7 Steps to Business Success on the Internet of Things

@xivelyiot  xively.com

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Executive Summary
The Internet of Things (IoT) promises to do nothing short of revolutionize the way the world does business. The ability to sense and control the physical world through sensor-enabled devices can unlock massive, previously unseen opportunities to expand revenue, optimize operations and delight customers and users. By integrating normally hidden bits of information with business systems, organizations can gain valuable insights that fuel growth and drive intelligent, automated action that transforms businesses (and lives). That’s why, according to research, 76% of businesses plan to use the IoT for internal process optimization and 74% will use it externally to run a connected product or service.¹

It all sounds great in theory, but what about in real life? How can your company turn ideas into vision and tangible reality that helps your business get the most value from the IoT? Doing so today requires understanding how to leverage a seemingly overwhelming set of IoT implementation options across an ever-expanding ecosystem of companies.

In this white paper you will learn:
- What the Internet of Things is and how your business can take advantage of this new revolution
- How to apply IoT technology to a real business case
- A practical process for building an end-to-end connected solutions
- Key design decisions that you will need to make along the way and how they impact your end result
- How Xively by LogMeIn can help accelerate the overall process

¹“The Internet of Things Business Index”, The Economist Intelligence Unit, 2013
Building an IoT-connected solution may appear to be a simple endeavor, where you just connect an object to the Internet and send its data to a mobile application. Unfortunately, most companies that begin building with this perception quickly end up with an un-scalable result that fails to meet even minimum business goals. In reality, the processes and choices involved in creating a successful connected solution require a complex, multi-discipline knowledge-set. To start, you must define and fully comprehend the full potential of your business case. Then, you need to explore a myriad of technology options, and select and apply the most appropriate technologies, including embedded components, connectivity, platforms, applications, clouds and security, as seen below.

It doesn’t end there, however, because truly transformative solutions that deliver exponential value can only be achieved by integrating your IoT solution with key, third-party business services that record and analyze the data flow, then return intelligent, automated responses to the physical business environment. The real art of the Internet of Things lies in orchestrating this network of functionality, from the simple to the complex, through the secure interconnection of connected objects and business systems.

The laundry list of decisions needed to successfully navigate the IoT ecosystem can be daunting, so we have used this paper to lay out an organizational flow of key concepts that your company can use to plan, build and operate connected solutions that provide significant business value.
What is the Internet of Things?

The term “Internet of Things” or IoT is rapidly progressing from an obscure concept known only by futurists and forward-looking developers to C-suite as a key business strategy. So what, exactly is the IoT? Exponential advancements in technology, fueled by the Internet, mobile computing, cloud platforms and an emerging class of small yet powerful processors, have combined with the plunging cost of electronics to create the next great online paradigm. The Internet of Things allows products, applications and services available through the Internet to understand and control almost anything in the physical world through an online system of bidirectional sensors and actuators.

“Things” in the IoT realm can be pretty much any physical object – a machine cutting metal in a warehouse, ECG sensors in your clothing, temperature and light sensors on your window shades, moisture sensors in your garden, and on and on. We are entering an era where we can track and control just about anything centrally as well as have these objects communicate with one another to influence their own actions. The benefits are as limitless as the imagination and will fundamentally change how we discover, understand and interact with our world. Regardless if you call it the Internet of Things, the Industrial Internet or the Internet of Everything, the promise of adding a sensory dimension to our digitally connected lives, locations and businesses has inspired tremendous visions for the future.

Now let’s talk about what it takes to make these visions a reality. Let’s look at each step of the process for building your company’s connected solution.
Building a connected system in the real world

Explore and define a transformative business case
Whether you’re upgrading an existing product, creating something new and revolutionary, or modifying an internal operation, a successful IoT outcome requires thinking through the entire process – from napkin sketch to deployment and management. Don’t just think about how Internet-enabling an object would be a cool idea. Instead, exhaust your imagination considering how unifying the physical world in an interactive manner with business systems can uncover revenue opportunities, streamline your operations or completely change a user or customer experience. The operational optimization and revenue discovery opportunities in predictive maintenance, product feature upgrades, supply chain optimization, device lifecycle management, remote service & support, in addition to other product and operational aspects of your business, are only limited by your imagination. Let’s look at two primary business case categories as well as an example case.

