CHAPTER 3

Polymath Profile #1: General Electric

General Electric (GE) is a polymath when it comes to industry coverage. Its products include aircraft engines, power generation, water processing, security technology, medical imaging, business and consumer financing, media content, and countless others. It has customers in more than 100 countries and it employs more than 300,000 people worldwide.

GE stays young through innovation. Indeed, it is the oldest remaining company in the Dow Jones Industrial Average. In 2008, GE ranked number four on *BusinessWeek*'s "World's Most Innovative Companies" list for the second year in a row. It was included in the 2008 and 2007 Dow Jones Sustainability Index.

In this profile, we look at four aspects of GE innovation:

1. GE Global Research
2. Its corporate IT
3. R&D at one of its business units
4. IT at one of its business units

GE Global Research

The Last of the Mohicans—the James Fenimore Cooper classic set in 1757—the movies it spawned, and the critical discussion it encouraged paint a vivid picture of the birthing motions of a New World.

In the valley in Niskayuna, New York, where the Mohicans, the Mohawk, and the Huron roamed and schemed with the Dutch, the French, and the English, a new tribe has emerged at GE Global Research. There are no scalps to show off these days, but there are plenty of patents, Nobel Prizes, and other recognitions. The 1,700 technologists, a majority of them PhDs in a variety of science and engineering disciplines, are at

the crossroads of a New World. It is a world of grand challenges laid out by the National Academy of Engineering and the United Nations Millennium Development Goals. These are goals that call for new medicine, new energy, and new algorithms.

GE Business Units take a challenge and weave it into their mission statements. The big market opportunity for the water business is to go from "scarcity threatening" to "abundant and cleaner sources"; for aviation and transportation, it is to go from "steady progress" to "breakthroughs in efficiency, emissions, and noise."

Jeff Immelt, the CEO of GE, is a modern-day polymath. He has to be to run a company with such a wide portfolio of products and geographic locations. He is, additionally, an ambassador who knows most world leaders on a first-name basis. He is also a salesman who has met every major CEO around the world. At the core, though, he is a geek. The helipad at GE Global Research, a short flight from corporate headquarters in Fairfield, Connecticut, is a favorite destination.

His predecessor, Jack Welch, earned the nickname "Neutron Jack" for his focus on efficiency; Immelt will likely go down in history as "Proton Jeff," as he encourages positive vibes toward all kinds of technology. GE Global Research is organized into 10 technology competencies: energy and propulsion, chemical technologies and materials characterization, material systems, biosciences, power conversion systems, electronic systems and controls, computing/decision sciences, imaging, micro and nano structures, and ceramics and metallurgy.

GE Global Research, of course, was born long before Immelt became CEO. This is, after all, the company that Thomas Edison started. (The GE Global Research blog is called Edison's Desk. The antique desk itself is still on display in the main lobby at Niskayuna. So are pictures of the most prolific GE scientists—members of the exclusive club must have 25 patents or more.)

Immelt is gradually and indelibly leaving his mark on the company with a refocus on complex, industrial technologies. In his annual letter to shareholders in 2009, he wrote: "I believe that a popular, thirty-year notion that the U.S. can evolve from being a technology and manufacturing leader to a service leader is just wrong."[1]

So, Immelt's tribe is marching to a different tune as the company diversifies from its finance operations after the recent market turmoil and as it sells a majority interest in NBC Universal to the cable operator Comcast.

Not that these PhDs just write esoteric papers or wear tweed jackets. They have Immelt's DNA. They are the company's ambassadors to the 14,000-plus visitors who annually visit the 550-acre campus: customers, collaborators, chiefs of state, and even curious media folk willing to look beyond the latest mobile device or social network for innovation.

They are a secret weapon of the sales team—they help close deals. A cynical prospect wondering what a health care presentation during his visit had to do with his interest in telematics finally had his "aha" moment: "Jeez, if they can track proteins which attach themselves to cancer cells, I am reasonably sure they can track the trucks in our supply chain."

Edison once said: "I find my greatest pleasure, and so my reward, in the work that precedes what the world calls success."

To make sure the technologists are focused on delivering usable technology that helps GE businesses grow, not just their pet projects, GE has honed a series of tools and methods.

Broadly, we can classify them into five categories:

1. Core innovation processes
2. Adjacencies and game changers
3. "Compounds" and collaborations
4. Global extensions
5. "Serendipities"

Core Innovation Processes

Not surprisingly, an organization with a long history of innovation has core processes in place. Roland Sedziol explains some of them. He is "Business Program Manager, Transportation"—that translates to his being the Global Research interface to GE's locomotive and other transportation businesses.

