Understanding How the Internet of Things will Transform Business

FROST & SULLIVAN

A Frost & Sullivan White Paper

contents

INTRODUCTION

The Internet of Things (IoT) is a concept that has emerged from a vision of an always connected world. The goal: seamless connectivity among devices anywhere, anytime, and in any conditions to improve living standards and create new business efficiencies and opportunities in retail, healthcare, logistics, buildings, energy, cities, and the home. A recent Frost & Sullivan survey of more than 1,100 IT decision makers around the world found that the Internet of Things is the top Mega Trend priority for them and their organizations.[1]

The Internet of Things can deliver significant, measurable benefits. It can help cities and companies increase environmental efficiency and reduce carbon footprints. It can help businesses utilize assets more efficiently and in a more innovative way to bring in new services to the market–resulting in additional revenue streams. It can help employees better do their jobs on a day-to-day basis. It can enable managers to ensure best practices are fully in force. And it can transform the experience of customers and consumers.

Companies that leverage the huge amount of information available today and in the near future–combining smart sensors, mobile devices and other technology–will improve decision making and enable the accurate delivery of advanced functionality like predictive insights. Pervasive, or ubiquitous, computing is gradually helping technologists worldwide to realize the IoT vision.

This paper will outline the value of the Internet of Things, highlight several key use cases, address the issues of privacy and security, and offer best practices for achieving success.

80 Billion Connected Devices by 2020

5 Billion Internet Users by 2020

500 Devices with Unique Digital IDs Per Square Kilometre by 2020

$100 ZB Big Data by 2020

$100 Billion Embedded Computing Ecosystem Market by 2020

$111 Billion Connected Home Market by 2020

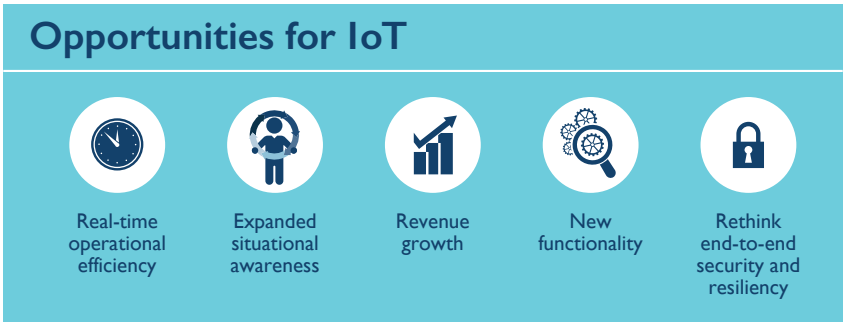
$228 Billion Connected Work Market by 2020

$1.5 Trillion Smart Cities Market by 2020

1 Mega Trends are global, sustained, and macro-economic forces of development that are transformational to business, economy, society, cultures, and personal lives, thereby defining our future world and its increasing pace of change.

THE INTERSECTION OF DATA AND DEVICES

Now that Internet connectivity is effectively ubiquitous, the ability to network any and all devices is closer to becoming a reality. Whether we are discussing traditional productivity endpoints like PCs, smartphones, and tablets, or other common devices, such as vehicles, thermostats, appliances, medical equipment, and manufacturing tools, the Internet of Things aims to make everyone more productive by connecting "things" to the Internet in order to leverage data, improve and speed-up decision making, and take advantage of opportunities as soon as they arise.



The Internet of Things is happening today, in businesses, homes, and government offices around the world. A recent survey of more than 1,100 worldwide IT decision makers revealed that 25% of respondents believe the Internet of Things is the most important Mega Trend for them to focus on over the next several years, tied only with Big Data (which it overlaps with), and well ahead of Mobility, Green Initiatives, and Bring Your Own Technology.

Not surprisingly, mobile devices and data analytics tools are considered to be the most valuable technologies when it comes to enabling the Internet of Things. Furthermore, 70% of respondents say the benefits of the Internet of Things include a better customer experience, followed by faster decision making, reduced costs, improved agility, and global competitiveness.