Products & Services for Sale
This category describes a connected good or service that is available as a sellable entity to a third-party, like a consumer or other business, outside of your company. The first step is to investigate the new benefits and pain relievers your company can bring to market through a connected object. Then begin to consider how you can build not only an innovative customer experience, but also an evolved business experience. What efficiencies can be gained or how can you better delight the customer by understanding how and when your product is being used? Are there ways to transform the sales, service and marketing of your products? By integrating these objects into business systems, can you fundamentally change the way your business interacts with customers?

A cloud-connected product allows your customers and your business to acquire real-time insights, predictive analytics, partner network integration, and much more. It also provides the opportunity to transform your business model. Connected solutions can unlock and expand business potential by removing the barriers inhibiting the complete comprehension and control of your customer and business. Continuous, 360-degree interaction with your business-connected objects delivers real-time insights that drive intelligent action.
Internal Operations & Process Optimization

Operations and processes are prime candidates for areas that can be streamlined via the Internet of Things. Connected process use cases abound, including after-sales services, maintenance, goods tracking, fleet management, systems monitoring, etc. Having the operational resiliency to respond to the unexpected instantly puts you ahead of the competition.

A few other questions to consider when devising ways to optimize internal structures by introducing the IoT are:

1. What is your break/fix cycle? Can the IoT reduce that window to save you time and money?

2. What does your business’s chain of custody look like? Can you validate and trace back the root of an operational issue or production pipeline?

3. How can you better understand and manage your supply chain?

4. Are you able to service and support your headless devices from the cloud?

5. What if you could extend the mean time to failure of an object by slowing its use cycle without stopping it, buying time to service it on your schedule?

6. Are there ways you can automate or expedite operational efficiencies by connecting physical objects to business systems via the cloud?

7. Can your Vendor Management and Inventory suppliers be better served by Internet-enabling your machinery? And are you able to automate some of your VMI process by linking this new data to your CRM or ERP system?
Business Case Example: The Connected Lab

The ability to transform a business into a new type of cooperative between vendor, customer and product can have profound effects on all parties involved. Take the case of the connected lab. In this real-world example, a life sciences company produces reagents and enzymes that scientists use to accelerate DNA-based experiments. Originally, the scientists would pre-order their enzymes and reagents, wait for them to be delivered, store and then use them as needed. The company was successful, but it was leaving revenue on the table and not fully satisfying the customers’ needs. The problem was this company had no idea what enzymes labs were using until they called for a freezer refill. They asked themselves the following question: “How can we become more responsive to our customers?”

The company formulated a next-generation business case for expanded revenue opportunities: an Internet-connected freezer that was essentially an enzyme and reagent vending machine. Enter the Internet of Things. Since their products are expensive and need to be temperature-regulated, they used a scientific-grade freezer, connected it to the Internet and created a custom application using a local touch-screen and mobile application. They then went a step further and interconnected it with Salesforce.com Service Cloud and Sales Cloud. Now, when scientists need an enzyme or reagent, they simply unlock the freezer through the application using their personal code and remove the enzymes needed. The freezer then automatically locks. The results have been nothing short of transformational.

Now that the company can store any number of reagents and enzymes on the local site and account for them electronically, they have realized tremendous benefits:

- The ability to offer a more compelling solution to customers through more rapid availability of products needed to accelerate critical experiments.
- Real-time awareness of inventory levels and signals that trigger proactive resupply, ensuring labs have the necessary supplies when needed.
- Expanded product lines in local inventory that address more potential experiments, increasing overall same-site sales.
- Instant understanding of revenue run-rates, contributing to income predictability.
- Integrated recognition of all sales activity by Salesforce.com, including triggering of automated business motion including emails, reports, and more.
- Quicker recognition of revenue.
- Sensors on the freezer allow the company to optimize placement of the device based on traffic patterns.
**Optimized Service**

- By Internet-connecting the freezers and integrating with Salesforce, the service chain became highly optimized as well:
  - Products are only delivered as needed and on an optimized supply route.
  - The freezers themselves are monitored for signs of failure, such as a compressor drawing more power while temperature is climbing, leading to a predictable mean time to failure.
  - Not only can the life sciences company fix the component before it becomes a real issue, the technician knows exactly which parts need to be replaced and how to perform the work, plus the repair truck now contains exactly the right parts needed for the job.
  - Through Salesforce.com Service Cloud integration, the service chain can be automatically scheduled and support tickets can be automatically closed when the component reports a healthy status after being repaired.

