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FRONTIERS

Four Strategies for the Age of Smart Services

If you're like many product-centric companies, you're scrambling to grow your revenues from services. The best ways begin with making the products themselves smarter.

by *Glen Allmendinger and Ralph Lombreglia*

Any industrial manufacturer that has not awakened to the fact that it must become a service business is in serious peril today. Sadly, there are many such businesses—companies that still think of themselves as builders of things and that state their gross margins, operating profits, and other measures of success solely in terms of “the product.” But even their more enlightened competitors, the ones who’ve begun to wrap valuable services around their products and, in some cases, profit directly from those services, are enjoying only a temporary advantage. They may be improving their customer relationships by taking on various burdens such as maintenance and replenishment of supplies, but that will get them only so far. A select group of companies is already upping the ante. Soon, it will not be enough for a company to offer services; it will have to provide “smart services.”

Smart services go beyond the kinds of upkeep and upgrades you may be bundling with your products, both in their value to customers and in their cost efficiency to you. To provide them, you must build intelligence—that is, awareness and connectivity—into the products themselves. And you must be prepared to act on what the products then reveal about their use.

Consider Heidelberg Druckmaschinen (commonly known as Heidelberg), a maker of high-end printing presses. Throughout its history, the company has offered repair services to its customers. Several years ago, when it developed the ability to monitor its equipment remotely, Heidelberg found that it could provide maintenance much more cost-effectively. Now with its machines communicating continuously over the Internet, relaying information about their status between the print shops and Heidelberg’s regional and global technical support specialists, the company has the access and insight to optimize printing performance in customers’ shops. The total product support that Heidelberg now offers—which extends even to removal and resale of the machines—represents a whole new level of value for buyers. The network context has made the difference for Heidelberg and has allowed the firm to achieve true intimacy with its customers.

The rewards of becoming a smart service provider are hard to deny. In our research, we’ve documented organic growth rates in double digits for many of the companies that are following this path. The leaders are establishing the new performance benchmarks for their industries, deriving more than 50% of their revenues and 60% of their margin contributions from services as opposed to product sales. For most management teams in product-centric companies, numbers like these sound like nirvana.

Joining the ranks of smart service organizations is not primarily a technical challenge. The necessary technologies, while critical to the task, are well-enough established by this point. Rather, in most companies, the biggest challenge is getting senior management to adopt a new perspective on the nature of the business. The companies in the vanguard of smart services think differently about their purpose and how they make their profits—but they have come to that new heading by degrees.

What Makes Service Smart?

Smart services are a wholly different animal from the service offerings of the past. To begin with, they are fundamentally preemptive rather than reactive or even proactive. Preemptive means your actions are based upon hard field intelligence; you launch a preemptive strike to head off an undesirable event when you have real-world evidence that the event is in the offing. Smart services are thus based upon actual evidence that a machine is about to fail, that a customer’s supply of consumables is about to be depleted, that a shipment of materials has been delayed, and so on.

For customers, smart services create an entirely new kind of value—the value of removing unpleasant surprises from their lives. Meanwhile, because the field intelligence makes product performance and customer behaviors visible as never before, manufacturers gain unprecedented R&D feedback and insight into customers’ needs and can provide even greater ongoing value.

Finally, because it is impractical to deploy humans to gather and analyze the real-time field data required, smart services depend on “machine intelligence.” In a smart services environment, reliable and blindingly fast microprocessors do what they are very good at doing: digesting billions of

data points, talking to one another about the data, controlling one another based upon the state of the data—all in a matter of nanoseconds. Humans cannot do this, nor should they; this incessant stream of business information should be invisible to people. At the same time, all this background activity gives managers and decision makers much more visibility into a business's assets, costs, and liabilities—precisely when they need or want it. (See the sidebar “What a Connected Device Can Do.”)

