TUCK SCHOOL OF BUSINESS AT DARTMOUTH
GLASSMEYER/MCNAMEE CENTER FOR DIGITAL STRATEGIES

The Internet of Things: The Opportunities and Challenges of Interconnectedness

A Roundtable Overview

Americas Chapter Discussion

Roundtable on Digital Strategies

The Internet of Things: The Opportunities and Challenges of Interconnectedness

Thought Leadership Roundtable on Digital Strategies
An executive roundtable series of the
Center for Digital Strategies at the Tuck School of Business

The Americas Chapter of the Roundtable on Digital Strategies convened for a day-long discussion of the phenomenon of the IoT: What it is, where it's going, and what is holding it back. Topics for the day included examples of current IoT deployments and the value they deliver; the business value behind IoT initiatives for both companies and customers; and obstacles slowing further progress. Participants shared perspectives from both the consumer and industrial sectors — and each group was surprised to discover how far along the other was, and how much could be learned from their experiences. Common themes included the primacy of providing additional customer value, the need for balancing privacy with commerce, the disruption to existing business models, and how in the world are companies going to manage and derive value from all this new data?

Participants in the session, hosted by Yum! Brands at the headquarters of Taco Bell in Irvine, CA, included CIOs and their business unit counterparts from Aetna, Bechtel, Chevron, Eaton Corporation, Hilti AG, Nike, Taco Bell, Time Warner Cable, and YUM! Brands.

Key Insights Discussed in this Article:

Introduction: Instrumenting the Physical World

Chris Rezendes, President of INEX Advisors, began the day's discussion with a presentation that described the Internet of Things as "the instrumentation of the physical world." Sensors and devices are being attached to or embedded in whole new categories of "things" — including people, pets, vehicles, clothing, buildings, and machines of all types. Even "landscape-scale assets" are being connected to the Internet: roads, bridges, tunnels, pipelines, rail lines, power lines, coastlines, rivers, and farms are just a few examples of big "things" that have already been instrumented. "People are experimenting with this instrumentation of the physical world on every possible dimension."

"So the question is why?" Rezendes asked.

> Because 99.99% of physical world assets are not connected, and those that are, connect at sub-optimal utilization. So we have very little data — almost no ground truth, no objective intelligence — to support the policies, the strategies, or the decisions that we're making about how to invest in, how to build, or how to expand assets or operations that are rooted in the physical environment. The point is not to take humans out of the loop, it's to augment and enhance human experience.

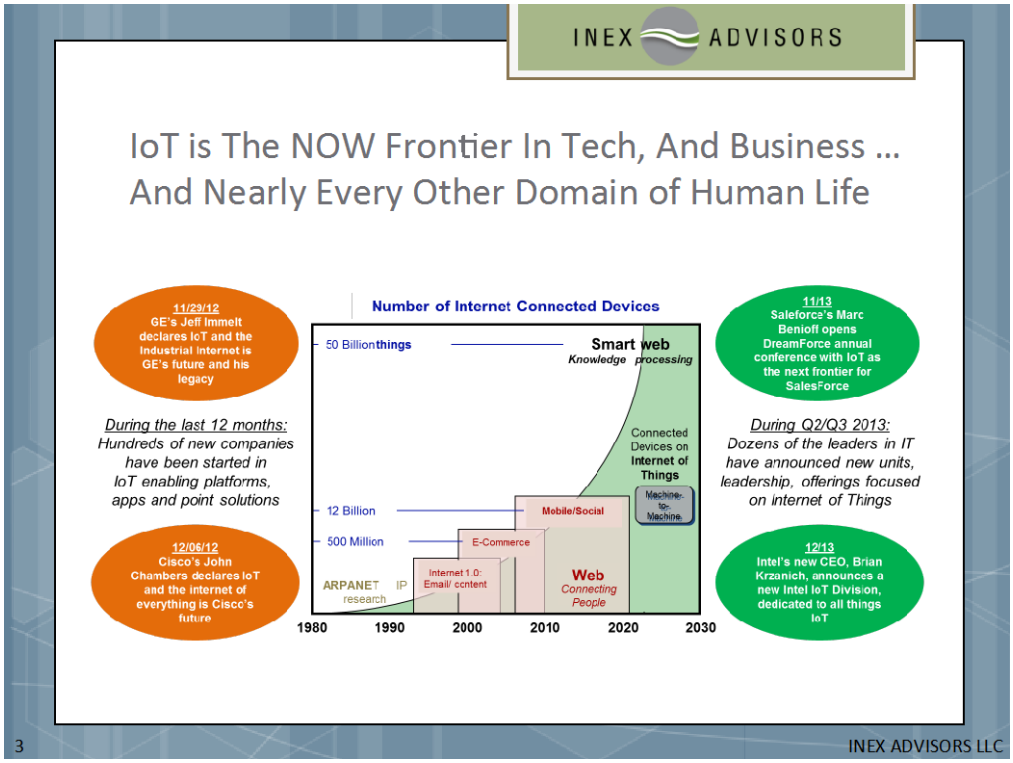
In some ways the IoT is not particularly new, Rezendes reminded the group: "Some market segments and asset categories have been going about this for almost 20 years, for example heavy equipment in agriculture, construction, materials handling, and mining. Fleet telematics has been around forever. Companies at this table are deep into it already it's not happening *around* you, it's happening in part *because* of you."

