actually sharing risk and reward with the customer. Intel pioneered insourcing as long ago as 1998 and imposed it on certain of its technology suppliers. Applied Materials guarantees a predetermined amount of uptime on their semiconductor fab tools and is willing to undertake penalties and reward commensurate with the extremely high cost of fab downtime. Increasingly, equipment suppliers will be rewarded or penalized based upon documented performance with statistics coming from data and analytics supported machines and devices.

Figure ES 5 Summary of Smart Systems Monetization Models



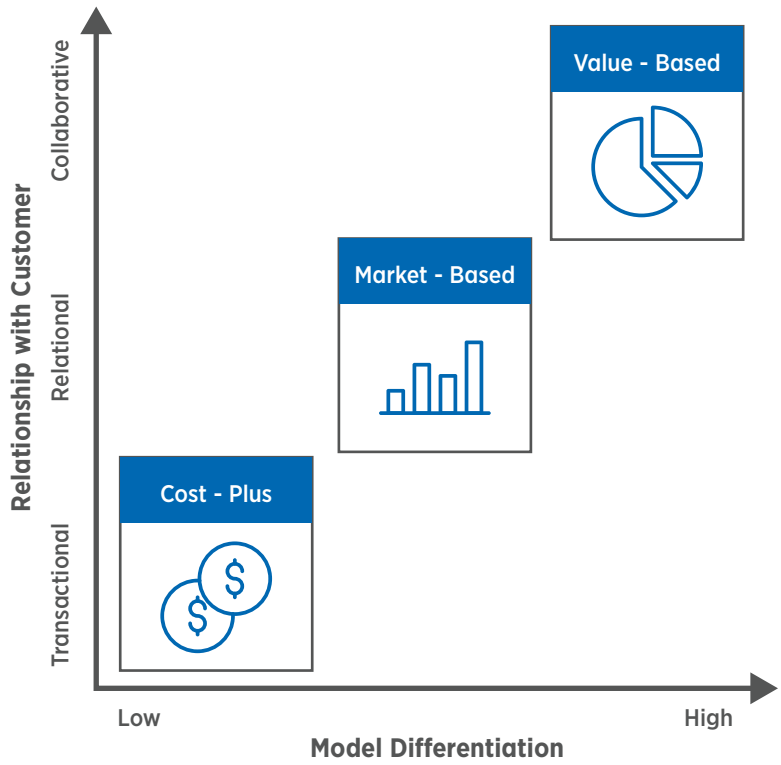
Source: Harbor Research

Pricing Model Considerations

A major aspect of monetization is pricing strategy, or how a supplier determines the price points at which its products and services are sold. Pricing is a perennial issue that pervades all types of businesses, and the rise of smart systems has created new challenges for product, service and solution providers. The types of pricing that are actively used in the market can be characterized in three fundamental types: cost-plus pricing, market-based pricing, and value-based pricing. Prices are set in these models based on two primary factors: competitive pressures and perceived customer value from the offering or solution set.

- **Cost-Plus Pricing:** Cost-plus pricing is exactly what it has been for a very long time – calculate the cost to deliver an offering to the market, multiply by an acceptable margin, and set a price. In a mature or commodity product-centric market, this might work, but its applicability to new smart connected systems is very low.
- **Market-Based Pricing:** Without adding significant value that differentiates your offering from the competition, prevailing market and competitive and/or customer-driven conditions will dictate a given vendor's pricing.
- **Value-Based Pricing:** Value-based pricing allows you the flexibility to price your offering dependent on the value you deliver to your customer, whether it is dollars saved, dollars earned, any combination of the two, or any intangible savings or benefit.

Figure ES 6 Comparison of Pricing Models



Source: Harbor Research

In an increasingly crowded and competitive market, suppliers need to look beyond cost-plus and market-based pricing strategies to remain differentiated. Cost-plus and market-based emphasize the "competitive pressures" dimension and largely ignore the value a customer receives from the offering. Value-based pricing focuses on this customer value dimension, typically driving differentiation for suppliers who organize their strategy as such.