Sedziol starts with funding:

> *Global Research funding is roughly 55% from businesses, 25% from corporate, and 20% from outside sources. The 55% keeps us focused on business needs, the 25% allows us to think longer term and not just on the short-term business focus. The 20% is to make sure we collaborate with governments, universities and other business partners to advance technology for the benefit of many.*
>
> *Global Research funding by itself is only $550 million out of the total GE R&D annual budget of $4.3 billion. So, there is plenty of shorter-term product, industry-centric development also happening at the businesses. And of course, we need governance to make sure GE Global Research focuses on the R in R&D, and the businesses the D. There are surprisingly few turf battles.*

Patrick Jarvis, communications and public affairs manager at GE Global Research, expands on the lack of turf battles: "At Global Research, we don't focus on building a new aircraft engine. We work on new alloys and

combustion technologies for the engine. We don't focus on a new scanner but on new materials for the scintillator."

Sedziol's presence at GE Global Research—like those of peers who interface with other business units—is a statement in itself. There are plenty of tours of duty from the business to GE Global Research. The year-round planning and budgeting processes are anchored around such concepts as the "Growth Playbook Process" and "Imagination Breakthroughs," which are part of the GE vernacular. There are the famous "Session T" formats, where business marketing and Global Research technology teams come together. There are internal "vendor fairs," similar to going to a technology conference and having vendors display their products in booths.

One of the competencies GE has honed is what Sedziol calls "traversing the Valley of Death." It happens all the time, where R&D hands off a product but a business cannot find a market for it or cannot grow it to sufficient manufacturing scale. According to Sedziol, deciding when to continue funding and when to pull the plug is an art form.

Art form is not good enough, though, so at the Pilot Development Center at the edge of GE Global Research campus, Paul Myers and Jonathan Janssen, both mechanical engineers, talk about the GE Manufacturing Readiness Levels methodology. It is an adaptation of the Technology Readiness Level maturity model the U.S. Department of Defense has been propagating. Says Myers: "Stages 1 to 2 deal with concept development, stages 8 to 9 with scaling of production. Stages 3 through 7 relate to prototypes and proof-of-concepts—where many new products typically fail. For each stage, we have maturity measures for components, packaging, etc., that make up the solution."

In the nondescript 10,000-square-foot Pilot Development Center facility, they test the maturing of a manufacturing process for flexible organic LEDs (OLEDs). The concept involves using printing-press-type concepts to mass-produce sheets of the next-generation lighting. The flexible OLEDs will soon become part of home furnishings and garments. Myers salivates at the thought of a similar facility 10 times its size being planned for an Advanced Manufacturing Center in Michigan to test out even more complex processes.

Sedziol, in the meantime, talks about GE Global Research "entrepreneurs" and other ways in which innovation flows:

> *We encourage our technologists to come in and ask for seed investments for ideas they are passionate about. Ideas flow in every direction.*
>
> *At the base level we have plenty of "core improvements" to existing products like the electronic fuel engine injection for locomotives and the GEnx aircraft engine, which improves fuel efficiency by 15% and reduces emissions by 50%.*

Adjacencies and Game Changers

GE has also become better over time at extensions into new markets and disruptive leapfrogs. Sedziol continues: "'Adjacencies' are new markets for innovations to the core, like a new gearbox for locomotives which we found an application for in mining. And across all our business units, we have been increasingly getting into services of all kinds."

The services are not run-of-the-mill—they generally involve complex intellectual property. The Booz & Co. *Strategy+Business* journal describes how GE reengineered the sales and support of one of its line of turbines:

> *It developed a proprietary remote monitoring and calibration system that did away with the need to dispatch technicians. But retaining ownership of the remote tuning technology and simply deploying it as-a-service enhancement was not a high-value solution either. It devised an entirely new business model for its remote technology, one that leased it to customers while simultaneously licensing to them the associated IP and service procedures. One utility, Florida Power & Light, saved more than $18 million within just the first few weeks of the new agreement. Over the last three years, this strategy has enabled GE to generate $300 million in new, high-margin revenue.*[2]

Sedziol continues: "Then there are 'game changers,' like a hybrid locomotive to reduce dependence on diesel fuel."

