The Smart Building

Value Proposition

DELPHIAN SYSTEMS

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Executive Summary

The first buildings were primitive shelters made from stones, sticks, animal skins, and other natural materials. Their primary purpose was to provide shelter from the elements. Today, buildings serve vastly more purposes. Many buildings are smart. And they are getting smarter every day. But what does “smart” mean when it comes to providing value to stakeholders such as owners and occupants of those buildings?

This paper presents an innovative approach to maximizing value in smart buildings that results in competitive advantages and profitable growth. The strategy presented addresses how to utilize emerging IoT technologies to realize numerous tangible and intangible benefits that satisfy the needs of multiple types of stakeholders.

In this paper, we will discuss:

1. The state of the smart building
2. The stakeholder types and the hierarchy of their needs that drive the smart building value proposition
3. The value proposition as measured by the nine types of economic value and how they relate to each stakeholder type
4. The best approach to realizing the value by mitigating the implementation risks

Stakeholder Hierarchy of Needs

Who and what needs drive the value?

Smart Building Value Proposition

How is the value measured and maximized?

Tapping the Value

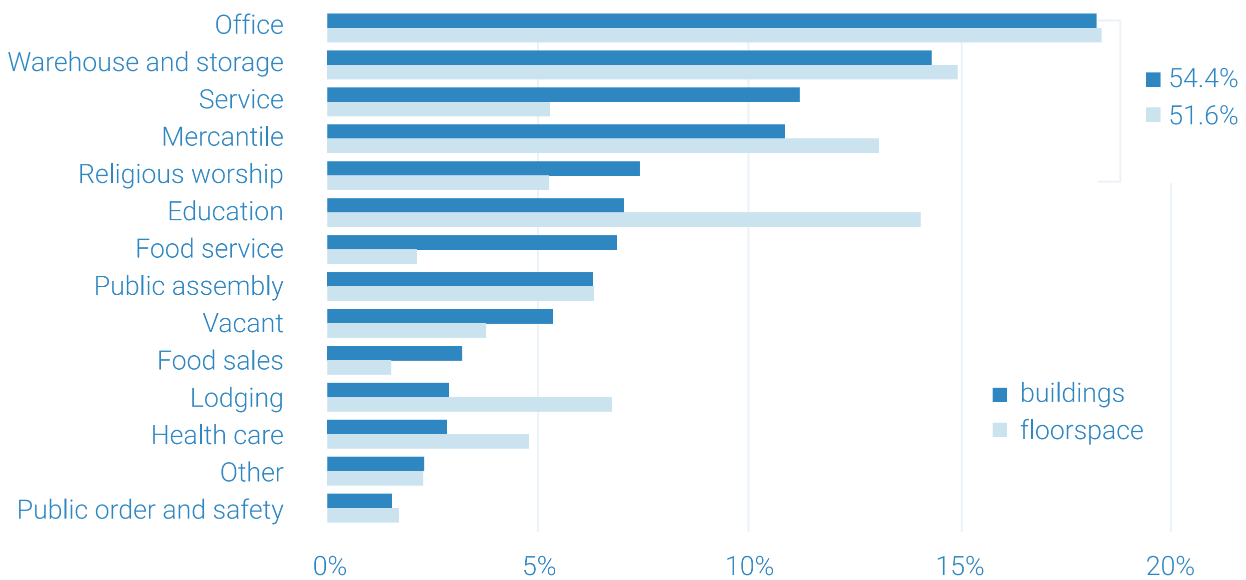
How to best realize it?

About the Smart Building

Market analysts estimate that the global smart building market will register a 15.3% CAGR between 2019 and 2026, and reach a market value of over $160 billion by 2026. The expectation is that North America will play a dominant role in that growth.

Research points to a fragmented market driven mainly by the addition of modern technologies and customizations that attract end-users. Vendors are concentrating primarily on offering innovative products and solutions that optimize energy consumption and offer a high degree of building automation.

USA Types of Buildings (General Categories) - % Buildings and % Floorspace



Source of type and size of buildings in the USA www.eia.gov/consumption/commercial/reports

In the United States, there is a wide range of building types that serve various purposes. Office, warehouse/storage, service, and mercantile buildings are the most prevalent commercial building types. Together, they account for more than half of the total number of buildings and the total amount of commercial floorspace.

About 10% of the total commercial floor space is comprised of buildings with less than 5,000 sq. ft. This represents 50% of all buildings. About 20% of the total commercial floor space is comprised of buildings above 500,000 sq. ft. This represents less than 1% of all buildings.