And yet, he said, "2013 was the pivot year, the year when the Internet of Things went from a concept to a reality. It didn't necessarily become a big business with lots of people making money, but it was the year that four behemoths in different parts of the global economy — GE, Cisco, Salesforce, and Intel — all came out with variations on 'the Internet of Things is the future.'"

"So why now?" Rezendes continued. "Because there's never been lower technical risk to do this:

> Yes, security is a huge issue, and it will be forever. But the meta-trends are lining up to remove so much technical risk. There won't be many architectures, and they'll be rooted in standards and available from merchant sources. There's the smartphone. We've got so much network, compute, control, and communications enabled, in so many different places. It isn't about new technologies being developed; it's about existing technologies being integrated, being configured, and co-existing. The only thing we really have to do is ask ourselves, "What could we connect, and why?"

Based on engagement by thousands of companies, Rezendes forecasts, the number of internet-connected devices will increase by at least another half-order of magnitude in the next few years, from 10–12 billion today to 50 billion or more by 2020:



"The benefits are real," he continued. "There are proven ROI cases, but they're not what we hear about all the time:

> In the oil & gas industry, for example, three of the top five use cases are compliance, safety, and risk mitigation. They're not just new revenue, new ad platforms, or persistent connections to customers to sell them more stuff: An intelligent egg tray may not be the best way to prove the value of instrumenting the physical world. Find something more meaningful — if you don't pay close attention to the operations technologies in your business and your ecosystem, you're going to miss the taproots of value creation in the Internet of Things.
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> If you have a relationship with me today over a specific product or service, start with that. How can you enhance my experience with that product or service? That's the number one area for return on investment. Revenue enhancement and competitive differentiation are important, but they come after the real stuff, and the real stuff is, "What does it do for customers?"

"The hardware we deploy to do this," Rezendes observed,

> Is not going to be like anything associated today with consumer or even commercial IT, with their two-to-five year upgrade cycles. That's too expensive. To instrument the physical world and to do it well, we're going to have billions of these things. The hardware is going to come from the community as much or more than it comes from any of the major IT or consumer supply chains."

"Connecting those physical assets and the data about them to a network, and delivering value in services and apps, will be a multi-trillion dollar opportunity," Rezendes concluded.

"The Best Damn Network"

IoT examples from the Roundtable reinforced Rezendes' points about using technology for operations to improve customer experience. Mike Hayashi, Executive VP of Architecture, Development and Engineering for Time Warner Cable, started by describing TWC's IoT environment:

> We are both a landscape-scale industry and an industry that serves consumers. We are an infrastructure company that enables connectivity, but we're not in the content business: We deliver services, but we don't create the services themselves. And customer-owned and customer-managed devices represent a new path by which we enable our core services, whether that's video or home management or security, and whether they're iPads or Android phones or televisions connected directly to the Internet.

"Historically," Hayashi's colleague Matt Zelesko, Senior VP, Converged Technology Group, explained,

> We have had separate infrastructure for different applications. Increasingly, all of them are running over the IP infrastructure, so the "things" we are putting in a customer's home are already Internet-connected. We're evolving into "stewards of the home," responsible for an ecosystem a lot broader than just the devices. It's all the connectivity inside the home, whether that's Wi-Fi or Bluetooth or Ethernet or MoCA, because most customers think about their home as an extension of our service and our plant.

Moderator John Gallant, Senior VP and Chief Content Officer of IDG Enterprise, asked about the potential changes in the TWC business model based on new connectivity:

> So increasingly you're looking at the customer as an IP address. It's a mobile world, and you're looking at individuals with a tablet watching HBO Go. That's a lot more information that the advertising community would find very interesting in a real-time fashion. Who is going to ultimately control the information and monetize it? To some extent you're in the catbird seat, with an opportunity to be the broker in the middle of that information stream.

"The information we can get from that environment is far richer than what we can collect from the classic legacy video environment," Hayashi answered:

> The technology allows us to know exactly what an individual household is consuming. We will eventually have the ability to say what a specific individual is consuming. But the key question is, "What do we do with it?" It's actually hard to market: There's a big gap between having this vast amount of information and monetizing it.
>
> There's a discussion about whether we become the aggregator of the various intelligent devices that consumers are buying, but it's really difficult: If you try to sell home management through

> security, then you're trying to convert existing security products to match your infrastructure. Whether we become the providers or the enablers of these kinds of technologies is still up in the air. There's a distinction between becoming the home management company, and being the company that enables and brokers connectivity to various home management technologies.

"We are looking at some really interesting uses of that data," Zelesko added. "For example, suppose you want to reach a certain demographic, and the best way is to advertise on ESPN, but that's really expensive. So we have enough data to say, 'Those people who are watching ESPN are also watching these shows on these channels at these other times.' So you could reach a very similar audience at a much cheaper price."