**Intuitive (and appreciated) Marketing**

Most unsolicited marketing is seen as either a negative or a necessary evil. However, in this case marketing offers benefits that are actually welcome and appreciated by the customer:

- Usage and sales data collected from the freezers can predict which experiments are being conducted at a particular lab. This information can better inform the company on which enzymes to stock ahead of customer needs.
- The company can market through email or other channels to the customer with information the customer actually needs and finds valuable.
- The automated delivery of these items through Salesforce.com's Marketing Cloud simplifies the acceleration of sales.

Through the power of the Internet of Things and a comprehensive use case, this company has transformed itself. Instead of selling products to customers, it now delivers “enzymes-as-a-service” to users, resulting in increased revenue and a continually optimizing business. Similar benefits can be realized in any business as long as the use case is thoroughly thought out. After you have outlined a key business case, you will need to create a connected object that addresses it.
Boards, Sensors & Actuators
Picking the best hardware for the job can be tricky. First, research and select a development board that fits the computational heft and form factor required to get the job done right. If you’re creating the next big thing in wearables, for example, chances are your product needs a lightweight chip that doesn’t take up a lot of space and keeps the connectivity options to a minimum (i.e., has a Bluetooth module added but no WiFi).

The sensors listening to the world around them also have a say in what board you choose. Computationally light boards may not be able to handle talkative sensors, nor would they be able to handle additional connectivity hardware within the product itself. Having five sensors attached to a device can produce a lot of data that doesn’t necessarily all have to be transmitted to the cloud. If your sensors are data hogs, be sure to pick a board that handles parallel processing of sensor stream data efficiently and can perform local computations with ease. Also, create a strategy for determining optimal computational load payoff between local data compute versus cloud compute. For example, an electrochemical sensor used in a biotech lab may be sending data to its board once every 10 milliseconds. For alerting purposes, code could be written on the board itself, however, a mean value every five seconds may prove sufficient for analytical assessment in the cloud. That said, no matter what the choice, companies like TI, ARM, Atmel, IBM and pretty much every other major chipset manufacturer are moving quickly to build boards and modules fine-tuned for IoT applications.
In tandem with board costs, sensor prices are quickly decreasing and the variety of sensors is increasing. If there’s a physical observation to be made about the world around us, there is likely a sensor for it already on the market. To get the creativity flowing, take a look at the “List of sensors” entry on Wikipedia. Resist the temptation, however, to add more sensors just because you can. Remember your business case, and how gleaning information from a sensor’s data results in happy customers and increased revenue opportunities.

And then there’s power supply. Your sensor, module and chipset choices will determine how big and what kind of power supply you need. Wearables have a small form factor and an even smaller power supply, so be careful about how your product weights the balance of data capability and battery drain. We’ll talk protocols later, but low bandwidth/power consumption protocols like MQTT are becoming increasingly popular due to key issues like power consumption.

There’s one additional sensor-rich object that we haven’t discussed yet – the smartphone. The hardware sitting in your pocket is a treasure trove of sensing capability: accelerometer, gyroscope, magnetometer, barometer, proximity, light, touch, camera, thermometer, etc. Your smartphone is not only a powerful computer with a phone inside, but also an Internet of Things object itself. In this case, you have a highly optimized hardware package with board, chipset, modules, sensors, and application-ready APIs already chosen for you.

Lastly, your product or device may not want to just sense the world around it but may also act upon the data it receives locally (or returned back to the device via the cloud). Often times, actuators are the method for making such machine-based actions happen in the real world. Generally speaking, there are four types of actuators to choose from:

- **Hydraulic actuators** rely on, not shockingly, hydraulic power and a cylinder or fluid monitor to act on some mechanical process.

- **Pneumatic actuators** are similar to hydraulic actuators only they use compressed gas instead of liquid.

- **Electric actuators** are powered by motors that convert electrical energy into mechanical torque.

- **Mechanical actuators** convert rotary motion to linear motion. Still awake? In other words, think gears and pulleys. Screw jacks and rack & pinion actuators are good examples.