What a Connected Device Can Do (Located at the end of this article)

This is not dazzling futurespeak; for many companies, smart services are already reality. For many more, it's a matter of reaping the harvest of seeds sown. For decades, businesses have been steadily building electronic intelligence into manufactured objects by means of sensors, controllers, and microprocessors. Today, virtually all products that use electricity—whether you're talking about toys, coffeemakers, cars, or medical diagnostic machines—possess inherent data-processing capabilities. Each has a wealth of information to offer about its current status, usage history, and performance. So if a manufacturing machine, consumer product, or building is not presently monitoring every detail that its creator might wish to extract, it can easily and cheaply be made to do so.

Learning from the Vanguard

If some companies are further ahead than others in offering smart services, it's for good reason. Manufacturers such as Honeywell with its aerospace equipment, ABB with its power plant equipment, Siemens with its medical equipment, and GE with its jet engines and locomotives all produce assets so critical to customers' work that, for years already, they've been using various kinds of networking to perform remote monitoring and diagnostic work. Meanwhile, as the forces of competition and commoditization relentlessly assault their product lines, most of these manufacturers have made it an explicit goal to change their business mix and increase the margin contribution from their service activities. As a result, they have already pushed themselves further into the life cycles of the products they sell—beyond purchase and installation and into customers' ongoing use. A favorite example in the business press is the industrial gases business. Companies such as Air Products and Chemicals and Air Liquide, because they provide expensive components of critical processes, have traditionally needed to offer customers performance-based service contracts. Even when this meant having “human sensors” sitting at clients' sites 24/7 watching everything that went on, it was worth it: The companies naturally learned more about their customers' problems than the typical manufacturer could have, and they converted those issues into business opportunities.

“Chance favors the prepared mind,” observed scientist Louis Pasteur. In the same way, emerging technologies favor prepared companies. When a global data network—the Internet—arrived on the scene alongside rapidly advancing technologies for large-scale storage and data mining, most management teams in the world were not thinking about the implications for device networking. But prepared companies, like the asset-intensive businesses cited earlier, spotted the shift in the economics. Now products could be wired throughout a business, and the connectivity was cheap enough to permit continual monitoring of them. Even a company like General Electric, already the poster child for downstream service expansion, saw unprecedented opportunities.

Look at GE's power turbine business, for instance. Its customers, major utilities, have good reason to hate equipment failures. At the least, any downtime creates huge opportunity costs for these customers; often it means they have to pay hefty regulatory compliance fines. To reduce that risk, GE (and its competition) invests heavily in remote monitoring and diagnostics so it can deploy a technician or engineer ahead of a failure (preemptively) as opposed to doing so according to a schedule based upon assumptions (proactively) or, even worse, after the power has gone off (reactively). For one thing, this has a dramatic effect on the profitability of GE's maintenance services. Most manufacturers cannot charge more than \$90 to \$110 per hour for their technical support because of price and benefit pressures from local competitors. But GE Energy, because of its efficient network-enabled remote servicing, can charge \$500 to \$600 per hour for the same technician. Even more important, the information generated by its continual monitoring allows GE to take on additional tasks, such as managing a customer's spare parts inventory or providing the customer's and GE's service and support personnel with complete access to unified data and knowledge about the status of the equipment.

Customers now look to GE not just for high-quality energy equipment but also for help in optimizing their ability to supply consistent and high-quality power to their customers. (In fact, GE has created a significant amount of customer dependency.) This has allowed GE to tie its pricing to the benefits it provides (“power by the hour,” for instance) versus the products themselves.

The same kinds of economics are at work at GE Healthcare. Its typical customer is a radiology practice in the market for an MRI machine. In truth, customers have not purchased such equipment in years; given the rapidly obsolescing technology and quirks of hospital finances, they've tended to lease the machines. Now even conventional leasing has gone by the wayside as companies like GE offer to install the equipment at no up-front cost and instead charge for its ongoing upkeep and use.

The wonderful result is a longer-term relationship than a traditional product sale would have yielded. Under the old model, a customer buys or leases a thing and gets some kind of warranty and support package with it—and then a salesperson is back within a predictable amount of time trying to sell an upgrade or extension. Under the new model, the customer simply signs up, typically for a five-year-plus relationship with a major asset. All the support and replenishables related to that machine are handled, through individual transactions, as part of the managed service. By analogy, imagine not buying or leasing the car of your choice but instead paying for its use by the mile.

