technologyforecast

A quarterly journal

2013
Issue 1

Internet of Things: Evolving transactions into relationships

Fred Cripe
Advisor to PwC
Former Executive Vice President
Allstate Insurance Company

pwc

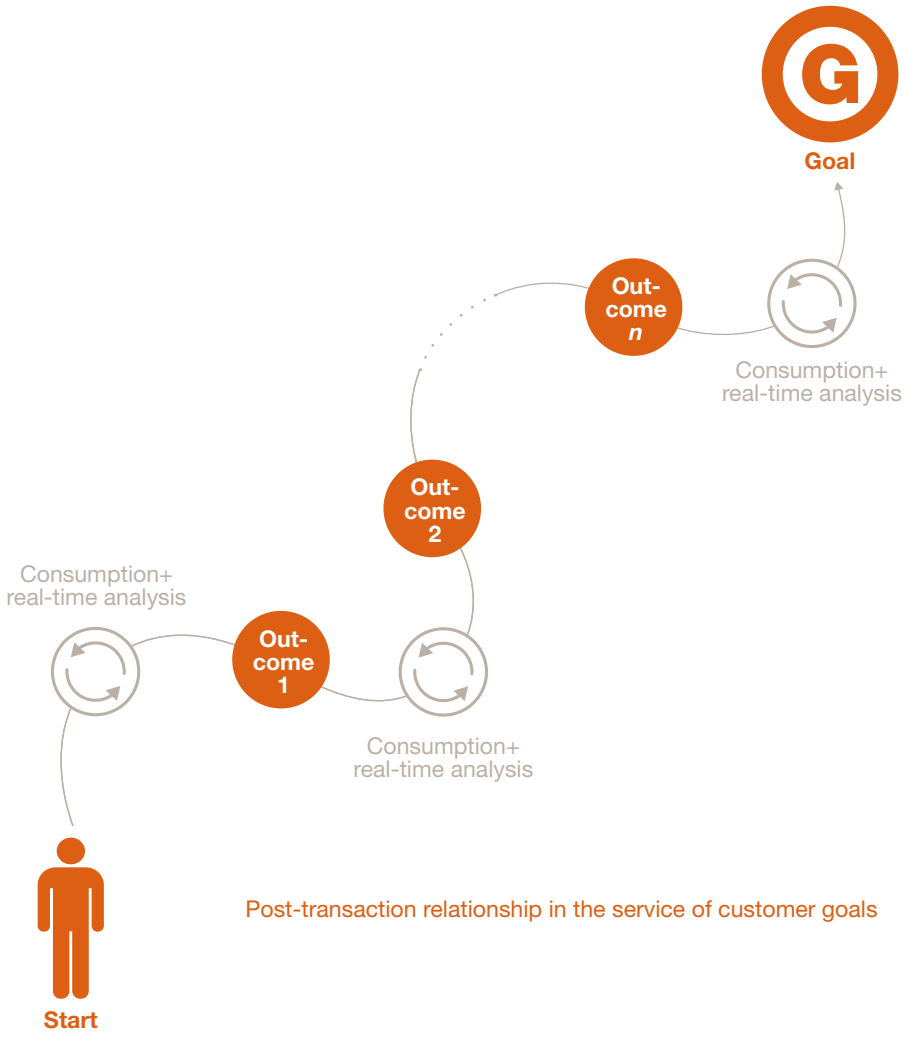
Contents

2013
Issue 1

Features

Interviews

Departments



Post-transaction relationship in the service of customer goals

Acknowledgments

Advisory

Global and US Advisory Technology Consulting Leader
Tom DeGarmo

US Thought Leadership

Managing Director
Howard Kravitz

Strategic Marketing
Katrina Najm
Natalie Kontra

Center for Technology & Innovation

Managing Editor
Bo Parker

Editors
Vinod Baya
Alan Morrison

Contributors
Scott Bauer
Thomas Foth
Galen Gruman
Bud Mathaisel
Bill Roberts
Christopher Wasden

Editorial Advisor
Larry Marion

Copy Editor
Lea Anne Bantsari

US studio

Design Lead
Beata Rutkowski

Illustrators
Chris Pak
Tatiana Pechenik

Production
Jeff Ginsburg

Online marketing

Managing Director
Jack Teuber

Designer and Producer
Scott Schmidt

Animator
Roger Sano

Reviewers

Craig Atkinson
Daniel Backo
Christopher Curran
Larry Gioia
Michael Marinacci
Marc Sirkin
Steven Zaloga

Special thanks

Dan Eckert
Avynash Gersappe
Mark Haller
Brett Hertzig
Mike Hiendl
Joseph Lamano
Anton Malygin
Dean Nicolacakis
Saumil Parikh
Amy Peirce
Thomas Putyamidan
Babs Ryan
Ted Shelton
James Yoder

Amy Elston, Axicom

Brittany Hodill, The Hatch Agency

Candice Eng, INK

Industry perspectives

During the preparation of this publication, we benefited greatly from interviews and conversations with the following executives:

Scott Bauer
Principal, Customer Impact Practice
PwC

Fred Cripe
Senior Advisor to PwC
Former Executive Vice President
Allstate Insurance Company

Walter De Brouwer
Founder and Chief Executive Officer
Scanadu

Carlo Gagliardi
Partner
PwC Consulting, UK

Jim Ingrassia
Vice President, Solutions Support Division
Konica Minolta Business Solutions

Suke Jawanda
Chief Marketing Officer
Bluetooth SIG

James McGee
Chief Executive Officer
The Oaks

Laura Mitchell
Vice President, Business Development
GrandCare Systems

Dominic Morea
Senior Vice President of Advanced Solutions and Innovation
First Data Corporation

Macario Namie
Vice President of Marketing
Jasper Wireless

Jonathan Riechantal
Chief Information Officer
City of Palo Alto

Daan Roosegaarde
Studio Roosegaarde

Making customer goals come true

Tom DeGarmo

Global and US Advisory
Technology Consulting Leader
thomas.p.degarmo@us.pwc.com

Message from the editor

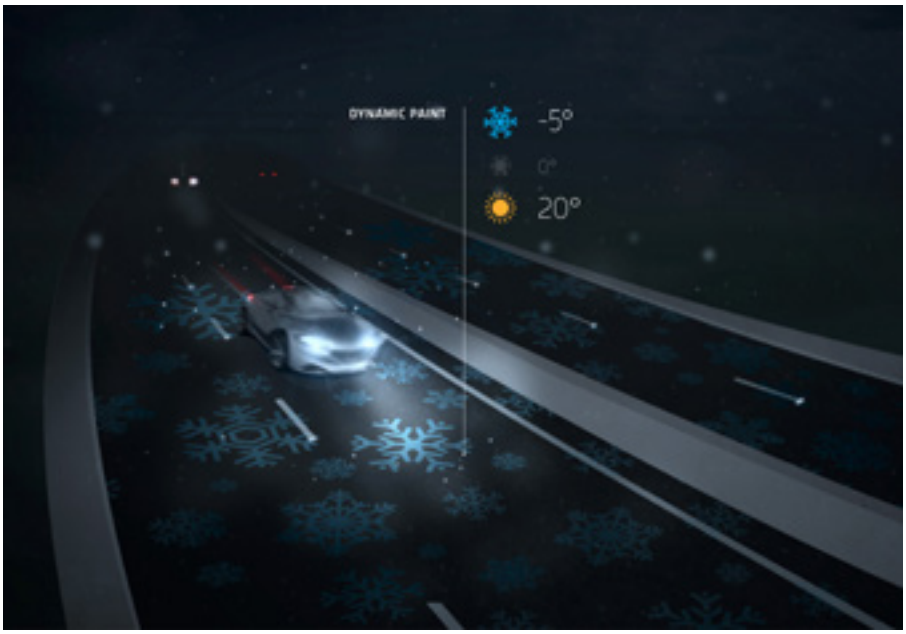
Daan Roosegaarde is a forward-looking digital inventor who finds creative ways to embed sensors and electronics into the physical world in ways that delight and inform. His Studio Roosegaarde has deployed interactive sculptures and walls that react to human movement and sound, used temperature-sensitive material to dynamically change the transparency of high-fashion clothing, and introduced "huggable columns" that change colors when approached and touched by patients in a mental health facility.

Recently, in collaboration with Heijmans, a major construction services business based in the Netherlands, Roosegaarde began working his digital magic on one of the most basic components of civilization—roadways. One example of this work is shown in the photo.

The road, which will be introduced in the Netherlands in mid-2013, has temperature-sensitive paint embedded in the surface. As the temperature approaches and falls below freezing, the paint activates otherwise dormant reflective capabilities. The road itself alerts drivers to dangerous, icy conditions by revealing images in the shape of huge snowflakes. Unlike warning signs that are permanently placed alongside roadways, eventually causing drivers to ignore them, these interactive roads are more likely to capture a driver's attention, encouraging safer driving and fewer accidents.

Many of Roosegaarde's installations may seem a far stretch for readers of the *Technology Forecast*. Our common interest is in emerging information technologies that have the potential to transform IT itself, business processes, business strategies, and whole industries. But think of Roosegaarde as the canary in the coal mine when you read his interview on page 26. His creativity may be distinctive, but the inexpensive technologies he uses to deploy sensing, interactive environments are available to anyone—even if very few of us are using them yet. Imagine if the road display technology were connected to mobile devices in the car, to car's monitor, to car's traction control, to weather alert systems, and so on. This interconnectivity of things opens a host of new opportunities to better engage with consumers.

But what's the point, you ask? Why should IT, especially, care about the



world out there—the world beyond my enterprise, beyond its people and processes, and beyond the markets that we buy from and sell into?

This issue of the *Technology Forecast* endeavors to answer these questions by weaving together something you've probably already heard of, the Internet of Things (IoT), and something you may not have thought much about, your company's direct role in helping its customers achieve their personal goals.

Why wouldn't you have thought much about that? Because, notwithstanding customer support, online forums, and (shudder) user manuals, customers have pretty much been on their own when it comes to creating the value they sought when they purchased your product or service. The focus of business by and large has been on bringing a customer to and fulfilling the sales transaction. There was no business model that would support a human helper and guide being assigned to each and every customer, providing guidance, feedback, progress reports, and other information that brought customers closer to their goals. Instead, the approach has been, "Here's a hammer. Good luck with that nail."

The rise of inexpensive, networked sensors and devices (the Internet of Things) is changing all that. Intelligence is being added to products and services themselves and even to the environments people move around in, not to mention the smartphones most everyone carries. Unlike technologies so far, which digitized commerce through the point of the transaction, emerging technologies today digitize the use of a product and augment the experience to help customers achieve their goals. In the process, customer engagement deepens and extends beyond the transaction, redefining products and business models.

This issue of the *Technology Forecast* examines how the Internet of Things enables businesses to evolve their transactions into relationships.

The article, "Using technology to help customers achieve their goals," on page 06 explains how the digitization of consumption sets the stage for post-transaction relationships with customers.

"The Thing Stack: Technologies that guide customers to their goals," on page 30, looks at the maturation of the technologies that create the potential for post-transaction relationships.

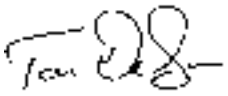
The article, "CIO leadership in post-transaction relationships," on page 54 explores the key role CIOs and IT staff can play in going beyond the transaction.

This issue also includes interviews with executives at enterprises that are demonstrating leadership with post-transaction relationships:

- Fred Cripe, an advisor to PwC, forecasts how the Internet of Things will shift the insurance business from loss compensation to loss control by helping customers achieve their goals.
- Daan Roosegaarde, an artist and an innovator, explains the importance of merging physical and digital realities into seamless, intuitive experiences.
- Macario Namie of Jasper Wireless describes how to capitalize on opportunities from the Internet of Things.
- Walter De Brouwer of Scanadu explains how IoT will create access to our personal health feed and transform healthcare.
- Jim Ingrassia of Konica Minolta shares how digitizing the use of its products was a source of competitive advantage.
- Dominic Morea of First Data forecasts how the future of the retail industry is going beyond the transaction.

Please visit pwc.com/techforecast to find these articles and other issues of the *Technology Forecast* online. If you would like to receive future issues of this quarterly publication as a PDF attachment, you can sign up at pwc.com/techforecast/subscribe.

As always, we welcome your feedback and your ideas for future research and analysis topics to cover.



Using technology to help customers achieve their goals

Businesses that embed capabilities to understand the use of their products and guide customers toward their goals stand to reap unparalleled value.

By Galen Gruman, Scott Bauer, and Vinod Baya

Insurance providers have started to offer customers a computer device for the car that monitors driving behavior and reports it back to the provider over a wireless network. The providers use the data to adjust insurance rates based on driving behavior, charging lower rates for those deemed to be safe and higher rates for those who aren't.

Adjusting insurance premiums based on data from this telematics technology is an obvious use case, one the industry is slowly adopting. Now, Allstate Insurance is exploring a more active approach—real-time feedback to help drivers become safer. A safer driver gets a lower premium and becomes less of a risk, which means fewer payouts by Allstate.

Whenever the driver makes a risky move, the device can give immediate feedback using a glowing red light on the dashboard or a sound that says, "That was a risky move." In trials of the usage-based telematics product with Allstate employees, 25 percent initially scored in the safe zone, but over the course of the test, that figure rose to 75 percent.[1]

"In the long run, insurance companies that use telematics successfully will use it to change their exposure," says Fred Cripe, the former executive vice president at Allstate involved in its telematics efforts. "By charging customers for the kind of driving they do, these companies will give customers more control over their insurance costs."

The result is the transformation of insurance coverage from a passive-response product to an active digital coach that helps the customer while reducing the provider's costs. (See Figure 1.) This use of active feedback illustrates an evolving goal-oriented solutions approach that engages the customer after the product is sold. It's an approach made personal and continuous thanks to the digitization of consumption and the augmentation of customer experience into a new relationship that extends beyond the transaction of a sale.

PwC believes that going beyond the transaction by building post-transaction relationships[2] is a major step forward

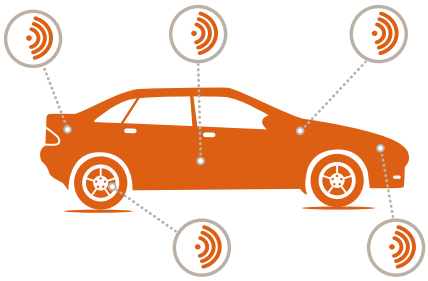
1 Allstate Insurance, "Allstate announces crowdsourcing effort to test usage-based insurance product," news release, July 25, 2012.

2 Scott Bauer and Carlo Gagliardi, "Creating post-transaction customer value: How digital technologies are re-inventing value for customers after the sale," PwC, 2013.

The post-transaction relationship reinvents the engagement with customers. It reaches beyond the sale transaction and focuses on helping customers achieve the personal goals they buy the products for.

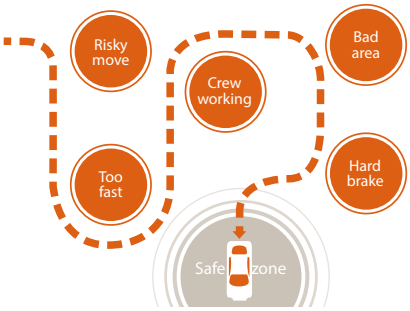
Figure 1: By embedding capabilities to understand how customers drive and augmenting the driver experience with real-time feedback on actions that create risks, insurance providers can go beyond the transaction of signing up customers and helping them achieve the goals of controlling their insurance costs and staying safe.

1 Consumer sets a goal to reduce his or her auto insurance cost from the current level.

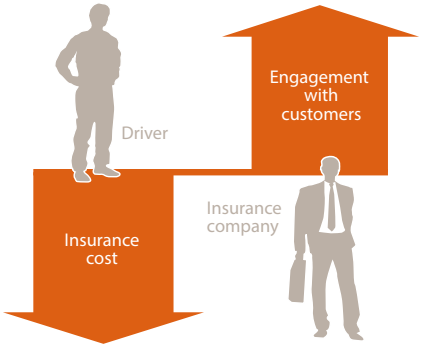


2 Digitizing consumption: Sensors in the car are surfacing data about driving behavior (braking, cornering, acceleration, etc.) and location.

3 Augmented experience: Analytics provides real-time feedback to the consumer.



4 Customer has actionable information to change behavior. Business has actionable information to guide customers toward their goal.



5 Achievement of goal: The insurance company lowers the rate as the customer's risk profile changes. Customer succeeds in lowering his or her insurance cost.

6 Win-win situation: Customer achieves lower rate. Insurance company faces lower payouts and a higher engagement with the customer.

in the interactions between businesses and their customers. The fundamental breakthrough is the digitization of consumption. Businesses thus far have transformed their pre-transaction relationship with potential customers, often referred to as *e-commerce*.

Major elements of e-commerce include digitally reinventing product discovery, comparison shopping, buyer feedback and reviews, and purchasing and delivery options; in essence, all the steps up through the transaction.

The post-transaction relationship reinvents the engagement with customers by reaching beyond the transaction and focuses on helping customers achieve the personal goals they buy the product for. What makes this approach possible is a set of emerging technologies collectively called the Internet of Things: wireless communications, cloud-based processing, sensors, embeddable computers, and real-time big data analytics.

This issue of the *Technology Forecast* explores how emerging technologies are facilitating the ability to create post-transaction relationships. This article examines how to go beyond the transaction, the opportunity it provides, and some of the rethinking it requires of businesses. The technology article, "The Thing Stack: Technologies that guide customers to their goals," on page 30 looks at the maturation of the technologies that make building post-transaction relationships possible. And the CIO article, "CIO leadership in post-transaction relationships: IT's role in customer engagement," on page 54 explores the key role IT staff can play in this transformation.

Rethinking products around customer goals and outcomes

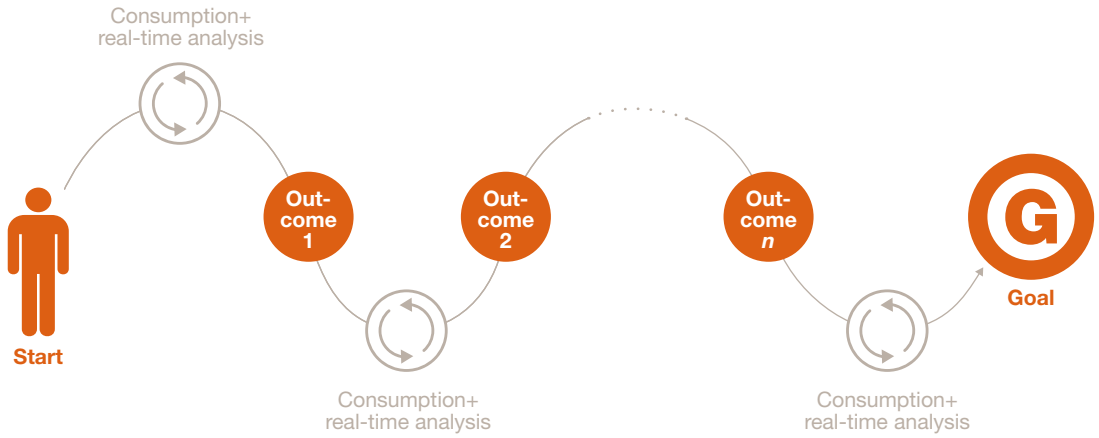
Nearly every company refers to its products and services as "solutions," but most are not. They create the potential to satisfy a want or need, but customers are pretty much on their own to translate that potential into reality.

From the customer's perspective, products and services are means to ends. Customers have goals. They usually want a particular outcome, one that is personal. They buy athletic shoes to stay fit, insurance to keep themselves healthy and safe, sports gear to improve performance, food to make meals for nourishment and enjoyment, how-to magazines and books to improve some important aspect of their lives, and so on.

Businesses try to understand these goals enough to market a product or service as a possible solution, but in most cases that's as far as it goes: a way to achieve a transaction. The story ends there, and it's up to the customer to achieve the desired goal. But it doesn't have to stay that way. "By charging customers for the kind of driving they do and communicating alternative behaviors that will cost less, these [insurance] companies will give customers more control of their insurance costs," suggests Cripe. To do what Cripe suggests, insurance companies will create a post-transaction relationship, a relationship defined around the customer goal of control on insurance costs. The implications are strategic. "The business model change will move the industry from what I will call a reimbursement model to a prevention and loss control model," Cripe forecasts.

> ***"The technology now enables companies to help customers achieve the goal that they're buying the product for—as opposed to just selling it to them most cost-effectively, which is what businesses have done in the past."***
>
> —Fred Cripe, Advisor to PwC

Figure 2: In a post-transaction relationship, the path to any goal is a journey directed by outcomes. Outcomes are incremental feedback that will direct consumer behavior to stay on the right path and move toward the goal.



Products and services that can help make personal goals actionable are in the best position to be chosen.

With a focus on achieving a sales transaction, businesses usually do not invest in understanding customers' personal goals. From a product perspective, customers are typically defined in broad-brush market segments based on demographics and psychographics. However, goals have specific characteristics:

- **Goals are personal:** Although the same product may be used by millions of customers, a goal is specific to the individual customer. For example, the savings any customer would want on his or her automobile insurance will be specific to the customer and his or her circumstances.

- **The achievement of goals is a journey:** While the paths may vary, each journey will unfold over multiple interactions rather than a single transaction. The journey is defined by the use of the product. For example, to achieve the goal of lower insurance rates, customers would need to demonstrate sustained safe driving behavior over long periods of time.

Outcomes direct progress toward goals

Progress toward a goal often has little to do with speed, and more with the direction. Customers need help to channel their energies in the right direction and advance toward the goal. What they need is feedback, in real time when possible, that recommends behavior that will keep them on the right path.

Businesses should define specific and measurable outcomes that become the basis for incremental feedback along the journey, and they should direct consumer behavior to stay on target. Whereas goals are aspirational, outcomes are incremental and directional—in some sense, they are the mile markers along the highway to the goal. (See Figure 2.) Emerging technologies in connected sensors now make possible the measurement of the outcomes of each behavior and their contribution to the overall goal.

For example, real-time feedback that indicates the driver has made a risky move or chosen a risky route provides information on

Sensing a change in behavior

Can the Internet of Things—as a combination of sensors, devices, and applications—change customers' behavior toward their goals? Evidence emerging from many experiments, such as Allstate's, seems to suggest yes. Real-time feedback taps into human psychology and physiology and helps people change their behavior. Why? Sensemaking theory explains why, as well as how people interact with a complex world around them and how people change their behavior to effect change in that world.

Sensemaking is the process by which people give meaning to experience.* Sensemaking theory says people make sense when three elements are present: cues, scripts, and schemas. Cues arise when a person receives feedback that something is wrong or amiss and needs to be addressed. Cues act as triggers for behavior change to ensure success and survival. Scripts are the rules people follow once they get a cue to change behavior. Scripts are based upon capabilities a person needs for a new and goal-achieving behavior. Schemas represent the structures that provide rewards or punishments for responding to the cues and following the scripts. They create the motivation for a new behavior.