Background

In the late 1980's the Intelligent Buildings Institute defined an intelligent building as one which provides a productive and cost-effective environment through optimization of four essential and interrelated elements: structure, systems, services and management.

An intelligent building matches its four elements to the users' needs in an optimal manner with an emphasis on the technology that enables the interrelationships. Building Management Systems (BMS) typically handle this task.

The last decade saw the emergence of smart devices defined by their ability to connect, share data, and interact with users and other smart devices that are comprised of decentralized systems, including IoT, mobile, and cloud technologies. Such technologies have leapfrogged BMS and offer the advantage of retrofitting older buildings in a better, faster, and less costly manner. These technologies offer capabilities for enhanced personalization and seamless user experience.

Smart Buildings Today

The definition of what a smart building is has evolved.

A smart building is a distributed ecosystem. It is a dynamic entity with smart devices that communicate wirelessly, collaborate, share data, and learn. These smart devices can also automate processes that control the building's operations, including access control, security, safety, lighting, climate control, and energy usage.

Additionally, these smart devices can be part of various interoperable systems. Those systems can interconnect and interoperate on-demand with multiple mobile or stationary user devices such as phones, smart cards and readers, tablets, and interactive displays. This distributed ecosystem of products and systems, and its ability to satisfy all stakeholders' needs in seamless and personalized ways, can create significant value in novel ways.

Today, a smart building responds and adapts to the ongoing needs of its various stakeholders across the entire demand-supply chain, from tenants and guests who create the demand to building managers and owners who supply the demand. Consequently, a smart building's performance is measured by the extent to which its stakeholder's needs are met.

> ***A smart building responds and adopts to the ongoing needs of its stakeholders in seamless and personalized ways.***

Stakeholders and Their Needs

The broadly defined stakeholder types are:

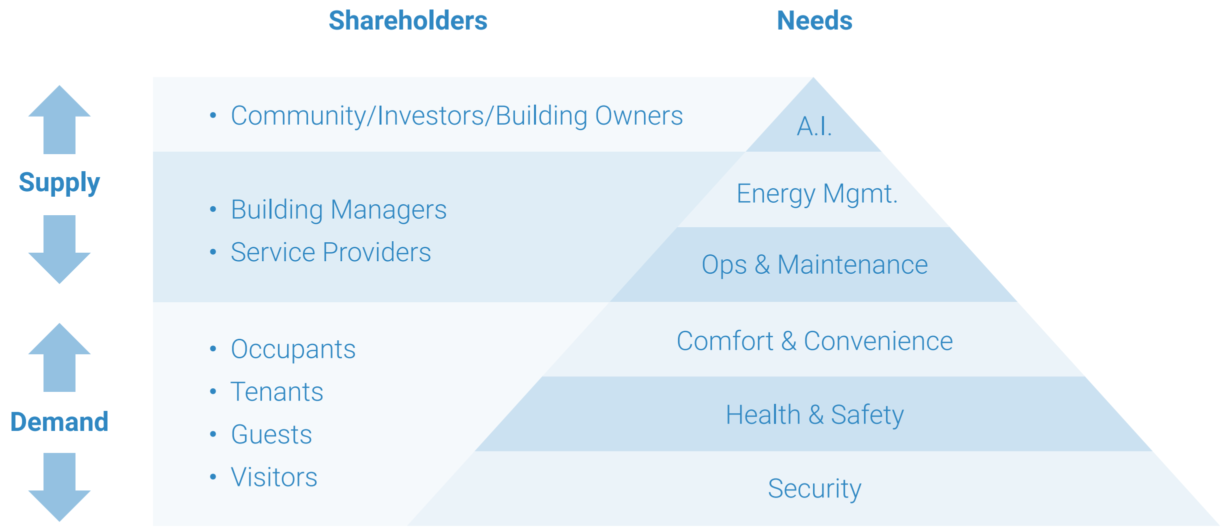
Stakeholders who Generate Demand for Services

- **Occupants** live or use building premises (tenants, guests, visitors, and various other classifications).
- **Tenants** pay rent to use or occupy building space.
- **Guests** pay to reside and to consume goods and services on a temporary, as-needed basis (hotel customers, shoppers, etc.).
- **Visitors** visit tenants or occupants in support of their professional, business, or personal needs (customers, vendors, patients, etc.).

Stakeholders who Supply the Demand for Services

- **Building Managers** manage all or any of the building management functions.
- **Service Providers** cater to the building managers' needs (staff, contractors, vendors, community services such as fire departments, police, etc.).
- **Community and Investors** are those who have a vested interest in the development of local government infrastructure and commercial buildings.