GE's ability to price those “miles” right is critical to its ongoing competitiveness. For an MRI machine, GE must estimate the number of images that will be required over the life of the contract based on the demographics of the served area. Again, the company can make such estimates because of its network monitoring. Not long ago, we met with managers in GE's industrial capital equipment leasing division. These are the people responsible for those leased trailers you find at practically every construction site on earth. We were incredulous when we heard how much self-awareness the trailers have—even down to the number of times a particular door or window is opened in a given period. Why collect those data? “Because,” we were told, “the business is actuarial science now.”

Finding Your Smart Service Opportunities

Thinking about the business opportunities associated with a networked product is a highly creative process. Often there are no cut-and-dried markets to identify and size. Rather, there are whole new markets that *might* develop as networked products are rolled out. To find your opportunities, start by looking at the life cycle of your product. What are the activities the customer engages in to procure, own, use, and dispose of it? Next, check out the adjacencies. For each of the identified activities, what else is the customer close to or in contact with when performing the activity? And what other activities precede and follow the activities you've identified? Finally, once you've examined the possibilities offered by these various activities and adjacencies, bundle the most economically attractive elements into a total opportunity. Each of these steps bears further explanation.

Looking at the Life Cycle.

The first step involves identifying the activities that are directly connected with owning and using your product. (See the exhibit "The Product Life Cycle from a Customer's Perspective" for the list of activities one company generated.) The most obvious activity that a connected product can streamline, while at the same time allowing the manufacturer to intervene, assist, and reap benefits, is maintenance. If your product can detect that one of its parts is approaching failure and can alert you to that fact, you are in a perfect position to benefit the customer—and to own the opportunity to deliver maintenance services.

 The Product Life Cycle from a Customer's Perspective (Located at the end of this article)

It's well known that the profit in printers, for example, is in the replenishables, such as toner cartridges. But there are clones of most toner cartridges, and they cut into both the revenues and the margins in a printer manufacturer's ink sales. Hewlett-Packard has responded by adding a very simple bit of connectivity to one of its printer models. The printer can detect when its toner is low and can initiate a just-in-time order for a new cartridge. By adding this simple new function to its machines, HP has reclaimed ownership of a high-profit transaction in which it had suffered encroachment.

But maintenance is only one activity to consider; the life cycle of a product has many pockets of value. In their HBR article "Go Downstream: The New Profit Imperative in Manufacturing" (September–October 1999), Richard Wise and Peter Baumgartner analyzed the difference between a product's value at purchase and its value throughout its life cycle, for a variety of industrial assets. They found, for instance, that a buyer of a locomotive engine ends up spending 21 times its purchase value to support its use. Our own research suggests that any asset that costs more than ten times its purchase value to use is a clear candidate for networking. At that level, almost anything a company does to learn about the product and its continual use will offer opportunities for the business to enhance its profitability.

Checking Out Adjacencies.

Having outlined the customer's activities in the life cycle of your product, you'll want to take a second look, this time studying the adjacencies. What else is the customer close to or in contact with when performing each of these activities? And what other activities precede and follow this set of activities? Sometimes, even when an opportunity is not directly connected to a product, the product can serve as a gateway to it. Nearly all digital cameras, for instance, need some form of connectivity to a computer, where the photos are viewed, sorted, edited, and stored. Kodak has responded to this adjacent opportunity by closely integrating its digital camera technologies with widely available PC software and Web applications so it can follow those activities and go beyond them. The company has also partnered with specialty service providers such as Target and Walgreens that produce quality prints of the photos.

Getting Perspective on the Whole Opportunity.

So far, we've been discussing how to look for opportunities, but, to be precise, we're actually talking about how to look for elements of an overall business opportunity. A manufacturer might find that adding connectivity to an MRI scanner, for instance, will help it in several ways. The connectivity might enable the just-in-time ordering of replenishable materials. It might alert the product maker to maintenance needs and so allow it to lock in service contracts with customers. It might allow the manufacturer to perform machine calibration and validation, functions previously handled by hospital personnel, for which it can now receive separate compensation. Each of these services is an opportunity in itself; together, they form an overall business opportunity.