"Will the technology be available to target an individual person?" asked Lynn Hemans, Director of Industry & Competitive Insights for Taco Bell. "To actually target five people that are brand advocates who are watching ESPN right now? That would unlock so much value in my industry."

"It would be an anonymized individual," Hayashi answered, "That's called 'personalization,' and every device could have a particular ad insertion for that particular experience. You wouldn't know that it was something done just for you, because it's part of the linear experience you're having."

"We've tried to drive synergies between products, for example between voice and the TV," Zelesko concluded. "But there are all sorts of concerns that come up, for instance, privacy issues in shared households. All sorts of things start getting in the way of the utility of those services. So to some extent we're going to do that, but really what we want to do is build the best damn network we can, to deliver a high-quality, high-speed experience with the internet."

Don't Be Creepy

"It is increasingly difficult to separate products from services," stated Chris Satchell, Nike VP and Consumer Technology Officer:

> If you buy a pair of shoes, how much of your end enjoyment is just the physical product? Or was it the in-store athlete who found you the best shoes and hooked you up with a running club? You start to not disconnect those things.
>
> A FuelBand is a physical product, but it's not very useful without the additional service that goes with it. It's the combination of human services, digital services, and physical products that gives the consumers benefit, that makes something happen in their world.

"But now because of that," Satchell continued, "The customer does expect a better experience:"

> If I've signed up for two marathons, registered 300 runs, and made 500 FuelBand entries, I expect that you know me fairly well. Then if I go into a store and you don't know who I am, and you recommended something stupid — well, I don't know why I want to deal with your brand. This idea of seamlessness is a huge force in the consumer world. But our company is

> very used to channels and product categories, and now we have to somehow blend those together to make the consumer experience seamless.

"The things you're doing at Nike are very visible," commented Gallant, "Because lots of people have these devices. They're recording a lot of stuff about their life. How are you using all that information? What are you doing with it? Where do you see it going?"

"What we really wanted to know," Satchell explained, "Is to understand the athlete that's using it:"

> If we know more about you, we can service you better, with motivation, with combinations of products, events, digital services, applications. We have over 20 million users on the running app: We know how fast you run, where you run, what time you run. Say we find out the majority of users run early morning, and a lot of them run in a cold environment? We can correlate with weather, and put more emphasis into our thermal and waterproof products.
>
> It's even more useful as we shift from consumer electronics on your wrist to sensors embedded in your apparel and your footwear. Say we start to see a huge population that pronates in a certain way? Maybe our shoes aren't helping that enough. We can actually change the product creation process based on what we understand about segments of our audience.
>
> But our real value is, "How can we take individual data, use what we know about you, and get it to the end points of the business as an actuation point with you in a way that's useful, whether it's helping you with training, with motivation, or with selecting products, to help you as an athlete get better?" We think that's the magic of wearables and sensors on a personal level.

"You are collecting a lot of information about customers and patterns and regions and all kinds of things. Has it changed how you market to people?" Gallant asked.

"It hasn't yet," Satchell answered, "One of the big things we'd like to solve is knowing whom we're talking to in retail. The problem with point-of-sale is, it tends to be a single-purpose device built by somebody else.

> If you can move mobile point-of-sale on a general-purpose device that you can update with software and service, you can put a lot of innovation in it. If we knew automatically who's in the store, and whom we are talking with, then we could serve them a lot better.
>
> But if there's an auto-sensing device, then the problem is, "How do you not be creepy?" Creepiness is a big thing with consumers. We've seen really quickly how much people value their privacy. Trust equals use: How much I trust something is how much I'll use it, and this will translate directly to the Internet of Things at a consumer level.

Dickie Oliver, the VP of Global IT for Yum! Brands, the corporate parent of Taco Bell, expanded on how the "personally-owned mobile general-purpose IT device" — aka, the smartphone — is taking on a variety of new roles. "The point-of-sale simply doesn't exist anymore in our delivery business. We

don't take face-to-face orders. We're engaging with the customer in the cloud: They're doing all the work themselves, either on their smartphone or on a PC."

"So then if you look at our quick-serve restaurant business," Oliver continued, "Why do we need a point of sale in the store? It's a tremendous cost burden for us — why aren't we using this device that every consumer is going to buy, that will just get more and more powerful, flexible, and convenient?"

"60 percent of all restaurant searches are done on mobile," Oliver's colleague and Taco Bell CIO Greg Fancher continued, "and 60 percent of those result in purchasing food within the hour."

> It is *the* "place" where people go when they figure out, "I'm hungry, what am I going to do about it?" So it's a logical next step to then order on it, pay on it, and show up in the restaurant. You don't need to talk to the cashier, you don't need to wait in line: Your food is just made and ready. We're working on a mobile app to order and pay, and it uses geo-location, because we don't want to make that food too early. We're optimizing the inventory flow.

IDG's Gallant commented on the changing role of the smartphone in dealing with customers: "Mostly when people talk about mobility from an IT perspective, they're talking about controlling it," he said. "They worry, 'Oh my god, people have mobile phones!' Well no kidding. We've got to deal with this: The real value of mobile would be envisioning how you work with your customers in completely different ways *because* they have mobile devices."