In the insurance example discussed in the main article, alerts signaling risky driving behavior are the cue to trigger change. A script is change that directs the driving behavior toward the safe zone by removing or altering the cue. A schema is the savings in premium associated with a sustained change in behavior. The Internet of Things enables all of these actions to happen in real time.

Sensemaking theory works, because the psychology of making sense of the surrounding world is grounded in human physiology where the brain receives chemical rewards (dopamine) and punishments (cortisol) based upon the cues, scripts, and schemas that emerge. Here are some examples of solutions that use a combination of sensors, devices, and apps to take advantage of sensemaking theory. They provide further evidence that sensemaking theory explains why consumers will change behavior to move toward a goal:

- Ginger.io provides software for smartphones that measures a customer's stress and anxiety based upon the apps used, the frequency of use, and voice patterns, and then provides coaching in real time to help modify behaviors and remove the stress.
- Motivation Science uses applications and tools to provide individualized motivations across many domains, including financial, social, and spiritual. The objective is to help people achieve their respective goals in these domains.
- WellDoc provides an FDA-approved mobile health application to deliver real-time coaching to help patients manage their diabetes by monitoring physical activity, dietary habits, and blood sugar levels. Clinical studies have shown that patients who use the real-time feedback via an app decrease blood sugar levels by three times more than the most effective diabetes drug.
- Atlantis Healthcare uses texting, e-mail, and other forms of communication and behavioral psychology science to improve patient adherence to drug therapy. Targeted real-time messages are used as cues to effect behavior change.

What all these companies and solutions have in common is that they gather data and information in real time through networked sensors, and they use this information to create cues to trigger behavior change right at the moment when the behaviors seem misaligned with goals. Their solutions include the scripts that can be followed to effect a change in alignment with goals. Finally, they also provide a schema to ensure appropriate and customized rewards and punishments (psychological and physiological) to sustain the change. New behaviors then provide new cues, which lead to new scripts, based upon new schemas—and the feedback loop of sensemaking can repeat.

* For more details, see http://en.wikipedia.org/wiki/Sensemaking.

whether the driver is progressing toward the goal of achieving certain savings. This information can direct driver behavior that will reduce the driver's risk and rates.

The leap businesses need to make is to understand customer goals, make them explicit, create measures and methods for tracking progress toward the goals, and redefine the product or service around how it advances the customer toward the goals.

By making the goal and progress toward it measurable, visible, and adjustable, a business lets the customer cross the chasm between theoretical desire and actual pursuit, so the customer can, in psychological terms, self-actualize the desire into reality. Evidence is mounting to suggest that providing real-time feedback taps into human psychology and physiology in ways that propel people to make substantial changes in the way they live, interact, and behave. The sidebar "Sensing a change in behavior" describes the theoretical basis that explains why a system of sensors, devices, and applications brings about behavior change toward the achievement of goals.

Because the goal is continual, so is the engagement with a provider such as Allstate, whether through software on a mobile device, hardware and software in the

"Technology is super important, but more important is the will to create new and seamless crossovers between physical and technological interfaces."

—Daan Roosegaarde, Studio Roosegaarde

car, the Allstate website, or some other venue—and most likely through several of these media. The providers gain access to an incredible wealth of data on individual customers and customers in aggregate that it can use to improve products and services, discover new products to support other customer goals, and build a richer, deeper, and engaging post-transaction relationship with each customer.

Understanding post-transaction relationships

Pre-transaction relationships focused on the transaction and the activities leading to it, using digital media such as the Internet, enterprise resource planning (ERP) systems, and databases to manage the shopping and supply chain processes, enabling greater access to more product choices for more people. But the products sold were largely the same: consumer electronics, clothes, books and CDs, medicines and medical gear, even pet supplies.

By pairing shopping with easy inventory search, relevant suggestions, previous buyers' feedback, and fast, traceable delivery, businesses created new value and transformed the shopping experience. However, once sold, there was little relationship carried forward concerning the use of the product itself, even if e-commerce providers did establish an ongoing shopping relationship in the broader sense.

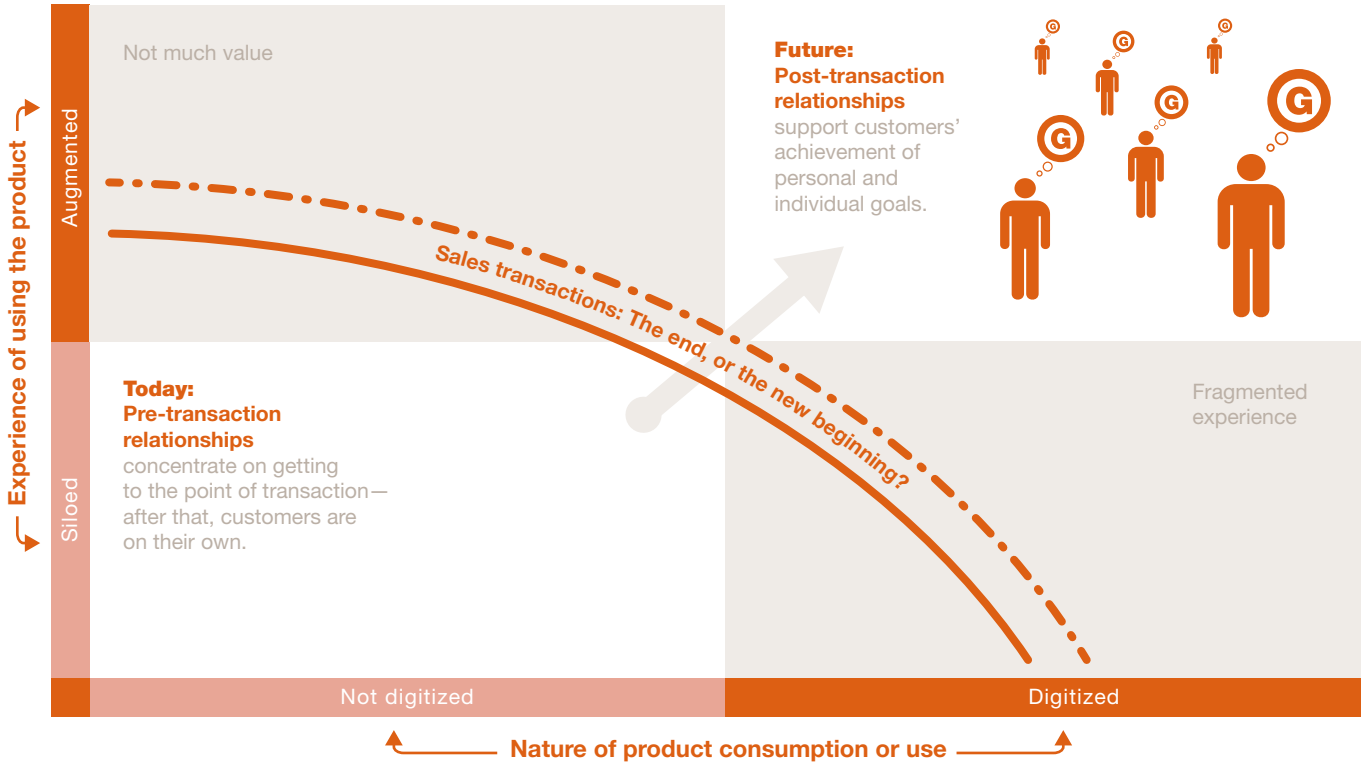
Focusing only on the transaction has resulted in two key disconnects that customers and providers face today and that limit the ability to create new value:

- **The transaction disconnect:** Businesses have focused on value up to the transaction, whether in a physical or digital channel. Engaging with the customer beyond the transaction has been all but impossible in a physical context, requiring on-premises personal support that is expensive and not scalable. The digital realm has been better able to stay with the customer after the transaction, but even here the cost of sensors and the complexity associated with networking, data storage, and data analytics to permit real-time engagement has limited the designs of most products and prevented the inclusion of post-sales involvement. As the costs change, and as digital technologies are increasingly fused into physical products, the possibility of engaging beyond the transaction expands to many more products.

- **The physical/digital disconnect:** Today, people experience the digital world (the web and Internet) separately from the physical world. Even if a product or service has a digital component, customers must switch between what they do on the computer or smartphone and what they do "for real." As a result, the user experience is fragmented across online and offline mediums, creating friction that limits engagement. As the digital and physical realms become more fused, this disconnect will eventually disappear, enabling the persistent engagement that is fundamental to a goal-oriented customer relationship.

A post-transaction relationship addresses both disconnects by taking advantage of developments along two dimensions. First is the growing ability to *digitize consumption,* which provides new information about how the product is used. Second is the ability to *augment experience* by extending the physical objects and environment into the digital realm, thereby facilitating an integrated and seamless experience across both physical and digital spaces. The confluence of these two capabilities provides the basis for a new value opportunity;

Figure 3: To help customers achieve their personal goals, businesses need to invest in post-transaction relationships that take advantage of two developments: digitized consumption and augmented experience.



that is, enabling businesses to help customers achieve their goals. (See Figure 3.) "The technology now enables companies to help customers achieve the goal that they're buying the product for—as opposed to just selling it to them most cost-effectively, which is what businesses have done in the past," Cripe says.

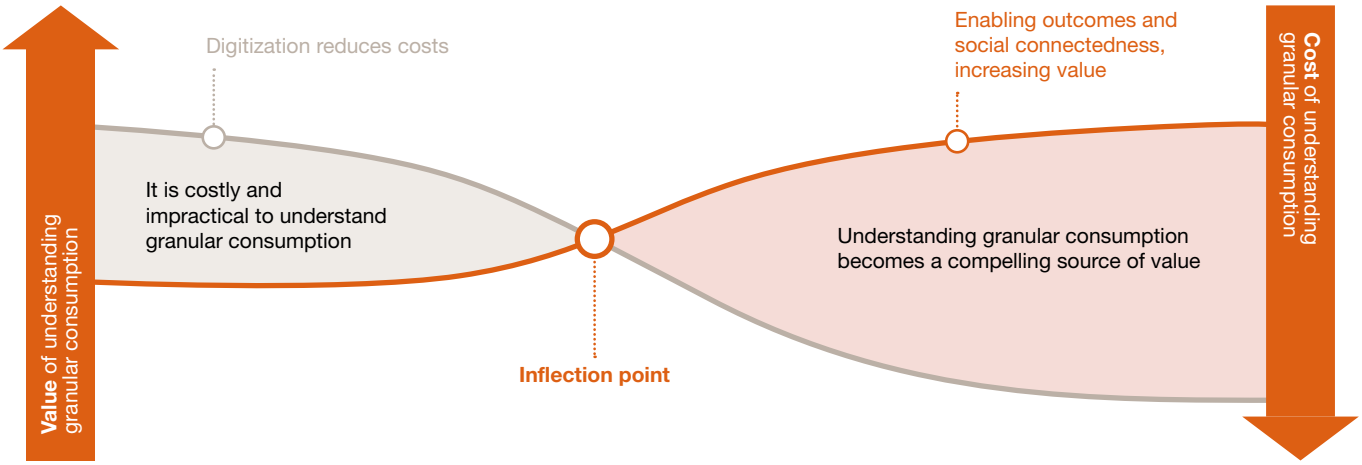
Digitizing consumption: New visibility changes the game

Until recently, it was too expensive to analyze customer activities at a level granular enough to gain an understanding of both individual customers and customer segments. But that's changed, as Figure 4 shows, thanks to a broad set of technology advancements. Most industries are either past or rapidly approaching the tipping point where the value that can be created by understanding granular consumption is higher than its associated costs.

With the availability of small and less-expensive sensors and the ease of embedding networking capabilities, all companies have the potential to digitize how products and services are consumed or used—from toothbrushes and forks to cars and roadways. "The ability to surface consumption-level data enables a relationship with a customer where you can help with their personal goals," says Carlo Gagliardi, a partner at PwC UK. To help with progress toward goals, businesses will need to understand where a customer is in his or her journey toward the goal. Granular consumption data becomes the basis of this understanding.

> *"The ability to surface consumption-level data enables a relationship with a customer where you can help with their personal goals."*
>
> —Carlo Gagliardi, PwC

Figure 4: Most industries have arrived at an inflection point where it is now economically feasible to understand customers' granular consumption activities, setting the stage for being able to build a post-transaction relationship.



Most industries are either past or rapidly approaching the tipping point where the value that can be created by understanding granular consumption is higher than its associated costs.

For instance, if a customer's goal is to bring his or her automobile insurance rates below a certain level, the data from the telematics device is essential to understanding the risk of this customer's driving behavior and providing feedback on this customer's progress toward the goal. Absent this data, neither the insurance business nor the customer has the necessary information to reduce the cost of insurance.

The digitization of consumption provides insights that are useful beyond helping customers to achieve goals. Visibility into how a large pool of customers uses the product can provide insights not possible by other means. For example, most customers will not bother to report small events, such as a paper jam in a copier, to its manufacturer.

"They just straighten it out and move on," says Jim Ingrassia, vice president of the solutions support division at Konica Minolta Business Solutions. "But when we see it happening across 50,000 or 60,000 machines during a period of 30 days, then we look at the data from a different perspective. We start seeing patterns and realize that perhaps we have a design issue."

By digitizing the consumption of its products to the point where every small event is collected, Konica Minolta also learns from events the customers may not view as significant. For about a decade, Konica Minolta has been using the digitized consumption of its copiers as a means to improve products, services, and overall value. (See the sidebar, "Many blueprints of businesses building post-transaction relationships.")

The digitization of consumption is not without its challenges. Granular consumption information can be sensitive, and businesses will need to earn an unprecedented level of trust to create a post-transaction relationship, as the sidebar "Trust issues in post-transaction relationships" suggests.

Trust issues in post-transaction relationships

It's amazing how much information can be collected about individuals, both directly through digital services and products, and indirectly through the analysis of databases that contain everything from statistics about web visits to demographics. While consumers demonstrate a growing acceptance to share usage data in return for value-added services, the prospect of being so closely monitored and tracked is not without risks to customers or businesses.

Various social networks and many "free" cloud services have already shown just how much information can be obtained about individuals—often from them directly—by offering a compelling personal value proposition. At the same time, the outcry every few months when such providers cross lines of comfort likewise shows the discomfort such aggressive usage of personal information can cause. It's unclear whether this discomfort is a fundamental barrier or a transitory reaction to a new highly connected world. In either case, navigating the bounds of privacy will be uncertain as the interplay of technologies, behaviors, and policies evolves.

Indeed, businesses should be open with their customers about what information is captured, how it is stored, who it is shared with, and on what terms. All this disclosure helps customers answer the most important question to them, "Who knows what about me?" However, should customers experience direct harm when information is compromised, then customers will react strongly and negatively. The outcry and swift legislation in response to some employers' demands for social networking passwords is an example; job applicants quickly perceived such requests as ways to deny them employment, a very direct harm.*

Business policies should protect customers from direct harm from breach and misuse of personal information. For example, stolen credit card information can have direct harm to customers, but the industry has highly sheltered them from any consequences, so the harm falls much more on the business than the customer.

It's clear that customers must trust either the businesses they deal with or the regulatory framework that governs the industry. Plus, customers must perceive no specific harm from the use of their personal information. It's up to the businesses to earn that trust, especially for products and services that use risky (to the customer) personal information, such as health data, driving behaviors, and even food purchases. And then businesses must maintain that trust by not abusing (again, in the mind of the customer) the information collected.

* Doug Gross, "Facebook speaks out against employers asking for passwords," CNN, March 23, 2012.

Augmenting experience: Integrating physical and digital

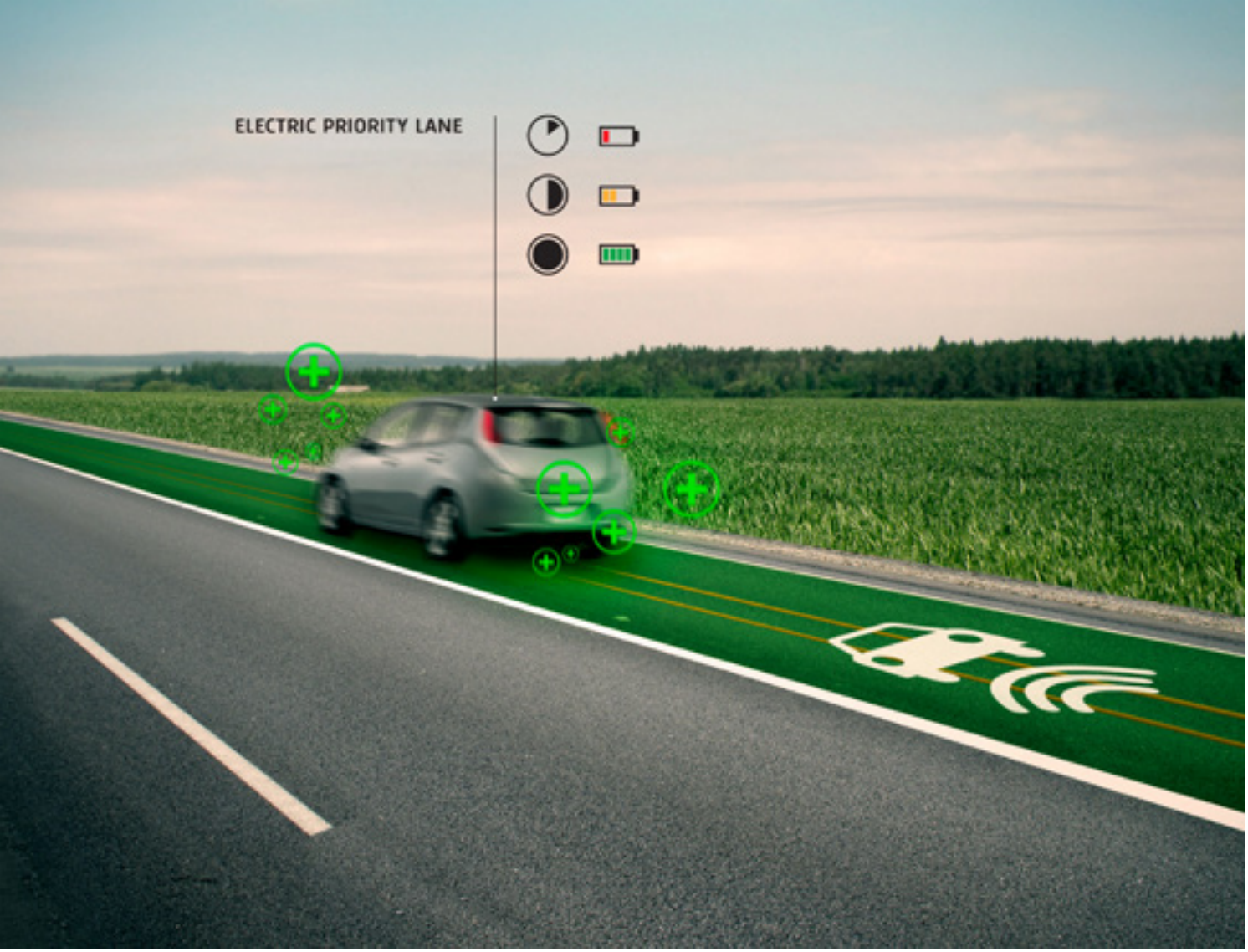
Customers today live their lives in two spaces—their particular physical world and the digital space they access using computers, tablets, or smartphones. The achievement of any goals will span these two spaces. When done right, the notions of online and offline aren't separate states but are coexisting, mutually aiding states perceived as one flexible, seamless state the user "lives" in for certain activities.

When asked how he created the sustainable dance floor[3] that fuses the physical space of the dance floor and the technology space of electricity generation into an augmented experience where the act of dancing generates the electricity to power the discotheque, Daan Roosegaarde, an artist, inventor, and entrepreneur whose Studio Roosegaarde consults on interactive design for human space, replies, "We upgraded reality. This is augmented reality in its purest form—not as a mobile app, but as a seamless integration of the physical environment and technology."

Roosegaarde has done several projects that use digital technologies to provide integrated seamless experiences across physical and digital domains. "Technology is super important, but more important is the will to create new and seamless crossovers between physical and technological interfaces," he says.

For example, he has proposed reimagining highway design in a way that exemplifies the concept of an augmented experience. He notes that billions of dollars are spent to make cars smarter, but not the roads they travel. Why, he asked, couldn't highways use sensors (many already have them for traffic monitoring and the detection of hazardous materials) to interact more intelligently with drivers based on local conditions?

3 For more information, see http://www.studioroosegaarde.net/projects/#sustainable-dance-floor.



While consumers demonstrate a growing acceptance to share usage data in return for value-added services, the prospect of being so closely monitored and tracked is not without risks to customers or businesses.

The Smart Highway concept[4] proposes using signs that are painted on the roads and appear only below a certain temperature to display warnings about icy conditions, or that are connected to wind sensors to display only during high winds. When these warnings appear on static year-round signs, they are more likely to be ignored. Lane markers, such as those designating carpool lanes or express lanes that skip some exits, could also be made digital, so they change with traffic flow and volume; they could be made with photosensitive materials that keep them lit at night and charged via solar power during the day. Streetlights could have detectors so they turn on only when cars are nearby.

4 For more information, see http://www.studioroosegaarde.net/project/smart-highway/photo/#smart-highway.

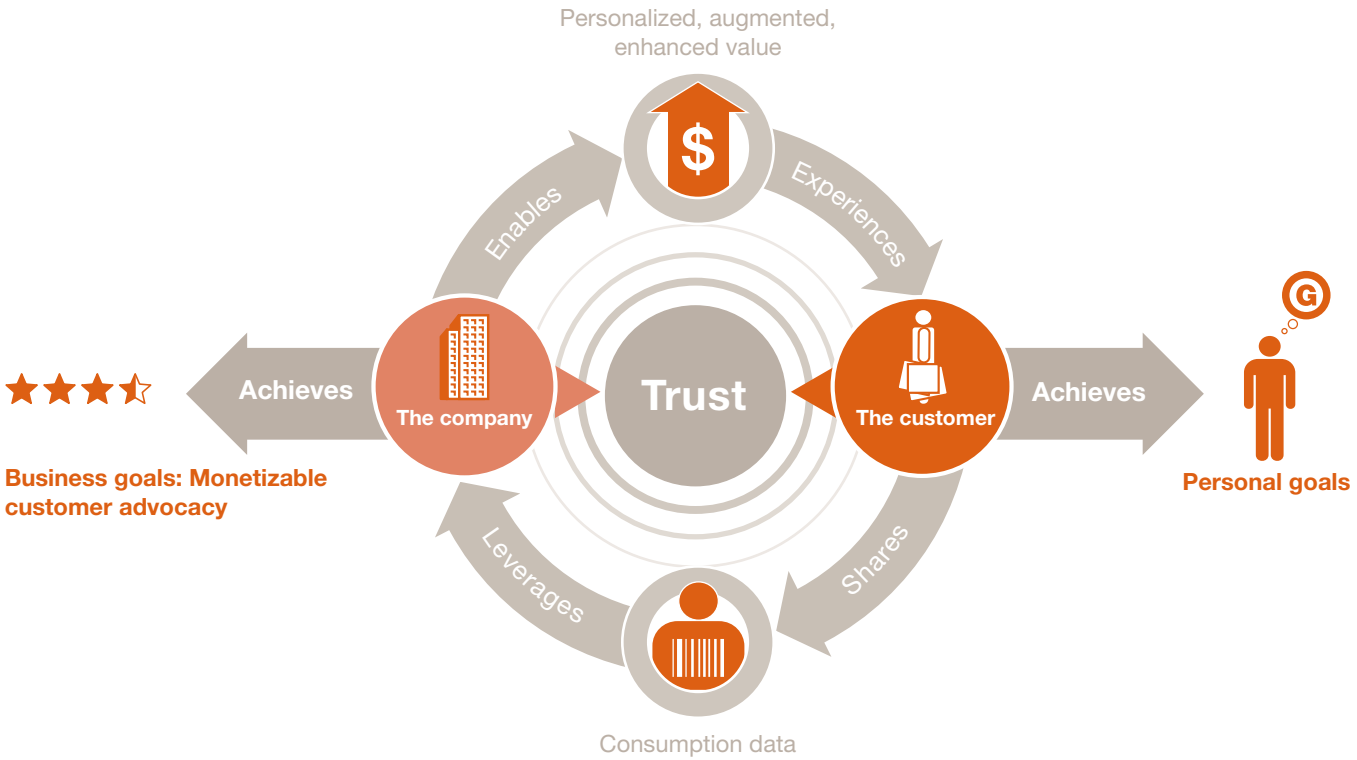
In augmenting the experience, businesses are empowering their customers to achieve their goals more effectively than they could on their own. By creating seamlessness between the physical and digital spaces, businesses create a real-time feedback loop between the context of consumer actions and the progress toward their personal goals.