Achieved Benefits for the Internet of Things -
Strongly Agree/Somewhat Agree Responses:
NA, Europe, and Latin America, 2014

Of course, like any new trend, the Internet of Things is not without its challenges. IT decision makers are most concerned with employee education, followed by identifying and accessing needed skill sets, and aligning business goals with IT. These are common roadblocks to many new initiatives, and Frost & Sullivan strongly believes they can be overcome with thoughtful and careful planning.

More important, concerns should develop around privacy and security as organizations fully embrace the Internet of Things. We discuss strategies for managing those very real concerns below.

> The IoT is a decentralized network of objects, applications, and services that can sense, log, interpret, communicate, process, and act on a variety of information or control devices in the physical world.
> –The President's National Security Telecommunications Advisory Committee.

IOT: KEY USE CASES

The Internet of Things is already being used in a wide variety of industries, educational institutions, and government agencies. There are six key areas in which leading-edge organizations are benefiting from this new trend. Not all will apply to every business or organization, but many do; even if they do not appear, at first glance, to be core to the mission, they can nevertheless save money, improve decision making, and contribute to better outcomes.

Public Safety

Frost & Sullivan research reveals that the transformation of so-called "safe cities" has been dramatic over the past several years. An area that was once limited to communications, and which then layered on video and unified communications (including visual mapping and the integration of IT with operations), is now fully positioned to leverage the Internet of Things to use Big Data analytics and broadband communications to improve outcomes for citizens and employees alike. The goals are to improve situational awareness, enable better decision making, deliver an increased force multiplier, and decrease operating costs.

When assessing threats, the most important issues are immediate identification, accurate assessments, and robust response. But day-to-day activities can also be improved upon with the careful and thoughtful use of the Internet of Things. As a result, the range of sensors and devices associated with the IoT and public safety is large and varied, and includes bio-monitoring, integrated display glasses, body cameras, environmental sensors, gun holster sensors, communications devices (smartphones, tablets), GPS tracking devices, in-car computers, facial-recognition software, and much more.

> Of the 15.4 million cameras deployed to police officers in 2024, 78% will be IP-enabled

Today, not all those devices can stream data, but Frost & Sullivan expects them to do so in the very near future. Our research shows that today, among the 15.2 million frontline officers working on a global basis, there are 5.5 million IP-enabled devices; by 2024, there will be 16.8 million frontline offers using 20.7 million

IP-enabled devices. Key trends driving this enormous growth include the desire to give officers better real-time access to relevant information to facilitate response and situational awareness; improvements in officer reaction times; device convergence; and citizen protection.

Similarly, the trend is toward turning police cars into mobile offices. Frost & Sullivan predicts that by 2024, there will be 1.3 million law enforcement vehicles on the road worldwide, and they will be connected to 3.6 million IP-enabled devices. By 2020, top-tier countries will have 100% of their cars connected to an average of eight devices each.

Best Practices Recommendation: *Cities and public safety departments should leverage wearable technology and IP-enabled devices to improve relations with the citizens they serve, as well as drive better outcomes around crime, terrorism, and overall safety. They should connect these to back-end networks and other data sources, leveraging data visualization techniques, so that officers on the ground and their commanders back at HQ can take immediate advantage of real-time data, and so that all in-field information is archived and recorded for later use. They should also use digital signage to communicate with their constituents, using road signs, building information systems, and other public screens to convey information on traffic volumes, wait times, policy and procedural changes, etc.*

Four Critical Components for the IoT

The Internet of Things requires certain technologies to be in place in order to work. These include:

- **Sensors:** Sensors are critical for the IoT, since they are the first line of data detection. Small, versatile, and able to withstand the conditions in which they operate, sensors can be rigged to detect very specific information, and then connect wirelessly to a network to share that data with the appropriate app or back-end system. Sensors can be embedded in almost anything: appliances, machinery, vehicles, parts and materials, road surfaces, screens, packaging, pallets, medical devices and equipment, power supplies–really, anything that might need to track temperature, moisture, pressure, motion, and other sensory input.