Smart Building Stakeholders Hierarchy of Needs Model



The hierarchy of needs model in Figure X shows the six hierarchical levels of need types and their relevance to the stakeholder types. The hierarchy, from bottom to top, defines the order of importance from basic to advanced.

The demand-related stakeholders' needs revolve around security, health and safety, as well as comfort and convenience. The supply-related stakeholders' needs revolve around operations and maintenance, labor productivity, energy management, and the cost/benefit of all related building services.

Security

Intrusion detection and prevention with access control systems ensure the safety of people and property while mitigating theft risks and vandalism inside buildings. However, due to the rise of technologies such as the cloud and the IoT, building security systems have evolved to offer remote monitoring, rule-based access control, and customized audit and transaction reports. Such features improve security while achieving significant labor and operating cost savings.

Health & Safety

A safe and healthy workplace not only protects people from injury and illness, but it can also lower injury and illness costs, reduce absenteeism and turnover, increase productivity and quality of life, and raise employee morale. Automation features that regulate or enforce proper workplace sanitation and related procedures can prevent possible injuries and illness as well as contamination from improper hygiene.

Comfort & Convenience

Improving the overall customer experience can involve automated climate and lighting control, motion-activated urinals, faucets and dryers in uncongested restroom facilities, and automated access control in cafeteria facilities and common areas.

Operations & Maintenance

Achieving operational improvements in all aspects of building maintenance, from cleaning and repairs to equipment maintenance, results in productivity increases and related cost savings. Connected sensors can detect building systems performance deterioration and activate maintenance procedures before an alert is triggered. This ability contributes to planned maintenance schedules for prevention instead of incurring more expensive corrective maintenance along with the resulting disruption and discomfort for building occupants. Additionally, data analytics can drive automated scheduling for predictive maintenance.

Energy Management

Enhancing the energy efficiency of heating, cooling, and lighting, without compromising occupant comfort, contributes to a more sustainable environment. Smart technology with unobtrusive sensors can achieve 5% to 35% energy savings.

AI – Data Analytics and Machine Learning

Artificial intelligence (AI) is for owners and operators whose goals are to discover and understand the evolving needs and behaviors of end-customers. This is important when the intent is to provide personalized services such as in venues where brand loyalty and customer satisfaction are of paramount importance. That includes hotels, sports venues, and entertainment venues.

AI achieves the owners' and operators' goals by leveraging large amounts of data and by using enablers such as data analytics, business analytics (BA), machine learning, data-driven learning (neural networks), optimized decision-making (operations research techniques, heuristics, etc.), and other applications.

One of the most valuable aspects of AI applications is that as they learn. It is this ability that builds knowledge that points to new opportunities not only for cost improvements but, more importantly, for revenue enhancements.

How Are Stakeholders' Needs Satisfied?

The satisfaction of demand-related needs is measured by benefits such as pricing, revenue, variable gross margin (VGM), and variable cost margin (VCM). The satisfaction of supply-related needs is measured by benefits such as CAPEX ROI, economic value added (EVA), and P&L cost savings.

The Traditional Approach

Traditionally, the primary focus of building automation and BMS has been to satisfy the needs of the internal customers. This satisfaction is based on tangible benefits. Those benefits include effectiveness, reliability, related costs improvements as a result of productivity and operational efficiencies measured by "total cost of ownership," ROI for infrastructure capital expenses, and various P&L and BS line-item cost improvements.

The Modern Approach

The advent of market strategy and price-value frameworks for industries whose products have a sizable share of intangible value, including the "Economic Value to the Customer" (EVC) framework by John Forbis and Nitin Mehta, point to the premise that the value of a product is ascribed by the customer.

Most recently, Josh Kaufman explained the nine economic values that people consider when evaluating a purchase shown in the Figure X. Note that the economic values in the shaded areas of the table are shared by both stakeholder types.

As we will explain next, the emerging IoT technologies bring transformative capabilities that enable tangible and intangible value propositions for all stakeholders.

Benefit Type	Economic Value	Stakeholders	
		Demand	Supply
Tangible	Effectiveness		✓
	Reliability		✓
	Cost		✓
	Flexibility	✓	✓
	Speed	✓	✓
	Ease of Use	✓	✓
Intangible	Aesthetic Appeal	✓	
	Emotion	✓	
	Status	✓	

The Personalized Value Proposition

Technological innovation has been the fuel that revolutionizes businesses by driving long-term benefits and growth.