Jarvis points to game changers in other GE areas: "Our integrated gasification combined cycle system converts coal into a cleaner burning fuel. Our Economic Simplified Boiling Water Reactor makes nuclear energy safer. We are looking to harness the power of pulse detonation of fuel and the resulting pressure increase—more efficient than combustion engines."

The hybrid locomotive concept, in turn, drove an investment in next-generation batteries. Across the campus, Glen Merfield, manager of the Chemical Energy Systems Lab, and with a PhD in chemical engineering, shows off a square-inch, 10-inch-long sodium-nickel cell, with a beta-alumina conductor optimized for sodium ions:

> *Twenty batteries, each with 500 of these cells, could power a locomotive. The cells can be packaged in smaller batches for other applications such as supporting telecom towers or backup energy for data centers. The core—basically salt—is pretty cheap to produce. They do not have leaking issues like today's lead acid batteries do and each cell is independent—so individual failures do not degrade the whole battery.*
>
> *GE is building a manufacturing facility to come on-line in 2011 with a capacity of 10 million of those cells. Through an investment in A123 systems, we also continue to advance the technology in lithium-ion batteries more common for smaller devices.*

GE has not been that focused on infotech markets, but Dr. Joseph Salvo, director at the Telematics group at Global Research has been talking about the "end of the Information Age." When it comes to sensory networks, he believes that "while the 20th century was the era of 'commoditization' of most physical assets, the 21st will change the perceived value of pure data in all its forms—because having data is far less important than connecting it."[3]

So instead of storing data at multiple locations, connect to it and access it only as needed. That could be a game changer.

Of course, the reality is that in other areas, storage is likely to explode. Indeed, the digital pathological image discussed below is 18 gigabytes (GB) in size. That opens up an opportunity for a holographic disc GE has developed, which can hold up to 500 GB of data—the equivalent of 100 DVDs. Blu-ray discs today go up to 50 GB. The big challenge was to find a way to allow these holograms to reflect enough light. GE achieved a quantum increase in the reflective power, which allows the new discs to be readable by current or slightly modified Blu-ray players. GE expects the cost to be around 10 cents a GB and is working on a format that would hold up to 1 terabyte. This size would be enough for many household and small businesses not to need external storage for archiving needs. Additionally, in previous generations of discs, the plastic acted as an inert carrier for the data that sits in a thin layer of metal, such as aluminum; in the new GE version, the plastic becomes the storage medium itself. The all-plastic disc could last a century. That could change long-term archival markets, where today's magnetic tape is good for only up to 20 years. That could be a game changer for the storage market.

There is a sidebar to the disc story, as is so common when discussing anything at Global Research. GE's interest in discs originally related to its GE Plastics division, which has since been sold to SABIC, a Saudi chemical company. GE often keeps rights to promising technologies and nurtures them even after it exits a business.

"Compounds" and Collaboration

In recent years, one of the biggest changes has been the evolution of "compound" solutions that leverage innovation, polymath fashion, across many technology disciplines.

Over the 2009 holiday season, the Global Research Web site displayed a new sleigh for Santa using a wide range of its innovations:

- Hydrophobic coating to keep ice off the sleigh
- Self-powered OLED lighting to help guide Santa
- Ultralight and durable sleigh blades made from ceramic composites

- Sleigh frame made from carbon composites
- Sodium batteries to store energy
- Cruise control via the Trip Optimizer
- Wearable radio-frequency identification sensor to check airborne particles and warn if the milk and cookies left out have gone bad
- The 500 GB holographic disc to hold the entire list of gifts he is carrying
- Wireless medical sensor to track Santa's heartbeat
- Asset Intelligence Tracking tech so his elves can keep track of Santa's whereabouts

While that was in fun, such compounds are increasingly common in GE products. Sedziol points to one compound—the Trip Optimizer for the locomotive:

> *It leverages concepts from multiple businesses like telematics—sensors and GPS—and advanced software algorithms to optimize performance on locomotives. It is "cruise control" for the locomotive—smoothes out the typical start and stop and slowdown common with a human operator. It is far more sophisticated, of course, and can optimize the velocity based on time, fuel efficiency and other constraints.*

Jarvis points to another:

> *Engineers from the Imaging Technologies group were looking at a system that would allow someone to see into the near infrared. At the same time, biologists in our Biosciences organization, who had joined Global Research following the GE acquisition of Amersham Biosciences, were working with imaging agents that had the potential to fluoresce in the near infrared. The two groups connected and the optical imaging program was born. The biologists immediately saw the opportunity to design agents to be used in a surgical setting, letting doctors see into the body like never before. Last year, the team transitioned an imaging agent to GE's Healthcare business that can identify tumor margins. These agents will one day allow surgeons to improve patient outcomes for cancer surgery.*