Selling outcomes in the post-transaction relationship

The use of the product or service forms the personal nexus between customer and provider in an ongoing relationship and becomes the conduit for persistent value.

This shift in thinking is significant. "Since you can track progress toward a goal, you can sell outcomes and not

Figure 5: The dynamics of the emerging value exchange in the post-transaction relationship. The new value businesses will provide is the enablement of customers' goals in exchange for the consumption data that a customer shares. The value businesses receive is a deeper relationship with and advocacy from the customers.



just products," PwC's Gagliardi says. Selling outcomes is a different mentality from the historic focus on selling a product but leaving achievement of any goal up to the customer.

The dynamics of value exchange between business and customer will change, as shown in Figure 5. Customers' willingness to share personal data about their consumption will be a critical component of the new value exchange. The benefit is mutual, as Cripe explains using the insurance industry example. "There is alignment of customer and enterprise goals. Insurers win because we pay out less relative to what we charge. The customers win because they save money and they really didn't want the annoyance and the danger and the injury that comes with being in the accident in the first place."

Creating the ability to measure and share incremental outcomes evolves the transaction into a deep relationship. Rather than satisfying a one-off want or need, products and services that go beyond the transaction satisfy an individual customer's ongoing needs through a continuous relationship. For example, a golf club that monitors swings to provide feedback for improvement, a medical monitor that allows patients more independence while monitoring them 24/7 and providing feedback and help as needed, or a car computer that provides route and driving suggestions to reduce risk every day and thus reduce premiums and insurers' outlays.

Enterprises will need to acquire new capabilities to take advantage of principles that enable post-transaction relations. In particular, they will need to do the following:

- **Anticipate the goals and outcomes that are important to the customer:** Organizations should use a much stronger behavioral lens to understand customers' goals, how to make them explicit and measurable, and how to track progress by means of incremental outcomes.

- **Deploy and master new capabilities linked to consumption:** Enterprises should be able to identify consumers individually and create the ability to gather, store, and analyze large amounts of real-time data.

- **Design and embed a digital coach to provide real-time feedback:** The enterprise product

In augmenting the experience, businesses are empowering their customers to achieve their goals more effectively than they could on their own.

or service should include the capability to coach the consumer, change their behavior, and guide them—all in the service of a defined goal.

- **Develop new metrics for organizational performance:** The metrics should focus on how well consumption data is understood and used to deliver a goal-oriented service, rather than using metrics only on volume of sales.

- **Upgrade the ecosystem interaction:** When a business focuses on customer goals, then enterprise relationships with its ecosystem partners, suppliers, and others would need to change from service level agreements (SLAs), contracts, and deliverables to arrangements based on contributions toward the achievement of customer goals.

Various enterprise functions—including product design and development, marketing, and IT—will need to collaborate to build these capabilities. The article, "CIO leadership in post-transaction relationships: IT's role in customer engagement," on page 54 provides some insight into how enterprises can go beyond the transaction.

Why is it possible to go beyond the transaction now?

Products that go beyond the transaction have a strong service orientation, interact with the customer directly, and over time rely on a broad range of inputs, process lots of data, and become an adjunct to a person's activities. They depend on a closed-loop system using sensors, real-time feedback, and analysis of consumption data. The notion of such capabilities is not new. But until now they have been difficult to deliver, given their need for constant communication, access to a large amount of data and data storage, and computing capabilities and sensors that can be embedded in devices people wear and carry without burden—and use for hours without needing a power source.

"It was too costly and impractical to understand how people used the product, where they used the product, and what they thought of it. But now because of always-on connectivity, a willingness to share personal data, and the growing capabilities of smartphones, it's no longer too costly or impractical to understand granular consumption," PwC's Gagliardi says.

The technology barriers are collapsing and will continue to do so during the next few years. (See the article, "The Thing Stack: Technologies that guide customers to their goals," on page 30.) For personal devices, technologies include radios (cellular and Wi-Fi), local wireless (Bluetooth and various emerging companions), embedded sensors (cameras, microphones, light sensors, temperature sensors, accelerometers, GPS receivers, pressure gauges), and central processing units (CPUs) and processing and memory hardware.

For the infrastructure, the technologies include cellular and other wireless networks to handle the communications, the constellation of online cloud services to provide storage and computing resources, and a loosely coupled, modular software environment based on application programming interfaces (APIs) and inspired by the emerging web platforms.

On the corporate back end, the technologies include big data analytics to analyze relevant data sources, gamification for managing and refreshing customer engagement, and back-end systems, such as ERP and supply chain management. Previous issues of the *Technology Forecast* explore the technologies involved with gamification, APIs, social technologies, cloud computing, and big data.[5]

5 For previous issues of the *Technology Forecast*, please visit: http://www.pwc.com/us/en/technology-innovation-center/publications.jhtml.

Many blueprints of businesses building post-transaction relationships

There's no single template for products that capitalize on post-transaction relationships. The approach will be industry specific and will depend on the nature of the product or service. Whatever the unique circumstances, the ubiquity of the technologies means the door is open to disruptive changes across design or product development and service, new business models, new sources of value, and industry change. All result in a proactively useful customer experience sustained over time. The following examples illustrate four blueprints.

New design and service at Konica Minolta

Improved internal processes and product quality through on-site intelligence

By going beyond the transaction with its copiers, Konica Minolta improves product designs and makes post-sales support easier on customers and more profitable for the company. Konica Minolta has a highly configurable system for collecting consumption data directly from copiers. End customers experience fewer problems, faster service, and improved satisfaction. Konica Minolta gains insight into usage patterns, proactive alerts of potential issues that produce fewer service calls and more efficient stockpiling, and better information on product vulnerabilities and defects to allow changes to new units that reduce future service costs. And all of this data improves Konica Minolta's processes.

"One advantage is being able to call a customer and tell them that they're having issues with the machine and that the service rep will be there within the next several hours or tomorrow to address them. Typically, customers won't even have been aware that they're having issues," says Jim Ingrassia, vice president of the solutions support division. It also helps engineers improve designs for future products, even versions of the same products yet to be manufactured. The result is a feedback loop that stretches from product design through customer service, providing a better experience to the customer, fewer post-design change costs, and a better understanding of customer usage by Konica Minolta. (See the interview with Jim Ingrassia on page 68.)

It also creates a different relationship between product engineers and their products, and between maintenance staff and the products they support. "We have transformed the overall experience [of technicians] by taking advantage of the tracking information and creating a seamless end-to-end experience for technicians," Ingrassia says. Technicians use a mobile app to seamlessly make warranty claims, order parts, schedule visits, visit sites, and so on, boosting their productivity and satisfaction.

Although the big benefits are better product and process design and delivery, the customer also benefits in a sustained, ongoing way through reduced friction and an "it just works" experience that leads to long-term satisfaction.

Redefining a business model in elderly care

Protecting the elderly through continuous monitoring

At The Oaks, a senior care facility in Orangeburg, South Carolina, semi-independent patients living in care facility settings or residential home settings are monitored with Wi-Fi-connected sensors so practitioners can see if someone is immobile for a worrying length of time, which could indicate a fall or fainting spell, or if they are moving around in the night, suggesting they are not sleeping. Such assisted-care facilities have long had buzzers that patients use to call for help, and their staffs have regularly performed in-person check-ins, but the connected sensors give the facility more immediate context and patterns that can reveal unknown problems.

James McGee, president and CEO of The Oaks, recalls a situation in which the sensors detected the patient moving around the apartment each night, yet she reported sleeping soundly. Something didn't add up.

"We looked at her medical chart, and the doctor had prescribed a medication that can produce a side effect of sleepwalking," McGee says. He quickly realized she was in fact asleep while moving through her apartment. He alerted the doctor, who changed the medication. "Once we did that, she was getting good sleep at night."

The Oaks uses technology solutions from GrandCare Systems. "Our solution embeds several sensors in the living space to track movements around the house, movement on the bed, as well as sleep, medication, glucose, weight, and so on," explains Laura Mitchell, vice president of business development for GrandCare Systems. The effect is to digitize everyday actions in the home.

There are many potential goals for such a service; one of them is to prevent emergencies. "We use this technology to try to predict something before it happens," McGee says. The direct benefits to the resident are obvious: better, smarter care. And the facility is digitizing the consumption of services to reimagine the business process behind a service (healthcare, in this case) as a proactive, preventive service rather than a reactionary, crisis-oriented one.

Healthcare is possibly the industry that changes the most by focusing on helping customers understand and achieve their health goals.

New sources of value at First Data

Reinvention of a passive service into an active assistant

When businesses start to go beyond the transaction, it is not always clear exactly what the new value might be, but it is important to seek it. That's what First Data is doing by exploring the notion of universal commerce.

"Universal commerce is an evolving concept that suggests movement toward a future where retail activities are seamlessly integrated into a single end-to-end experience—shopping, payment, marketing, loyalty, money management, and offline and online experiences," says Dominic Morea, senior vice president of advanced solutions and innovation at First Data.

The payments processor is exploring how it might tap into customers' transactional data to create new values for its retailing customers and their shopping customers. Morea cites several possible enhancements that, when combined, create a seamless experience for shoppers and retailers alike. (See the interview with Dominic Morea on page 72.)

For example, by having access to the transaction data via First Data, customers and retailers avoid the hassle of dealing with paper receipts for returns, and discount redemption becomes automatic and less labor-intensive, both of which increase customer loyalty while reducing operational costs. Morea calls such capability "adding value at the basket level."

Many companies already have some forms of loyalty and customer-account programs. Morea believes a larger improvement in customer experience and retailer insight would occur if companies could access a wide pool of customer transactions from multiple retailers. "We are creating the ability to see the consumer on a longitudinal basis," he explains.

For example, by tracking the products customers are exploring at online retailers and the products they have purchased, First Data may be able to help customers complete more transactions. First Data could flag when an item is available at a nearby shop (via geo-location capabilities in a smartphone) to encourage its purchase or, conversely, to suggest an online order of a product being explored but unavailable at a retailer's physical outlet.

Industry change in healthcare

Reinventing the methods and processes of healthcare

Healthcare is possibly the industry that changes the most by focusing on helping customers understand and achieve their health goals. "What the consumer has now is a thermometer and Google. There is nothing in between," says Walter De Brouwer, CEO of Scanadu, a startup developing a tricorder it expects to release in late 2013. De Brouwer envisions the convergence of health and smartphone to lead to a health phone that will create a health feed for each person. (See the interview with Walter De Brouwer on page 50.)

When it comes to health, everyone has goals. "Consumers want services that guide their behavior to habits that improve their health and well-being," suggests Christopher Wasden, global healthcare innovation leader at PwC. By extending the capability of smartphones to include molecular diagnostics, using the camera in the phone as an imaging device, and using physical contact with the device to monitor vital signs, the phone will maintain a continuous health feed—a time series of the person's vitals. Such data will be a big resource to help consumers with their health goals.

The center of gravity of care will shift. "The place of care must be shifted to the home—where it was in the first place," De Brouwer says. He expects that will happen and that in the long term, a tricorder on a chip could be implanted in a person's environment and that person's medical records could be in their body, always with them.

The relationship with healthcare professionals today is transactional in nature, usually based on an illness or injury. "What she [the doctor] sees is a Doppler effect, a distortion of our health feed, since she does not have access to the full feed," De Brouwer says. A health phone will capture the full feed, remove the distortion, and set the stage for everyone to advance toward the goal of better health.

Conclusion

The enabling technologies available today to better understand customers' behavior when they consume or use products and services can create an incredible opportunity to redefine value for customers and businesses. To realize that value over the long term, businesses must focus on helping customers achieve their personal goals by going beyond the transaction and building post-transaction relationships.

This new relationship requires a goal-oriented approach to product and service design. It starts with a reframing of the fundamental value proposition beyond the typical one-time, transactional approach of addressing a specific need or want. In going beyond the transaction, the purchase is not the end of the sales relationship but the start of a goal-satisfaction process that could last months or years, with plenty of opportunity for new insights, additional sales, and delight. Products and services that can help make personal goals actionable are in the best position to be chosen.

Businesses that fuse digitized consumption with an augmented experience in the service of the customer's personal goals will find a new level of success. Thanks to the maturation of the enabling technologies, they can now begin to do so.

Aligning customer and enterprise goals

Fred Cripe shares how the Internet of Things will shift the insurance business from loss compensation to loss control by helping customers achieve their goals.

Interview conducted by Vinod Baya

Fred Cripe

Fred Cripe is a senior advisor to PwC and a former executive vice president of Allstate Insurance Company.

PwC: Fred, what is the history of telematics use in the auto insurance industry?

FC: The concept goes back a couple of decades, when Progressive filed patents related to the use of a tracking device in the automobile. It started with the thinking that tracking mileage was a better measure of risk exposure. Over a period of time, it became obvious to many in the industry that the accident rate is not proportional to mileage. The accident rate per mile actually drops off fairly steeply as annual mileage increases.

What the industry realized is that risk relates to how people drive. So the focus shifted more and more to using emerging technologies to track how people drove, where they drove, under what conditions, on what kind of roads, how congested the roads were, and so on.

PwC: Is such tracking becoming possible now?

FC: Cars already have a number of sensors that can provide information relating to how someone drives—information such as how fast they are going, how quickly they accelerate, how quickly they stop, what kind of turns they make, and so on. With advances in telematics, which is related to the broader trend called the Internet of Things, it's becoming possible to get this information in batches or in real time at costs that are dropping.

"In the long run, insurance companies that really use telematics successfully will use it to change their customers' exposure to loss."

From such information, and from knowing what the road conditions and speed limits are, you can in essence understand how well someone is driving. And that correlates with accidents. Obviously, the more dangerously someone drives, the more likely they are to be in an accident.

PwC: How is this information being used today and what is the long-term impact to the industry?
FC: Most carriers today focus simply on doing what insurers have historically done better, which is assess risk and charge people for it. Telematics can help determine whether someone is a better than average driver or a worse than average driver, so it is used as another input into pricing.

In the long run, insurance companies that really use telematics successfully will use it to change their customers' exposure to loss. By charging customers for the kind of driving they do and communicating alternative behaviors that will cost less, these companies will give customers more control of their insurance costs. So if someone drives five miles on a dangerous road, that will cost the person more than driving five miles on a safe road. If someone engages in dangerous maneuvers such as hard braking, that will cost the person more than if they don't. So in the long run, there is potential for far more sophisticated pricing, but that pricing enables consumers to have better visibility and control over their costs.

When I was at Allstate, we did some early trials with our own employees and agents to see what we could learn. We put sensors in cars that would measure how people drove, and the sensors also would give feedback whenever the driver made a risky move. Drivers would receive feedback by a little red light that would glow or by a sound that would say, "That was a risky move."

In later tests of Allstate's Drive Wise telematics product, they saw dramatic changes in driving behavior by employees. Whereas in the beginning only 25 percent of the testers scored in the ideal "safe zone," over the course of the test that number increased to 75 percent.[1] Providing real-time feedback promotes safer driving habits.

PwC: How will telematics change existing insurance company operations?
FC: In addition to loss control, I see telematics being used to transform our service, particularly in claims. When there's an accident today, there's enough information in the car from the accelerometer, airbag sensors, and other devices to indicate roughly the speed and direction of impact. We already know the particular make and model of the vehicle. With a set of predictive models, we can say with some confidence how much damage has been done, whether that car is going to be drivable, and the extent of possible injuries. And we can coordinate an appropriate response.

For instance, an insurance representative can call a customer's mobile device in the car and check in: "We got the signal that you were in an accident. Is anybody injured?" We can provide necessary details: "Based on our assessment, your car is not safe to drive, and a tow truck is on the way." If the customer has rental coverage, we can also send a replacement vehicle. "We'll tow your car to this body shop and they'll have an estimate by tomorrow."

There is potential for much value-add. You can start to interview injured people immediately. You can get the police report in real time. The company maintains control of the damaged vehicle. Telematics will start to change how companies settle claims and serve their customers by making the overall experience more seamless.

PwC: What is the impact on the business models that are prevalent in the industry?
FC: By and large, today automobile insurance works as what I call the moving the money around business. Money goes in and then money comes out. Customers tend to think about

1 Based on publicly reported data in the press release from Allstate Insurance, "Allstate announces crowdsourcing effort to test usage-based insurance product," news release, July 25, 2012.

"The business model change will move the industry from what I will call a reimbursement model to a prevention and loss control model."

whether they're doing well or poorly in that relationship based on whether they're getting more money out in claims relative to the money they're putting in.

The business model change will move the industry from what I will call a reimbursement model to a prevention and loss control model. The basis of competition will switch from the ability to predict an individual customer's expected loss to the ability to understand how a customer's driving affects their expected loss and how changes in that driving—whether it's where they drive, how well they drive, or when they drive—could change their expected loss.

PwC: Why is this ability possible today and not before?
FC: The business model I have described is only possible with a closed-loop system using sensors, real-time feedback, and predictive analysis of behavior data. We have had such a feedback loop for high-value assets. For example, in the property/casualty large commercial industry, part of the contract includes what is called loss control. If you had a factory, an insurance company would send experts to look at how your factory works and what kind of safety devices there were. They would also give you advice on how to how to run a safer factory, or have a safer store, or prevent theft, and so on. This advice is part of the service.

Such advice was always too expensive to provide for individuals. But with the Internet of Things, sensors, communications technology, and analytical power now make it feasible for insurers to offer loss control on an individualized scale for large numbers of customers. This capability extends to homeowners insurance as well. There are now devices that you can attach to pipes in your house that will let you know in minutes if a leak starts anywhere in the house. Also, you can plug a device into an electrical outlet, and it will let you know when a short circuit is likely in a particular circuit in the house.

PwC: Clearly there is much value-add potential to customers and the insurance industry. What are the challenges?
FC: First is a battle for customer acceptance. Only a very small part of the personal auto market is rated using telematics. Consumers really weren't willing to have devices in their car that could track where they drove. There's a major privacy issue about that. However, customer sentiments and expectations are changing, in part because of the smartphone. Customers expect more information and greater seamlessness in their experience, and telematics allows insurers to do that.

Today, about 1 percent of auto insurance customers use telematics. During the next 5 to 10 years, that percentage might grow 1 percent of the market a year. At some point it will skyrocket, and a critical mass from one-third to one-half of all auto insurance customers will be willing to purchase a telematics-oriented product as opposed to the traditional insurance product.

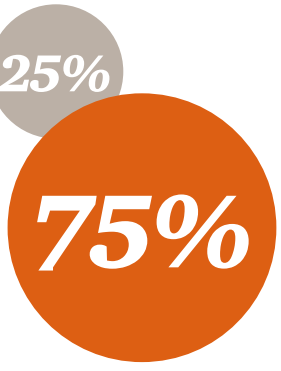
PwC: As you look at the history and future of the insurance industry and the impact of the Internet of Things, what is the cosmic change here?
FC: The technology now enables companies to help customers achieve the goal that they're buying the product for—as opposed to just selling it to them most cost-effectively, which is what businesses have done in the past.

In the case of the insurance industry, most customers don't buy insurance to have a product. The insurance is to pay for the losses that occur when something bad happens to them. Their goal is to prevent a bad thing from happening to them in the first place.

Additionally, there is also alignment of customer and enterprise goals. Insurers can create more value in loss prevention for customers by saying, "I'm going to charge you 80 percent as much but reduce the likelihood you'll be in an accident by 30 percent." Insurers win because we pay out less relative to what we charge. The customers win because they save money and they really didn't want the annoyance and the danger and the injury that comes with being in the accident in the first place.

Benefits of digitizing consumption

"Whereas in the beginning only 25 percent of the testers scored in the ideal 'safe zone,' over the course of the test that number increased to 75 percent. Providing real-time feedback promotes safer driving habits."



Augmenting reality

Daan Roosegaarde, an artist and an innovator, shares the importance of merging physical and digital realities into seamless, intuitive experiences.

Interview conducted by Vinod Baya

Daan Roosegaarde

Daan Roosegaarde is an artist and innovator whose work explores the dynamic relation among architecture, people, and technology.

PwC: Daan, trends such as the Internet of Things are introducing more and more technology in our physical environment. What is it that you see happening?
DR: Technology, in a way, has always been around us. From day one we have created things, invented things to make the world around us more understandable. So the wheel is an extension of our legs, the glasses are an extension of our eyes, and so on. But now the technology has become so advanced that in a way it is getting a mind of its own. It creates its own language. And what I find interesting is that technology is not staying within the computer screen. Technology is jumping out of it and is becoming part of our body, of the walls and doors that surround us, and of the landscapes that you and I live in.

As an artist, designer, and innovator, I've always been fascinated with how does our future look, particularly in the coming three to five years. I think about some questions in all my projects: How can we create environments that are interactive, which engage people in an emotional and communicative way? How can we be more sustainable in energy and in the way we consume information?

PwC: You advocate merging the physical and digital in a new seamless reality. Why?
DR: I think the old system is crashing in terms of economy and in terms of ideas.

"What I find interesting is that technology is not staying within the computer screen. Technology is jumping out of it and is becoming part of our body, of the walls and doors that surround us, and of the landscapes that you and I live in."