- **Mobile devices and apps:** Many users of the IoT will rely on smartphones and tablets to leverage the data in apps on the fly. For instance, a plant manager can use an app on a smartphone to monitor the environment in a given location (checking for temperature, moisture, and other factors that could affect production), and keep tabs on whether machines and personnel are operating properly and productively.

- **Smart networks:** Not surprisingly, the Internet of Things requires that "things" be connected to the Internet. Frost & Sullivan research estimates that the number of global mobile enterprise connections will grow from 885 million in 2015 to 2.6 billion in 2025. But for those connections to be meaningful, they must leverage a so-called intelligent network: one that has diagnostics, management, fault tolerance, and other capabilities to keep it running at peak performance in response to real-time usage and information. IoT devices are also designed to require relatively little bandwidth and power, and to interface with a mesh network–that is, a decentralized network that connects one node to several others, rather than to a centralized switch; this ensures self-healing and reliability, and is necessary for the types of environments the IoT will run in (i.e., everywhere, over a large area).

- **Digital signage:** Digital signage has been around for years, of course, but when connected to the IoT these communications devices can be both more accurate and interactive. By relying on automated, real-time information to deliver messages via text, images, and video, digital signs can offer up-to-date information for both consumers and employees. These can include alerts and notifications, information on changes in plans or activities, instructions for getting business done, and new offers and opportunities. For instance, traffic signs can automatically update based on weather conditions, volume, accidents, and construction; airport monitors can offer up-to-the-second information on delays, cancellations, and gate changes; and manufacturing plants can screen directions about what is being produced that hour or day, to what degree and in what configuration, based on real-time customer requirements.

Fleet Management and Transportation

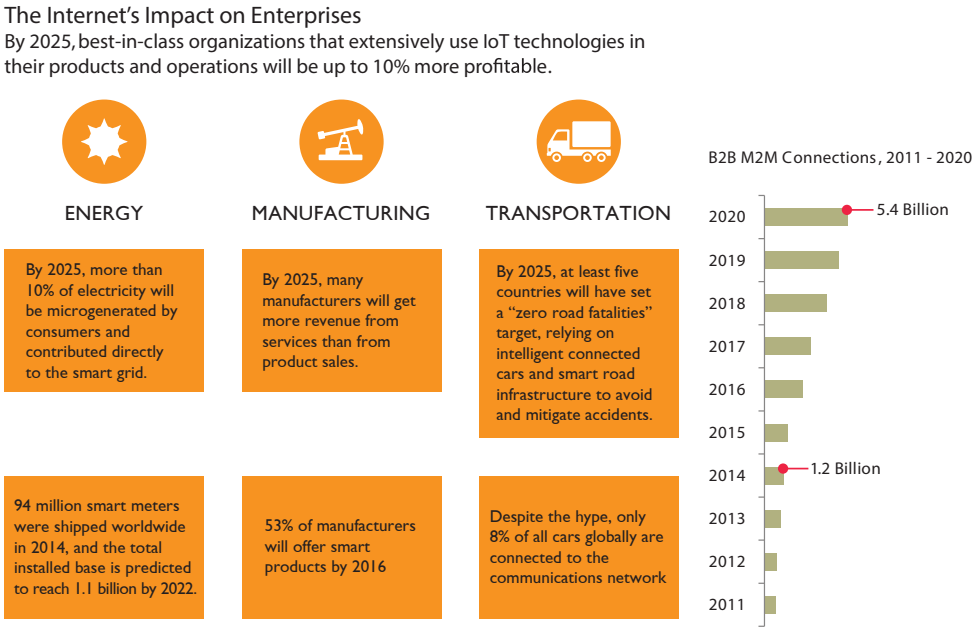
The Internet of Things offers significant benefits to both public transportation and private fleet management. By connecting vehicles and drivers to the Internet, and leveraging data such as traffic updates, road conditions, passenger demand, and freight loads, transit managers can track resources and alter systems automatically.