"The smartphone is absolutely going to be the center of an individual's digital or virtual life for the foreseeable future," concurred Rezendes.

> Wearables will complement it. Yet at the same time, in a really interesting tension, the most successful companies will develop applications that don't emphasize stickiness, that actually emphasize efficiency: Get in and get out. The most successful companies in IoT are going to free people from screens.
>
> A second factor is integration. People want a COP — a common operating picture — of what's going on, whether it's in healthcare, athletics, dining out, or any domain of an individual's or business' activity. They want access to all the data they need for decision support to spend time or spend money.

Industrial companies are taking a similar approach, according to Tom Black, VP of IT, Enterprise Information Management for Eaton Corp:

> We are instrumenting a lot of things — seven or eight product lines right now — and we need to step up the aggregation of all of those. We have facilities with hundreds of devices, and people want to see them on one screen, quickly. How do you do that? The user experience is a big challenge; so are the data life cycle, and the privacy.

Better Living through … Telemetry?

"If you think you have privacy concerns there, or about inserting personalized TV ads," began Michael Palmer, Chief Innovation & Digital Officer for Aetna, "Then just wait till we find out from your pacemaker that it gave you an extra jolt because you had some irregular rhythm, and we send an ambulance to your house because you're going to have a real problem later today. *That's* where the Internet of Things is going in the healthcare industry."

"People are living longer, and the most effective care setting is your home," Palmer continued. "So to the extent that we can keep people in their homes and bring care to them, that's a better outcome." He gave examples of Aetna's pilot programs in healthcare-related IoT:

- Diabetics can get ulcers on the bottoms of their feet, which if not treated can end with amputation. So there are little mats that you put in front of the mirror on your bathroom floor that sense whether there's an indentation in the foot, long before one of these ulcers gets to the point of erupting.

- If you've had a mild stroke, your gait is likely to have changed. So we can have a sensor in the carpet that says "Grandma's gait has changed, it may be worth having a visit from the physical therapist."

- There are five factors that indicate metabolic syndrome, and if you have three of them, you're at five times the risk for getting diabetes, at 1.6 times the healthcare cost of someone without those factors. Newtopia is an Aetna program that integrates data from several connected devices: A BodyMedia exercise tracker, a food logging application, and a weekly Skype session with a coach. The point is to help people lose seven percent of their body weight, which gets them much closer to heart health. 500 people signed up for the pilot. Six months into the pilot, 62% are on track to lose the target amount, "which is an unbelievable stat on patient engagement."

"We have all kinds of standards around 'do not resuscitate, do not intervene,' Gallant pointed out. "If you're getting all this information about me, do you have to create a whole new set of rules around when it's okay for my insurance company to tell me what to do?"

"We can be the 'Intel-Inside' of healthcare data and predictive analytics," Palmer answered, "To help the doctors know whom to intervene with, so our model can be to enable the physician and hospital community to be the locus for health advice. No one ever wants to pick up the phone and call their health plan."

"Ultimately are we going to wind up where healthcare is the other killer app in the home, in addition to entertainment?" asked Hans Brechbühl, Executive Director of the Center for Digital Strategies.

"Most things start centralized, but they tend to land in the lower-cost, more accessible location," Palmer replied, "So the short answer is 'Yes:'"

> Pushing monitoring equipment to the home for patients with pulmonary disease, for example, is the right way to do it, rather than having them show up in the emergency room with a breathing issue. The technology is becoming so cheap that avoiding one ER visit could easily pay for all of the equipment.
>
> Once we have a proven solution for something, the tradeoff is, "How much will we save in medical costs, and are we willing to invest that amount instead in prevention, hardware, software, and monitoring equipment?" We see huge opportunity there.

Let's Make a Deal

"But we've got to create a connection for consumers to make it worth their whiles to be measured and quantified," Palmer concluded, echoing Satchell's comments about Nike's experiences with customers sharing data. "And that's one of the hardest things:"

> Consumers are willing to connect to devices if they get something back for it. To the extent that we can help people make good choices about their health, that's part of the reward. So you start with a wearable, for the people who really want to understand their health, or to manage their weight and fitness. Some people are willing to give up an amount of privacy to get a lower premium, but it's only a very small subset of the population. So we're trying to figure out, "How do we help people select the healthy apps that are going to change their behavior?"

"Then you're fighting the fear that you're going to use their own data against them?" asked Gallant.

"When the internet came," Geir Ramleth, retired CIO of Bechtel and Executive Fellow at the Center for Digital Strategies suggested, "Individuals felt they had control over the interaction with a laptop, and they could manage their own destinies. Now all this stuff is floating in the cloud somewhere, and people don't have the same level of control, or comfort of control. This will be harder to accept."

"All of our tools have RFID chips in them," volunteered Jean-Louis Keraudren, Corporate Head of Direct Marketing — Big Data for Hilti AG, "And we are getting some pushback already."