Thanks to digital technologies modern buildings are becoming smarter thanks to sensors that monitor human interactions with the spaces they use. These sensors are capable of automatically regulating the building environment from climate control to lighting. They can also generate tons of data that can be used to improve productivity, resource efficiency, and environmental sustainability by responding to real-time events.

Coupled with emerging IoT and AI technologies, smart buildings are becoming increasingly smarter in automating business, management, and maintenance processes and events. They are also intelligent enough to predict and remediate in advance equipment and device failures involving such things as HVAC systems, plumbing fixtures, and smoke detectors.

Additionally, thanks to mobile devices, smart buildings in large venues of high scale, operational complexity, and extensive stakeholder heterogeneity make the best candidates for IoT innovation. These buildings include hotels, entertainment venues, stadiums, and hospitals. The reason is that they can provide personalized services to each individual end-customer for any reason, anywhere, at any time – all in a seamless manner.

Ecomomic Utility of Smart Products

- [ ] Form - Individual customer needs
- [ ] Time - Availability
- [ ] Place - Accessibility
- [ ] Possession - Information Value

Key Enablers

The key IoT technology enablers that bring the smarts and intelligence into a building in a robust manner are summarized in four categories:

1. IoT products. Such products comprise both a physical and virtual set of functionalities. This phenomenon is commonly referred to as the “digital twin.” Virtual functionalities allow the product to be provisioned by the manufacturer for hassle-free ongoing support and improvement through over-the-air (OTA) upgrades. They also allow the user to configure and interact with the product in personalized ways remotely at any time.

2. Interconnectivity. This refers to the ability of the products to wirelessly interconnect with one another as well as with user devices such as mobile phones and other building management systems in an automatic and seamless manner. In general, connectivity is defined by the wireless protocols and methods that enable either local connectivity (within a building or facility) or global connectivity (via the Cloud) or a combination of both on an as-needed basis.

3. Interoperability. This refers to the ability of IoT products to work with one another as a complete ecosystem without requiring any integration. Ecosystem products are commissioned, operated, and managed by a centralized administrative system residing in the Cloud or an Edge server on premises. Interoperable products have complimentary features and benefits so that their combined value exceeds the value of the individual products.

4. Cybersecurity. IoT security has been continuously cited as the biggest obstacle to IoT adoption and the biggest threat to IoT applications. Hence, the ability of IoT product manufacturers and system providers to provision secure identities and to enforce end-to-end security management across all interoperable product devices is necessary.

Combined, the above enablers maximize the potential benefits in a highly synergistic manner. They push the envelope beyond the current state of the market.

Typically, the value proposition is the result of the problem-solving process whereby the customer’s needs describe the problem that seeks a solution provided by a building product. Such products are broadly defined as physical, software, system, service and combinations thereof. The product with features and benefits that best match the customer needs is the the desirable solution. The value of the solution is measured by CAPEX investment ROI metrics such as economic value added (EVA) – incremental difference in the rate of return over a company’s cost of capital.

Customizing the Value Proposition

IoT technologies and products offer configurable features that can be tailored to meet narrow needs or even individual needs.

The Old Way

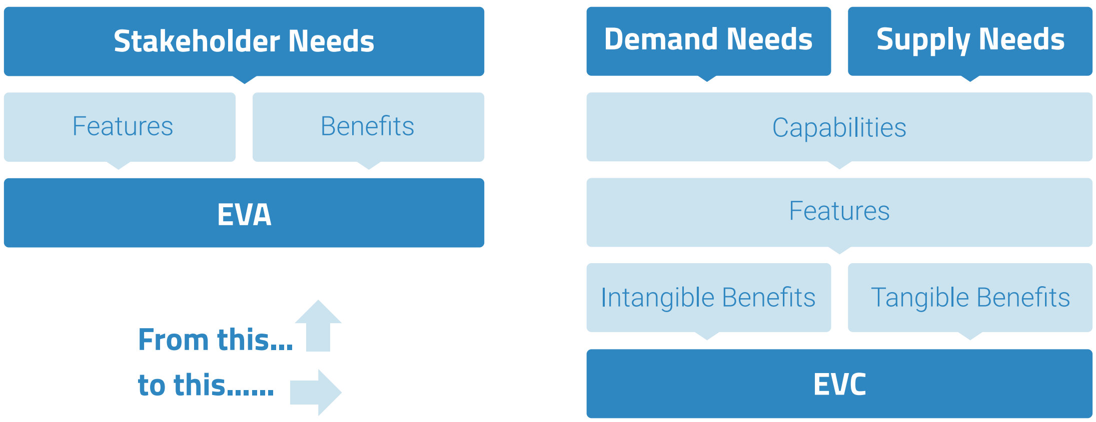
Selecting and integrating disparate systems for smart building applications with core business systems such as enterprise resource planning (ERP) systems and enterprise asset management (EAM) systems that manage IT assets poses two inherent problems. First, it restricts the value proposition mostly to internal customers' needs subjected to tangible cost justification benefits. Second, it requires integration effort, time, and expense which although typically cost justified, it nevertheless lacks agility.