Four Flavors of Success

HP and Kodak both found business opportunities by looking at their product life cycles and examining the adjacent activities related to their products' primary activities. In HP's case, a single product (a printer) made by a single company (HP) was the sole gateway to the business opportunity. In Kodak's case, the company tapped a business opportunity in which it supplies the products (digital cameras) but also relies on partners to supply their expertise in user interfaces and photo processing.

As you look at the opportunities available to your company, there are, likewise, two possibilities. It may be that most of the elements of the opportunity are attached directly to your product's life cycle, so you'll be able to pursue the opportunity alone. Or it may be that the opportunity lies mainly in the adjacencies, so you will have to partner with others. The direction you take will help determine the kind of business model you should adopt after connecting your product. If you go it alone, it may be as what we call an "embedded innovator" or, more ambitiously, as a "solutionist." If you partner with others, it may be as an "aggregator" or as a "synergist." These are the four basic business models available to product makers that decide to embrace smart services. Let's look at each in turn.

The Embedded Innovator.

The embedded innovator is the most product-centric of the models. Customers may still perceive the physical product as the source of primary value, and they will expect to continue receiving the support services they have in the past (installation, warranties, maintenance contracts, and so on). Historically, manufacturers have bundled such services with their products to make sales. Thus, embedded innovators that decide to add connectivity to their products may have a hard time levying additional charges in relationships where everything was previously included.

Because the embedded innovator has built intelligence and communications into its products, however, these goods become the company's inanimate silent partners. The near-perfect visibility of products that can be remotely monitored greatly optimizes the delivery of services, eliminates waste and inefficiency, and raises service margins. Thus, it is largely in these areas that companies achieve ROI on their device-networking investments. (Think PepsiCo's returns on its vending machines and fountain systems, and Emerson Electric's returns on its backup network power systems.) But it doesn't have to end there. The embedded innovator can also add new value to its products that could not have been achieved without networking—for instance, allowing customers to automatically upgrade their products by means of software downloads. Heidelberg is a good example of a successful embedded innovator.

The Solutionist.

In the solutionist business model, a single product is still the dominant gateway to a business opportunity, but the scope of high-value activities associated with the product is broader. Think, for example, of all the activities associated with the life cycle of an MRI scanner:

1. Determining requirements and whether having a scanner is justified
2. Financing the scanner
3. Installing the scanner
4. Testing, calibrating, and validating the scanner
5. Maintaining and replacing parts
6. Replenishing materials (gases and imaging media)
7. Training personnel to use the scanner
8. Determining a patient's need for a scan (preliminary diagnosis)
9. Preparing the patient for a scan
10. Scanning the patient
11. Interpreting the scan
12. Updating the software
13. Upgrading the hardware

Because of the high value, complexity, and cost of MRI scanning, nearly all of these activities represent an opportunity for a scanner manufacturer. (Activities 8, 9, 10, and 11 are primarily medical matters and thus cannot be the province of a manufacturer—but that still leaves nine activities that are economic opportunities for scanner makers.) This is precisely the situation GE Healthcare has stepped into, positioning itself as a complete solution provider, or a solutionist.

Along similar lines, consider Honeywell, which makes (among other things) control and automation systems for petroleum refining. Recognizing that the start-up of a new refinery to process petroleum represents a fraction of the total expense associated with maintaining and optimizing the facility, Honeywell developed a new mode of customer service called Experion Process Knowledge System (PKS). PKS is a collection of embedded-intelligence technologies deployed at a customer's refinery and controlled and monitored remotely. The system performs a variety of manufacturing equipment support and optimization tasks formerly handled exclusively by maintenance personnel.