For instance, GPS technology allows managers to see whether truckers are maintaining pre-determined routes, taking mandatory rest breaks, and delivering their goods on time. But they can also use the tools to alert drivers to impending weather, real-time traffic jams, and changes in pick-ups or drop-offs that require a new routing system for maximum efficiency. Likewise, public transit managers can leverage sensors in vehicles and at bus and train stops to monitor ridership levels, adding new buses and train cars as needed to meet demand; and they can use GPS and other technology to track on-time performance.

The Internet of Things can also help with fleet maintenance and management. In-vehicle sensors can alert managers to needed engine maintenance and repairs, then connect to fleet-management software that is intelligent enough to take those vehicles offline and schedule them for the necessary work in a timely manner. Sensors can also transmit information on less-critical vehicle components, such as luggage and bike racks, on-board payment systems, handicapped-accessible equipment, and so on. And they can track the usage of such features, letting managers know peak times for cyclists, or that a certain wheelchair-bound user boards every weekday at 8:57 a.m.–information they can then use to make fleet, routing, and even personnel decisions.

Sensors can also report on driver behavior, indicating whether someone is speeding or otherwise driving recklessly; obeying all rules of the road and customer-service requirements; and collecting payments as required.

Finally, transportation companies can leverage the Internet of Things to enter (or bolster their presence in) the logistics market. By leveraging RFID sensors on pallets and even single items (or bulk packages), trucking companies can better track what's where, when it was delivered, and even what happened to it once it was removed from the truck, ship, or train car. This can help them better plan their groupings, routings, and personnel needs, and dramatically improve the customer experience.



Source: Verizon

Best Practices Recommendation: *Private logistics and transportation companies, as well as any business with an in-house fleet, should use IoT to maximize the efficiency of their operations by tracking routes based on real-time traffic data, updating assignments based on changes in customer orders and behaviors, monitoring drivers for compliance purposes, and for vehicle maintenance needs. Data visualization can help employees and managers make the most efficient analysis and use of the information. Public transit system managers and elected officials should act immediately to leverage the IoT to better serve their customers. This should include adding sensors to all buses, trains, and other vehicles to track movement, updating schedules in real time, monitoring driver and passenger behavior, and managing maintenance and other issues; and then making that data available to employees and the public as appropriate via digital signage at stops and stations, and apps for mobile devices.*

Asset Tracking and Tracing

The Internet of Things can deliver advanced capabilities for facilities and enterprise asset management, including predictive maintenance, facilities planning, inventory optimization, and better operational decision making, all in real time. By taking into account up-to-date information on production, plant conditions, staffing, customer needs, and likely swings in demand, IoT analytics can help managers identify ways to increase asset utilization, reliability and productivity; mitigate risk; and increase operational efficiency. Better managing physical assets can also improve safety, compliance, sustainability, and corporate responsibility.

> The Internet of Things relies on three key types of analysis: descriptive (alerts), predictive (flagging problems), and prescriptive (offering solutions).

Asset-intensive businesses need to understand exactly where their equipment and devices are, how they are being used, and whether they are encountering any problems. Often, this needs to be done automatically, because the environment in which the assets operate is itself devoid of people. Those employees that do work on production floors are often tasked with monitoring and management to begin with, and giving them better, real-time data into the equipment and materials they are responsible for improves productivity, safety, and outcomes.

Furthermore, in asset-heavy environments, the assets are often the reason for accidents, spills, and manufacturing mistakes; having up-to-date information on their viability and performance can reduce such risks, protecting employees, neighbors, and the company itself. And by monitoring such data as energy usage and waste, companies can ensure they are reducing their carbon footprint while saving money.

But other businesses and organizations can benefit from applying the Internet of Things to assets as well. Office managers can use the Internet of Things to better track and trace PCs, desktop phones, mobile devices, and even furniture and supplies. Retailers can apply analytics to their in-store devices, including bar-code scanners, registers, tools, and heavy equipment. Service managers can leverage the Internet of Things to keep track of vehicles out on call, as well as whether service personnel have the necessary materials and equipment for a particular job.