> The chips exist so that we can best serve our customers in the AMS processes, but the reaction in some cases is "We don't want you to know even more about the Hilti tools, you're too powerful already." So we have to show people in a very authentic way that we want the best for them first, before we make more revenue and profit.

On the other hand, he continued,

> We don't want to add services to too many products without clearly demonstrating the differentiation and value-add they create, so that it's possible for us to sell. Otherwise, our customers will get used to a certain level of premium value, and it will be impossible to charge for it afterwards.

Rezendes combined this comment with the earlier thoughts from Satchell and Palmer: "Authentic value builds trust. You can charge for anything that is of authentic value from a trusted party. And then you don't have to be opaque about what you're doing with the data."

> There is a backlash now: "I don't want my healthcare insurer to know that I hit my refrigerator every midnight." In a freemium world, an appliance manufacturer might look at the data and say, "Let's put it into a data store and sell it." But the value of data is now known to everyone who is sentient. No one is going to participate in a big freemium way in IoT: They're just too smart. Companies need to move from the freemium-based model to a value-based model, and through an education process get people to understand the value of the application, the reasons both for why they're paying for it, and for why it needs to be secure.

"Will it start on the commercial side," asked Bill Braun, CIO of Chevron Upstream and Gas, "Where companies can *require* sensors be worn, for example? If a pilot's going to have a heart attack, you do want to know, you'll be obligated to know. 'We're not asking, it's just how we operate: *Just like you wear a hard hat, you've got to strap on this device, and we get the data.*' That could start much more easily in a corporate environment."

"Danger, Will Robinson!"

Mike Lewis, Senior VP and Corporate Manager of Construction, Bechtel described safety-related IoT applications already in use:

- A device for all truck drivers in the Andes, because of anoxia and working at altitude. It flashes in front of the driver and causes him to look at it. It looks at his retina, measures his reaction time, and determines if he's fit for duty, and if he should be driving or not. If he's not reacting appropriately, it stops the truck. It's wireless, and it reports back to the dispatcher, "This truck is stopped, this guy's not fit for duty."

- Vests — "wearables" — that use radar and a proximity system to help the machine understand if a person is in close contact, and therefore, does the machine operator need to be warned that he's about to contact somebody, or does the employee need to get a buzz that he's too close to a piece of equipment. We've used a similar system in London for when we're doing maintenance on the train tracks, and we know that trains are coming, so that we can warn people if they're about to go into a hazardous area.

- Telemetrics on all our cranes and all our mobile equipment. We use mesh networks, satellite systems, wi-fi location, and rAgent technology developed by DARPA to locate and monitor them in real-time, so we know availability, we know utilization, we know a lot of the operating parameters associated with the equipment. We can program the parameters for the speed of a dump truck going down the road. We know who's driving the dump truck, and if he's speeding or not, from a safety standpoint. The trucks all have inclinometers on them, so if he's raising his bed up and it's overloaded, we know.

"You're getting a lot of data about those vehicles," moderator Gallant pointed out. "What's the back end that you need to capitalize on that, to make sure that problems are being resolved?"

"All that data feeds into a regional control center," Lewis explained. "Our rAgent system warns a supervisor, who can be monitoring 20 or 30 pieces of equipment doing hazardous work. And the backend is programmed: If you set the parameters for warnings versus shutdowns, you can kill the equipment."

Hilti's Keraudren agreed: "People get used to this Internet of Things, and they come back to the manufacturers and say, 'My appliance, or my equipment, is down. You have all this information, why don't you do something about it?' The pressure is getting very high, and if we don't move fast, it will get too high."

Gallant posed a question raised by Satchell's earlier point about automated actuation: "If you know a lot more about your customers and your equipment, and how they're using it, does that create a set of potential problems around liability?"

"IoT and M2M stumbled in the middle of this decade," Rezendes admitted,

> In part because most of the solutions being deployed got you asset identification, location, and that's about it. You had virtually no ability to provide any kind of remote, real-time actuation. So most enterprises got really scared: "Once I have enough security and data and intelligence, my entity assumes responsibility. If I can't have the digital, virtual, real-time, cost-effective, secure, autonomous agent to remotely change the condition of the asset, then I don't want to know about it, because *all* I've done is assume the liability."

Bill Blausey, Senior VP and CIO of Eaton Corporation, countered the objection with the potential benefits: "We're trying to drive a zero-instance safety culture, if we can bring together information about behaviors of the human, what they're about to do, and the state of the machine, we could prevent people from doing something stupid: 'I don't have my protective electrical garb on — should I really be doing maintenance on this charged machine?'"

"So there's a race on," added Blausey's colleague Black:

> It's table stakes for us to put IoT in switch gear and power monitoring equipment, but it's a value-added service to use RFIDs to measure where a hose is about to fray and send an alert, so that a customer gets more life out it. It's a big savings, because normally our customers just periodically sweep through and change everything. But I can see that somehow we'll wind up with the responsibility for all of that equipment, and the people and safety issues will somehow transfer to us.