Jarvis also points to growing collaboration with other enterprises:

> *A decade ago, the GRC campus was pretty secretive and not that open to many outside visitors. Today, we are working with Eli Lilly on cancer diagnostics and therapies, with Schlumberger on carbon sequestering, Chevron on subsea electrification, Konica Minolta on organic LEDs, and many more.*

We do joint research with leading universities like MIT and UC Berkeley. Our Munich location is on the campus of the Technische Universtät Müncben. We are working with government research groups like the National Institute of Health. We are constantly talking to VCs [venture capitalists] about collaboration with their portfolio companies.

An example of such collaboration is Omnyx, a joint venture of GE Healthcare and University of Pittsburgh Medical Center.

Robert Filkins is an electrical engineer by training, but he is showing off GE's digital pathology product. It digitizes the process that lab technicians use to look at tissue on the traditional format of a glass slide under a microscope. Filkins is using an Xbox controller to twist, turn, and magnify the image on a computer screen and explains that "Not only is it easy to store the digital results in an Electronic Medical Records database; it can be reviewed by peers halfway across the world if need be. It also cuts into expensive FedEx charges for sending those slides to labs."

Global Extensions

Software competencies such as those needed in the locomotive Trip Optimizer led GE to open its first international branch of Global Research in Bangalore, India, in 1999. Now with 400 technologists, it helps beyond software on research on applied fluids and electromagnetics. Later centers, such as one in Shanghai, China, with competency in water desalination, and another in Munich, Germany, with a focus on renewables, bring other unique specialties. Like Bangalore, though, they are leveraged across multiple areas. A fifth center is planned for Brazil. Satellite offices in Japan, Russia, and Israel draw on other local competencies.

These centers also position GE better for local opportunities as these markets grow rapidly. As we will discuss in Chapter 5, there is the opportunity for "trickle-up" innovation, as with the MAC 800 ECG, which was introduced in the United States after being designed (and priced) for Chinese and Indian markets.

Immelt was quoted saying, "Globalization is in its fourth stage. It started out importing high-end products from the United States to India, then turned to local joint ventures, followed by moves to build factories in China and India, its current focus. The next stage is designing technologies in India for the rest of the world."[4]

In 2009, the U.S. Congress saw the introduction of an immigration bill titled STAPLE (Stopping Trained in America PhDs from Leaving the Economy). It would fast-track the immigration process for foreign students doing their doctoral studies in technical sciences at U.S. institutions of higher education. Given the current U.S. mood on immigration, it will likely

meander for a while, but GE Global Research is the poster child for supporting the bill. Walk the halls of GE in Niskayuna and you see last names like Liu, Krishnan, and Potyrailo—talented immigrants from everywhere. The tradition of Charles Proteus Steinmetz, the founder of the original GE research lab and an immigrant from Germany, is alive and well.

"Serendipities"

GE Global Research has not been called the "Magic Factory" for nothing. There is a secret sauce that even a Six Sigma, documentation-intense organization cannot completely codify. Conversations in the cafeteria, in the hallways, and at the 40-room lodge attached to the center effortlessly drift from pathology to holography, from one "aha" to another.

The Global Research ethos is "Innovation occurs at the intersection of disciplines." So, put chemists, mathematicians, engineers of all stripes, and biologists in close proximity and who knows where the conversations will lead. It is a great setting for what the Kate Beckinsale character in the movie *Serendipity* calls "fortunate accidents."

Todd Alhart, a colleague of Jarvis's in Communications and Public Affairs, has a couple of examples:

> *GE had developed composites for aviation uses, now as we explore much longer wind turbine blades (increased from 40 to 55 meters) and increased yield (from 1.5 to 2.5 megawatt) the composites of carbon and fiberglass are delivering higher efficiency and lowering noise.*
>
> *The lotus leaf repels water and is self-cleaning. Our research on nano-hairs is showing up in hydrophobic [water-resistant] coatings to reduce wind turbine blade drag and antifreeze applications. It has significant safety and fuel efficiency implications.*

Biomimetics—a term Mark Little, senior vice president of GE Global Research, used in a presentation to financial analysts in 2006[5]—refers to the discipline of science mimicking nature, as in drawing innovative inspiration from the lotus leaf.