A new system still must be developed, and it's unclear today what it should be. From an artistic or a design point of view, I see the physical and digital merging to be useful to us. For example, on the roads in the Netherlands and the United Kingdom, the lighting is being shut down, because government cannot afford the money to power them anymore. This lack of lighting creates a lot of very dangerous situations, because people don't see where they're driving. We could develop a paint that charges up during the daytime and gives light at night. Use elements from nature and apply them. It merges the two realities and creates a sustainable solution.

PwC: What should enterprises be doing?
DR: Stop optimizing old ideas, and look at reality in a new way. Open up. This is a very old message, in a way. At my studio, we trigger the imagination of people. We merge experience with innovation, and imagination with a business plan.

We want to create a situation of co-control in which you make things, but this making also makes you again. This kind of relational network—and how to create that network—is about technology and sensors and the Internet of Things, but it's also about design. How does it feel? What does it look like? What kind of feedback does it give? I think we're only just beginning to realize the type of interactions we can have within that.

Enterprises should think of new systems that relate to their products and services and that augment the experiences of their customers by merging the physical and digital realities. The value of creativity, of relooking at what you're doing and reimagining how you want the future to look, automatically leads to new R&D, new products, and yes, new profits. But if you do not invest in that, you're gone. Big companies are starting to realize that now.

Within this story there is soft and hard capital. The soft capital is the impact on the brand as people start to imagine or think differently about the products and company. The hard capital is, for example, that a road manufacturer must change from being an asphalt, hard concrete company to an information technology company.

PwC: Much of the technology used today is behind a keyboard or touch interface. How do you see those interfaces changing?
DR: There are two things. There's message and there's medium. The medium right now is so underdeveloped. I mean, yes, everybody's impressed with the touch interface, but I still feel like we're people in caves making a drawing, and everybody thinks we have Photoshop. Current interfaces are non-intuitive. They are very hard in a way. I think we can learn much more from the human body and from nature to make things that are more organic, intuitive, and seamless.

We are always interested in nature. For example, look at a piece such as Lotus, which has this material that folds open like a flower and then closes again when the light goes away. We're applying this concept to greenhouses. The sun hits it, it folds open at daytime, and it closes at night so the greenhouses don't create a massive amount of light pollution, which is a big problem in the Netherlands right now. So we learn from nature.

Second is message. What is the story you want to tell? Yes, I can make a sticker that I stick on my body, and it shows how much vitamin C I still need for that week. You can self-enable people again, in information and in food and in energy. That's the driving force of everything we make, and that's why we always team up with different companies to make that happen.

PwC: What interface solutions do you see on the horizon that appeal to you?
DR: You have a lot of people thinking about using mind control, so you think right and it [for example, the cursor] goes right. They're tapping into the body somehow and asking: Who needs a keyboard? Who needs a display? This literally embedded interface technology is, I think, very appealing.

On the more social side, an example is when elderly people get an RFID tag, usually in hospitals. They often sit inside all day, as they cannot go out on their own. Sometimes they

"To spot opportunities, you go to the periphery where nobody has gone before, and then you hack it..."

"I look for missing links, and I look for disciplines where we can transform something."

"The old system is crashing in terms of economy and in terms of ideas. A new system must be developed. I see the physical and digital merging to be useful to us."

can go out when a nurse comes, but nurses don't have time. The RFID tag knows who they are and what their condition is, and the doors can be programmed to automatically open or close, so they can walk around freely. I think these are incredibly fascinating ways of using new technologies to make us more human again. And there is a gigantic market for that.

PwC: In your sustainable dance floor project, the dancing on the floor creates all the power for the discotheque. Can you take us through what prompted its creation?
DR: Sure. We believe the future is about interaction and sustainability. So one question we continually seek to answer is how can we engage with a wide audience in a new, profound, and more intuitive way? In this case, it was literally me in a discotheque looking at all these people and just wondering, why can we not do something with that?

You have your bicycle that creates light, so why not use the power of the dancing to do the same? Make a floor tile that can move a couple of millimeters but produce electricity of 20 or 25 watts per module.

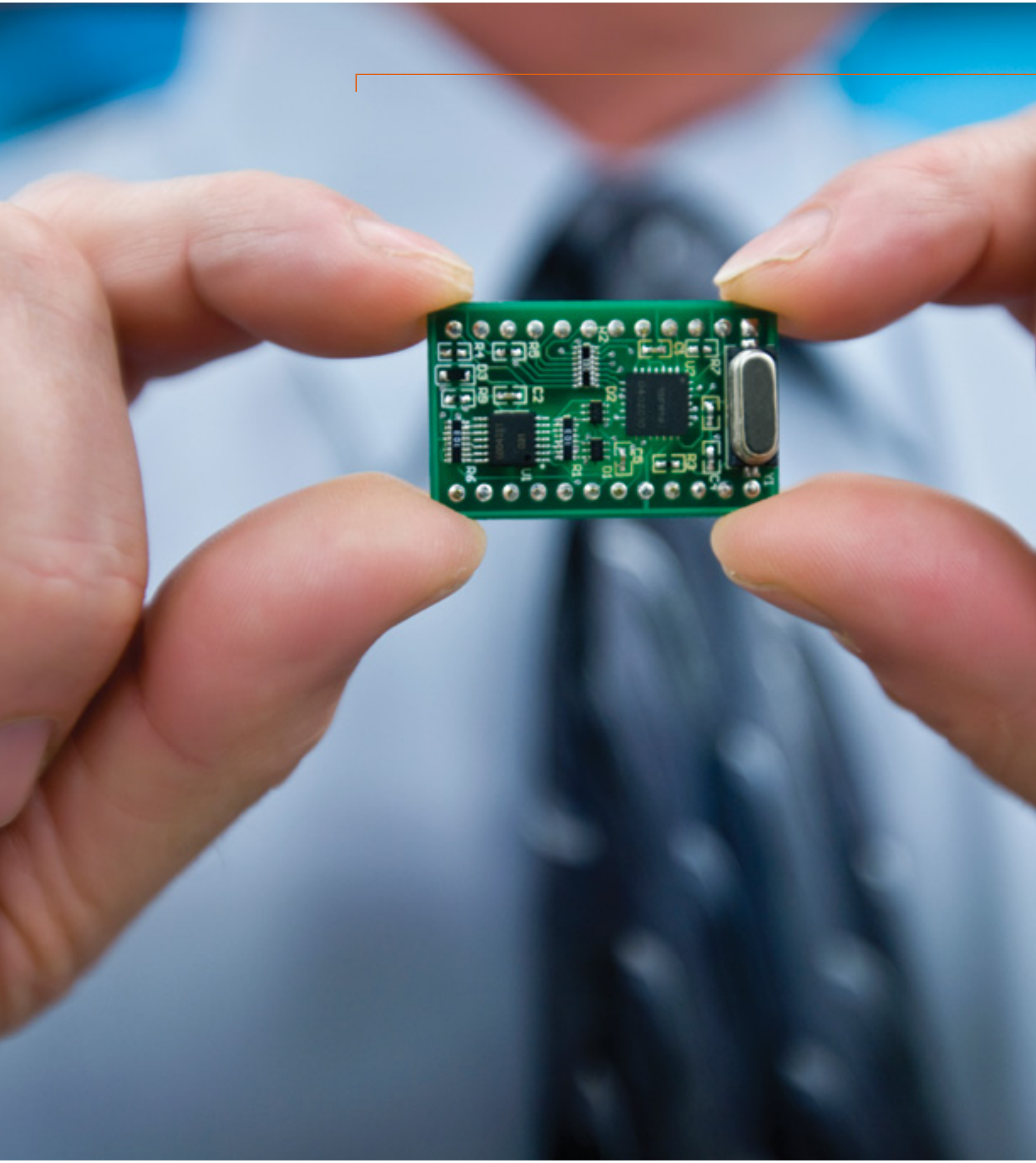
PwC: So you created a new reality that blends technology with the dance floor?
DR: Exactly. We upgraded reality. This is augmented reality in its purest form—not as a mobile app, but a seamless integration of the physical environment and technology. Technology is super important, but more important is the will to create new and seamless crossovers between physical and technological interfaces.

PwC: Is there a process that enterprises can understand or follow to create the new realities related to their products?
DR: That's a very corporate question, I think. I mean, it starts with a taste in your mouth of which you do not know the ingredients yet. So you start to read, to write, to travel, to talk to other people, to make prototypes, and to figure out what the ingredients are to make that taste in your mouth possible. And you're not sure if you're making a pancake or a pizza or a quiche.

You need to be ready to invest in a process, to launch and to learn, to fail, to start again, to not copy-paste old ideas, but to copy-morph them and to learn from what you've done. Do it again, learn from it, and do it again and again. That's what we always have done in the studio in a design way, but also in a technological development way and in a contextual way. So you're asking for a key, but there's no door.

PwC: What have you learned about spotting opportunities? How do you select the projects you work on?
DR: I look for missing links, and I look for disciplines where we can transform something. For example, why are billions spent on innovations in cars and almost nothing on roads? Nobody could give me an answer to that question. To spot opportunities, you go to the periphery where nobody has gone before, and then you hack it. You update it with the knowledge, ideas, vision, and techniques you have.

But this periphery is everywhere, since the world is changing, right? Old rules don't apply anymore.



The Thing Stack: Technologies that guide customers to their goals

Emerging technologies continue to bring down the cost and complexity of adding networked sensors to products and services, accelerating their integration and driving new customer value.

By Vinod Baya and Bo Parker

The Internet of Things[1] (IoT) is upon us. For years, market analysts have been obsessed with how many people use the Internet, but the fastest growing group of "users" are things. More devices than people are already connected. Estimates of Internet-connected devices range from 50 billion to 1 trillion by 2020. The technological and cost barriers to add sensing and networking capabilities to things are falling rapidly. At the 2013 Consumer Electronics Show, innovators displayed services based on connecting everyday things, such as HAPIfork (a fork that monitors eating habits),[2] Beam Brush[3] (a toothbrush that tracks dental hygiene habits), and others.

As discussed in the article, "Using technology to help customers achieve their goals," on page 06, the IoT is creating the potential for a post-transaction relationship with customers in which enterprises take advantage of information from sensors embedded in their products that are linked to smartphones and to the cloud. They use the information to track and then guide the use of products and services that better align to the customers' goals. Thus far, technology generally introduced digital processes into the design, manufacturing, marketing, and selling of products and services; that is, up to the transaction. Now emerging technologies enable a post-transaction relationship between customers and vendors.

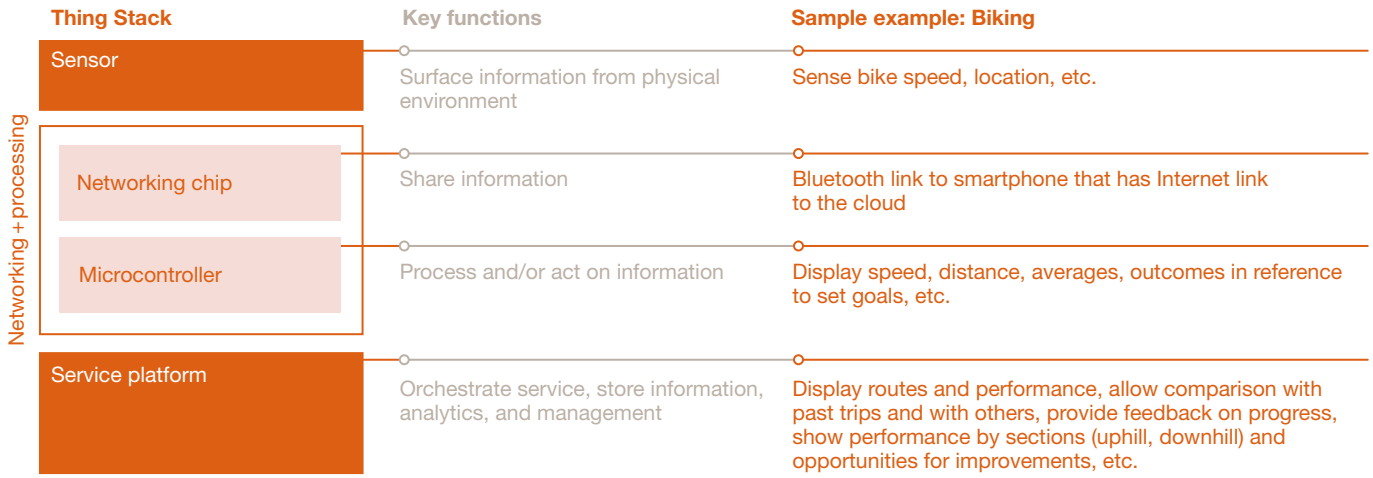
Until recently, embedding sensors and connectivity hasn't been easy or economical, thereby limiting the possibility for post-transaction relationships to high-value segments, primarily in business-to-business (B2B) scenarios such as monitoring power plants or jet engines. Many emerging technologies are now pushing down the cost curve, in effect democratizing the opportunity to digitize any customer's consumption process.

1 The term "Internet of Things" was first used by Kevin Ashton in 1999, according to Wikipedia. The initial use referred to industrial technologies such as radio frequency identification (RFID) for radio tagging items in the supply chain. More recently, the use of the term has expanded to include the machine-to-machine communications market and broadly the ability to embed sensing and connectivity into any physical environment, so it can be used in or acted upon by a service.

2 For more details, see http://www.hapilabs.com.

3 For more details, see http://beamtoothbrush.com.

Figure 1: The layers in the Thing Stack



"To become a service provider, [an enterprise] must learn to build and own the full stack—from network to device to application."
—Macario Namie, Jasper Wireless

But to capitalize on post-transaction relationships, enterprises will need to become service providers, bringing together a distributed system using hardware and software technologies, with the goal of integrating sensing, networking, computing, and the end-user experience into a valuable service for customers. This integration will extend their business model beyond the device itself. "To become a service provider, [an enterprise] must learn to build and own the full stack—from network to device to application. That's the name of the game at this point," says Macario Namie, vice president of marketing at Jasper Wireless, a provider of machine-to-machine network management solutions.

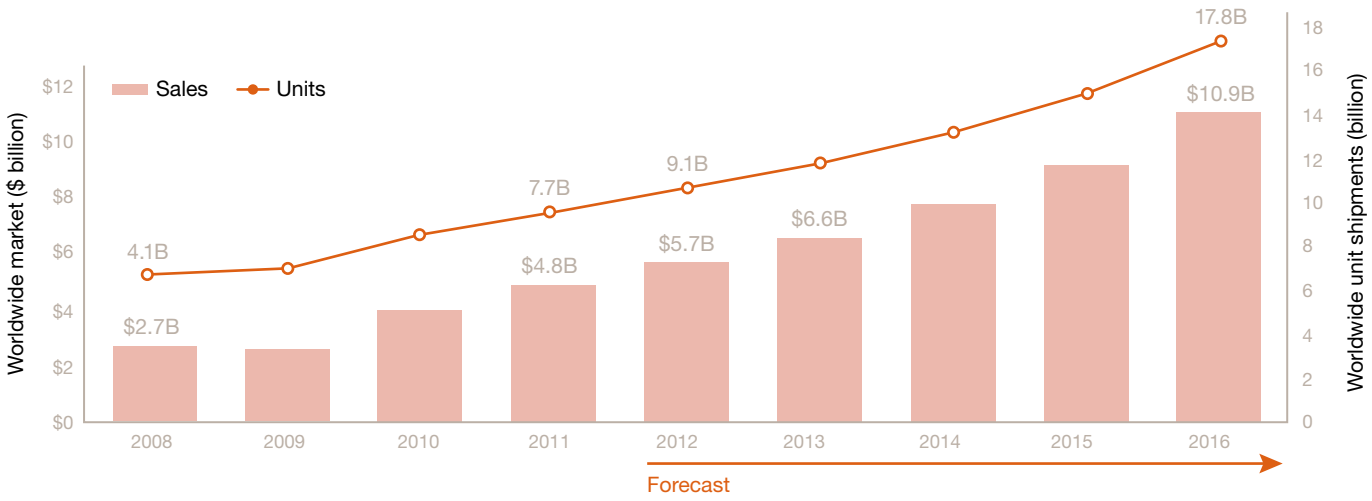
This article provides an overview of the emerging technologies and where they fit into the stack. Prior issues of the *Technology Forecast* cover related advances in social technologies, mobile technologies, analytics, and cloud computing (SMAC), which also contribute to going beyond the transaction.

The Thing Stack

Historically, the adoption of information technologies accelerates after the layers of functionality are conceptualized and delivered as semi-autonomous, loosely coupled offerings. In essence, the tech industry coalesces around an IT stack of hardware and software capabilities and interfaces that create the full system. The IoT stack is rapidly approaching this level of maturity to become something PwC calls the *Thing Stack*. It has three layers, as illustrated in Figure 1:

- **Sensors:** Embedded in devices or the physical environment, sensors capture relevant events or information.
- **Networking and computing platform:** This platform shares the sensor information and acts on that information to affect the environment.
- **Service platform:** By aggregating data and analysis, and by defining and orchestrating the overall experience, this platform serves the end customer.

Figure 2: Worldwide sensor market and unit shipments from 2008 to 2016



Source: IC Insights *2012 O-S-D Report*

New technologies, solutions, and choices are emerging rapidly—even accelerating—in all three layers. This trend is not surprising, given the broad range of use cases across different industries. At the same time, the service-specific requirements for local processing, networking method, power constraints, size, cost, and other concerns will vary widely based on use case. "A healthcare application that monitors a person's temperature and blood pressure will be very different from a utility application that monitors a smart meter," suggests Namie.

For any given enterprise, the context defined by their devices, the use cases, and the knowledge of what information will create value will guide designers toward particular choices of emerging technologies and solutions in the Thing Stack. What follows is a discussion of some of the developments in each of the layers of the Thing Stack.

Layer 1: Sensors

Sensors have been used for years in industrial, automotive, healthcare, manufacturing, and other contexts. Now they are becoming small enough and inexpensive enough to embed ubiquitously in all devices and the physical environment.

According to IC Insights, worldwide sensor sales will increase by a compound annual growth rate (CAGR) of 18 percent, to $10.9 billion between 2011 and 2016. (See Figure 2.) During the same time, the unit shipments will increase from about 8 billion to 18 billion.[4]

4 "New Embedded Features Will More Than Double Sensor Sales by 2016," IC Insights, June 11, 2012.

"Today we are making a tricorder that will fit in a pocket. In the long term, it will be a tricorder in a chip that we can implant in the environment."

—Walter De Brouwer, Scanadu

Table 1: Sensor types used in the various mobile operating systems

Sensor type	iOS 5	Android	Windows 8
Ambient light sensor	✔	✔	✔
Audio (microphones)	✔	✔	✔
Camera(s)	✔	✔	✔
Humidity sensor		✔	
Inertial motion sensors - Accelerometer - Magnetometer - Gyroscope	✔	✔	✔
Pressure sensor (barometer)		✔	
Proximity sensor	✔	✔	✔
Temperature	✔	✔	✔

Source: http://www.edn.com/design/systems-design/4398203/Comparing-the-effectiveness-of-sensors-in-mobile-operating-systems

Driving this proliferation of sensors is their inclusion in smartphones, which already include the types of sensors shown in Table 1. Sensors in smartphones capture contextual information about location, motion, orientation, light, and other environmental elements, which app developers can use in new services.

Besides embedding sensors in smartphones, innovators are bringing to market new devices that contain many more sensors that take advantage of smartphones to capture and integrate data from the cloud and the device. For instance, Sensordrone, a Kickstarter project, packs a dozen environmental sensors—including humidity, pressure, color intensity, and gas sensors—into a keychain-sized dongle that collects information about the surrounding environment and relays it to the smartphone via Bluetooth.[5]

Such innovation expands the range of services that can be provided by digitizing the use of the phone as well as the physical world around the device.

Another class of sensors is used in watches, wristbands, contact lenses, fabric, and other devices worn or implanted in the body or skin. Nokia recently patented technology for magnetic tattoos that vibrate on incoming calls or messages. This action would be possible by tattooing, stamping, or spraying ferromagnetic material onto a user's skin and then pairing it with a mobile device.[6] In another example, researchers at Microsoft and the University of Washington are expanding the use of the contact lens to provide real-time updates on biochemical fluctuations in the body. Such a

5 Dario Borghino, "Sensordrone adds more sensory capabilities to smartphones," *Gizmag*, June 21, 2012.

6 "Vibrating tattoo alerts patent filed by Nokia in US," BBC, March 20, 2012.

device could be used to monitor insulin levels in diabetes patients.[7]

ABI Research forecasts the wearable computing device market will grow to 485 million annual device shipments by 2018. Much of what makes this growth possible are advances in materials science and augmented reality. New developments in materials science are essential to safely and seamlessly embed sensors in fabrics, implantable devices, and the human body. For example, Proteus Digital Health makes an ingestible sensor that is one square millimeter and embedded in a pill.[8] The sensor transmits a signal when it comes in contact with stomach fluids. When used in conjunction with a patch on the arm, the sensor helps track patient compliance with prescription medicine regimes.

Advances in augmented reality will be essential to blend the physical and digital worlds into a seamless experience. For instance, Google's Project Glass is experimenting with making augmented reality part of individuals' daily lives by shrinking the size of a head-mounted display to the equivalent of regular eyeglasses. These glasses are capable of capturing and playing audio and video, have a built-in compass and accelerometer, and allow interaction with voice and head movement.[9]

The size and price of sensors are dropping, thanks to microelectromechanical systems (MEMS). MEMS combine electronics and mechanical components at tiny scale by integrating sensors, actuators, and integrated circuits. Bosch, STMicroelectronics, Panasonic, and Texas Instruments are the largest suppliers of MEMS. The fastest growing segment for MEMS is gyroscopes and accelerometers used in smartphones, where increasing volumes are driving down prices. The price of a three-axis accelerometer dropped by about 80 percent between 2007 and 2010. And the price of a one-axis automotive gyroscope dropped by about 88 percent between 2006 and 2010.[10]

There are many reasons to expect prices to continue to fall. MEMS use the production techniques of the semiconductor industry and benefit from manufacturing efficiencies at large volumes. As volumes rise, the MEMS industry is also getting better at reducing the cost of testing and packaging.

The state of the art in MEMS typically allows one discrete microsensor to be combined with discrete electronics in a silicon substrate. As techniques to pack multiple sensors and electronics on a single substrate are developed, further reductions in price and size are expected. "Today we are making a tricorder that will fit in a pocket. In the long term, it will be a tricorder in a chip that we can implant in the environment," says Walter De Brouwer, CEO of Scanadu, a healthcare startup developing a tricorder and aiming to transform the smartphone into a health phone by packing it with various sensor capabilities. "The tricorder will have a complete diagnostic experience so consumers can explore their health."

Over the longer term, nanoelectromechanical systems (NEMS) hold promise. NEMS integrate electrical and mechanical functionality at nanoscale, and they will provide ample opportunities to further reduce the size and price of sensors.