The New Way

Selecting and implementing smart IoT-native systems and products enhances the value proposition in several ways. First, because they can address a wider spectrum of needs for both demand and supply stakeholders. Second, such products have technological capabilities that allow for customizing the features and benefits to satisfy both tangible and intangible benefits for a broad range of stakeholder types. Third, the economic value to the customer (EVC) is the sum of both tangible and intangible value elements and, as such, this method can guide a business on how to best price its product or services.

Hence, the EVC process enables businesses to capture more value than traditional cost-plus pricing strategies. And the value proposition can be mass-customized to narrowly defined customer personas or even down to the individual.

All the above points to a paradigm shift from incremental improvements to breakthrough innovative solutions through a problem-solving approach. Under this approach, the discovery of micro-segmented and individual needs comprises the problem that seeks a tailored solution.



Realizing the Value

Companies can choose to use the transformative power of IoT to achieve various rewards such as creating strategic advantages or improving business processes and necessary tactical efficiencies. Before launching an IoT initiative an enterprise must first clearly define the magnitude of the reward and its value chain – which customers will realize what benefits derived from what capabilities.

Rewards are associated with opportunities that are subject to uncertainty which in turn amplifies risks. This is the reason why major business initiatives require a phased approach starting with proof of concept pilots. Realizing the value is about successful planning and implementing under risk and uncertainty. The business goals for planning the plan and implementing it are intertwined in that one set affects the other. As with any capital investment, IoT projects are subject to risk-reward and are consequently measured on risk-adjusted return on investment.

Risk-Reward Planning Insights

The first step is to evaluate the opportunity that leads to the reward and figuring out how to best maximize the reward. It is necessary to assess the enabling features of the solution as they relate to benefiting the needs of each customer type. Then, organize the enablers in a sequence most synergistic to meeting all the customers' needs. Based on that, prioritize the implementation sequence in the most synergistic manner. It is not unusual that 20% of the enabled features account for 80% of the benefits.

The second step is to minimize the uncertainty of the related assumptions. Even in the most uncertain business environments there are factors that seem unknown but are in fact knowable if the relevant information research and quantitative analysis is done to identify clear trends. The uncertainty that remains after the best possible analysis has been completed is referred to as residual uncertainty and requires qualitative assessment.

The third step is to determine the project scope and the implementation steps and to identify ways to mitigate the severity of implementation risks. Adopt best practices to reduce the severity and likelihood of planning and implementation risks. The biggest controllable planning risk is driven by the selection of fragmented and disparate technologies which in turn drives integration complexity and implementation risk. Mitigating implementation risk calls for a phased approach so that each phase can be effectively managed and controlled with ongoing progress reviews, lessons learned, new challenges, and necessary adjustments to the implementation plan.

Calculated RISKS make the difference between good, better, and best.

Critical Success Factors

Experience has generated industry insights and has taught us best practices. What follows is a summary of eight critical success factors which can significantly improve the odds of success of an IoT project. See Figure X.

1. Value Proposition. Many organizations fall into the trap of not spending enough time and effort upfront to document and communicate the expected outcomes and challenges of the solution for their customers. Before plunging into the development of IoT applications, organizations must set and manage expectations to establish a common understanding of the solution. Of particular importance is what value will be delivered through what capabilities to which customers.

2. Project Planning. Planning an IoT project strategy must take place concurrent with the technology infrastructure assessment. Such planning aims to identify gaps, core skills, tools, and resource requirements. The plan should address these challenges in a phased approach so that each phase can be properly scoped, managed, and controlled on specific objectives, resources, and deliverables. Also, ongoing risk assessment with reviews on progress, lessons learned, new challenges and necessary adjustments to the implementation plan.

3. Technology Infrastructure. In the digital era, most things can be interconnected. However, they may not necessarily interoperable.