Finally, the various branches of the armed services can benefit enormously from applying the Internet of Things to asset tracking and tracing–both on the home front and on the battlefield. The US military is one of the largest logistics organizations in the world, moving everything from heavy equipment and a wide variety of vehicles, to food and other basic supplies, to ordnance, weapons and other materials of battle. Being able to track all those assets from a central command-and-control location–and with the express purpose of responding to changes on the fly, based on everything from weather and conditions on the ground to deployment schedules and the realities of war–will ensure that the fighting forces have what they need, when they need it, and that everything will work as promised.

Best Practices Recommendation: *Think outside the box when it comes to asset tracking with IoT. RFID chips can deliver basic data on almost anything, and sensors can tell you not just where an asset is, but also how it is being used, whether it is in good working order, and when you need to replace it. Data visualization can help everyone from plant and retail-floor employees to executives at HQ monitor and react to real-time data and trends.*

Payment (POS, Vending, ATM, Parking Meters)

Wearable tech and the ubiquity of mobile devices are driving a significant change in payments, affecting Point of Sale (POS) systems, vending machines, meters, banking, and more. In this arena, the Internet of Things goes well beyond swiping a credit card on a mobile device or using a pre-defined payment system like PayPal; instead, payments can be made from a digital wallet, a chip embedded in a ticket or pass, or a smart watch or other devices.

In many cases, applying the Internet of Things to payments means consumers don't even have to take anything out of their pocket or purse, scan a device or card, or in any other way "authorize" a payment; the embedded chip simply talks to the POS application and makes a secure connection. Likewise, chips embedded in tickets allow users to skip lines and walk right onto a ski lift or other attraction, without having to display, remove, or scan their pass; and cars and even bicycles can be embedded to enable toll payments without stopping or having to pre-purchase a device specific to any one region or transit authority.

But forward thinkers are also devising new approaches to payment, thanks to the Internet of Things. For instance, smart electric, water, and gas meters with embedded chips allow users to pay their utility bills automatically, at regular intervals, while also taking advantage of information to save money by reducing their energy use. Health clubs and other membership-based businesses will be able to charge people based on their actual usage by using chips that register with exercise machines during use. And restaurants can let diners leave the table without ever having to see or handle the bill by embedding payment into a tablet or smartphone app and charging diners as soon as they electronically place their orders.

> By 2025, best-in-class organizations that extensively use IoT technologies in their products and operations will be up to 10% more profitable.

Even retailers can get into the game by allowing customers to download an app to their phones, watches or other wearable tech, and then registering them as soon as they enter the store. If the customer decides to purchase an item, all he has to do is walk it out the door—the system will automatically charge his account for the payment, sending an eReceipt via text or email as desired.

Best Practice Recommendation: *Make it easy for your customers to make payments for your goods and services by enabling smart payments. Start with mobile devices and wearable tech by teaming up with third-party payment providers. Then, branch out to payment methods that are specific to your business. Hotels can enable room keys to act as payment mechanisms with a single swipe; amusement parks and other attractions can link tickets to credit cards to enable food and souvenir purchases; and cities can attach transit passes to bank or credit-card accounts to allow users to use a single card to pay for all government services. Meanwhile, consider the ways in which digital signage—on everything from parking meters to turnstiles—can ease customer interactions by supplying up-to-date information on wait times, prices, new services and offers, etc.*

Remote Monitoring and Control

For several industries, remote monitoring and control offers one of the most exciting use cases for the Internet of Things. This is especially true in manufacturing and healthcare, where plant managers and caregivers are not always located in the same place as the device that needs monitoring.

In a manufacturing environment, the IoT allows plant managers to continuously monitor and respond to performance metrics, productivity, equipment failures, personnel issues, and so on without having to be on the production floor–or even in the facility at all. By leveraging the data provided by sensors throughout the manufacturing process–monitoring equipment, materials, processes, environment, and personnel–companies can cut costs and drive productivity in response to real-time information.