PKS customers typically experience fewer false alarms indicating that a process is in danger of failing, less unanticipated downtime, and lower maintenance costs. They can work with Honeywell to access knowledge related to their systems and equipment performance. The clear value of the program has allowed Honeywell to charge a premium for the system, and, in many cases, the company has been able to increase the scope of services and value it provides its customers.

📖 How Smart Do You Want Your Products to Be? (Located at the end of this article)

Again, the difference in the opportunities facing an embedded innovator and a solutionist is the breadth of *high-value* activities associated with their products. So, between HP's printers and GE Healthcare's MRI scanners, there is a world of difference in the scope of services that could be offered with or through the connected device. In HP's case, the change in business model has been incremental; the company has remained a manufacturer of printers and toner cartridges and has made money by selling these things. Connectivity simply gives it a lock on the toner sales, which is where the profits are. By contrast, GE Healthcare's new business model is far from that of a simple maker and seller of products. The connected scanner opens up many service opportunities, and to tap these, GE has built a large, well-tooled, complex service infrastructure. What both companies have in common is that they've found and tapped business opportunities dominated by their own devices. Neither organization has been very dependent on

partnerships (although they could use them, and GE certainly does).

The Aggregator.

The two remaining business models are those in which the business opportunity cannot be tapped by a single device and a single vendor. There are situations in which a device may collect data, but the information, in and of itself, may not be valuable enough to create an opportunity. Instead, several disparate devices may work within an environment, and only by connecting all or most of them can a company create a high-value body of data. An extreme example of this is a simple table lamp. It can be enabled to sense and communicate information such as when it is on and when it is off, the wattage flowing through it, and perhaps even the age of the bulb or bulbs it is burning. Of course, none of these data, on their own, are likely to be of high economic worth. If the lamp burns a 100-watt bulb constantly in an empty room, the money being spent on the wasted electricity will hardly break most families. But the sum of all wasted electricity is worth a home owner's attention, and so an application that collects and deploys all those data may be of enough value to represent an economic opportunity for a manufacturer. And there may be further value in building remote-control options into the lamp and other devices.

In the case of a system that gathers and processes data from multiple devices, your product may play one of two roles: It can be central or peripheral. The hub or a spoke. The brains of the operation or just a body part. This last variable defines our third and fourth business models. When such a system is required in order to define and tap an opportunity, then there will be an aggregator, which controls the application's actual data collection and central-processing power; and there will be synergists, whose devices contribute valuable data or functions that are controlled by the application.

Aggregator businesses we've studied include Eaton Electrical, Gardner Denver, Electrolux, and Rockwell Automation; they all provide remote monitoring and related Web-based services across channel, alliance, and customer-fulfillment networks. In other words, these companies bring their "secret weapon" to bear on all their business relationships, not just on their relationships with customers.

Aggregators are still primarily product companies and don't vertically integrate all aspects of their product life-cycle management. For example, they tend not to be involved in product recycling or disposal. Instead, they sell interested third parties smart-information services—or access to the data collected from networked devices—either for a fee or for a share of earnings. Where aggregators do choose to deliver services directly to the customer, they now own that relationship as never before, with distinct barriers to competition. Aggregators cannot be cut out of the services loop by competitors or channel partners because their possession of device-generated data allows them to offer services more intelligently and profitably than entities that cannot see into the status of the products in question.

Aggregators will make larger investments in data warehousing and data mining than will embedded innovators, and they will achieve some of their ROI by providing smart services to their distributor and system-integrator partners. For example, a large percentage of installed uninterruptible power supply (UPS) devices contain dead batteries. Unfortunately, users discover this only when these devices fail to work during a power outage. In the embedded innovator model, a networked UPS device could initiate its own order for a battery replacement from the vendor—in itself, a smart service. But imagine how an aggregator could build on that opportunity. Eaton Electrical (a global leader in circuit breaker technology), for instance, is bringing something called Home Heartbeat, a home monitoring system, to the consumer market. Eaton has partnered with companies that sell power-quality devices, such as fire alarms, backup generators, and the UPS devices mentioned previously. Eaton has even partnered with insurance companies, which would gladly offer Eaton's customers incentives for deploying verifiable battery replacements in their connected devices. (See the sidebar "Out of the Basement.")