A product with any form of actuator can turn sensor-based data into outputs to close the loop between sensing and acting. One could imagine a scenario in which a window shades company attaches a light sensor and linear actuator onto the shade to make it raise and lower depending on the amount of light and time of day. The window shade could also be connected to a larger home automation network that ties in predictive analytics to optimize energy efficiency in a home or office.
One notable IoT feature is its ability to push network capabilities out to the edge. Unfortunately, there are some cases in which it is not beneficial to have devices talking directly to the cloud. Some examples are devices in a manufacturing plant that send important data that is best routed through one central access point, or thousands of lampposts without cellular connectivity sending small data points to a WiFi-enabled piece of hardware first before being shot up to the cloud. There are a number of IoT-ready gateway hardware technologies on the market now. We will simplify them to two major buckets: Bluetooth and Low Power RF.

Bluetooth. Bluetooth and Bluetooth Low Energy are becoming very popular in consumer devices. The proliferation of smartphones with Bluetooth means that just about everyone owns a Bluetooth gateway now. Bluetooth is a good choice if you want direct control through a phone, yet it doesn’t work as well if you want the device to talk out to the Internet and to be globally controllable. Plain vanilla Bluetooth also has less than stellar battery life — about one day of active use and 7 to 10 days of on/off use. The newer Bluetooth Low Energy standard (of which Bluetooth Smart is a part) provides a way for devices to exchange small amounts of information in a very low-power way. BLE is optimized for one-way communication, as in Apple’s iBeacon specification. Since only small amounts of data are being transmitted, BLE devices can survive for up to two years on very small batteries.

Low-Power RF. There are plenty of new standards for doing low-power communication between devices. The major ones currently are ZigBee, Z-Wave, and 6LowPAN. All three of these are part of the 802.15.4 standard of which Bluetooth is also a member. This means that they implement their own radio frequency protocol over one of the ISM bands (usually 2.4GHz for 802.15.4). There is also the option of coming up with your own RF protocol to fit your specific product’s needs. Many manufacturers have taken this approach. This is going to give your device the longest battery life, with some devices lasting up to seven years on a single coin-cell battery. The drawback here is that, just like Bluetooth, these devices do not connect directly to the Internet; they require a gateway connected to the Ethernet, WiFi, or cellular networks. The most common of these are Ethernet gateways, which allow all devices in one house or location to reliably connect to the Internet. Setup is easy since the gateway just needs to be plugged into a router and power is usually not a concern for the reasons mentioned in the Ethernet section above. Another advantage to many of these low-power RF protocols is the ability for devices to mesh network. Mesh networking means that your message can hop multiple times between other devices before reaching the Internet gateway and still make it out the Internet. This makes having lots of devices in one place both powerful and extremely price efficient. 6LowPAN is perhaps the most adept and efficient protocol for this kind of networking.
Your Phone. Again, your smartphone not only allows you to slice fruit like a ninja, but also acts as a collection point for sensor data. As mentioned above, the iBeacon spec makes it possible for Bluetooth-enabled devices to send streams of data to an iPhone before having the data be processed in an app, relayed to the cloud or a combination of the two.

Once you have the hardware taken care of, know your connectivity strategy. How do you want the data to get to the cloud? There are advantages and disadvantages to selecting 3G, 4G, WiFi or Ethernet. It all depends on your use case. Here are some pros and cons of each:

3G/4G/Cellular. Cellular connectivity has been a major part of connecting disparate devices. It’s not just your phone that uses these technologies to connect; cellular networks now cover about 85% of the world. This means that you can connect something almost wherever it is. Cellular bandwidth comes at a high price premium though so low bandwidth protocols like MQTT can really benefit your product here. Cellular radios also consume a lot of power, so be sure this is something that can have a stable power source like mains or solar.

WiFi. WiFi is a technology that has transformed the way people use computers and mobile devices. It has also been the driving form of connectivity for the first wave of consumer-focused IoT devices. Vast improvements have been made in the last couple years that allow WiFi devices to run on battery for months at a time instead of just days or weeks. However, if you are considering WiFi, you still may want to consider main power as at least an option for the device.