Likewise, physicians and nurses can use the Internet of Things to better monitor and treat patients, inside the hospital or office and at home. By connecting device data with other information–including medications currently being taken, diet and exercise, blood pressure and temperature, and other factors–doctors can ensure their patients are receiving the best treatment for their particular needs. Furthermore, wearable technology that transmits information on insulin levels or white blood cell counts can help physicians better monitor and care for patients, even after they've been discharged or have left the office.

Finally, organizations should think outside the box when it comes to remote monitoring and control. Consider a military organization: remote sensors and GPS devices embedded in uniforms, helmets, and weapons can help commanders monitor the action from behind the front lines, dictating changes on the fly in response to real-time information. Such information could also help technicians fix problems in the field (with malfunctioning weapons and tanks, for instance), and even integrate remote-controlled devices with a human-led attack. Finally, troops could search for missing comrades using GPS and other data, as well as better understand what happened in a given firefight based on data transmitted from the soldiers involved and their weapons and on-board technology.

Best Practice Recommendation: *Work with your legal team to set clear policies around monitoring, especially when it involves off-duty employees, or employees who may be on call or using their personal devices or vehicles to get business done. Data visualization tools make it easier for employees to digest complex information, especially when it comes to interpreting and acting on trends, patterns, and exceptions.*

Smart Energy

Applying the Internet of Things to energy should be done on two planes: meters and the grid itself. Most readers are likely familiar with the idea of smart meters. On the consumer side, they are embodied into smart thermostats, which are designed to change electricity usage based on a wide variety of data, ranging from peak

usage signals from the electric utility to weather patterns and personal habits. Companies, of course, can use such smart meters as well to better maintain temperature within an office, store, or production plant; and to run high-energy operations during off hours to save money. And the benefits are not just limited to thermostats; lighting, ventilation, locking mechanisms, appliances–all can be connected to the Internet so that they can adjust their settings in relation to the actual experience on the physical premises at any given time.

Smart thermostats work by analyzing historical and real-time data to proactively respond to changes in behavior and other factors, with the goal of reducing energy costs over the short and long terms. In an office setting, for example, a smart meter will start with the time of day, anticipated occupancy rate, outdoor temperature, and building design to set the temperature at a level that keeps employees comfortable while maximizing conservation. But it will also adjust to changing conditions on the fly–if, say, there are fewer employees on the premises than expected or the larger grid is experiencing heavier-than-normal demand.

Smart meters measure usage, provide real-time information, and respond to signals from the utility regarding peak usage, rates, grid health, and performance. They also interact with control devices to shed load, including smart thermostats, secondary lighting, A/C, pumps, and other devices that can be cycled less often during peak usage or high-rate times. Smart meters also give utilities immediate information regarding outages and heavy load conditions that may lead to an outage.

For the energy industry as a whole, however, applying the Internet of Things to the grid itself–and to take that beyond electricity to include other energy sources and needs, including oil and gas, coal, wind, solar, and so on–will be transformative. Its effects will be felt not just by the companies themselves, but really by the entire planet. Smart grids respond to changing patterns and react accordingly, turning what is today a one-way process into an iterative endeavor. That allows energy companies to respond to very granular changes in usage to ensure the grid has enough power exactly when it's needed, and to nudge certain users and use cases into times when demand is lower. Aided by sophisticated sensors, a smart grid can analyze a variety of general and specific data (including weather conditions, historical usage patterns, special circumstances like holidays or natural disasters, and real-time demand) to optimize storage and delivery.

Utility companies are also looking at ways to leverage new energy sources in an intelligent way from the start. For example, many utilities offer credits to customers who install solar panels on their homes or businesses–but they also require that those same customers allow the utility to monitor energy production and consumption, and then make adjustments as needed, in real time, to ensure the vitality of the overall grid. So, a company that installs solar panels on the roof of its office building will also allow the utility to lower the thermostat by a degree for a few minutes during a peak time, saving the company money and allowing the utility to avoid blackouts for all its customers.