How many financial analysts would have heard that term? Hey, if you have communications folks like Alhart and Jarvis who are tech savvy, why should Wall Street analysts not keep up? Jarvis humbly jokes about it: "Our general assumption is when we walk into a room with all the PhDs, here we are the dumbest people in the room."

What keeps the technologists themselves humble and focused? The grand challenges. Two-thirds of the way through to 2015 the UN Millennium Development Goals are far from accomplished. That fact spurs the GE technologists. Also, let's face it, many of the technologies discussed in

this profile have been announced and showcased by GE for years as it commercializes them. Its PhDs are toiling away at plenty more in the labs that GE is not ready to discuss.

And then there is the short-term deliverable for the technologists: the 2010 model sleigh for Santa.

Let's now turn attention to how corporate IT at GE is innovating.

Corporate IT

"We have an initiative we call turning IT inside-out," says Mark Mastrianni, Manager, GE Global Technology Acquisition and Licensing. He is an attorney with a law degree from Syracuse who also studied Computer Science at Union College, legal economics at the London School of Economics and did an entrepreneurial stint prior to joining GE. As such, he has a broad charter at corporate IT in GE—he is into IT strategy, negotiations with technology suppliers, and even some marketing and licensing of GE-developed IT capabilities and technologies to third parties. Mastrianni continues, "It's about support of growing digital opportunities across our businesses—in software, systems integration, etc."

It would be easy to dismiss that statement as coming from yet another IT group struggling to transition from an internal cost center to an external, results-focused mentality. This is, however, a company whose sophistication in IT and other internal technology usage is typified by three industry episodes from the past decade:

- In 2000, a dot-com entrepreneur found a prime piece of real estate at an affordable price. Excited about the move into the facility, his attorney pointed out that the lessor wanted share warrants in his company. "Warrants? Is this a private equity firm?" the entrepreneur asked. No, but it was a unit of GE, which is savvy enough to understand the risks and potential upside from such warrants in a technology start-up.
- In 2003, a Siemens executive was both impressed and annoyed. As he visited several vendors on a due diligence trip to India, he noticed that he was not allowed to enter any GE-designated areas. Siemens competes with GE in many markets, and the executive took it as a good sign, since his company's interests would be similarly protected. He was bothered, though, with the number of GE units he saw at each vendor. His advisor explained: "GE has a mature global IT delivery program that is embedded in most of their units. Across all of GE, it gives them at least an annual $1 billion advantage over Siemens."
- In 2007, Genpact, the leading business process outsourcing (BPO) firm, went public after a decade of explosive growth, most as a captive unit of GE. Says a customer:

Pretty impressive that GE was so ahead of the curve. Back then (1997), few of us had even heard of BPO. We were trying to grapple with the basic concept of internal shared services, and our version of low cost was Florida or, at a stretch, Ireland. GE was thinking of consolidating all our shared services for even more scale. And applying Six Sigma concepts and doing it in Hungary, India, or China for even better process quality and economics.

As Mastrianni discusses various GE corporate IT initiatives, you can see how the company is innovating based on savvy understanding of global technology economics and astute leverage of licensing and intellectual property rights. It shows in two big areas: IT as a profit center and vertical opportunities.

IT as a "Profit Center"

Mastrianni talks about several GE projects, aimed first at internal needs but then getting ready to springboard to market through licensing arrangements with external technology vendors. They include:

- *SupportCentral.* This "professional networking platform," launched with former GE global CIO Gary Reiner's vision and support in 2000, has more than 50,000 communities with over 100,000 experts across almost 20,000 business process flows signed up to answer questions and manage information. It gets a mind-boggling 25 million hits a day in 20 languages from GE employees around the world. SupportCentral is the biggest business-focused social network you have never heard of in a market dominated by fawning media coverage of Facebook and Twitter. And with workflow, mashups, and connectivity to more than 2,000 enterprise systems, it has evolved to a "self-service cloud," helping people manage processes and projects and solve business problems.
- *Mobile application framework.* While the iPhone App Store has seen explosive growth—more than 175,000 active applications as of April 2010 and billions of downloads—the majority of the applications are aimed at consumers. GE has built a framework to allow it to rapidly develop business applications on BlackBerry and iPhone platforms.
- *Advanced collaboration lab.* Mastrianni says: "Team productivity—we have barely squeezed that lemon in terms of opportunities." GE has been leveraging telepresence, shared whiteboards, and other emerging technologies to enable widely dispersed teams to collaborate better in product design.
- *PR insight.* GE has made a multiyear investment in a platform to visually aggregate snapshots of the company's social media activity and

signals from Twitter, YouTube, blogs, and the like. PR insight gives GE business intelligence on external perceptions and market acceptance of a given campaign.