Ethernet. Ethernet is the easiest type of connectivity to use, especially in early stage development. For the most part, you plug it in and it just works. The other advantage of Ethernet is that, generally, if you are near an Ethernet port you are also close to main power, so you don’t have to worry about overall power consumption. You also have the option of using Power of Ethernet (PoE). Ethernet is commonly used when you need a gateway for some form of low-power RF.
**Messaging**

Your intelligent objects are ready to connect to the Internet, but how do you get them there, exactly? Despite the lack of industry agreement on a particular protocol, many platforms are moving toward a publish-subscribe or “pub-sub” message broker architecture. Without going into technical details here, the main idea is that publishers can post messages to a broker (server) where subscribers can listen if granted privileges to do so. As of now, the popular communications protocols for IoT platform messaging are MQTT (Message Queuing Telemetry Transport) and WebSockets. Of course, HTTP is also an important protocol for the Internet of Things as it has become the de facto standard for most Internet communication – including “things.” Other competing standards like CoAP (Constrained Application Protocol) and XMPP also have their merits but have yet to see widespread adoption.

**Data Center**

Although storing data in literal clouds sounds pretty fantastic, the reality is that you’ll need a highly robust data center to handle all of that highly valuable device data coming in. There are two options here. First, you could go with a cloud platform like AWS or Azure that gives you a known feature list fit for redundancy and security. Or you can build your own data center, but this obviously requires an entire series of documentation to begin a discussion on this topic.

**API**

To make it easy for your developers to write applications for talking to and hearing back from devices, it’s important to have an API. Also, if you plan to benefit from the numerous partner channels that the IoT will open, you’ll need to share an API with them in order to allow access to your data. Obviously, you can pick and choose what types of information to share with partners and vendors based on the reciprocated benefits.

**Security**

Security is the number one concern that businesses have with deploying IoT technologies today.² A recent Forrester report lists three important security and privacy matters worth considering: 1) protecting any connected assets from attacks, 2) protecting asset data from misuse, and 3) protecting a customer’s data being sent to the cloud for viewing or processing. End-to-end security using industry-standard symmetric data encryption (TLS, SSL) protects your connected device’s communications channels as well as fine-grained permissioning (API keys).

Right now, most IoT devices depend on existing security standards like SSL. Encrypting the communication path between the device and server, then the server and application, will decrease attack vectors. We have yet to see a new security paradigm for IoT but one certainly may emerge.

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² “Mapping the Connected World.” Forrester report by Christopher Mines and Michele Pelino, 10/31/2013.
Once a device is successfully and securely publishing data to a data center, its data needs to be stored somewhere. There are distributed database management systems like Apache Cassandra that make storing large amounts of data easier. The two main types of data that are sent to the cloud are time series data points and blob files. Sensor data is inherently time-focused, so storing and handling incoming streams of time-stamped data points are essential. In fact, the lack of real-time data handling in the cloud has been an issue for many cloud services such as AWS, yet Amazon and others are beginning to release platforms that are able to process data streaming from IoT products.

Who is using what device? What permissions do they have to access what sensors on that device? Which users can talk to groups of devices with different action queues? Managing administrators and other user accounts gets complicated quickly with connected devices. There are an infinite number of grouping configurations one can think of to manage everything in one place. For example, let’s say Bob manages a large conference space with thousands of connected light bulbs and window shades. Bob may have access to turn lights on and off in addition to allowing Gary, the shades technician, to have access to only certain actuator controls of the shades but not the lights. And Gary may only have access to shade motor health with the application provided to him for his tablet. Building this sort of accounts and grouping management system makes life far easier for all parties involved, and also protects your company from unauthorized attempts to tamper with device information from a security standpoint.

One area of potential concern is the possibility to extract keys from a device’s memory. This is an edge case but can be hard to protect against. One approach to prevent attacks from this is to only use keys with very fine-grained permissions. For example, a device’s key only has access to that device’s data, and perhaps only has permission to take specific actions on that data. This device, then, may only have the ability to READ and UPDATE data as opposed to also possessing DELETE permissions.

Another matter of security not discussed by Forrester is the issue of compliance. Do you need to consider HIPAA, PCI DSS, ISO, SSAE16/SAS70 or other certifications? Also, be sure to bring IT into the conversation from day one to make sure you’re aware of any outbound firewall issues that may arise from sending data via MQTT or other IoT protocols.