Bechtel's Lewis gave an example of a high-ROI deployment around equipment:

> We tag our tools around the world for checkout and control. From a pilferage standpoint, the business case is huge. To be able to control what comes in and goes out of the gate or what stays on the project is a huge savings to us from the tools that tend to "walk off" or be

> "destroyed." We also use RFID tagging in our tool maintenance and management system to monitor when it's time to redo a cord inspection, or to determine if a tool is reaching its useful life, since now we know how long they've been on the job site and what they're doing.

"The challenge for Bechtel," said Ramleth, "Is how to build large infrastructure and still deliver the kind of seamlessness that Chris talked about."

> We have little sensors you throw into the concrete, and we can watch what's happening from an iPad on the ground. Then they just stay in there forever. How can we use sensors like that for the efficiency and effectiveness of building the project, and leave them in the infrastructure so that they continue to deliver benefits for 20 or 30 years, once the customer has taken over the physical plant?

Blausey returned to Satchell's concept of the convergence of products and services to highlight its difficulty in the industrial sector: "We've been instrumenting things as an industrial manufacturer for a long time, to sense behaviors and predict reliability. We have systems that capture that data, trend it, and understand in advance if something's going to fail. But we're generally one piece of a system — power distribution, or lighting. We have pockets of things, but limited success with selling services around them."

Andreas Wagner, IT Process Consultant for Hilti AG, described a middle ground between the Eaton/Bechtel world of machinery and landscape-scale assets and the Nike/Aetna world of consumers:

> Hilti has been merging products and services for decades. Now we're adding more and more software, that we see as embedded IT, or as a digital service.
>
> For one example, we track improve usage times of tools on job sites, so customers can distribute tools more efficiently. For another, there are very tight health regulations on how much vibration a worker can be exposed to. So, we have a device like a smart watch, that can tell how long employees can continue to work with our tools, and compare this to the allowable time with competitors' products — because Hilti products, being premium, produce fewer vibrations.

"There's an interesting point here about deployment," Chevron's Braun observed, "Because consumers can drive large-scale investments fairly quickly, while broad-based corporate infrastructure takes a long time to move, to get buy-in, figure out the price, figure out the maintenance. How these come together or combat each other is going to be very interesting."

Data, Data, Everywhere, nor Any Drop to Drink

"So with the level of instrumentation we're getting now, is anyone struggling at all with the data side of this?" asked Satchell from Nike.

"Massively," answered Braun. "Massive echo on that," emphasized Rezendes:

> The first phase of IoT isn't really about IoT: It almost always begins with more secure real-time access to a broader range of existing data sources. It's about harvesting, and about leveraging the existing sources of data that are stovepiped or stranded or siloed. But then everyone is drowning in data, because they've sensed and instrumented.

"That is the hard part," Taco Bell's Fancher agreed. "We have sensors that have been out there for a long time, taking temperatures, we can do that pretty reliably. It's the centralized control and management of those sensors — getting the data back, and what do you do with it? The sensor is the tangible piece, so people want that. The hard work is connecting back to get some value out of it, to drive the action: What decision are you going to take?"

Ramleth suggested the solution to the data deluge is to approach it with a different set of objectives:

> We often got too enamored with analyzing the depth of information. We go *down* more and more and more, so what we get is a "more correct" answer, because we have more statistical data points. But as we go *wide*, we can start to correlate data sets that we could not otherwise compare before. So now we can get answers to questions we never asked before.

"But we have people in the business who have been trained for years on small data, on narrow data," Satchell objected, "And those are the only questions they can think about."

> People can't even formulate the questions that might move the business. You need somebody who can think differently, across the business, and laterally from how we think today. One of our impressive recent hires was from Facebook, and he spends a lot of time answering really interesting questions. His comment was, "This is really simple math. The hardest thing I do is a regression; the rest is like addition. The problem is figuring out which addition to do, that can move the business and give you new insight."

"We're struggling to find people who can ask the business questions," Christian Reilly, Manager of EPC Systems at Bechtel, affirmed. "It's got nothing to do with the data. The technology is there, in spades. The mechanisms for analyzing it are there. But something we see is that people don't trust the results, even if you ask the right questions, because it didn't come from a recognized, traditional mechanism. There's an inherent distrust: 'This can't possibly be right.'"

"And we've all been very successful companies for a long time *not* using data at this level," Oliver pointed out. "It's hard to move the corporation and the leadership team from where they've *been* successful to where they need to be successful in the future, using data at that level."

The key, Ramleth suggested, is to use those new questions the data enables "to get predictive indicators, rather than reactive indicators, so that as we start getting information from the IoT environment, it can actually start to act on itself, by itself. Why should the guy wearing the vest have to get an alarm? Why doesn't the machine just stop?"

"Even if you have someone who can ask the right questions," added Taco Bell's Hemans, "You still have to tell the story to influence your organization. So you need the data people who are really good

at analytics, and great storytellers to tell the story, and it's the mash-up that is powerful enough to influence the organization."