 Out of the Basement (Located at the end of this article)

Illinois-based Gardner Denver has a similarly expansive vision of how it might aggregate information from many sources to serve buyers of its air compressors. Compressed air is used in all kinds of industrial processes; some 350,000 systems are in place in the United States, covering 97% of manufacturing plants. As a first step toward intelligent device management, Gardner Denver has enabled its equipment to monitor and communicate the wear and tear on "expendables" in plant equipment, such as piston rods and cylinder liners. As a result, customers can buy subscriptions from the company and can receive performance trend information and preemptive maintenance service. But while Gardner Denver makes the compressors, any application of compressed air calls for a total system that includes components such as air coolers, filters, and dryers. Once Gardner Denver's devices are in place for its own and its customers' benefit, it's a short step to providing other manufacturers and distributors with data that could inform their pieces of the system. The opportunity is especially appealing to a manufacturer like Gardner Denver, which is not the biggest in its industry and must sell through channels that are hardly captive to it. If it can use networked devices to tie customers, distributors, and other support elements into a closed-loop, asset management system, it can participate in the highest-value deals instead of being cut out of them. That's the beauty of being an aggregator.

The Synergist.

It is possible to succeed in the age of smart services simply by providing intelligent devices that play well with others. When you set out to create a product that can contribute valuable data or functionality to other connected products, you are pursuing a synergist model.

Consider the Dutch electronics manufacturer Philips, which specializes in lighting ballasts and controls. The company believes there could be a huge opportunity for value creation if complementary manufacturers in building-systems equipment could share their data. That is, if data could be collected from all the electrical devices in a commercial facility, the aggregated information could then be used to create extraordinary levels of customer service. So Philips is helping to build a community of several parallel players in the commercial building-management arena in order to leverage all the valuable data about usage patterns, potential energy savings, and the like. Central to this community's plan is an agreement to go with the ZigBee open standard for wireless connectivity. Through its participation in the ZigBee Alliance, a group formed to further the ZigBee standard, Philips has been pursuing a synergist model with several important global partners.

Your Worst Enemy

What will stand in your way as you try to move forward in one of these business models? It would be irresponsible for us to minimize the technology hurdles you'll face. Automated information gathering can easily generate trillions of data points every day for a typical product manufacturer. Each of these data points may be very tiny (the torque, pressure, or temperature of a specific component or the physical location of a product), but they must all be validated and stored and then subjected to the sophisticated techniques (data smoothing, data mining) that turn them into intelligence that can be acted upon. Clearly, such intense data processing cannot simply be thrown at today's average corporate IT infrastructure or application suite. For example, companies pursuing RFID-tagging initiatives will need organizationwide data standards and new middleware to synchronize the data from disparate sources into compatible formats.

Still, it's safe to say that IT infrastructure is not the biggest obstacle for most companies. Much harder to overcome is the product-centric mind-set of most senior management teams, along with the P&L structure that perpetuates that philosophy. Manufacturing remains the basic building block of the P&L for most product companies, and the cost structure of a product business raises all kinds of barriers to service-oriented investments. Across virtually every industry, dozens of examples of intelligent device management have sprouted up as technical or functional initiatives—in R&D, in supply chain applications, or in customer support, for instance. These initiatives hit a ceiling, though, when the expense of implementing them became hard to justify. Often, a smart services initiative will benefit each functional area to varying degrees—either in the scope of advantages gained or in the time needed to realize advantages—making it hard to get everyone to agree that the initiative makes sense and should be considered a financial priority. The frustration in organizations is immense, as middle managers who believe in the potential of smart service try to elevate the topic to a strategic level.

Senior management, one middle manager told us, “kind of gets it, and kind of doesn't.” We've seen this for ourselves. A different manager invited us to his company for a presentation on the need to invest aggressively in remote services. The ranking executive in the room had a predictable response to the proposal: “As soon as you lose the line of sight between the product P&L and the plan, you lose control of the business.”