Go to Market with Vertical Technology Opportunities

Below, Mastrianni talks about a number of the technologies we heard about in the previous section on GE Global Research:

In sector after sector, we find that technology suppliers sometimes lack deep domain knowledge when it comes to vertical technology solutions. That has opened the door for GE Healthcare, GE Transportation and other units to become technology leaders in their markets. We are a multi-billion dollar software and technology company in our own right.

When we say aligning IT with business, it also means making these units smarter about what we have learned over the years in IT procurement and contracting. Part of my role is to coach these business units on the unique nuances of technology sales compensation, revenue recognition, IP issues, and other technology industry opportunities and challenges.

It also means IT getting close to businesses in other ways:

In our planned Michigan Advanced Manufacturing and Software Technology Center, we will have experts in software development, data architecture, networking, business intelligence, and program management—right next to those from next-generation manufacturing technologies in areas such as renewable energy, jet engines, gas turbines, and other high-technology products. In fact, it will be the only GE Center where every one of our many business units is represented and core IT skills will be right there with all of them.

Asked about GE's guiding technology acquisition principles, Mastrianni outlines a few, as described next.

Objectively Evaluate All Options: Buy, Build, Lease, Rent, Whatever

Many IT groups face an interesting dilemma. Their CFOs frown on any staff hiring—spend on contractors is far easier to get approved. It's the same thing with custom development versus a packaged software acquisition. Often, it is more convenient for IT to buy than to build new technology. That explains the 90 percent spend with outside vendors we talked about in Chapter 2.

Mastrianni has a refreshingly different perspective:

At GE, we are becoming really good at agile development methodologies. And we are pretty good at technology talent pool identification and sourcing around the world. So we are not afraid to build captive units that compete with what we also buy from external suppliers. Buy, build, rent—we are agnostic.

Clearly in the new business climate, conserving cash is key. So capex [capital expenditures] versus opex [operating expenditures] gets more scrutiny. But we go with whatever the business case justifies.

Often, a vendor decision has more to do with domain knowledge and time-to-market issues:

You think we would be market leaders in adopting the new trend of cloud computing. In some ways perhaps we are—for example, we have developed a portal to normalize the offerings across cloud infrastructure providers. That way each user does not have to make that supplier decision every time they need to provision new capacity.

We have one of the largest current deployments of Aravo—a supply chain management SaaS [Software-as-a-Service] software to help with our half a million indirect suppliers. It was a domain knowledge decision more than a SaaS decision. Same thing with a security SaaS offering. In many other business processes and IT areas, we have not made the shift to SaaS. It's got to make business sense.

Start-Ups Can Be Vibrant Sources of Innovation

While many companies have consolidated much of their IT spend with larger vendors (over 50 percent of technology and telecom spend is with the top 25 global vendors, as shown in Chapter 2), thousands of innovative vendors fight for scraps, and many are shut out of an opportunity at too many large IT shops. Mastrianni says:

We have always tried to keep an open mind about opportunities with start-ups and mid-caps—they can be a good a source of technology innovation. In fact, we have demanding due diligence standards before smaller suppliers can become part of the GE ecosystem. Our culture of root cause analysis and Six Sigma means we push our smaller suppliers as much as our larger ones. [Former CIO Gary Reiner also led their company-wide quality initiatives.] But most suppliers tell us we are

very constructive in our feedback and that their products grow with our enhancement requests.

Many suppliers use the GE experience to go on to bigger things. Talk to many GE and Infosys executives, and emotions flow about the Infosys decision in 1994 to exit a technology services relationship with GE. Risky as the decision was—GE accounted for a third of its revenues—Infosys did not want to reduce its rates any farther. It has not done too badly since—annual global revenues are now more than $5 billion, and the company was celebrated in the Thomas Friedman bestseller *The World Is Flat*. In turn, GE has gone on to find many newer vendors in India, Mexico, Eastern Europe, and China to diversify far beyond what Infosys would likely have provided it.

Mastrianni jokes about other benefits that sometimes accrue to smaller tech suppliers at GE:

From time to time after we have completed and implemented technologies with an emerging firm, they became an acquisition target. Perhaps coincidental, perhaps not. We signed a broad licensing deal with Mercury Interactive. HP eventually acquired them. We did a deal with Opsware. HP acquired them.

Both sides owe us broker fees!