According to McKinsey, 40% to 60% of the total value lies on the ability to achieve interoperability between disparate systems and products. Legacy systems requiring more integration to start with, coupled with multiple vendors, service providers, and OEMs make it complex, difficult, and costly to achieve and maintain interoperability.

Currently, half the time and cost of implementing IoT solutions is spent integrating various IoT components with each other and back-end systems. Additionally, complexity drives risk which in turn inhibits success.

Data processing fragmentation is a related critical issue. According to Hubspot, of the 86% business stakeholders who claimed data is integral to their IoT project, only 8% were able to capture and analyze it consistently. The purpose of capturing data from various sources is to transform it to the proper format that can be analyzed and automated.

The antidote to fragmented integration risk is the selection of a vendor with a proven IoT product platform and wide bandwidth of service capabilities.

Critical Success Factors	Planning	Implementing
1. Value Proposition	✓	
2. Project Planning	✓	
3. Technology Infastructure	✓	
4. Change Management	✓	✓
5. Security	✓	✓
6. Technology Development		✓
7. Project Management		✓
8. Value Delivery		✓

Figure X.

Critical Success Factors

4. Change Management. Project success is directly tied to effective involvement of the organization's executives. The number one reason for project failures, according to experts including the Project Management Institute (PMI) and Gartner Group, is because of insufficient executive commitment and sponsorship.

A successful IoT initiative requires a change-management approach. The first element of change management is to identify the problem and the pressing needs for tackling it. The second element is to develop and communicate the vision for how the problem will be addressed, the third element is to mobilize a management coalition team, and the fourth element is to identify and empower an executive champion who will be addressing all stakeholders' concerns.

5. Security. Security has been by far the #1 issue in IoT projects. According to recent research 25% of cyber attacks target IoT devices. Security breaches have affected even Apple which is known for its security claims. Presently, there are about 20 billion connected devices, and integrating them involves complexity and a lot of security risks. Connected devices on a platform need a specific system architecture that identifies, authenticates, and authorizes their use by designated authorized users. Best platforms are those that can provision the devices with secure identity credentials and commission them with end-to-end (E2E) security and multi-factor authentication (MFA) methods.

6. Technology Deployment. Technology deployment depends on the currently available infrastructure. The number of connected devices is growing faster than network coverage capabilities which affects Internet availability and latency, which in turn creates monitoring and tracking problems. The quality of signals collected by sensors and transmitted through ISPs largely depend upon LAN, MAN, and WAN routers and gateways. These networks must be well-connected through different and emerging new technologies like 5G to facilitate responsive and reliable data transmission.

Critical Success Factors

7. Project Management. Implementation is about executing the plan as flawlessly as possible. Project management involves the use of people, processes and methodologies for tactical planning, execution and completion of activities on time and on budget. An essential part is continuous and rigorous monitoring with status reports and timely communication to all project stakeholders. Choosing the right project management methodology or applying a hybrid approach is a vital step for success. There are many methodologies to managing project complexity. Agile, originally adopted within the software development industry uses short development cycles called sprints to focus on continuous but staged improvement. Today agile is utilized in most industries in the development of a product or service.

8. Value Delivery. Value delivery is more than monetizing the value proposition. Specifically, while the value proposition is a solution for intended customers, value delivery is the value the marketplace stakeholders will return to the organization that builds the solution. The IoT can turn on both these value streams as part of a closed loop business model also referred to as a value loop. In their Deloitte Insights article Michael Raynor and Mark Cotteleer articulate how actionable information can create value in a never-ending value loop.

As the writing of this paper coincided with the COVID-19 crisis it stirred new thinking amongst our customers and our team members about the future of the smart building in a brave new world. This rather extraordinary time of uncertainty will most likely lead us to new business norms and models through bold leadership, collaboration, and agility. In our view, now more so than ever, thought leadership can set the direction for extraordinary accomplishments.

In light of the above, this critical success factor is all about foresight, vision, leadership, and leading or adapting to new norms – the most important ingredients for the success of any business endeavor of lasting significance.

Conclusion

About Delphian Systems

Founded in 2010, Delphian Systems LLC (Delphian) is an IoT technology development company focusing on embedded systems that utilize low-power wireless network technology which are fully interoperable with mobile devices. The company employs 50 hardware and software engineers and technologists and has significant IP with multiple patent pending applications since its inception.

Our mission is creating value for our customer partners with innovative IoT product technology that enables market-disruptive business models. Our IoT vision is to dramatically enhance the interaction value between humans and their places by reengineering all place-related processes with automation technology and artificial intelligence enablers.