What seems to be missing is a good script that communicates the opportunity to senior management in a compelling way. Our research regarding smart services is our contribution to creating that script—and it may find an audience in a competitive context that increasingly focuses managers' minds on the need to grow organically and to do so by selling service. If not, we expect the script ultimately to be handed to business leaders by equities analysts. When they start asking questions such as “Are the assets you sell to customers networked?” and placing the companies that say yes in a distinct group in terms of potential future performance, interest in the topic will undoubtedly boom.



Companies such as GE, Heidelberg, Air Products, and others we've discussed have undergone what we like to call the “ubiquity shift.” They've perceived that once intelligent devices become ubiquitous—as they will—the commercial context will change, and they've realigned their strategies to capitalize on that new reality. Meanwhile, most product-centric companies remain at least a full step behind in their thinking. They know that their best hopes for growth lie in increasing the services component of their businesses, but they are focusing on the same kinds of services that have always surrounded their products. Their plan is to capture the adjacent service markets currently owned by other companies and persuade customers to pay for the (marginally enhanced) services they used to provide gratis. In other words, they are moving aggressively to implement—by about 2010—a 1990s “dumb services” strategy and are in serious danger of destroying value rather than creating it.

Making the ubiquity shift is challenging, but it starts with a simple insight: A device that can report back to its maker on its status and usage represents the foundation for much richer and longer-term customer relationships. From that straightforward proposition spring the four new business models we've outlined. For any given company, it may make the most sense to be an embedded innovator, a solutionist, an aggregator, or a synergist. But woe to the company that takes none of these paths; it will soon find its best customers locked in—and happily—to other smart service providers.

What a Connected Device Can Do

Most companies still view their electronic and electromechanical products as stand-alone objects, not things that could or should be connected. But it's the networking and management of these devices that will generate the intelligence businesses need to deliver smart services. Connected products will be able to perform the following functions:

- **Status.** Status applications capture and report on the operation, performance, and usage of a given device or the environment being monitored.
- **Diagnostics.** Diagnostic applications enable a device to self-optimize or allow a service person to monitor, troubleshoot, repair, and maintain devices.
- **Upgrades.** Upgrade applications augment the performance of a given device. They prevent problems with version control, technology obsolescence, and device failure.
- **Control and Automation.** Control and automation applications coordinate the sequenced activity of several devices. They can also cause devices to perform one-off, discrete actions.
- **Profiling and Behavior Tracking.** Profiling and behavior-tracking applications monitor variations in the location, culture, performance, usage, and sales of a device. These applications can create more customized or predictive responses for end users.

- **Replenishment and Commerce.**

Replenishment and commerce applications monitor consumption of a device and buying patterns of the end user. These applications can initiate purchase orders or other transactions when replenishment is needed.

- **Location Mapping and Logistics.**

Location mapping and logistics applications track and optimize the service support system for a device. These applications also support supply chain and sales activities.

The Product Life Cycle from a Customer's Perspective

One company we worked with identified the following activities involved in owning and using one of its products. The question then became, "Which of these activities represent opportunities?"

- Determining requirements and justifying purchase of the product
- Finding a product supplier
- Financing the purchase
- Installing the product
- Modifying other products or processes to work with the product
- Adapting the product to its environment or to a specific use
- Maintaining the product and replacing parts
- Replenishing materials (for instance, paper and toner for a copier)
- Training personnel to use the product
- Using the product
- Upgrading the product
- Disposing of product waste
- Disposing of the product

How Smart Do You Want Your Products to Be?

Obviously, not all devices and subsystems need to be networked. Consider, for example, the difference in value between networking a refrigerator in a small office and networking a refrigeration system in a grocery store, where failure would have much greater consequences. In the latter case, a one-night shutdown could cost the store a year's profits, so the up-front cost of networking is an obvious investment. The decision to network a product will depend largely on how that product will be used and the potential role it can play in a larger system.