Sensing information and sharing that information over a network are often handled by separate components in a device. However, another trend is to integrate sensing, networking, and power on a single node, so they can be

7 Charlie Osborne, "Microsoft develops glucose-monitoring contact lenses," *SmartPlanet*, January 6, 2012.

8 For more details, see http://proteusdigitalhealth.com/technology/.

9 Dara Kerr, "Google Glass development charges ahead," *CNET*, January 1, 2013.

10 Paula Doe, "Sharply Falling MEMS Prices Spur Rising Demand," SEMI, July 6, 2010.

For any given enterprise, context defined by their devices, the use cases, and knowledge of what information will create value, will guide designers toward particular choices of emerging technologies and solutions in the Thing Stack.

used liberally in many environments without being constrained by a power source or networking capability. For example, Streetline's smart parking solution has a networked sensor to detect and transmit the presence or absence of cars in a metered parking spot. The sensors communicate with each other via a wireless mesh network protocol.[11]

The HP Labs' Central Nervous System for the Earth (CeNSE) project combines advances in materials, nanotechnology, and MEMS to develop a planet-wide sensing network using billions or trillions of tiny, inexpensive, and tough sensors.[12] Such sensor ubiquity will accelerate the integration of the physical and digital worlds, making possible various new use cases, including monitoring the conditions of bridges, forests, and the air people breathe.

Layer 2: Network and computing platforms

The second layer in the Thing Stack provides processing, local storage, and connectivity. The IoT, as its name implies, requires a connection to the Internet to combine sensor information with cloud-resident data. But even before connecting to the cloud, most devices will need local processing capability for quantifying, summarizing, and analyzing. In some cases, the things will do more than sense; they will take action, such as by turning something on or off. Programmable microcontrollers typically serve these functions. Finally, local data storage for staging sensor information usually resides in this layer.

The first key capability of this layer is networking. Networks can be wired or wireless. For devices that are stationary and can access external sources of power, a wired network would be suitable but carries the burden of running cables from a nearby network node. As a result, it is no surprise that various types of wireless networks are by far the most commonly used protocols for the IoT. For instance, Wi-Fi is popular for home devices, wireless mesh networks are popular for smart city applications, and so on. Several choices are available, some of which are listed in Table 2.

Device manufacturers must consider a range of use case dependencies: Is their device meant to be fixed or mobile? Will it have a power source or need a battery? Will high or low data rates be necessary? Does connectivity need to be continuous or episodic?

Table 2: Some of the popular wireless networking options in use today and emerging for the future

Various versions of cellular mobile networks	2G, 3G, and 4G networks available globally. Requires subscription or SIM card from carrier, availability wherever carrier networks provide coverage.
Wi-Fi	Wireless technology for local area networking (LAN) that is built into most PCs, smartphones, tablets, and more and more consumer electronics devices. Widespread use in homes and businesses. Uses a Wi-Fi router or gateway to access the Internet. Suitable for high data rates.
Bluetooth and Bluetooth low energy (LE)	Wireless personal area network (WPAN) technology standard for exchanging data over short distances. Uses a hub device such as a smartphone, laptop, or tablet to connect to the Internet. Supports high data rates for audio transmission. Bluetooth LE, released in 2012, expands use to low-power and low-data-rate applications.
ZigBee	A wireless mesh networking protocol targeted at applications that require a low data rate and long battery life. Suited for sporadic data exchanges or a single signal transmission from a sensor or input device, such as from light switches, smart meters, and security systems. Operates in the industrial, scientific, and medical (ISM) radio band, supporting data transmission rates of 20 to 250 Kbps.
Z-Wave	Wireless protocol for home automation, specifically to remotely controlled applications in residential and light commercial environments. Uses a low-power RF radio embedded or retrofitted into home electronics devices and systems. Operates in the sub-gigahertz frequency range, around 900 MHz.
6LoWPAN	IPv6 over Low power Wireless Personal Area Networks (6LoWPAN); also called wireless embedded Internet. Brings IP networking to the smallest devices and sensors, so low-power devices with limited processing capabilities can participate in the Internet of Things. Use is not restricted to wireless radio links alone, and can be extended to run over other physical media.

11 "The rising value of linked information," PwC *Technology Forecast* 2012, Issue 2.

12 HP CeNSE: Sustainable Brands '11 keynote.

The other key component in this layer of the Thing Stack is the microcontroller, which is essentially a tiny computer on a chip. It includes a processor, a small amount of random access memory (RAM) to hold data, a few kilobytes of erasable programmable read-only memory (EPROM) or flash memory to hold any programs on the device, and some solid-state memory for caching data until it can be uploaded. The microcontroller runs the programming that captures and digitizes sensor data, performs any initial analytics or data summaries, and manages its transfer to a hub or the cloud.

Health and fitness devices used in running, exercise, or bicycling store data during the activity and synchronize with the cloud when in proximity to a hub device, such as a smartphone, PC, or tablet. The vendor offerings for this layer of the Thing Stack today span various networking protocols, architectures, hardware, and software. Given the diversity of use cases and environments, the good news is that manufacturers have many options when adding networking and computing capabilities to their devices. The most important emerging capabilities are the following:

- **Simplify network setup:** It is important to remove complexity from network setup and configuration, so it works every time and adoption of the device can scale.
- **Simplify device programmability:** Advanced offerings allow programming in higher-level languages and even support web technologies.
- **Expose data and capabilities as APIs:** To ease integration with the web and mobile apps, expose key data and functionality via application programming interfaces (APIs), minimizing the knowledge that programmers need to have about the inner workings of the device.

Many vendors are creating solutions to bring networking and computing to things. Table 3 provides a sample. Some vendors focus largely on hardware components; others provide a system of hardware and software solutions. In some cases, the software components begin spilling over into the third layer of the Thing Stack, which PwC calls the *service platform* and discusses in the next section.

Table 3: Sample of vendors that provide solutions for embedding networking and computing in things

Hardware-dominant solutions	
Arduino	An open source electronics prototyping platform with a microcontroller board. USB interface to allow programming from a computer. Able to receive input from various sensors and affect the surroundings by controlling light, motors, and other actuators. Simplifies by standardizing on the microcontroller. Developers need to perform embedded programming to program the microcontroller.
openPICUS	A system-on-module solution for Wi-Fi and Ethernet connectivity that can run the application on the system, so an external microcontroller is not needed. Embedded web server enables direct communication with mobile or web apps without mediation from a cloud server.
Raspberry Pi	A credit-card-sized computer board running Linux OS with an Ethernet interface for networking. Uses SD card for storage. Enables the embedding of full desktop programming capability in devices. Capable of playing high-definition video.
Hardware and software system solutions	
Arrayent	A hardware and software system. Hardware solution provides the ability to embed Wi-Fi or other home networking protocols to connect consumer products. Software solutions, offered as a cloud service, provide the ability to configure, manage, and monitor the devices and support web/smartphone apps for the end users and the enterprise.
Bug Labs	Bug's Blocks are snap-together hardware modules, including a Linux-based CPU, sensors, actuators, and transceivers, that connect using Wi-Fi or a 3G network. The Swarm software is a cloud-based platform that abstracts device capabilities (such as sensors, actuators, and transceivers) as web services and web APIs, so they can be used in applications.
Electric Imp	Hardware for networking and processing. Integrated board with Wi-Fi networking and microcontroller. Simplified network setup using proprietary BlinkUp technology that can establish a network by making a smartphone blink at an Imp. An Imp is an SD card–sized modular component that maintains the network connection and can execute a program. The software platform is in the cloud. Device manufacturers can install an Imp card reader to embed networking and computing capability.
Ninja Blocks	Ninja Blocks are cloud-enabled open source computers running Ubuntu Linux that take input from various sensors and can affect their surroundings by controlling lights, power sockets, and other actuators. They have an Arduino-compatible microcontroller. A combination of the Ninja platform and the Ninja Rules app simplifies the creation of web and mobile apps by abstracting above the complexity of embedded programming.

Source: Vendors' websites. *Note: This list is not exhaustive and is not an evaluation of vendors' products.*

"Now you can, in essence, bring things into the connected world and completely change the scenario and the user experience for the consumer, the OEM [original equipment manufacturer], and other service providers."

—Suke Jawanda, Bluetooth SIG

While new inexpensive microcontroller platforms such as Raspberry Pi and Arduino can simplify the task of getting things on the Internet, they also create new risks. The devices can be attacked and hacked, making it possible for hackers to assume control, falsify information, or change system behavior. The network enabling of devices also increases the need for robust vulnerability testing and threat management of the overall system.

Given diverse devices, networking methods, and use cases, the market is fragmented and there are legitimate concerns about interoperability, data and interface standards, security standards, governance standards, and so on. Consortia are forming so devices and services from different vendors can work with each other and create an intelligent fabric useful to all. For instance, 10 companies, including Logitech and Basis, recently created the nonprofit Internet of Things Consortium to work toward creating interoperability by promoting an open approach to integrating with other companies.[13]

Adding sensors as well as networking and computing capabilities to any device will add cost to the bill of materials. But the rapid reduction in these costs, and the simplification of networking to a plug-and-play experience, creates a huge potential for a much larger universe of things to embed connected sensors. Wi-Fi chips are available in the $4 to $5 range today compared to more than $16 in 2002. Similarly, the price of Bluetooth chips is less than $1, compared to about $20 when introduced in 2000.

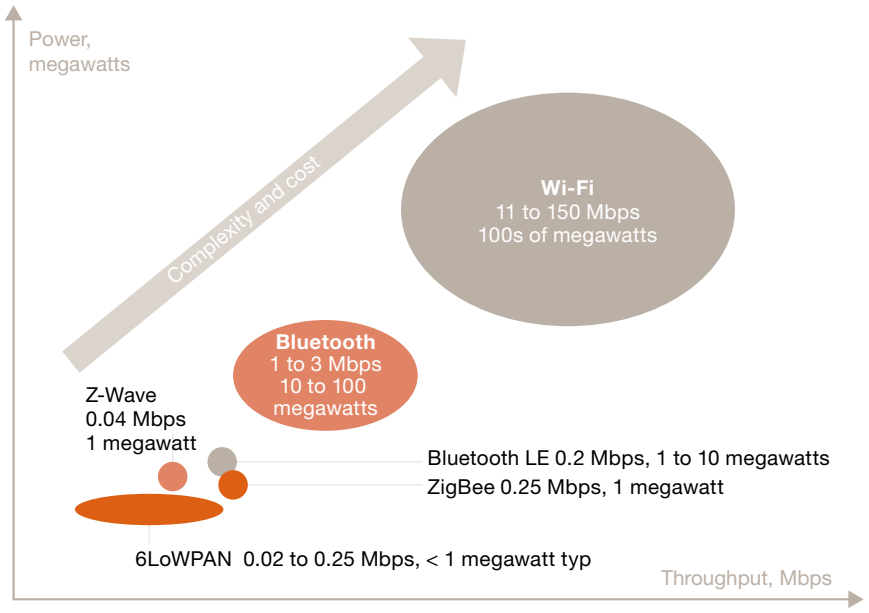
New capabilities are also simplifying the connecting of devices to hubs and networks. Texas Instruments has unveiled a Wi-Fi module, SimpleLink Wi-Fi CC3000, that simplifies the task of connecting devices without screens to a Wi-Fi network by using a smartphone.[14] Electric Imp has created the BlinkUp feature for setting up a Wi-Fi network by having a smartphone blink at a device with an Electric Imp board in it. The smartphone's blinking transmits the information to configure the network to the Imp board. With such features, there is no need to add a display or input device purely for network setup. As a result, the complexity and cost of bringing connectivity to devices can stay low.

Power requirements to keep untethered devices running has been one of the big barriers to greater penetration by smart devices. This challenge is being addressed in several ways, including chips designed to perform with minimal power. Another effort is new network protocols to reduce the power needed to wirelessly transfer data. "Bluetooth 4.0, with its Bluetooth low energy (LE) feature, augments the 3.0 specification by adding a network architecture optimized for power conservation. It does this by transporting data in bursts rather than a continuous

13 For more information, see http://www.iofthings.org/.

14 Texas Instruments, "Latest TI SimpleLink Wi-Fi CC3000 module simplifies home network setup and improves user experience," news release, January 3, 2013.

Figure 3: The power and throughput ranges supported by the various wireless networking protocols



Source: PwC and adapted from *EE Times* https://www.eetimes.com/design/embedded-internet-design/4395675Wireless-connectivity-protocols-for-embedded-systems

stream at high data rates, as is needed for audio media," says Suke Jawanda, chief marketing officer of the Bluetooth Special Interest Group (SIG). For example, a coin cell in a heart rate monitor that lasts for two to three months with Bluetooth 3.0 can last up to two years with Bluetooth 4.0. "Now you can, in essence, bring things into the connected world and completely change the scenario and the user experience for the consumer, the OEM [original equipment manufacturer], and other service providers," Jawanda says.

The Internet Engineering Task Force (IETF) has specified an IP-based protocol that small sensors and things can use to participate in a personal area network called 6LoWPAN. It allows things to connect to IP networks without a gateway. Some network protocols in use today tend to be popular in specific markets—ZigBee in building automation and Z-Wave in home automation. Not having actual IP addresses does make it harder to integrate devices using these protocols with Internet applications without using a gateway for translation. 6LoWPAN solves this issue, creating the potential to greatly increase the number of small and low-power devices that define the IoT. Figure 3 compares 6LoWPAN with the Bluetooth and Wi-Fi protocols.

"A big part of what we do is creating an operational standard, so that enterprises can run their connected device initiatives consistently across operators."
—Macario Namie, Jasper Wireless.

Layer 3: Service platforms

The first two layers of the Thing Stack embed sensors and tiny, networked computers in the things in the physical world. In some use cases, such as digital thermometers, nothing else is needed. Many emerging use cases, however, take advantage of a third layer, which PwC calls the *service platform*. These platforms can include middleware, analytics, and application software that usually combine sensor-originated data with other contextually relevant information. One of the most important roles for service platforms is to establish a feedback loop between the things at the edge of the network and the management systems that monitor, maintain, or upgrade the device firmware.

In most cases, service platforms are in the cloud and take advantage of cloud computing traits such as multi-tenant software architectures that scale efficiently. In many ways, the service platforms are the backbone of creating post-transaction relationships because cloud infrastructure can power business applications and end-consumer applications that greatly extend the utility of raw sensor data.

The key capabilities of these platforms are to perform the following:

- **Simplify and automate the provisioning and activation of a subscriber service:** For example, activations of cellular data services can be time-consuming and require human intervention. Service platforms automate these activations.
- **Provide scalability and high availability:** At scale, a large number of devices will generate huge quantities of data, which will need to be stored and analyzed. The service platform needs to stay available and scale to the needs of the enterprise.
- **Offer an integrated development environment:** The best service platforms are designed to explicitly support developers so that application design and deployment can be accelerated.
- **Expose APIs for accessing and sharing information:** Offering standardized, RESTful, and other interfaces for accessing information from cloud-based platforms is standard practice; service platforms are no exception.
- **Provide data storage and staging:** Service platforms store, replicate, and mirror data for service continuity, including staging the data before passing it on to other services and platforms.
- **Manage devices:** Advanced service platforms manage, update, and check the operating health of sensor devices.
- **Provide real-time alerts:** Alerts or notifications, usually implemented with a policy or rules engine, help end users take better advantage of their smart devices.
- **Deliver analytics:** Most use cases require applications to summarize, show trends, offer social comparisons, and more using analytics. Many of the algorithms will be industry specific, requiring deep knowledge of the industry.
- **Deliver security:** Service platforms must provide the necessary security frameworks and protection of data and controls.
- **Manage privacy:** Service platforms should provide controls to manage privacy policies, manage opt-in and opt-out capabilities, and create transparency with customers regarding what data is shared with whom and when.

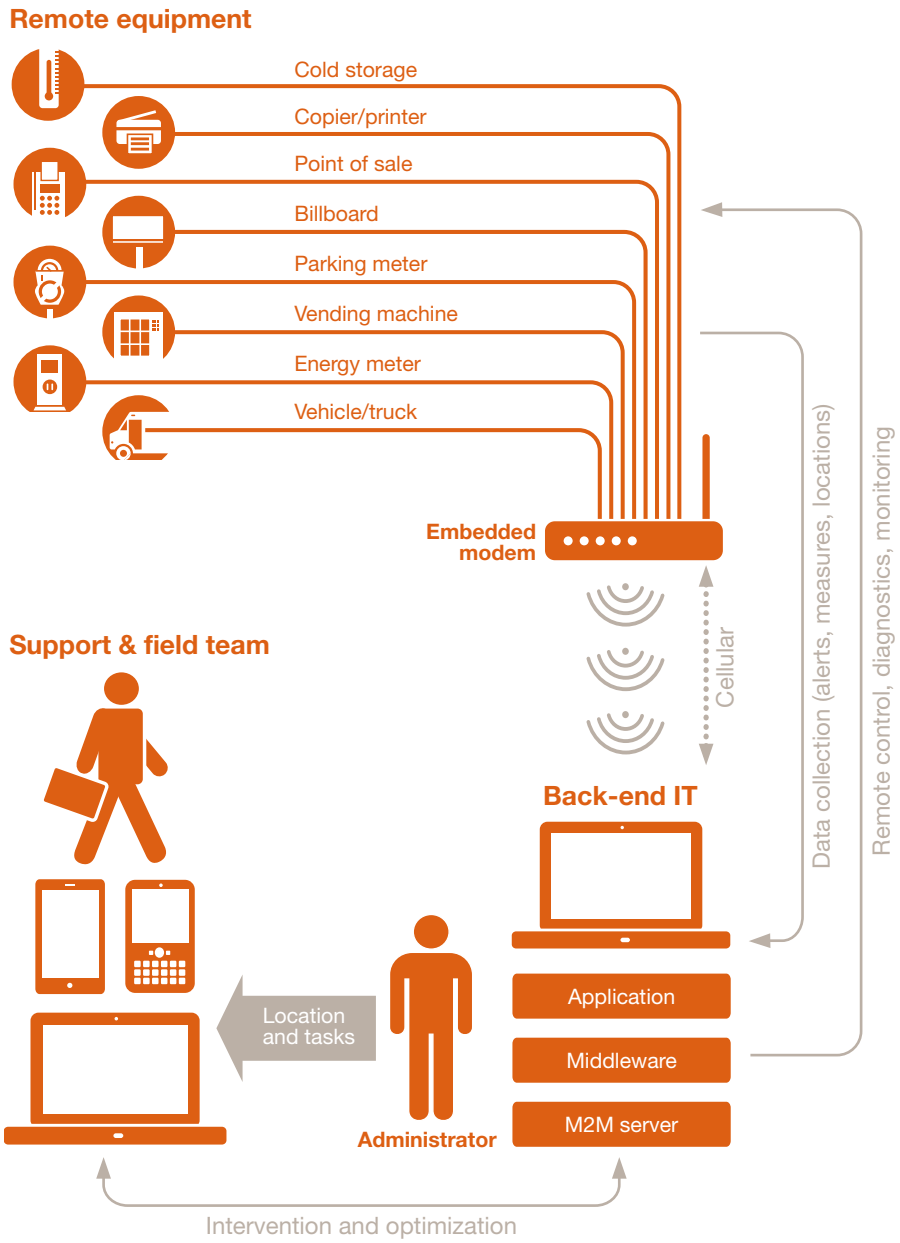
The vendors providing solutions for these platforms today can be divided into two groups, mobile network-centric platforms and web-centric platforms, as listed in Table 4.

Table 4: Sample of vendors that provide service platforms to enable post-transaction relationships

Mobile network-centric service platforms, also called M2M platforms	
Jasper Wireless	A cloud-based solution to simplify the provisioning, configuration, management, and enablement of the end-user experience in the M2M market using mobile networks. Wireless platform enables network operators to offer new services and enterprises to optimally run their connected device businesses. Standardizes M2M operations for enterprises across different carrier networks globally.
Numerex	Offers M2M service across carrier and satellite networks. Owns and operates a proprietary network. Provides solutions on a subscription basis. Services are organized in four layers: network-as-a-service, platform-as-a-service, software-as-a-service, and management portal.
RACO Wireless	Preferred M2M solution provider for T-Mobile. Solutions for M2M device management with features such as real-time and historical reporting, SIM provisioning and management, usage alerts, online billing, SMS console, and others.
Wireless Logic	UK-based provider of M2M managed services and mobile network connectivity. Services span provisioning, monitoring, and a control platform for visibility across SIM estates, with real-time usage statistics, billing solutions, and tariff management.
Web-centric service platforms, also called Internet of Things platforms	
Cosm	A platform, API, and community that brings together devices, information, developers, apps, and commercial applications to enable connected product ideas. It connects devices with apps and provides real-time control and data storage.
EVRYTHNG	Technology to create and serve Active Digital Identities for devices and other objects. These identities create a persistent and unique digital presence for any physical object on the web, enabling communications, apps, and services across the objects.
IFTTT	Technology that allows consumers to build new services by enabling programmability using simple if-this-than-that rules, called channels. Each channel has its own trigger and action; for example, if the garage door is open, send a text.
Sensinode	A solution to provide IP and web services to the end node, combining highly optimized embedded client software with a web application platform. Enables enterprise applications in the Internet of Things.
SensorCloud	A sensor data storage, visualization, and remote management platform that provides data scalability, visualization, and user programmable analysis. Supports any web-connected third-party device, sensor, or sensor network through a simple OpenData API.
ThingSpeak	An open application platform to enable connections between things and people by providing features such as an open source API, real-time data collection, processing and visualizations, an application infrastructure, and apps.

Source: Vendors' websites. *Note: This list is not exhaustive and is not an evaluation of vendors' products.*

Figure 4: Use of a mobile network in an M2M deployment



Source: Adapted from Jasper Wireless

Mobile network-centric platforms (also M2M solutions)

The first group defines a market often referred to as machine-to-machine (M2M) solutions. They support the need for devices to connect to commercial cellular networks, mediating the many technological variations and presenting a consistent, standard access method. In the past, M2M technology was limited to organizations, such as government and transportation and logistics companies, which had the size and capacity to build proprietary data networks. However, with widespread coverage of cellular networks globally, M2M can be used by organizations of all sizes. Figure 4 shows the typical M2M platform arrangement and how these platforms interact with IT systems at an enterprise to support employees or customers.

M2M solutions offer a value proposition to both carriers and enterprises. For carriers, they create the potential to address a new market and business model based on connecting devices that are not human mediated, such as mobile phones. For enterprises, they reduce the complexity of using a carrier's network and bring together a rich set of features that can power post-transaction relationships.

"A big part of what we do is creating an operational standard, so that enterprises can run their connected device initiatives consistently across operators," says Namie of Jasper Wireless. "Even though we work with multiple operators, we enable enterprises to have one standard way of operating, reporting, provisioning, configuring, and controlling their devices worldwide."

According to Forrester, in 2016 approximately 450 million connected M2M devices will generate nearly $17 billion in connectivity revenues for carriers globally, a 34 percent CAGR between 2010 and 2016.[15] Vendors active in this market are Jasper Wireless, Numerex, RACO Wireless, Wireless Logic, and others.