Economics Are Not Just about Lowest Price per Unit

Over his career, Mastrianni has seen every conceivable trick in the technology vendor playbook. Although he finds some irritating, he looks at the bigger picture:

We value compelling economics, to be sure, but low prices have to be viewed against the filter of a framework of long-term procurement volumes, quality, service levels—and frankly, overall competitive advantage.

As companies search for innovation, few look at IT economics and licensing as a source. Mastrianni and GE provide compelling reasons to turn IT "inside out" for more innovation, for better alignment with core business growth, and for opportunities to monetize the value that IT brings to the business.

R&D at a Business Unit

In Chapter 12, we discuss how Silver Spring Networks is helping in the rollout of smart utility grids, how many German consumers today sell

surplus solar energy from their homes back to the grid, and other cleantech innovations.

In July 2009, the GE Consumer & Industrial business unit announced plans to make the Net Zero (as in annual energy bills) home a reality by 2015. The concept blends appliances it already offers with cleantech products it plans to introduce. The newer products include "small" wind products. GE has an investment in Southwest Windpower, which makes 3-kilowatt-rated Skystream turbines, ideal for homes. Other new products include the software that will be the "brains" of home energy management, hybrid home heaters, LED lighting, and next-generation batteries. As we saw earlier in this chapter, the Global Research Center has initiatives around many of those technologies in such products.

Figure 3.1 describes the components GE showcased.

Much will need to evolve between now and 2015. Will smart grids be available in many markets? Do we expect nighttime energy costs to be low enough to change consumption patterns? Will the economics of solar panels—which can cost as much as $10,000 per kilowatt to install—and wind turbines get much better with manufacturing scale and global

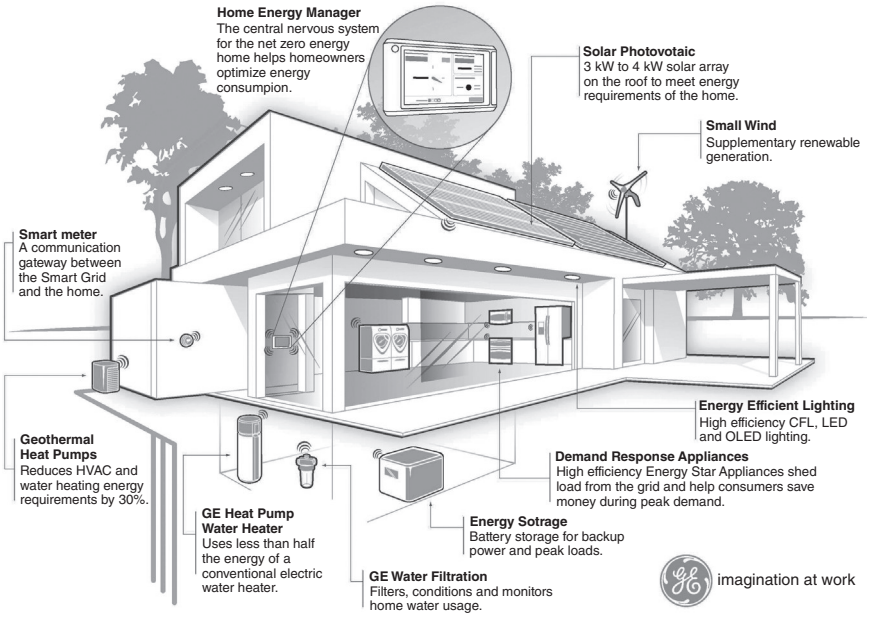

FIGURE 3.1 GE Targets Net Zero Homes by 2015
Source: GE.

competition? What tax credits will governments offer for home improvements around home cleantech? Will homeowners wait to replace current appliances at the end of their useful lives, or will they replace them earlier with smarter ones given proper incentives?

There are lots of questions, but it is interesting to see the polymath-style unified vision that GE has pulled together across its product lines.

Business Unit IT

Trying to implement an agile project with its emphasis on iterative design-development and minimal planning in the regulation-heavy health care industry sounds like an oxymoron, but GE's Healthcare (GEHC) division did just that successfully. Striving for constant improvement, the team used agile methods to reduce the project timeline by 25 percent while maintaining quality and scope. These techniques provide another perspective on how GE innovates.