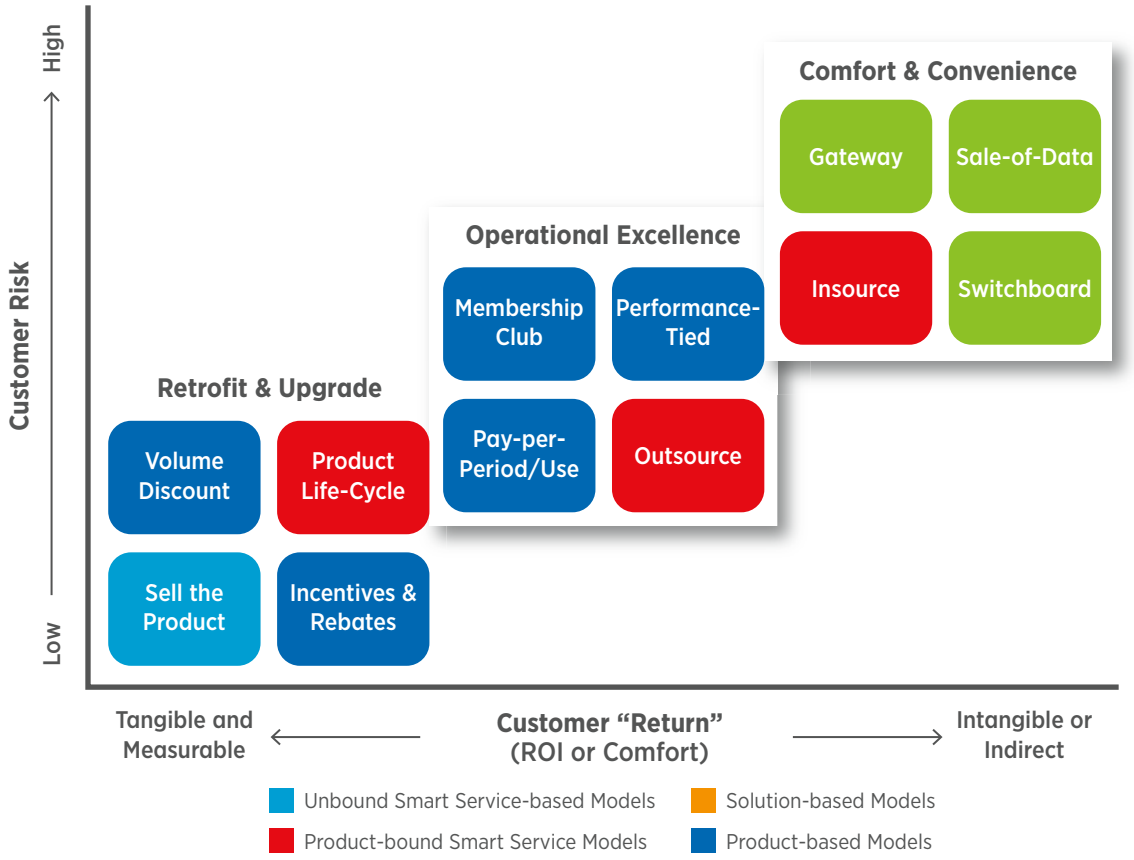
The rate at which pricing models have evolved is constrained by the conservative behaviors that this market has engendered for many years and is largely restricted to predominantly cost-plus and market-based pricing with a distinct minority truly embracing value-based pricing. Value-based pricing strategies include pricing based on the expected outcome of a solution (e.g., a guaranteed level of system uptime), and "freemium" pricing models, among others. While outcome-based pricing is more advanced and requires working closely with customers in a consulting-style mode during solution development, freemium strategies are a somewhat simple, but imperfect, way to approximate customer value.

Recommendations

Having discussed the intersection of business models and monetization, and since suppliers can capture value with any of the identified business models, the most important dimension remaining is how the use cases customers want today are best monetized by suppliers, and how that may shift over time.

The use cases desired by customers fall in three general categories: retrofit and upgrade, operational excellence, and comfort and convenience. The ROI of the use cases in these categories have varying levels of tangibility, or, in other words, some use cases have an ROI that is more easily measurable and more clearly communicable, while others have an ROI that is indirect or requires additional partners to achieve.

Figure ES 7 Risk-Sharing or Risk-Diffusing Monetization Models



Source: Harbor Research

For retrofit and upgrade and operational excellence use cases, the ROI is much more measurable and easily communicated. These categories include the use cases most desired by building tenants, owners and operators, and the value is more directly achieved by the purchaser. As demonstrated by the owner/operator survey, customers are more willing to pay up front for these use cases if the value can be communicated and the timeline for ROI is within 12-18 months of purchase. So, what does this mean for monetization models? Use cases with less tangible or indirect ROI will require solution providers to operate with more complex, partner-driven business models and with monetization models more closely tied to the value of the solution or that capitalize on adjacent or new revenue streams, as a way of sharing or diffusing the risk of ROI with customers.