Web-centric IoT platforms

The second group of service platform solutions uses web-centric technologies and facilitates connections at the data API level to make products smart. These platforms bridge the connection between the sensors, which surface the data, and the web or mobile apps over which services are experienced. Typically, these platforms assume the presence of network connectivity and therefore are network protocol agnostic and do not aim to simplify the complexity of provisioning or configuring network connections. They leave that to the device manufacturer or to the vendors that provide the network and computing layer.

Most vendors in this class are emerging companies that are innovating how post-transaction experiences will be monitored, managed, and facilitated. Cosm, EVRYTHNG, IFTTT, Sensinode, SensorCloud, ThingSpeak, and Wovyn are some of the vendors. A few of the vendors that provide network and computing layers, such as Bug Labs, Electric Imp, and Ninja Blocks, also couple a service platform with their hardware solutions for networking and computing.

15 Michele Pelino, *M2M Connectivity Helps Telcos Offset Declining Traditional Services,* Forrester Research Inc., December 2011.

Conclusion

The continuing reduction in size and price of sensors and the ability to network every device is propelling companies to more fully engage with customers, going beyond transactions to goal-oriented post-transaction relationships. The digitization of consumption and the convergence of the physical and digital worlds is creating opportunities to evolve single transactions into long-running relationships. To do so, devices need a Thing Stack composed of a sensor layer that captures information from the environment, a network and computing layer that shares that information over computer networks, and a service platform layer that orchestrates the overall experience to deliver value-added services to consumers.

The convergence of the physical world with the digital world will put stress on other parts of business and IT operations. In particular, it will increase the burden of data storage, tagging, management, and analysis and related activities. Solutions emerging from mobile and social technologies and big data analytics will address some of these issues.

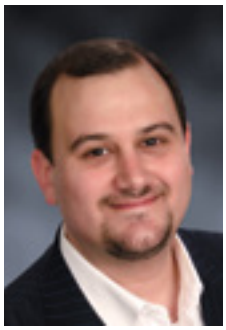
Behind any purchase is a customer goal or desired outcome. Customers buy insurance to cover unpredictable losses; they buy running shoes to lose weight; or they use new golf clubs to improve their golf scores. In light of the emerging technologies discussed in this article, the challenge to enterprises is to rethink their relationship to their customers' goals. By selling customers smart things rather than dumb things, enterprises can surface information that guides their customers to more successful outcomes.

The continuing reduction in size and price of sensors and the ability to network every device is propelling companies to more fully engage with customers, going beyond transactions to goal-oriented post-transaction relationships.

Becoming a service company

Macario Namie of Jasper Wireless explains how to transform from a hardware company to a service company to capitalize on the Internet of Things opportunities.

Interview conducted by Vinod Baya



Macario Namie

Macario Namie is the vice president of marketing at Jasper Wireless.

PwC: Macario, can you please tell us what Jasper Wireless does?
MN: Certainly. We're a software company that provides cloud-based software to enable both mobile operators and enterprises to build and scale connected device initiatives.

For the mobile operators, we are effectively the infrastructure on which they run their M2M [machine-to-machine] business. This infrastructure includes the entire stack of core network BSS/OSS [business support system and operational support system] technologies, which are distinct from what the mobile operators use to run their handset business. The dynamics of the M2M or connected device market are vastly different from the mobile handset market, hence the need for the capabilities we provide.

For the enterprises, we enable them to capitalize on embedded wireless connectivity in their devices to power whatever business case is strategic for them, whether it is cost savings or new revenue streams or new consumer experiences.

Today, we are the infrastructure for the connected device business of 12 mobile operator groups. Across these operators, we support the connected devices for more than 2,000 enterprises in industries ranging from consumer electronics (such as Amazon Kindle, Garmin, and TomTom navigation devices), to the automotive sector (such as Ford, Nissan, General Motors, and others), as well as commercial industries and others.

"A big part of what we do is creating an operational standard, so these enterprises can run their connected device initiatives consistently across operators."

PwC: How are customers using your product?
MN: A big part of what we do is creating an operational standard, so these enterprises can run their connected device initiatives consistently across operators. Even though we work with multiple operators, we enable enterprises to have one standard way of operating, reporting, provisioning, configuring, controlling their devices worldwide, and delivering the user experiences that they wish their devices to have.

We've abstracted much of the network intelligence, capability, and complexity as configurations, so enterprises can configure things to take advantage of the carrier network and network assets to suit their particular use case and business model. For example, we support Amazon's Kindle, and Amazon uses our APIs [application programming interfaces] to achieve a singular view of the health of its device—from details that are very specific to the Kindle device all the way down to the operator level.

PwC: How do your solutions relate to the Internet of Things?
MN: For us, the Internet of Things is related to M2M communications. In an enterprise, M2M communications usually results in the exchange of data between a remote device and a back-end IT infrastructure. The transfer of data can be a one-way or a two-way transfer. In the past, the high cost of deploying M2M technology made it the exclusive domain of large organizations that had a business model for and could afford to build and maintain their own dedicated data networks. Today, the widespread availability of cellular technology has made wireless M2M technology available to all enterprises around the world. Market forces have reduced the cost of embedding and using network connectivity.

Also, when Amazon Kindle came out, it was a game-changer. Its rise opened operators and enterprises to new business models for using mobile networks—models where a singular device, shipped in millions and that wasn't a phone, could use the mobile network without having a subscriber relationship with the operator. Today, two years of connectivity is included with the sale of every connected Garmin device. And, Garmin has a whole host of value-added services, such as Google searches, movie searches, real-time traffic, local gas prices, and so on that the company delivers along with it.

PwC: Most Internet of Things use cases are vertical specific. How do you serve so many verticals?
MN: We sit in an interesting place in the enterprise stack. Think of a stack of three layers. The bottom layer is the network—the mobile network in our case. It is a very horizontal layer and common across all use cases. Our solution is part of the network layer. Anybody who uses the mobile network has to touch what we do. There is no way around it.

The next layer up is the hardware or the device itself. The module connecting to the network is inside the device. Now you start to get a little bit more diversity, because of the hardware specifications. For example, a connected module that must last 10 years and be subject to high temperatures or a lot of dirt inside an automobile will have very different specifications from a module that might be put into an e-reader, which has a life span of maybe two to three years.

The next layer up is the application itself. Frankly, this layer becomes extraordinarily proprietary as the application defines the end-user experience. A healthcare application that monitors a person's temperature and blood pressure will be very different from a utility application that monitors a smart meter.

PwC: As you help enterprises embrace M2M connectivity, what are some challenges you see?
MN: The era of the Wild, Wild West is still very much in play here, and it's really around what business model will work. The technology is the easiest part. You can no longer come in and say, "Well, we can charge $30 a month for the new services." The few that have tried it have failed; there is subscription fatigue among consumers. OEMs [original equipment manufacturers] must figure out the business model for connectivity itself.

Take, for example, a medical device that is connected. Business model questions include the following: Who pays for the connectivity? How do you get customers to buy it? Do you go direct or use a retail channel? Do you get the insurance companies to pay for it?

"Market forces have reduced the cost of embedding and using network connectivity."

Do you try and get the doctors to prescribe it? Do you try and get the employers to offer it as part of the insurance plan? Answers to such questions are essential to define the connected device strategy.

For devices that want to use mobile networks, the cost of the modules is a big hindrance as well, as it goes to the BOM [bill of materials] cost. Today, a 2G module is about $12 to $13 in volume. A 3G module is around $22 to $23. A 4G LTE [Long Term Evolution] module is still upward of $70 to $80. For OEMs, a business case must justify the cost of the module built into the device.

PwC: What are some changes that enterprises should be willing to make to capitalize on the Internet of Things?

MN: I'll give you an example. Garmin established a very successful business by building great navigation hardware as cost-effectively as it could and putting it in retail distribution channels. When a customer makes a purchase, Garmin at some point down the line gets a check for that sale.

Now if a customer gets a connected Garmin device, suddenly Garmin has a subscriber on its hands. That simple act of embedding connectivity

"The act of transitioning from being a hardware company to a service company is quite profound."

inside this device has transformed—really revolutionized—how Garmin must work with this consumer. Suddenly the company knows who the consumer is and gets data about how the consumer uses the device, the features used and not used, and so on. Garmin is no longer a product company. Now it must deliver real-time services to the consumer.

The act of transitioning from being a hardware company to a service company is quite profound. Garmin is now responsible to make sure that service works, that it is activated or deactivated properly and seamlessly, and that the customer gets all the real-time traffic and content expected. If the customer wakes up one day and gets into his car and there's no real-time traffic report, he picks up the phone and calls Garmin, as the customer is a Garmin subscriber. Garmin is now playing the role of service provider and must have billing systems, revenue stream systems, diagnostic systems, customer care systems, and network control systems that provide real-time visibility into the service and the customer.

Multinational enterprises have an additional challenge. It is one thing to offer a service in one country. But offering the service across 53 or more countries around the world, in a cost-effective manner so it allows this business to be profitable, is also an operational challenge.

PwC: How can enterprises become service providers if they have been steeped in a device culture?
MN: I described the three-layered stack earlier. Most device companies own the middle layer. To become a service provider, [a company must learn to build and own the full stack—from network to device to application. That's really the name of the game at this point.

A big part of our value is that we enable enterprises to own the stack. We effectively provide a BSS/OSS as a turnkey cloud solution—so enterprises can run their businesses as a service without significant investments. We reduce the complexity by taking advantage of network capability and intelligence.

PwC: What new use cases do you anticipate will become real in the future?
MN: I've heard a lot of futuristic ideas. For instance, I'm going to be able to have my stoplight talk to my car, which talks to my refrigerator, which talks to my grocery store and tells me I need more peanut butter. So as I drive up to the grocery store, a robotic arm hands me the peanut butter jar and charges a credit card I have on account.

That may be true far in the future, but I don't see that in the near term. It's just the practicalities of getting there—the barrier is so high. What I see is very purpose-built use cases that are meaningful. Over time we'll see a lot more things connected, but I think we're going to live in a much more practical world in which specific use cases serve a particular purpose. Experience shows that the ones that have attempted to overreach tend to die very quickly.

Creating the health feed

Walter De Brouwer of Scanadu forecasts how advances in sensing will give access to our personal health feed and transform healthcare.

Interview conducted by Vinod Baya

Walter De Brouwer

Walter De Brouwer is the founder and CEO of Scanadu, a personalized health electronics company.

PwC: Walter, can you please tell us about your company and why you started it?

WDB: Sure. Our company Scanadu is about two years old. We are creating products that empower consumers with medical tools that educate in real time. We were thinking, "What was the last thing that really surprised us in medicine as a consumer?" It was the medical tricorder that Dr. Bones uses in *Star Trek* to get real-time vitals and a diagnosis on the patient.

At the same time we saw the rise of the smartphone. It was clear to us that smartphone plus consumer plus medicine will be a whole new sort of medicine. What the consumer has now is a thermometer and Google. There is nothing in between. Bridging this gap is what we saw as the opportunity.

Consumers do not have the tools to monitor their health and make informed decisions about when they're actually sick and need to see a doctor. We want to empower consumers to take control of their health and give them direct access to their personal health feed.

PwC: How will users experience such a device, and how will data be collected? Will it be passive or active?

WDB: I think consumers want their devices to watch them, and not them to watch their devices. So the device must fit seamlessly in their lifestyle. That will come. Rather than a separate device, it will eventually be integrated into the phone. Seamlessness is giving power to the people.

"We want to empower consumers to take control of their health and give them direct access to their personal health feed."

Today we are making a tricorder that will fit in a pocket. In the long term, it will be a tricorder in a chip that we can implant in the environment. And then the next thing will be our medical records in our body, where they belong in the first place. These visions will be solidified in the next 20 years and are certainly what we're going for.

PwC: What are the capabilities of the tricorder you are building?
WDB: We are designing the tricorder to essentially be a hospital's clinic in a smartphone. It will have a complete diagnostic experience, because consumers want to play with that and explore their health. We are designing it to be within 1 percent of accuracy and cost less than $150.

The device is a very convergent apparatus and we are building it from the ground up. It brings together sensors that blend technologies from many disciplines. It's not only electrical engineering and mechanical engineering. It's also imaging, physics, and molecular diagnostics, because you have to get into wet stuff, too.

Also, we do not expect the consumer to take this device and go to every part of his body to check. You must find one position on the body, and in 10 seconds it must give you all your vital signs. You simply hold our tricorder to your temple, and in fewer than 10 seconds it will be able to read your temperature, pulse transit time, heart rate, and blood oxygenation. It will send the information to an app on your smartphone via Bluetooth.

PwC: Why 10 seconds?
WDB: I was in telecom many years ago, so I will use a telecom analogy. In the late 1990s, we fought about the last mile. The last mile has cost us much money. Every meter cost about $20 million, because you really had to dig in—you had to bring cables to where there was nothing. I now think that we are no longer in the last mile, but we are in the last minutes. This is the instant gratification generation.

People think their microwaves are too slow. One minute waiting is too slow. So it's about the last minute. If you have a device and you want to diagnose yourself, we think this device should give you all your readings in 10 seconds—actually in 8 seconds, because that is considered the attention span online.

PwC: Why do you want it to be in the smartphone rather than a separate medical device?
WDB: Because when you invite the smartphone, you invite the crowds. And when you invite the crowds, you make it peer-to-peer medicine. With the crowd, in just one minute I get more medically relevant information. That's peer-to-peer medicine. It is going to change everything, I think.

Also, smartphones today come equipped with many sensing capabilities. A smartphone can be used as a reader that reads molecular diagnostics, the camera in the phone can be used as an imaging device, and your vital signs can be monitored by contact.

The first device maker that brings a health phone to the market will create an avalanche. Everyone will buy it, and all the other device makers will have to follow because it will introduce a new species of devices. But we are a few years away from this.

PwC: Such a device would collect a large amount of data. What are you learning with respect to how large amounts of data will be used in the future?
WDB: The first thing we learned about data is that when it comes to health, population averages are not adequate. Medicine today is mass medicine that is population scaled. At the same time, our vitals change throughout the day and vary from person to person. We each have our personal ranges. Health decisions shouldn't be based on averages; they should be based on a real, accurate, and personalized health feed of data. Now we have the ability to give that to the consumer.

Another key benefit from a data standpoint is that all the data collected is pre-structured. It's time-series data that is usable as soon as it is collected. If the data were unstructured or semi-structured, it would be a bigger challenge.

In a couple of years, with several devices on the market, there will be portals for medical data that will offer sandboxes for various use cases. You can try out several models, such as a consumer model or a physician model. People may not understand the mathematics behind the models, but they will be able to mine

"In a couple of years, with several devices on the market, there will be portals for medical data that will offer sandboxes for various use cases."

their health data stream. They will look at it as personal health metrics and use personal health analytics to understand, monitor, and improve their health.

PwC: What is the impact of such a device on the healthcare industry?
WDB: To be successful, we must build a goldilocks [just right] device that is loved by consumers, by hospitals, by government, and by doctors. Doctors should care, because whereas clinical medicine is accurate, tricorder medicine will be a lot more precise simply because we will not test on 100 or 1,000 people in a clinical trial, but on millions.

Out of that will emerge a medicine that is personal and versatile. And therefore people will ask for more advice and talk more about their health, because although we're all the same, we're all completely different.

Every government in the world knows that the place of care must be shifted to the home—where it was in the first place—that these hospitals are not hotels, and that the emergency room is not the doctor.

There is going to be impact on efficiency and effectiveness of the industry. The one thing I can say from my telecom experience is that a lot of jobs were lost or transformed all over the world in all the telecoms, not because machines cost less, but because they were more efficient and less prone to error. Every human in the process is an opportunity for error, so telecom companies replaced them with switches. I think the same message applies to other industries where errors can be costly. Machines such as tricorders will help medicine be more efficient and reduce errors. The impact on the healthcare industry will be profound.

PwC: What about identity, privacy, and security issues?
WDB: These are important issues. I agree with Kevin Kelly and his theory that data wants to be common. And that we all should be anonymous data donors. If we are already organ donors, we might as well give our data, because epistemology badly needs it.

On the other hand, you have privacy issues. However, the one thing I've learned in telecom and in banking is that there will be frauds. Try to minimize it with everything you do, but you cannot eliminate misuse. Concentrating on perhaps the 0.001 percent of misuse and not looking at the good side of things is also not good.

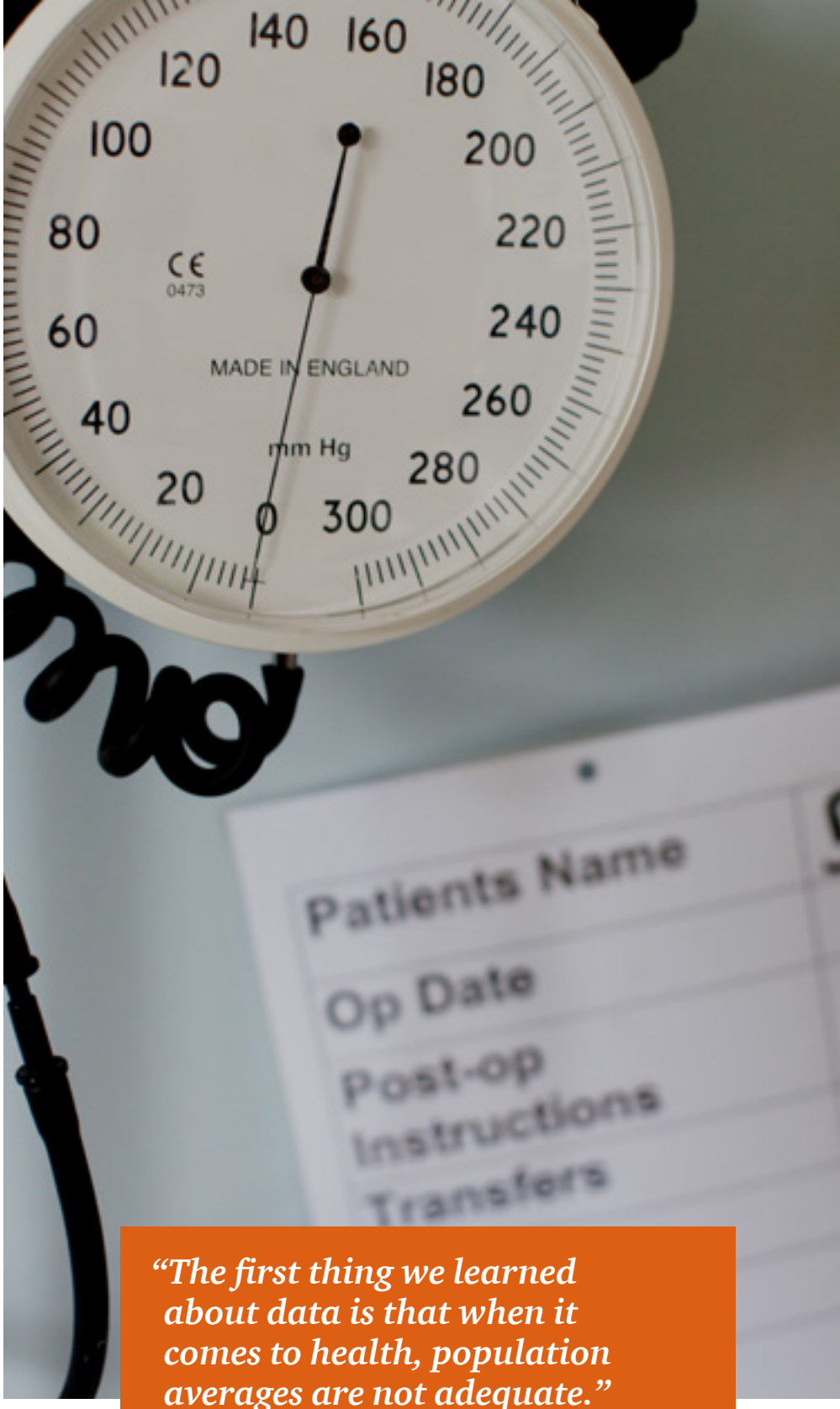
For the moment, we don't know what the data actually is and how quickly this data will educate us and how consumers will react to it. But we believe it will be big.

PwC: What you are working on represents a tremendous change. What is the cosmic message for the long term?

WDB: The feed metaphor brings to life a lot of the transformation and change that's happening. Each of us has a health feed, a time series of our vitals. Today, when we visit a doctor, she checks our vitals and asks us questions. What she sees is a Doppler effect,[1] a distortion of our feed, since she does not have access to the full feed. And she is biased by the Doppler effect.

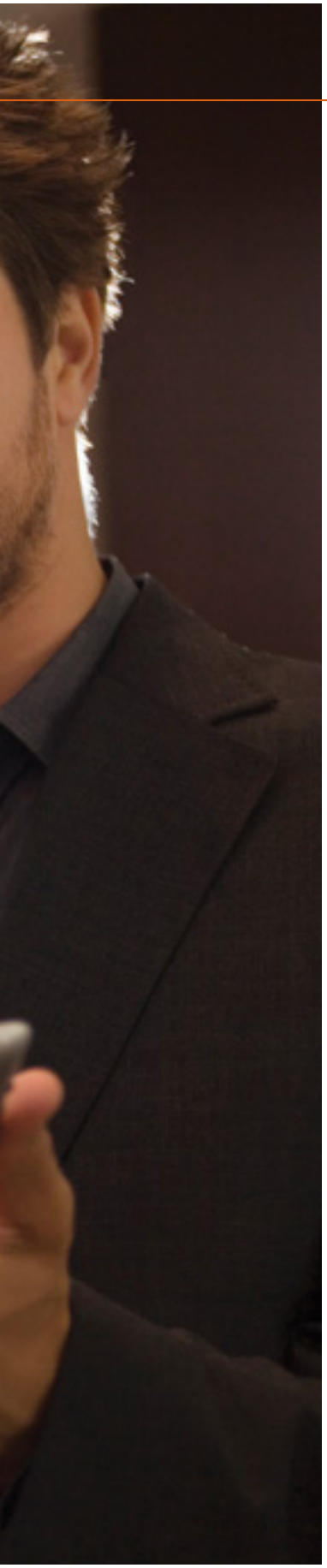
So it is our responsibility to tell her who we are and how we took care of ourselves. That is our full feed. Continual monitoring with devices such as what I am calling a health phone or tricorder makes that possible.

I think it's a bit like surveillance cameras. In the beginning of surveillance cameras, we thought they would prevent crime because there would be people looking at all the images, and they would act when they saw someone commit a crime. For most of the cameras in use today, no one is watching. But when something happens, we go back and we see what happened. And we try to make sure it doesn't happen again. This will be the big role of hospitals. They will learn enormously from our feed of data and keep us healthy.



"The first thing we learned about data is that when it comes to health, population averages are not adequate."

1 A change in frequency and wavelength of waves that results from a source moving with respect to the observer. For example, the change in pitch of a car horn or ambulance siren (sources) as they pass by a spot on a sidewalk (observer). First explained in 1842 by the physicist Christian Doppler. More details at http://en.wikipedia.org/wiki/Doppler_effect.



CIO leadership in post-transaction relationships: IT's role in customer engagement

By evolving IT to focus on the end customer, CIOs have the opportunity to be key partners in helping their businesses break new ground.