In general, a device is *not* a candidate for networking if it:

- Is not mechanical or electromechanical
- Is very simple or inexpensive and thus not worth the initial investment of networking
- Has no important information to share
- Has no available or reliable network access
- Has a very brief or very long (15-year-plus) life span

The benefits of networking depend on the context, but there are some important issues to consider when deciding what to network:

- **The Impact of a Device Failure.**

Not every failure is catastro-phic. If a keyboard breaks in a food-processing plant, production won't stop. The failure will be confined to one specific computer, and the keyboard can be easily and cheaply replaced. But if the plant's power system suddenly stops working, the end result could be vast amounts of wasted products and employee time.

- **The Value of Device Information.**

A scanner at a department store is a good candidate for networking because the data it collects can inform many decisions related to customers' buying behaviors. Connectivity will deepen the manufacturer's insight into purchasing patterns, inventory, procurement, and product or store designs.

- **The Impact of Networking.**

If technicians know in advance that the HVAC system in a commercial office building may break down (because the connectivity they've built into the system allows the equipment to be continually monitored), they can diagnose and repair the problem before tenants notice any issues. They can eliminate the downtime and the expense of evacuating the building.

- **The Cost and Ease of Connectivity.**

Most companies can comfortably justify buildingwide networking or device enablement because they can amortize the expense across multiple departments and products. By contrast, the initial costs and complications of creating a home network are prohibitive for most households.

- **The Device Turnover Rate.**

If you add connectivity to a device with a life span of more than 15 years, you will probably create a technology obsolescence problem—even if the device is designed so it can be updated remotely via software downloads and so on. Meanwhile, a device with a very short life span might be networked only for its content or commerce opportunities rather than for its performance or maintenance considerations, potentially making the ROI harder to achieve.

- **The Service Needs.**

If a vending machine could notify its owner when it needed to be restocked or repaired, the company could use employees much more efficiently and save a significant amount of money by eliminating unnecessary site visits.

- **The Importance of Information.**

Medical devices that need to transmit vital health information quickly to a variety of people and locations are excellent candidates for networking. The ability to simultaneously inform technicians, specialists, primary care physicians, and the patient is extremely valuable.

- **The Location of the Device.**

Certain devices and systems are harder to maintain than others simply because of their location. If a motor in an offshore oil rig could remotely inform the owners of its health and performance, complicated and unnecessary service visits would be a thing of the past.

Out of the Basement

If you take only one message away from Eaton Electrical's Home Heartbeat initiative, it should be that successful product-centric businesses are rapidly transitioning to smart services. The story is all the more interesting because it goes beyond the business-to-business realm, bringing the benefits of machine-to-machine communication to home owners.

Cleveland-based Eaton started out in 1911 making axles and other truck parts and later diversified into other engineered components, including residential circuit breakers. As the end of its first century in business approached, it found itself in very mature businesses fighting with established competitors over every point of market share. That's when a few visionary managers within the electrical products division started to think about device connectivity and the broader solutions it could offer consumers.

The system they envisioned, recently launched as Home Heartbeat, monitors the status of a home and alerts the home owner when something is amiss. To do this, it uses water sensors, open/closed sensors, and power sensors, which communicate to a base station over a wireless network. That base station communicates with a key fob device carried by the home owner. The system can also be instructed to send an e-mail or text message to a cell phone if there is a change in the state of a sensor.

Pause for a moment to consider how useful this would be. You're sitting on the train to work, and it occurs to you that a space heater might have been left on. You can check your key fob to be reassured instead of having to turn back. (The key fob device works only within a certain range of distance but does capture data about the status of your home as you left it.) Home Heartbeat features a water shut-off valve that can be automatically activated by sensors. So if you're on vacation, and you hear about a cold snap, power outages, and burst pipes back home, you can check your e-mail; in the meantime, you can be confident that if the water needed to be shut off, it was.

Home Heartbeat is a good example of smart service innovation: Eaton built awareness and connectivity into the devices it was already selling and, in this way, was able to position itself not just as a product vendor but also as a service provider. No longer consigned to an obscure corner of the basement, the Eaton brand now stands for total home awareness. And the company is now in the role of aggregator, courting an entirely new range of partners, from wireless carriers to insurance companies.