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It’s probably clear that building the infrastructure for sending sensor data to the cloud is no small feat. If you want to rely on the experts for an IoT platform instead of taking the DIY approach there are some things to consider. The number of IoT platforms continues to grow, so it’s important to know the capabilities and limitations of each. Some platforms are very vertical-specific while others may use proprietary software that makes them difficult to update firmware in an efficient, agile manner.
No matter how advanced the technology in your devices and sensors may be, what the vast majority of users care about is the application that lets them view information and make decisions based on what they see. Creating both end-user and internal operations connected device applications can open recurring revenue opportunities and elucidate new insights into your user base and operations health.

**End User Apps**

For development of either B2B- or B2C-facing products, know your customers and how they consume information. Are they desktop, laptop, tablet or smartphone users? Do they prefer web, iOS, Android or Windows apps? OS decisions also influence API development and what your partners can and cannot support. Application hosting platforms such as Heroku can also play an important role in how you run the application.

As for what your app content contains, again, listen to your users. Your company could conceivably create a number of different Line of Business apps – be it for consumers, vendors, or partners. No matter the end user, it comes as no surprise that we are already overwhelmed with information, so instead of adding to that deluge with exponentially increasing amounts of IoT data, determine what processed or chosen information matters most to the user. More data often makes for more confusion...unless, of course, the app is targeted at users that require as much device detail as possible.

**Operations Apps**

Provisioning product devices as well as handling the lifecycle of a device are both key components of any OEM. This becomes even more important with connected products. Handing off a device to the end user requires knowing a device ID and user credentials in order to have access to that device and likely an application displaying information coming from it. Also, knowing the state of a device (active, not active, etc.) can help determine the next part of the equation – lifecycle management. This can be tracked from the warehouse creation date to the onboarding process along with permissioning between other devices, users, queues, and applications.

What about devices tracking data for internal operations? Building apps for your team that allow them to connect aspects of the business that weren’t possible in the past is a major advantage of the IoT. The ability to visualize data coming from sensors on warehouse equipment, supply chains or basic infrastructure can save a company orders of magnitude in bottom-line costs. Device data can also be connected with other business systems, which will be discussed a bit later.
Never underestimate the importance of user experience. Once you have a connected product or operation, it needs to be intuitive and utilizable by the end user. With the proliferation and variety of smartphone apps available today, consumers expect a higher UI/UX standard that fits the innovation you’re bringing to market.

**Some key app creation questions to answer are:**

- Do you buy, build, or outsource your app?
- Do you need to build a web, mobile, or custom internal app?
- Is your app built on Heroku, AWS, or your own secret server sauce?
- Can you benefit from app builder tools from companies like ThingWorx or Phonegap?

**A few UX questions to consider depend on who the end user is:**

- For customers – Do they need to register, activate and operate their connected product with this app? Are there existing services from your company that customers need to interact with as well?
- For service teams – What support and service app model considerations should you consider so that your team can improve service delivery?
- For internal monitoring – Can you build an app from scratch or will you be integrating connected device content into existing systems?

It’s important to answer or at least think about the above questions while you are still in the early stages of your hardware and firmware development. Make sure that you have the tools and options needed in your hardware to deliver the right features to your end users.
Companies use 3rd party software in their business systems to handle sales order processing, accounting, HR, time and materials billing, security systems, service, support, vendor management and countless other services. What if you could transform your business by connecting existing systems with real-time data from products used by customers or information streaming from office, farm, refinery, utilities and warehouse equipment? Moving beyond machine-to-machine communication by publishing and subscribing data to the cloud expands the opportunity to tie in just about any information to existing software used in your business.

Deep integration of connected products, services and processes into line of business applications can bring far greater visibility into your organization from top to bottom. This includes everything from manufacturing and inventory ERPs (SAP) to marketing and sales CRMs (Salesforce) to support (Salesforce Service Cloud) and logistics (Fleetmatics).

For example, an arcade might want real-time updates in Salesforce of how much each pinball machine is contributing to its total revenue stream. By creating a custom Salesforce app directly linked to your connected product data, Mr. Pinball could now track sales in real-time or call a technician via Service Cloud when a game malfunctions.

In addition, CRM integration is a great thing to add to your end-user application. It gives sales, marketing, and service employees a better look into your product and business motion. Practically speaking, this looks like improved service delivery, understanding feature usage patterns, real-time preventative maintenance, etc. So while your front-end application might let users set the temperature of their thermostat, you could integrate with Salesforce to monitor which thermostats are online, what features are used most commonly, and if people are having a good experience with the product.