Best Practice Recommendation: *Utilities should look at ways to entice their customers to allow them to manipulate their power usage within the home or office to save energy during peak times. Companies should work with utilities to benchmark their energy usage and do a complete analysis of where they spend the most money; then, they should develop a plan to move high-energy processes to low-demand times, using data visualization for the analysis and sensors and monitors to ensure that their adjustments continue to remain efficient.*

PRIVACY AND SECURITY

One of the biggest issues IT managers, CTOs and other executives will face when it comes to the Internet of Things is security around networks, devices, and data. Privacy will also be of paramount concern, especially to employees and customers.

We are talking about an enormous proliferation of data and devices with the concurrent expansion of network access. The convergence of operational technology with information technologies creates vulnerabilities, especially as their upgrade cycles, management, and use differ, often dramatically. Furthermore, the expanded attack surface (i.e., all the connected sensors and devices), lack of clear public policy, the enormous volume of data, and the fact that IoT will be spread across multiple jurisdictions and nationalities only increases the challenge.

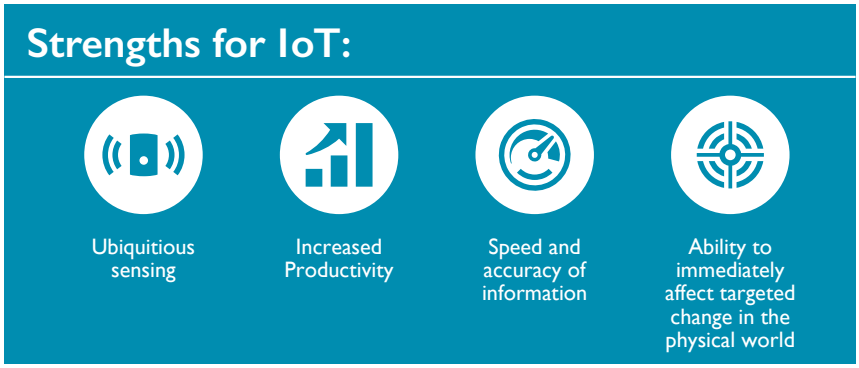
Unanticipated attacks will leave cities and businesses open to new threats, and they can expect emergent and often disruptive behavior on the part of their end users. Frost & Sullivan predicts that the pace of innovation around IoT will far exceed the ability of security systems and protocol to keep up–and this will be a risk for many organizations. We recommend that companies pay close attention to managing privacy and security in conjunction with any and every new IoT initiative they embrace.

Privacy is also a big concern. Companies that use the Internet of Things to track and monitor employee movements and behavior must do so only during their employees' working hours–even if those employees take certain trackable devices home with them. And they should confer with their legal advisors to discuss the current law around data privacy, overtime requirements, and so on. (For instance, if an automated system sends an employee an alert based on data it receives "after hours," that employee may then need to be paid for the time he spent processing and/or acting on the information.)

Customer privacy is another area of concern. Frost & Sullivan research shows that consumers and business buyers are willing to share personal and even sensitive corporate information under certain circumstances if they believe that doing so will help them get a better experience. But they are also extremely sensitive about what happens to that data, how it is stored and used, and with whom it is shared. Companies must have clear, enforceable policies in place for how they deal with customer data as it relates to the Internet of Things.

CONCLUSION

The Internet of Things (IoT) is intended to seamlessly connect sensors, networks, data, and devices to improve business efficiency and change the way we live our lives for the better. The IoT can reduce carbon footprints, improve asset utilization, drive productivity, and increase revenues. And it can significantly improve the customer experience.



Companies that leverage Big Data on smart networks and devices have better, more reliable information; using it in real time to improve decision making–either automatically or with human input–will bring a measurable competitive advantage. But they must pay attention to privacy and security concerns, and ensure their networks and sensors are designed to take advantage of the IoT trend.

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