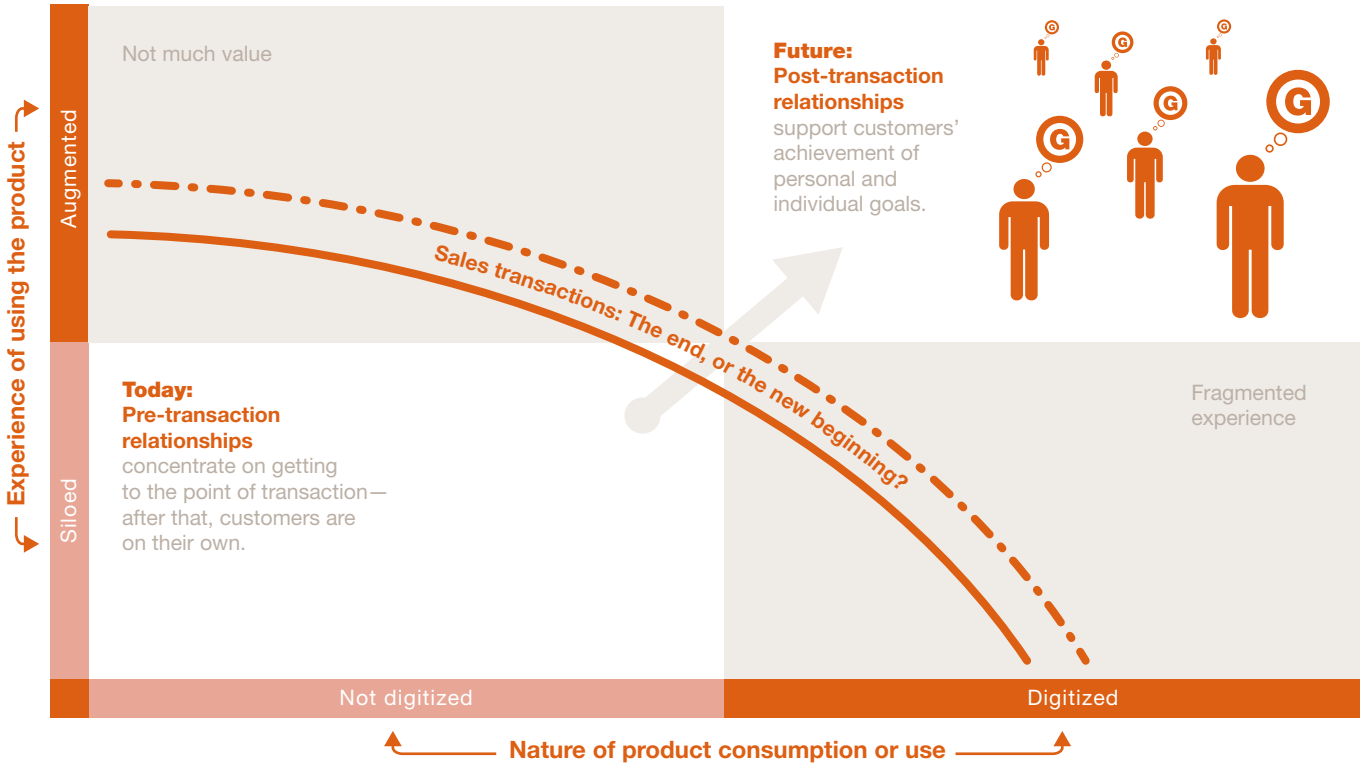
By Bud Mathaisel, Bo Parker, and Vinod Baya

CIOs have a greenfield opportunity in evolving transactions into relationships. Until now, the CIO has focused mainly on applying IT to front-office and back-office processes, including the web channel. The new opportunity is about *out-of-office* systems, which will stretch CIOs beyond IT's traditional role. Done right, though, this stretch will place the CIO much closer to the customer than ever before.

As discussed in the article, "Using technology to help customers achieve their goals," on page 06, the proliferation of connected sensors is accelerating, creating an Internet of Things. Businesses now can collect consumption and usage data from sensors they embed in their products, and they can use this information to redefine customer relationships. PwC believes changes are afoot for businesses to go beyond the transaction. Businesses thus far have transformed their pre-transaction relationship with potential customers, often referred to as e-commerce, by digitally reinventing marketing, product discovery, comparison shopping, buyer feedback and reviews, and purchasing and delivery options; in essence, all the steps up through the transaction. A post-transaction relationship approach creates new services, post-transaction services, which use consumption data to reinvent the provider-customer relationship in the service of customers' goals. (See Figure 1.)

CIOs already play a key role in transforming business processes, most recently by enhancing extended processes that involve suppliers and distributors. E-commerce and e-support established IT as a player in customer-related processes that primarily support company goals (selling and help desk). Efforts in going beyond the transaction will pull the CIO and the IT organization to use its assets and skills to support customer goals. Fundamentally, the "business process" of interest becomes the "customer process"—that is, the set of activities targeting a customer goal, which is the reason for the customer's purchase of a product or service in the first place.

Figure 1: In post-transaction relationships, the digitization of consumption and the augmentation of the customer experience set the stage for businesses to help customers achieve their personal goals.



CIOs have a greenfield opportunity in evolving transactions into relationships.

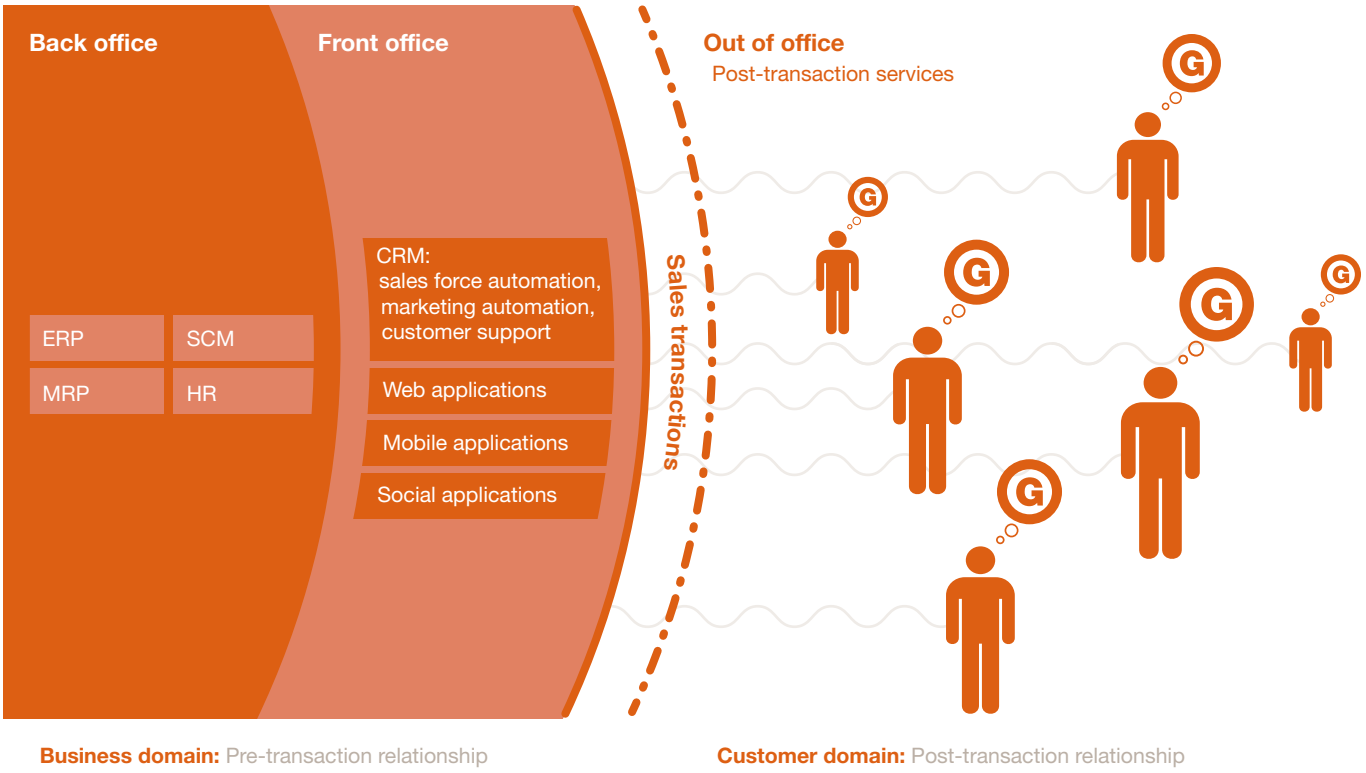
The digitization of consumption via connected sensors creates a continuous flow of data between the customer and the business associated with this customer process. Aggregating, integrating, and applying analytics to this data will generate information businesses can use to help customers be more successful in achieving their goals. CIOs have the skills and experience to make a difference here.

Capitalizing on post-transaction relationships is not a straightforward extension of existing IT capabilities. It requires new formulations of IT, even if legacy IT solutions can serve as the starting point. Because post-transaction relationships offer the potential for new, differentiating business models, they also require new approaches to engaging with the business and its extended ecosystem.

The rise of out of office

As enterprises have adopted new IT, both enterprises and their IT leaders have seen their event horizons broaden

Figure 2: The post-transaction relationship presents a new horizon for CIOs, the out of office.



significantly. In earlier times, IT focused on internal business processes, mainly in the *back office* of enterprises, starting with payroll and accounting, and eventually extending to manufacturing, human resources, and other internal operational systems. Over time, the IT event horizon expanded to the *front office* and the customer-facing capabilities or capabilities used by employees facing the customer. This front office included systems for sales force automation, marketing, customer support, the web channel, and others.

Going beyond the transaction is a significant challenge for customer and product centers of the business, but it calls for a quantum leap by enterprise IT to a new horizon, *out of office*. Out-of-office systems power post-transaction services and put the customer consumption value proposition front and center. (See Figure 2.) Out-of-office systems serve the customers by augmenting their experiences and helping them achieve personal goals.

The digitization of consumption via connected sensors creates a continuous flow of data between the customer and the business associated with this customer process.

"You need to be ready to invest in a process, to launch and to learn, to fail, to start again, to not copy-paste old ideas, but to copy-morph them."
—Daan Roosegaarde, Studio Roosegaarde

Table 1: Comparing the CIO opportunity in the front office, back office, and out of office

Characteristics	Front office, back office	Out of office
Operations focus	Business at the center	Customer at the center
Customer focus	Populations, demographics, psychographics, transaction data, sales data	Individual customers, product performance data, customer usage data
Boundary	Up to the purchase transaction for the product or service	After the transaction
Operating model	IT/outsourcers own and operate all technology infrastructure; they partner with the business on applications	Partnership model; IT works with R&D, product management, customer service, carriers, and device makers to create new functionality
Feedback loop	IT systems provide employees and business unit leaders with key data about internal processes and customers	IT systems provide customers with usage data and analytics that guide them to their goals
Capabilities	Transactional apps	Real-time closed-loop apps, augmented experiences

Despite the apparent challenges, out-of-office customer processes complement back-office and front-office processes. Table 1 contrasts key differences between the focus on front office or back office, and out of office. Done right, initiatives that seed post-transaction relationships can position the CIO and IT much closer to the customer in what could become their most strategic role.

The post-transaction relationship demands on business

To take advantage of the post-transaction relationships, most businesses will need to evolve. Businesses will face not only a technology or innovation challenge, but a process and operating model challenge to maintain an ongoing, data-driven relationship with customers as their product experiences evolve. Success will not come by simply extrapolating from existing operations.

"You need to be ready to invest in a process, to launch and to learn, to fail, to start again, to not copy-paste old ideas, but to copy-morph them," says Daan Roosegaarde, an artist, designer, and entrepreneur who founded Studio Roosegaarde. Studio Roosegaarde has developed many examples of unique experiences that merge physical and digital environments into an integrated experience.[1]

1 See http://www.studioroosegaarde.net/projects/ for examples.

Here are some of the key capabilities businesses must develop:

- **Connected device design competencies:** Most product and device manufacturers operate business models that require excellence in the design and manufacturing of standalone, unconnected devices. They will need to extend these capabilities into connected sensors and associated software that orchestrate customers' experiences and help them advance toward their goals. Businesses will need competencies in software development methods, managing software life cycles, and supporting deployed solutions in the field.

- **Connected device service competencies:** The service relationship with the customer through call centers and help desks will need to be reengineered to incorporate services supported by connected sensors. Much can be automated, which may even reduce the costs of customer support. Konica Minolta digitized the consumption on its copier products more than a decade ago. It owns the full stack of the hardware, networking capability, and the software solutions embedded in the copier, which enables remote management and interaction, device monitoring, and an improved experience for the technicians who service the machines. "The benefit is that we have transformed the overall customer experience by taking advantage of tracking information generated by the sensors and creating a seamless end-to-end experience for the technicians to do what they need to do," says Jim Ingrassia, vice president of the solutions support division at Konica Minolta Business Solutions.

"That simple act of embedding connectivity inside a device has transformed—really revolutionized—how a business must work with the consumer."
— Macario Namie, Jasper Wireless

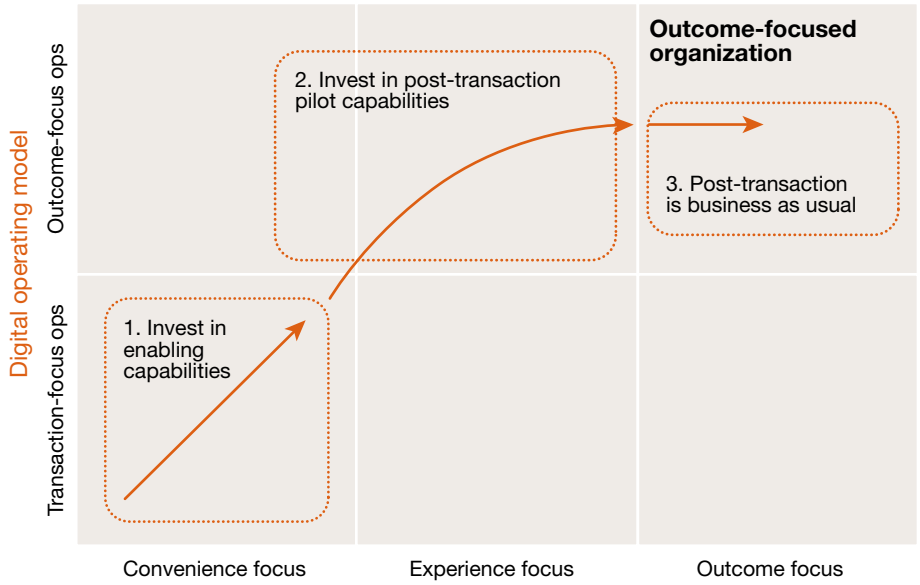
- **A continuous real-time service:** Businesses selling unconnected devices have a relationship with the customer that is very different from those selling connected ones. When a device is connected, the business, in effect, has a subscriber with different service expectations. "That simple act of embedding connectivity inside a device has transformed—really revolutionized—how a business must work with the consumer," says Macario Namie, vice president of marketing at Jasper Wireless. "Suddenly the company knows who the consumer is and gets data about how the consumer uses the device, the features used and not used, and so on." Namie suggests that to establish post-transaction relationships, product companies must become service companies that deliver 24x7 services and support to the consumer just to meet basic expectations.

- **The ability to engage customers individually:** The post-transaction relationship takes the notion of serving individual customers to a whole new level. The goals of each customer will be personal. Pursuing individual goals means charting a unique path for each customer. Business has long had this ambition, but has had to settle for proxies, such as situational customer feedback and focus groups after the sale. Now, the digitization of consumption will create the digital flow of information to serve customers one at a time and uniquely. "We are clearly moving toward a model where customers are willing to be uniquely identified, in exchange for some type of value," says Scott Bauer, a principal in PwC's customer impact practice. Businesses will need to take advantage of advanced analytics capabilities and predictive modeling, and employ them in every interaction with the customer to augment experiences.

Many CIOs have the skills and assets, both technical and operational, to help their enterprises adopt these necessary competencies and operating procedures. CIOs manage organizations that have extensive experience in designing, deploying, monitoring, and managing full hardware, software, and network stack solutions. The CIO organization has significant experience managing 24x7 operations and support. It also has expertise in surfacing, integrating, storing, and analyzing data from batch and real-time processes.

In short, CIOs and enterprise IT can be key resources as the business goes beyond the transactions. Delivering the services infrastructure and advising business unit leaders unfamiliar with connected sensors are two obvious ways to contribute.

Figure 3: Journey to better alignment with customer outcomes



1. Invest in enabling capabilities

- Single view of the customer
- Customer experience
- Data analytics
- Multichannel
- Digital marketing
- Security

2. Invest in post-transaction pilot capabilities

- New product/service innovation
- Business model innovation
- Business ecosystem collaboration
- Community management

Aligning with customer outcomes and goals

PwC identifies three stages of organizational development on the path to helping customers achieve their goals. (See Figure 3.) The journey commences with a set of enabling capabilities to develop a more complete understanding of customer experiences. With these capabilities in place, the second stage unleashes business leaders and product managers to pilot many opportunities for product, service, and business model innovation. The final stage incorporates all of the preceding in a broader, enterprise-wide set of feedback loops driven by more explicit, detailed knowledge of customer outcomes (an outcome is incremental and directional feedback that steers the customer toward the goal). In short, the focus evolves from customer value proposition and convenience alone to enterprise alignment with customer experiences and outcomes. A digital operating model[2] is at the heart of the journey as businesses extend their operations beyond the transaction.

Many IT organizations already have strong competencies in the enabling capabilities in Figure 3. IT may or may not be as experienced in directly supporting innovation and business and community engagement; creating post-transaction services is an ideal opportunity to develop or sharpen these capabilities.

2 "Exploiting the growing value from information," PwC *Technology Forecast* 2012, Issue 2.

"We are clearly moving toward a model where customers are willing to be uniquely identified, in exchange for some type of value."
—Scott Bauer, PwC

Post-transaction relationships can enable new business models that could complement or displace the current ones.

Advancing to out of office: CIO response to going beyond the transaction

Post-transaction relationships will stretch the CIO and the IT infrastructure, requiring new enabling infrastructure, new skill sets, a new organizational structure, and changes to the business partner model.

Businesses are at different levels of maturity in their post-transaction strategies and initiatives. Therefore, a first recommended step for the CIO would be a current state–future state assessment relative to the enterprise's maturity:

- **The enterprise has a well-developed and functioning post-transaction service capability:** Less than 10 percent of enterprises are in this group. If you are a progressive CIO, you are probably already involved in the initiative as a partner or as a provider of the service. But PwC has witnessed a number of early adopter initiatives emerging from business units with limited involvement from IT. CIOs not engaged in these initiatives need to strategically position IT capabilities and assets in light of emerging developments and potential. As the scale and volume of data increases, the business will need mature processes for managing the service, something IT does well.
- **The enterprise is actively considering or piloting post-transaction service initiatives:** CIOs need to have an early role in planning for the infrastructure (networking and data acquisition, cloud, data integration, and analytics). This planning is one of the biggest opportunities for CIOs to extend their value to the customer. Take the initiative by investing in a deep understanding of the customer goals and objectives associated with the products and services they purchase from your business.
- **The enterprise has not considered post-transaction service potential:** PwC views this trend as potentially more impactful than pre-transaction relationships. So be the first voice among executives in the enterprise to describe and explain the transformative impact of connected sensors and the post-transaction, digitally connected customer.

Post-transaction relationships can enable new business models that could complement or displace the current ones. It will likely require a redesign of existing business processes or the introduction of new business units and processes. But CIOs have been here before, first with back-office automation, and more recently with front-office automation. The out-of-office focus explicitly ties the CIO

and IT to customer outcomes, which some in the C-suite might view as too risky. Planning a way forward must complement the risk appetite that defines the overall business. Will the enterprise simply focus on a more automated way to deliver customer support, or will it push the envelope and assert a new business model?

That answer depends on many factors, including the enterprise's industry, regulatory mandates, and competitive positioning; how progressive the enterprise is; how far along the adoption curve it is; the current state of its IT; other enterprise and IT priorities; and the level of management support, especially for new investment.

Post-transaction services will require significant investments of talent and technology, and there must be a long-term commitment. Customers will quickly realize if your post-transaction service offering is dedicated to their personal success or not. Such services are a fully transparent glass house of digital-physical convergence. CIOs need to help business units ensure the plan is comprehensive, is endorsed by the C-suite and the board, and has realistic potential to succeed. An inadequate plan can lead to a highly visible failure, put customer relationships at risk, and damage the brand.

CIO game plan

Post-transaction relationships rely heavily on a post-sale digital connection between the customer and the enterprise. Only by establishing such a connection can the enterprise efficiently capture data describing individual outcomes relevant to the customer. This new infrastructure means new demands on IT. Solutions must be reliable, secure, and scalable for real-time operations across potentially millions of end users, involving perhaps billions of transactions. To meet these requirements, IT must work with product managers to describe and map a new set of behavioral patterns and associated data structures. The raw data will likely require sophisticated analytics and visualization solutions to deliver effective guidance to customers (and customer support) as they work toward the outcomes they are targeting.

The good news is that the technology industry already provides many of the building blocks, such as a reliable Internet, mobile devices, cloud services, open application programming interfaces (APIs), data analytics tools, and IT security tools. The CIO's role in the past has been to select, integrate, and operate the assembly of these capabilities. Post-transaction services will build on these strengths and experiences, with new emphases on the following:

Post-transaction services will require significant investments of talent and technology, and there must be a long-term commitment.

"We are opening up our capabilities to allow merchants and publishers to take advantage of our infrastructure to deploy end-to-end seamless experiences."
—Dominic Morea, First Data

- Developing a facility with connected sensor devices, which likely requires a closer relationship with R&D, product management, and customer support, where IT focuses on data structures and reliable data delivery
- Provisioning transaction data and real-time data analytics for everyone from the back office to the individual; this provisioning includes the integration of data from multiple sources, such as the device, core legacy ERP, operations, planning, and service systems
- Integration of new components with the architecture of core legacy systems, ensuring the core systems and new capabilities work well together, end to end
- Compliance with regulatory considerations such as data privacy
- Tracking, or even leading, the evolution of open source machine-to-machine standards and tools to benefit the CIO's enterprise, supply chain partners, and customers
- Designing innovative business practices in the context of new capabilities, with a focus on the customer experience as measured directly by connected sensors

Partnership model based on open architecture

All businesses understand the need to put the customer at the center of the business. For some businesses, where the product is a digital service, IT may already have the most direct link to customers. In other cases, the customer link is shared with business partners, such as product development, sales, marketing, and R&D. The focus on the customer will always mean partnering with customer-centered business units.

At a technology level, partnering between IT and business units increasingly looks like co-creation, where IT delivers a set of core services via published APIs. Central IT is the one place where all data come together. Acquiring and shepherding that data and/or the analytics derived from it is IT's core competency, but localizing the value from it is often best delivered via applications built by others inside or outside the enterprise. (See Figure 4.) PwC calls such an arrangement an *open IT* platform.