For OEMs, customer support normally entails shipping the product back to the manufacturer to troubleshoot or driving to a retail store where the customer waits in long lines to talk with an expert. What if you could remotely access a customer’s device and troubleshoot it in real-time? Internet-connected products make this possible. Again, your ERP support system would be able to nicely integrate into this process as well.
Whether you want to call it Business Intelligence, Predictive Analytics, Big Data, Machine Learning or some mix of them all, the fact is that connected devices introduce a new realm of data to be explored. Let’s break down a few categories based on the functional relevance to your business:

**Reporting**

A simple plot of incoming activity can go a long way to help visualize trends in your data. The number of vendors offering cloud reporting tools is growing daily, so it’s important to know what your reporting needs are before choosing. Do you need Excel or CSV export functionality? Do you need data pushed directly to your CRM or ERP? What types of plots help you tell your data’s story?

**Filtering**

No matter how good your data looks, there are always outliers that need to be weeded out and smoothed. Leaving your data unfiltered can sometimes render bad results, so it’s important to add triggers or more complex code into your system to handle different conditions in your data.

**Exploring**

The more data points you collect from your devices, the harder it is to see the forest for the trees. Data deluge is a huge issue in Big Data, but there are simple things you can do to find clusters of content or trends in your data. Even basic algorithms can illuminate new ideas in your products or operations that you would never have noticed by simply “eyeballing” your data.

**Acting**

Collecting device information in the cloud is just one piece of the puzzle. What if you want to take a certain action based on a particular data point, or time series trend, coming from your device? The ability to not just view but respond to variable conditions can set you apart from the competition and open up new possibilities for how customers interact with your product. This requires knowing what rules and triggers should be created ahead of time to send action requirements to an actuator, device or user.

**Predicting**

This is similar to taking action, but focuses on the fact that you can use past data to make decisions about a current or future state in your data. Machine learning and artificial intelligence algorithms are commonplace now in many database-driven or other types of cloud-based systems. Predictive analytics and actions can be an integral part of anything from staying ahead of break/fix cycles in a manufacturing plant to predicting the best time to go running based on data from your internet-connected wearables.
Ongoing support and maintenance of these systems are an important part of any connected solution. In some cases the lifespan of these systems can range from months to years. Your company must think through the systems needed to ensure your solutions not only stay up and running but are able to be fixed with minimal effort, while minimizing any direct human servicing. Some of the questions you need to ask include:

- Will this object be physically accessible over time?
- Is it part of a larger system that will be difficult to access or impossible to send in for service?
- How often would you expect the firmware needs to be updated?
- What happens if the system is running but unresponsive?
- Is remote servicing important?
- Can a user interact with the system and with support at the same time?
- Will this be a headless device or something that has a visual interface?

The point is to make sure you clearly think through the support and maintenance scenarios then build or buy and integrate a solution to meet these needs.
How Xively Accelerates Business Transformation

As seen in the preceding pages, building a successful connected product, service or operational process requires you to thoroughly think through the business case then navigate a vast ecosystem of partners, vendors, hardware decisions, and protocol choices. Unfortunately, customers must then build the majority of the functionality themselves. This causes them to go-to-market much more slowly and at greater cost. However, Xively can help accelerate many of these areas through our award-winning line of solutions.

Identify a Business Case
Xively’s business services team has worked with customers in every industry to move them beyond talking technology to determining the best avenue for rethinking their business model and go-to-market strategy in a connected world. Our team of strategy consultants and system architects has deep experience in the multi-discipline requirements and process of building a connected solution. Xively’s unique “Business First” approach helps you first understand and define your business objectives, and then design powerful connected solutions to meet or exceed those objectives.

We take you through the process of connecting, optimizing, transforming, and interconnecting your solution to achieve optimal business impact. In order to accelerate business value, Xively can help customers:

1) Envision a solution that scales and grows with your business.
2) Quickly build a proof of concept to acid-test your ideas with real life working prototypes.
3) Work through the numerous kinks of launching a pilot project.
4) Launch a full-scale connected solution at scale.
5) Maintain and support a connected product or solution over the course of the device’s lifecycle.
Create a Connected Object

Even though Xively does not sell hardware, we have a vibrant, global ecosystem of companies that have Xively connections built in. We have partnered with chipset vendors such as ARM and Atmel to create jumpstart kits that make it extremely simple to connect to Xively Cloud Services in a matter of minutes. Xively offers a number of tutorials and library support for a variety of board manufacturers to get you up and running fast. Our team of geeks also has expansive knowledge on sensor, protocol, logic distribution, and OS support to make sure you select the right hardware combination for your particular use case.