Rise of the Digital Natives

The discussion turned to what companies need to do to prepare and execute. Ramleth addressed outstanding technical issues around standards and security:

> As you go into IOT, you kind of have three or four different kinds of participants: people, devices, applications, and something in the cloud, and you have to get those four to somehow talk together, without having the luxury of a really set, fixed set of standards. So the standards will have to be quite fluid, because you can't get all these participants to play in the same sandbox.
>
> On the security side, you can secure the systems, but how do you secure the information? Often, by looking at behavioral actions on it. So you have to find out the pattern of information behavior, and when is it going out of the norm, because watching systems and monitoring systems to see if you have a breach is not enough.

"It's even worse," Satchell said. "When you have actuation built in, that's a whole different level of security, a whole new set of problems, like the ability to disrupt a centrifuge in a foreign country."

> There's more processing power in devices, and they have access to a network. Nine of your ten devices are completely secure and great, but somebody made a mistake on the tenth, and that's one of the classic ways to break through networks. They get into that one, then they jump to the next network. And the more of these devices you've got, the worse gets.

"Security is still an issue for us," Blausey responded, "Because of the kinds of things we do: Our devices sit on the power grid. They're smart. They have firmware and software. They're hackable. And we know that's a target for taking down infrastructure. And so any time we're enabling these devices, they suddenly become disable-able as well."

The solution, Ramleth proposed, is that "You have to actually go down to the sublevel, where people interact with data. That is where rogue machines interact, and where you see abnormal information flow or information gathering. And then the system has to be able to self-react, and shut something down because what it sees is abnormal."

"What's the chief obstacle to deal with all this?" asked Brechbühl, posing a lightning question round. "Is it a) Culture/society, b) Corporations' ability to execute, c) Technology, or d) Government and regulation? And how ready are we to move forward on the IoT on a scale of 1 (not very) to 5 (very)?"

Fifteen of the seventeen roundtable participants identified corporations themselves as the biggest bottleneck, with an average readiness score of only 2.5.

"We're so busy reacting to what's already coming at us," Chevron's Braun explained, "That we're just trying to get our heads around it and keep up with it:"

> I can't see too far down the road, but I can see our business being very, very different, with things shifting pretty fundamentally. Are we doing enough? We are 30 percent driving and 70 percent reacting, and I don't want to do anymore until we figure out how to get neutral, so we don't feel like we're always behind.

Keraudren suggested another reason for the relatively slow pace of IoT adoption:

> There is a generation change. The people in charge of corporations at the management level are mostly older, especially in companies that aren't in the digital world or the internet. Implementing sensors and collecting data is the easy part: These people don't naturally understand the power of what we're talking about. They have rather risk in mind, more than opportunity, so there's a lack of vision on this topic: They sometimes don't even see the business case. We don't have a holistic, integrated vision of what we can do.

"They just can't help themselves," Satchell agreed.

> There's lots of innovation, but it's incremental and narrow within a field of business. You don't get new directions for the company because they're way too focused on next quarter's results. Even if they start a project that's supposed to be very innovative, it will get sucked into everything else. So you need to protect these kinds of projects, but then you have the problem, "How do you integrate the results back into everybody's roadmaps when they're already 100 percent maxed out on their committed revenue plans?"

"The use-case driven approach to IoT is a start," Wagner asserted, "But leadership is needed to drive the whole thing, because it needs to be cross-silo. The IoT needs to have a clear visionary leader, to merge the products and services really completely, to change how we interact with our customers. It's a responsibility for the company: The digital natives are rising. They're going to expect a certain handling by us."'

"The bridge between the two," said Keraudren, "Is to come back to a very core assignment within the company, which is the basic task to understand customer needs:"

> The IoT brings a multitude of new ways to better understand customer needs, and we are simply not familiar with them all yet, especially when we're not talking about facilities or devices, but we're talking about customer behavior. That's much more complicated. There are plenty of sensors we can put out there, but we don't know which ones to look at, which is where our whole question of data analysis comes from.
>
> The best solution is to avoid silos. We have good developments here and there, but no breakthroughs, because we have a silo here, a silo there. What we are *not* doing is to have all these people work together to have a holistic, consistent understanding of the customer experience, so we can make a strategy out of it.