"We are opening up our capabilities to allow merchants and publishers to take advantage of our infrastructure to deploy end-to-end seamless experiences," says Dominic Morea, senior vice president of advanced solutions and innovation at First Data. The need to go beyond the transaction and the innovative devices emerging from the Internet of Things are not the only drivers of this change. Advances in social technologies, mobile technologies, analytics, and cloud computing (SMAC) are also pushing IT departments to be more open, so the enterprise can participate in increasingly digital partner ecosystems.[3]

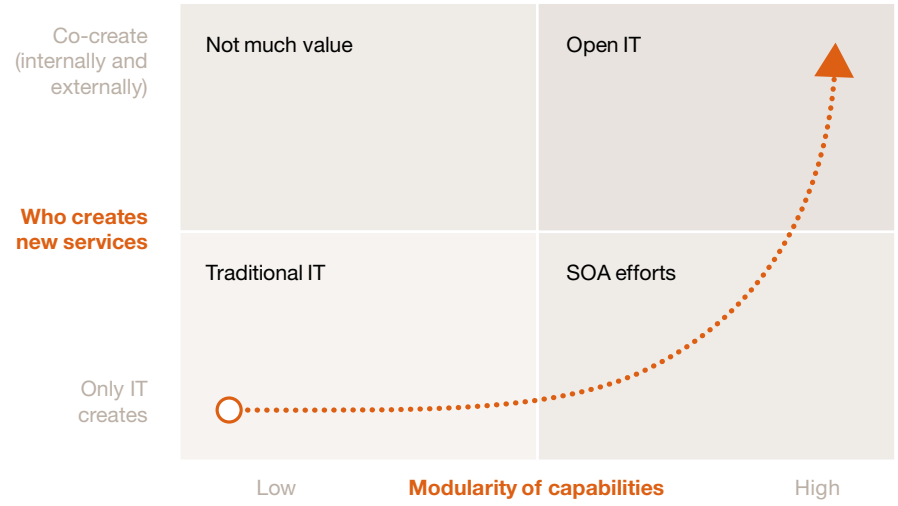
The core requirement for open IT is that it scale efficiently and reliably. PwC described how to do this in the *Technology Forecast* 2012, Issue 2.[4] Done right, open IT delivers information services that internal and external partners build on rather than passively accept as the endpoint in an information supply chain.

For IT, this approach is a change from delivering and maintaining full, end-to-end applications to delivering a platform that has modular capabilities expressed as reliable interfaces. "The IT department creates a foundation by integrating the machine data with

3 "Embracing open IT: Enabling the permeable enterprise," PwC *Technology Forecast* 2012, Issue 2.

4 "Business value of APIs," PwC *Technology Forecast* 2012, Issue 2.

Figure 4: Open IT builds on prior or ongoing service-oriented architecture (SOA) and API efforts, and it reorganizes IT capabilities in modular chunks to allow co-creation with internal and external partners.



various other sources to enable a wide range of use cases," says Konica Minolta's Ingrassia. "We use this enabling foundation to power the applications that my organization develops to support the technicians and their support experience."

In post-transaction services, many of the connected sensors and devices will expose their information as APIs that form part of this modular technology ecosystem. Similarly, almost all network and cloud services are built with explicit anticipation of API support.

For the CIO, open IT is an architectural matter more than a technology purchase. As business ecosystems become more digital, the value differentiators increasingly come from information generated by or associated with a product or service. The post-transaction relationship capitalizes on this transition of value as connected sensors digitize consumption at the individual level, helping customers achieve their goals.

New skill sets

Embracing post-transaction services via open IT and associated infrastructure requirements will be an organizational challenge as well. Enterprise IT has historically been optimized around the design, deployment, and operation of core systems; it is unlikely the organization has many of the new skills needed.

The CIO needs to focus on building an API-, web-, mobile-, connected-sensor-, and cloud-competent IT organization. Some CIOs are creating startup-like tiger teams under separate leadership. PwC often sees agile methodologies and approaches to code management and deployment in these groups. Other CIOs are establishing incubator groups or centers of

"The IT department creates a foundation by integrating the machine data with various other sources to enable a wide range of use cases."
—Jim Ingrassia, Konica Minolta

excellence for SMAC and/or RESTful API development. Sometimes embedded in business units, these distributed groups focus on building a competency in a given area and acting as evangelists for the methods, tools, and so forth to be used in the future. The members of these centers might also begin to plan, execute, and gain experience building the future state architecture as laid out by the CIO. The great news is that many in the IT organization today are anxious to upgrade their skills and would welcome the opportunity to learn new skills and technologies.

Conclusion

CIOs have long been advised to get closer to the customer. Post-transaction relationships are the opportunity to do so down to each individual customer. The CIO's vision is clear—use information at the point of consumption to guide customers to better outcomes. Implementing this vision will require CIOs to define a new out-of-office context for IT that builds on and complements the capabilities CIOs have assembled with earlier back-office and front-office projects. Because the action takes place out of office, there are new imperatives. Connected devices present their own hardware, software, and network stack, as well as requirements for remote, automated services and for coordination with R&D and product managers. Post-transaction services will also push IT further into the cloud where many network and device management services already reside, seeding a partnership model based on an open IT via APIs.

The huge potential created by post-transaction relationships is real. So are the challenges. The connected things on the Internet are likely to be as disruptive to the enterprise as e-commerce was in pre-transaction relationships. But CIOs have met the disruptive future before, and they have responded by investing in new skills to address new requirements. This challenge is all about making customers successful. Because of that, post-transaction services will be the most compelling business opportunity CIOs have ever had.

Better outcomes?

The CIO's vision is clear—use information at the point of consumption to guide customers to better outcomes.

Digitizing product use

Jim Ingrassia of Konica Minolta shares how digitizing the use of its products set the stage for competitive advantage across R&D, product design, marketing, and customer support.

Interview conducted by Vinod Baya, Bo Parker, and Brett Hertzig

Jim Ingrassia

Jim Ingrassia is vice president of the solutions support division at Konica Minolta Business Solutions.

PwC: For some time now, Konica Minolta has been active in the Internet of Things via the remote monitoring features in many of its products. Jim, can you share what was the genesis of this capability?

JI: Sure. In the late 1990s or early 2000s, before the merger, both Konica and Minolta were working on ways of gathering information from devices—via phone lines at that time—to provide feedback for product engineering and R&D. The purpose was to collect information about device operation and its use to understand issues that arose in the field and potentially what was causing them. Our teams created the ability to remotely see every signal in the machine. We can detect low voltages, internal jams, faulty signals on PCBs [printed circuit boards], and everything happening in the machine—periodically or on demand.

Although developed for engineering and design purposes, that capability has led us to find other ways to use it. Today we use remote monitoring to enhance our services and our support for our products to our channel partners and end customers. We have been able to build significant value-added capabilities with the remote monitoring feature. My division offers these capabilities to empower about 7,000 to 8,000 technicians in the US. We call this system vCare.

"We have been able to build significant value-added capabilities with the remote monitoring feature."

PwC: How many products do you monitor this way?
JI: In the US, we monitor equipment locally within our own territories to see what's happening with the machine, how healthy it is, and whether it has a problem. In our direct channel, we have more than 120,000 units in the system and more than 106,000 of them are connected with the remote monitoring feature. Globally we have about 550,000 to 600,000 systems that are hooked up this way.

PwC: What are some examples of information you are collecting, and what is the granularity of the information?
JI: What we collect is highly configurable. We can have the machine report the tiniest and most insignificant problem up to or including the major problems for any error codes, such as low toners, paper jams, and so on. We can configure it for each customer, for each machine individually, and as appropriate for the environment where the machine is placed.

The information we collect is very granular. What the machine reports is a raw data packet, varying in size from 15k to 30k, that captures the machine's state. The data literally can be translated into thousands of readings that describe machine behavior. We translate the signal to a more understandable format, such as the voltages in the various boards, the speed of the fans and if they're slowing down or malfunctioning, and so on. We can also tell how many 8.5 × 11 sheets or 8.5 × 14 sheets are printed and whether they were landscape or portrait, or color or black and white.

PwC: How have things changed for you from the days when such connectivity did not exist?
JI: There have been many changes and improvements. First is getting insights that you cannot have unless you look across a large population of devices. For example, customers generally don't report a jam. They just straighten it out and move on. But when we see it happening across 50,000 or 60,000 machines during a period of 30 days, then we look at the data from a different perspective. We start seeing patterns and realize that perhaps we have a design issue.

In one instance, tracking data told us that certain machines had a higher frequency of jams in a particular area of the machine. After analyzing the data from the machines, our teams determined that the jams were caused by a slight deformation of one of our plates. So the issue was taken back to engineering, which redesigned the plate to put a slightly different bend on it, and the problem went away.

As a result of this real-time feedback, a very limited amount of machines were actually manufactured with the original design and for years the rest of them are manufactured with a corrected design.

We can also look at usage and predict features for future products. If we see machines being run more and more for sizes 11 × 17, or 12 × 18, or 13 × 19, for example, it tells us what to optimize the future designs for.

PwC: What are some of the business benefits you are reaping?
JI: One of our key operational benefits is better use of our resources in multiple areas. Most of our machines are on a pay-per-copy contract, so based on usage. To track usage, the old method was to have a team of people call customers at the end of every month and request them to read the meter to the caller. Each meter read probably cost the company between $5 and $8. Today the readings come in automatically from the machine every day.

Going back 10 years, if a customer called, he already had a problem. Over the phone, you would try and ascertain what might be the cause and then send a technician with your best guess as to what to take to fix the problem. Today, we see the problems occurring before or at the same time the customer sees them. With the granularity of the

Global reach with remote connectivity

"In our direct channel, we have more than 120,000 units in the system and more than 106,000 of them are connected with the remote monitoring feature. Globally we have about 550,000 to 600,000 systems that are hooked up this way."

information we collect, we have a much richer understanding of the health of the machine and can diagnose much more accurately. We only make trips that are necessary, we fix multiple issues in one visit, and overall we make fewer trips.

As a result, our service profitability improves. Service profitability goes down every time you get into the car and go to work on a machine that does not require service. Our technicians can service a larger pool of machines than before. Today a technician can handle about 275 to 300 machines. Of course, a lot depends on the size and speed of the machines and the geographical concentration of the machines.

We gain a competitive advantage in the marketplace, because this capability is a strong marketing tool. We are able to know and do things very well, and we continue to innovate to bring new value adds.

PwC: What about the end customer? What benefits are they experiencing?

JI: There are new benefits for customers, too. We can call customers and tell them that they're having issues with a machine—even before they are aware of it—and that we will send someone within the next several hours or day to address it.

For simple problems, we get customers up and running quicker. If we know that all we're going to do is drive 25 miles to clear a jam in a certain area and maybe take a rag and wipe clean a piece of glass, we can actually tell the customer the remedy, "Hi, if you want to, just wipe this area and see if that fixes the problem. I'll call you back in an hour." Generally, the customers say, "Really, that was it." They have the machine back without having to wait for us.

We can also help customers by advising them how to use the equipment more optimally. We can let them know that perhaps the machine they have is being driven very hard and a different machine would be a better fit, even more inexpensive for them based on their usage.

When we understand their environment, their workflow, and how they are using the machine, we can create a win-win situation by making things better for them and us.

PwC: The technicians are the key audience you serve. What are some of the benefits they receive from the information collected?

JI: Technicians see benefits in two areas. The first is in optimizing their trips. We actively use the connectivity to detect impending problems. Before a technician goes out, he can use our mobile applications to look into that machine, so to speak, and inspect all the other components to see if any other parts or consumables are in need of maintenance during the call. For example, are rollers close to life or is any component close to needing replacement? Now, they can gather together all the necessary components and tools and handle everything in one visit, instead of realizing that they may need two other components and then making another trip.

The other benefit is that we have transformed the overall experience by taking advantage of tracking information generated by the sensors and creating a seamless end-to-end experience for the technicians to do what they need to do. They can get a message on their smartphone from a machine that needs attention. They look at the machine's health and diagnose the problem. For certain error codes, they can switch directly to our knowledge database through that smartphone. In the knowledge database, they can find modifications or fixes to correct the situation, including diagrams, parts required, and instructions. From there, they can seamlessly make warranty claims, order parts, schedule visits, and be on their way—all with our mobile applications

on the smartphone. This capability has surely boosted their productivity and overall service experience.

PwC: What roles do IT and the CIO play in enabling what you do?

JI: IT is fully involved in enabling us. The communication method with the machines is either one-way e-mail or direct IP transmissions. The foundation is what we call a communication server that collects data from the machines in the field. We have about 35 servers running right now to collect all the information, and that number increases every month as we put 3,000 to 4,000 more units in the field. IT manages and maintains these. The IT department is also integral in load balancing and maintaining our domains to keep things secure and make sure our databases are fully indexed and provide the necessary peak performance. The data we use comes through our SAP system. IT maintains the SAP systems and the integrity of our database servers. The IT department creates a foundation by integrating the machine data with various other sources to enable a wide range of use cases. They take the machine data, massage the data, and integrate it with the service call system, dispatch system, warranty system, consumable replenishment systems, and others.

"With the granularity of the information we collect, we have a much richer understanding of the health of the machine and can diagnose much more accurately."

We use this enabling foundation to power the applications that my organization develops to support the technicians and their support experience.

PwC: What is your advice to others who have not embraced connected device initiatives yet and are curious about it?

JI: The main thing is to never forget the main purpose or the goal of your customers. For us, the goal is to inspire customer passion by providing support and answers for the technicians when they're trying to repair or modify a machine. Customer satisfaction is always our top priority.

Enabling the end-to-end retail experience

Dominic Morea of First Data shares how the future of the retail industry is going beyond the transaction.

Interview conducted by Vinod Baya and James Russell

Dominic Morea

Dominic Morea is senior vice president of advanced solutions and innovation at First Data Corporation.

PwC: Dom, can you please tell us about the group and function you lead at First Data?

DM: Sure, I'd be happy to do that. I lead what we call the advanced solutions and innovation team here at First Data. The ASI team acts as the incubator of innovation and next-generation ideas for the company. We are driving a handful of initiatives that our strategy has deemed to be transformational or disruptive or both.

We're responsible for the company's mobile commerce or universal commerce strategy. We are also very focused on personalized marketing and the next generation of loyalty as it relates to merchants and financial information, identifying—as best we can—where payments, commerce, and shopping are headed.

PwC: What is universal commerce and what is its genesis?

DM: We began to focus on mobile payments about four and a half years ago. We cycled through several phases of learning and experimentation and saw the evolution of a contactless form factor, such as a fob or NFC [Near Field Communication] embedded in the phone. We realized that change in a payment transaction itself is not a seismic change. There was no real consumer value proposition there, and the credit or debit cards work very well today from a payment perspective.

What became clear is that the impact of many emerging technologies such as mobility, mobile wallet, the Internet of Things, and others is much broader, beyond the payment transaction. In

"The impact of many emerging technologies such as mobility, mobile wallet, the Internet of Things, and others is much broader, beyond the payment transaction."

retail, the new value propositions are at the intersection of personalized marketing, mobile marketing, loyalty, and improved user experience. These capabilities and their fusion with seamless payments really are where the opportunity is headed, in our view.

The effort took our thinking toward a strategic vision we label *universal commerce,* which very simply is commerce that happens anytime, anywhere, and on any type of device. More specifically, it is an evolving concept that suggests movement toward a future where retail activities are seamlessly integrated into a single end-to-end experience—shopping, payment, marketing, loyalty, money management, and offline and online experiences. The impact of this integration is only just beginning to be felt by merchants, consumers, and financial institutions.

PwC: How does the vision manifest itself in your products and services?
DM: We've reoriented the way we pursue product development and innovation. With a focus on seamlessness and end-to-end process, we account up front for the need to mash up a number of capabilities as opposed to a point solution or point product. That fuels the ability to create seamless integrations across account types, experiences, loyalty, and data access.

Our core competencies are in infrastructure, networks, connecting endpoints, and connecting players in a multisided ecosystem, so that is what we focus on. We will enable the diversity of use cases expressed as apps or devices, or websites or in-store kiosks or other scenarios. In the multisided ecosystem, we really bring together a marketplace of publishers and merchants where offers can be linked to an account and seamlessly redeemed.

We are opening up our capabilities to allow merchants and publishers to take advantage of our infrastructure to deploy end-to-end seamless experiences. Cloud-based technology simplifies integration while allowing us to provide many value-added services. For instance, the open application programming interface [developed by CardSpring] has allowed hundreds of developers and offer publishers to use the OfferWise solution to create innovative new types of e-commerce, loyalty, daily deal, and mobile experiences to help retailers create new value-added relationships with their customers.

PwC: What new capabilities will you add to your infrastructure in the future?
DM: The future is really about going beyond the transaction by understanding and facilitating the end-to-end experience. We want to tie together what the consumer is doing before, during, and after a transaction. Today, the "during" piece is where the online payment networks come into play. We are creating the ability to see the consumer on a longitudinal basis and add value to a merchant at a basket level. For example, one of the capabilities on our road map is to go to the line item detail in a transaction, so merchants can build a more insightful engagement with their customers.

PwC: What are some examples of new experiences in universal commerce?
DM: One emerging example is Red Tomato Pizza in Dubai, which has changed the ordering experience by making it as easy as pushing a single button. Red Tomato Pizza provides its customers with a refrigerator magnet that has a button on it. When a customer presses the button, a preprogrammed pizza order is submitted via a Bluetooth connection to a smartphone or tablet [which relays the order over the Internet]. Upon receipt of the order, Red Tomato Pizza transmits a confirmation text message to the customer with options to cancel or change the order. There is seamless interaction between the physical action of pressing a button and the virtual action of placing an order.

In another example, global home furnishings retailer IKEA has released a catalog app that extends the print catalog experience. Customers can hold their smartphones and tablets over mobile-enabled catalog pages and gain access to rich content, such as videos, images, and 3D product models. You can imagine that in the future, customers could see how a product is assembled, the ease or complexity of it, and take that into account in their decision making.

In both these cases the value proposition to the customer goes well beyond the transaction.

PwC: It seems that the consumer experience is fragmented across devices, online or offline channels, and so on. How much of a concern and problem is this?
DM: Fragmentation of the experience is a significant challenge, and we need to address that. If the multichannel experience is not fluid, I think it's not useful. And by the way, this fragmentation is not just in the shopping experience. It is across the full lifestyle. We are seeing progress today where sessions and data captured on one device can be seamlessly accessed on a different device to continue the experience. So if I'm shopping at home on a connected device—say a wired device—and I didn't finish what I started, but now I'm at work or I'm out and about with a tablet, I can continue from where I was and then maybe even take that into the store.

The ability to do something online and then be able to carry that experience to the physical store is really important. Take couponing, for example. As you know, consumers love coupons, daily deals, and other discount offers, and merchants rely on them to attract new customers and return visits from existing customers. However, redemption of these offers is usually paper based—a cumbersome and inconvenient process for both the consumers and merchants.

Our OfferWise solution simplifies offer redemption and makes it seamless, by letting consumers link their discounts to a payment card or mobile wallet and redeem them automatically at a participating merchant's point of sale. Merchants can take advantage of this solution with no changes to their points of sale, operations, or infrastructure—and more than 500,000 merchants can accept these card-linked redemptions.

This capability is valuable, because it removes the clunky nature of paper. It delivers real value to consumers, who now don't need to clip coupons or print out paper that proves they bought a deal, registered for a loyalty program, or have a certain number of reward points.

PwC: What is the greatest challenge in what you are doing and what is the greatest benefit?
DM: For a long time, there has not been a cost-effective way to deliver insight back to the point of sale. Most point of sale systems use old technology, and it's fairly costly to change that. In addition to the point of sale devices, what has held us back is the fact that the outermost edge is a very narrow and highly specialized network service. It does authorization and settlement—a two-part message or a one-part message. Sure, it does that for a number of account types, but only these few things.

The opportunity with universal commerce is much broader and deeper. We now have this data in the cloud, and the work going forward is how to deliver the acknowledgments that help our merchants and their consumers get a much richer level of engagement, relationship, membership, and insight into the end-to-end experience. We're just at the early stages of that. We think it's critically important in the mobile channel and the future.

"Fragmentation of the experience is a significant challenge, and we need to address that. If the multichannel experience is not fluid, I think it's not useful."

"The future is really about going beyond the transaction by understanding and facilitating the end-to-end experience."

To have a deeper conversation about this subject, please contact:

Tom DeGarmo
Global and US Advisory
Technology Consulting Leader
+1 (267) 330 2658
thomas.p.degarmo@us.pwc.com

Bo Parker
Managing Director
Center for Technology & Innovation
+1 (408) 817 5733
bo.parker@us.pwc.com

Robert Scott
Global Technology Consulting Leader
+1 (416) 815 5221
robert.w.scott@ca.pwc.com

Paul D'Alessandro
US Customer Impact Consulting Leader
+1 (416) 815 5221
paul.dalessandro@us.pwc.com

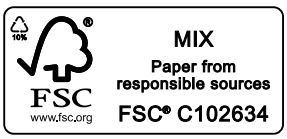
Scott Bauer
Principal, Customer Impact Practice,
PwC US
+1 (678) 419 1128
scott.d.bauer@us.pwc.com

Carlo Gagliardi
Partner, PwC Consulting, UK
+44 (0) 207 213 5659
carlo.gagliardi@uk.pwc.com

Comments or requests?
Please visit www.pwc.com/techforecast or send e-mail to techforecasteditors@us.pwc.com

Photography
Allen Bourgeois: Cover, page 22
Daan Roosegaarde Design: pages 05, 16, 28

This publication is printed on McCoy Silk. It is a Forest Stewardship Council™ (FSC®) certified stock containing 10% postconsumer waste (PCW) fiber and manufactured with 100% certified renewable energy.



PwC firms help organisations and individuals create the value they're looking for. We're a network of firms in 158 countries with close to 169,000 people who are committed to delivering quality in assurance, tax and advisory services. Tell us what matters to you and find out more by visiting us at http://www.pwc.com.

Subtext

Post-transaction relationship	The post-transaction relationship reinvents the engagement with customers. By taking advantage of the digitization of consumption and the ability to augment the experience, it reaches beyond the sales transaction and focuses on helping customers achieve the personal goals they buy the products for.
Digitization of consumption	Digitizing the information about how products and services are consumed or used by embedding connected sensors in products. The availability of small and less expensive sensors and the ease of embedding networking capabilities is making it possible to digitize consumption of any and every product from toothbrushes to cars to roadways.
Augmented experience	Enhancing the experience of using the product so that it empowers the customers to achieve their goals more effectively than they could on their own. By creating seamlessness between the physical and digital spaces, businesses create a real-time feedback loop between the context of consumer actions and the progress toward their personal goals.
Thing Stack	A technology stack that enables any device to be part of the Internet of Things is composed of three layers: sensors, networking and computing platform, and service platforms. Together they enable the digitization of consumption and augment the experience.