As for gateways, Xively is hardware agnostic, which makes it easy for us to integrate nicely with popular low-power RF options such as ZigBee and Z-Wave, or beacon hardware like Estimote. We also work with numerous carrier networks and telecomm service providers to ensure data gets to Xively Cloud Services efficiently.

Build the Infrastructure

As discussed earlier, there are two main choices for infrastructure – you either build it yourself or go with an IoT platform. The former choice requires countless man-hours and decision points that immediately rule out the DIY approach. Connected solutions require a laundry list of services requiring countless lines of code. Xively Cloud Services offers the following to make the process simple:

- Storage for handling archived time-series and blob data
- Messaging and routing protocols that can accommodate real-time device data
- Infrastructure & Application Security that addresses secure cloud handling of consumer or operations data
- Trust Engine for secure permissioning from messaging to infrastructure
- A Directory that is searchable and able to set varied permissions based on object or group properties
- Management of users and devices in a web interface for admins and other users
- APIs that allows for easy access of data based on standard messaging protocols by way of public RESTful APIs, HTTP, HTTPS, MQTT, etc.
- Analysis & automation to build business intelligence dashboards, reporting, basic analytics, predictive analytics, and even automated action and response
Create Applications
Xively’s team has helped customers build both line-of-business and operations apps of every variety. Our application development team creates custom applications to monitor, manage, remotely update and control your business’ connected devices or solutions. Beyond basic functionality, custom applications can make intelligent, automated decisions based on analysis of system or environmental conditions.

Business System Integration
This is where the IoT truly shines – when products connect and integrate throughout every facet of an organization. Whether your business is running SAP, Oracle, Sage, Microsoft or any other back office system (ERP, CRM, etc.), integrating your connected product or service can unlock exponential benefits almost immediately. Xively integration consultants have been working to integrate connected products into ERP systems for many years. Xively also has strategically partnered with 3rd party software providers that provide industry-specific IoT integration knowledge.

Drive Business Transformation with Analytics & Automation
Having a nonstop stream of data coming in across numerous sensors from hundreds, thousands or even millions of devices and applications can be a paralyzing thought. The Internet of Things is creating a deluge of Little Data amassed over a vast number of devices and time periods – all adding up to become a very different kind of real-time Big Data problem. Once you realize how quick and simple it is to connect devices to Xively, the next logical step is to think, “What can I do with all this new information”? Finding new insights with advanced machine learning or statistical methods are the means by which predictive maintenance goes from being a theoretical idea to actual, actionable outputs from Bayesian or neural network clustering algorithms running in real-time on your data. Now you can close the feedback loop by automating action both to and from devices and apps. Xively has extensive knowledge in event-based triggering, analytics, and advanced neural networks and machine learning algorithms to create the most effective strategy for creating meaning out of IoT data.
Service and Support
Xively's open approach unifies the best of breed solutions across the connected product stack allowing many options for support and maintenance. This includes LogMeIn products such as BoldChat and Rescue. With LogMeIn BoldChat, you can integrate real-time chat support into your connected solution, whether it’s in the object itself (provided there is a UI) or in the user facing application, providing a quick lifeline to direct support. LogMeIn Rescue is a powerful remote support tool that allows a support technician to remote control and repair an IoT based connected object or application, exponentially increasing the reach of your support. Both solutions accelerate the creation of a successful support capability in your connected solution.
Conclusion

It's clear that building a successful IoT-enabled product requires far more than just a Raspberry Pi, a sensor, and an iPhone app. This is a great place to start, but to really transform your business you'll need to think through your business cases and then support the strategy with platforms, business intelligence, CRM integration, and other partners that work together to provide a comprehensive connected solution instead of just a connected object.

Despite how complicated the entire process appears at first glance, Xively works collaboratively with you to accelerate an end-to-end solution, unlocking unseen business opportunities that expand revenue, optimize operations and delight customers and users.

So are you ready to transform your business? **Let's get started!**

**Contact Xively:**
Email - sales@xively.com
Phone - 866-478-1812