A Honeycomb of Interests

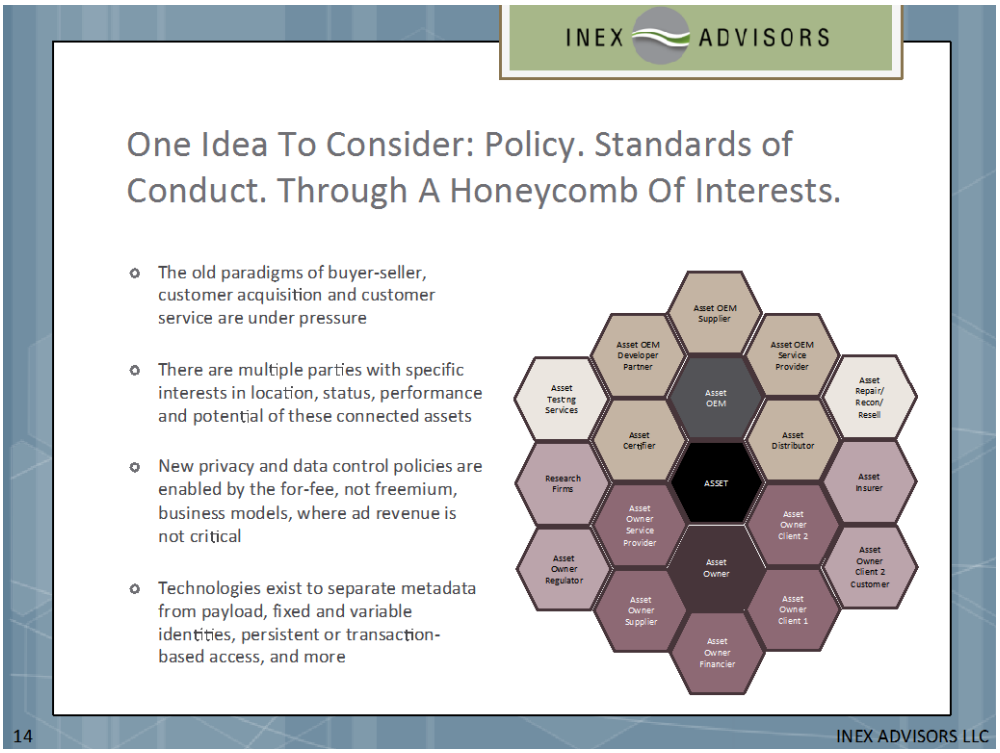
Gallant turned the telescope around, and asked about who would be the sources of IoT technologies: "Are the household names — IBM, Cisco, HP, Dell, Oracle — are these the companies that are going to become strategic vendors?"

"Enterprises are looking for deep subject matter expertise in the IT vendor community, to meet where their internal operations communities already are," Rezendes answered. "IoT has more to do with embedded operations technology than it does with information technology, and there's never been a big IT vendor with a big footprint in embedded technology, ever."
"We're not going to see them doing great layers to control these embedded devices," Satchell agreed. "The hardware will probably come from the leaders that we see today, but the software is more likely to come from the open source community. It might be productized, like Hadoop, but a lot of it is still a small industry."

"We won't see any leading innovation out of that cluster of companies," Ramleth finished. "If they do anything radical, it's to buy someone. And over time, they'll do enough acquisitions that they then do become the providers."

"There aren't a lot of companies that have an 'IoT Strategy' yet," Rezendes pointed out.

> The strategy may not be about our physical product at all. It may be about the intelligence that we can capture from our physical products, their ambient and operational environments, and their antecedents and their downstream contributors or complements. So in other words, we've got to figure out who's going to own that data, who's going to get access to that data, how that data can be deployed, because if we don't, we're going to end up in a really bad place, where, for example, in integrated commercial value streams, one entity may have all the intelligence. One entity may have massive leverage, and be able to aggregate all the profit in that space.



If you think about all the new interconnections and interdependencies between your businesses and your suppliers and customers, a lot of companies forget that when they start instrumenting physical assets that are either products or inventory or consumables, they sometimes forget that in that instrumentation, there will be impacts upstream and downstream on their trading partners. Think honeycomb: Think about all the potential stakeholders that might be interested in that data in one way or another.

"There is this big ecosystem," Black agreed.

We have to change our whole culture to think about how to extract value not just for ourselves, but for this honeycomb. If we could be more transparent with the analysis we're doing, and give the data or sell the data or share the data…. It's re-creating the supply chain, to protect your channel partners, to keep them in the fold. The data becomes a new form of currency. But that's not comfortable, not comfortable at all.

"IoT data will be disruptive to the existing balance of power," Black continued. "How do you decide who gets all the data? We are not asking the right questions yet, because we aren't thinking about the honeycomb."

Reilly proposed "the 5 Cs of IoT" that companies will need to complete in order to develop their IoT strategies:

- Connect: What layer you are operating at, with what type of connection.
- Create: The context of the data that's created by the sensor or the thing.

- Collect: The aggregation of that data via push/pull.
- Correlate: The question about how the data impact the business.
- Comprehend: Understanding what action we're going to take.

"What this means," he continued, "Is that we're going to have to do a hell of a change management exercise and pick the battles at the right place to get any traction with this. It's more difficult than mobile, because you can't see some of this stuff, and mobile generally augments people. It doesn't replace them. So our capacity to accept change is going to be a major challenge."

Rezendes returned to his earlier theme of growth of the IoT, and talked about the unquantified aspects, the qualitative environment that companies will be working in as the IoT develops:

> What we've done with social and mobile and with most technology to date pales in comparison to the velocity and potentially to the violence with which our business models, our customers' requirements, and certain industries are going to be reshaped. This isn't going to be smooth, and it isn't going to be monolithic. And I can tell you based it's going to be fraught with tension. The best thing we can do is to identify and be honest with what the tensions are, because if we can identify and define them, then we can start to build our new businesses based on understanding those tensions and the negotiation of them.

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The Internet of Things: The Opportunities and Challenges of Interconnectedness
February 20, 2014

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