While the exact placement of a specific monetization model on the chart below is somewhat illustrative, the comparison between the models is what matters. Moving from the bottom left to the upper

right on the chart, monetization models reduce the need for upfront payment from the customer by tying the payment more closely to what a customer uses or receives value from over time, or by allowing the supplier to capitalize on adjacent values, such as the sale of data or enabling partner applications.

The survey discussed in section 4.1 supports this idea of risk sharing or risk diffusion. While building owners and operators prefer paying upfront as a capital expenditure for solutions such as energy efficiency measurement and verification (a use case within the retrofit and upgrade category), more prefer a subscription or value-based model for the occupant comfort-focused use case (a use case within the comfort and convenience category). As ROI becomes less tangible and measurable or more indirect, customers are less willing to pay for the solution up front.

This conclusion has significant impacts on how solution providers organize to capture value in the intelligent buildings opportunity. The following sections describe additional considerations for various stakeholder types. While these considerations are not perfectly applicable to all scenarios, especially as supplier business models continue to evolve, they do provide important distinctions between supplier groups.

Supplier-Specific Considerations

- **Pure-Play Technology Suppliers:** offering connectivity and network hardware, software platforms and applications, and related value-added services, should consider partner-driven and open collaboration-driven business models to succeed in the intelligent buildings market. The issue these suppliers tend to face is demonstrating industry expertise and communicating the value of more complex solutions to building owners, operators and tenants. Partnerships with OEMs and service providers help drive this industry expertise, meet fragmented customer needs, and create stronger, more interoperable solutions.
- **OEMs:** including building equipment manufacturers as well as building automation and control device suppliers, remain in a precarious position, as traditional sale-of-product models will need to evolve if these suppliers hope to capitalize on the intelligent buildings opportunity. Expanding to providing technology-enabled and information-based services and solutions requires a focus from the outset on ecosystem partnership and customer relationship development that is not typically necessary in product-only offerings. Product life-cycle, performance-tied, membership club, pay-per-use, and outsourcing models are all attractive opportunities for OEMs looking to capture value from new software and service solutions.
- **Service Providers:** such as utilities, network providers, cable companies, insurance providers, and systems integrators are all well-positioned to capitalize on intelligent buildings opportunities, due to their proximity to customers. These companies can act as both intermediaries for technology suppliers and OEMs in delivering value to customers, as well as organize to offer new captive products and services to their existing customer base. As for OEMs, partner- and open collaboration-driven business models will open new revenue streams for service providers. The ability to bundle services across a set of providers, offer membership club discounts or rebates, or exchange data across different services and offerings all represent attractive monetization opportunities. Which partners and which revenue streams are most attractive depends on a service providers current set of offerings, relationships and market position.
- **Building Owners and Operators:** function as a specialty service provider to building tenants and consumers, while also typically being the customer or purchaser of intelligent building solutions. While there are some use cases and solutions where building tenants could pay directly for the value being provided (e.g., energy efficiency or operational uptime), there are many cases where the owner/operator can only capture the value indirectly, either through raising rent or through partnerships with other solution providers that enable adjacent revenue streams. This is particularly true for use cases such as digital signage and smart

kiosks where tenants and consumers look to these solutions for convenience values. Unless building owners and operators develop partnerships with technology suppliers, OEMs or service providers, the upfront cost of digital signage and smart kiosks will be difficult to recoup without advertising or sale-of-data revenue streams. Either way, building owners and operators should not try to monetize these solutions alone.

Concluding Considerations

The intelligent commercial buildings space is defined by horizontal pain points and basic requirements, as well as segment specific elements such as budget options, willingness to pay, top use cases and the degree in which the segment interacts with consumers. Horizontally, pain points such as budget and concern over intangible ROI lead to operator preference sets that typically read, when budget is available, up-front solutions that increase operational efficiencies of existing and necessary systems and provide tangible ROI are top of mind. Although operational efficiency is the top horizontal theme, there are unique ways to enhance efficiencies across segments; RFID tags in medical, outdoor cooling mechanisms for industrial, etc. However, each segment requires more specific, vertical innovations. These pockets are where new technologies are first adopted and are used as proving grounds, before becoming tangible ROI and implemented in segments with operators that have a lower willingness to pay. Within these pockets is also where there is an intersection of innovation and new strategies to monetize these innovations. Important factors of monetization include what the technology application is doing (retrofitting existing systems, addressing customer comfort, etc.), operator attitudes (prefer to pay upfront, wants the solution to prove its worth with performance-based evaluation, etc.), and several other key considerations. Ultimately, as the world continues trending towards smart systems, the commercial buildings space and the innovations coinciding with each segment, will be rendered necessary — how the opportunity is monetized is dependent on the solution, the supplier, and the operator.

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