In 2007, GEHC began an initiative to streamline its international sales and marketing processes through an improved customer relationship management (CRM) solution and seamless integration of the supporting processes. Chad Dodd, GEHC IT leader, Damon Auer of Tribridge, Inc., and Bob Glynn of Affinity Inc. led the program office. Auer and Glynn represented two boutique systems integration firms that assisted on the implementation. Using Tribridge and Affinity, even though the companies had little experience with GE and its rigorous implementation processes, was the first of many innovations for the project team, which ultimately paid off for GE.

The initial plan was to use a sequential "waterfall" implementation and testing methodology (common in many traditional IT projects) to develop, validate, and deploy a Siebel (now part of Oracle) solution to more than 2,500 users in a 36-month period. The methodology was deeply integrated into GEHC's quality processes and ensured compliance with Food and Drug Administration (FDA) regulations and quality standards. It was a good plan, but three months in, business needs changed. Now, the team was under pressure to deliver the same scope solution but in 25 percent less time. If the solution was not deployed in that shortened time frame, the business was at risk of losing millions of dollars. Due to this risk, the team began to rethink its implementation strategy and plan. Team members quickly came to the harsh realization that the waterfall methodology, while tried and tested, would never get them successfully across the goal line in time.

To meet this challenge, the team considered another innovative but risky suggestion: "Let's change gears and try an agile methodology."

Agile is a relatively new religion in software development that has grown over the last few years and emphasizes iterative design-development,

collaboration, process adaptability, and continuous improvement. The Manifesto for Agile Software Development emphasizes four elements by stating:

> *We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:*
>
> - *Individuals and interactions over processes and tools*
> - *Working software over comprehensive documentation*
> - *Customer collaboration over contract negotiation*
> - *Responding to change over following a plan*
>
> *That is, while there is value in the items on the right, we value the items on the left more.*[6]

Even though other GE units had experience with agile IT projects, the GEHC organization raised many questions and concerns—particularly the manifesto's deemphasis of processes and documentation.

Other questions came up:

- How do you execute an agile project while dependent on 26 other teams?
- How can you collaborate effectively when the team is located across seven countries and three continents?
- How does a custom development methodology such as agile work for a packaged application such as Siebel?
- In a short cycle, how can you document the design, test scripts, and test results with sufficient detail and traceability to satisfy FDA regulations?
- How does this methodology work with the current IT and documentation standards required within the waterfall methodology?
- How does this methodology affect the system integrators' fixed-fee contract?
- And what exactly are agile terms like "scrum," "sprint," and "backlog"?

After getting support from GEHC's leadership, the GE program office made another innovative—but again risky—change to the project. It introduced a third boutique consulting firm, ThoughtWorks, to an already large and complex project team. ThoughtWorks, led by Glenn Kapetansky, brought a unique view and expertise around agile, which was desperately needed. The team was broken into five small "scrums" with no more than six people in each. Each was tasked to complete requirements analysis, design, development, unit testing, and document creation in a two-week cycle: a sprint.

ThoughtWorks wisely proposed a "garden wall" around the project team. This concept protected the team members from the barrage of questions and concerns raised by other stakeholders in the organization. Dodd took on the thankless job of establishing this garden wall and protecting the team from external distractions.

Auer looks back at the scribbles in his notebook and says that if there had been a team Twitter message stream, it would have shown the skepticism and chaos the team navigated:

05/14/08: New challenge to deliver 9 mos early—evaluating plan
05/28/08: Mtg w/ Infrastructure—says we'll never make it
06/04/08: Validation and Quality team says we'll never make it
06/10/08: Reorganized Program Team into 5 Scrums—working out Sprint schedule
07/18/08: Sprint 1 complete—shortening subsequent Sprints to 2 weeks
08/01/08: Product Backlog is a mess—need Product Owner help to clean up
08/12/08: Scope change—adding Korea to 1st deploy plan
09/16/08: Falling behind—adding more capacity to Pricing Scrum
09/24/08: Chicken or a pig? Scrum of Scrums mtg at 8AM CT
10/18/08: Adding 3 more Sprints to handle new reqmts
11/04/08: Release mgmt says we won't make our first go-live in July
01/06/09: Crunch is on to hit user acceptance—pls prioritize
01/18/09: Final Sprint 13 complete—thanks everyone!
02/02/09: Scrums dissolved—Validation and migration focus for next 4 months
07/08/09: Application in Prod now—great job all!!

The new CRM system was migrated to production just 14 months after the decision to use agile to speed product development. While not lightning fast, this was an incredible delivery pace for a program of this scale in GEHC's highly regulated environment. Many of the program skeptics became vocal supporters, and the agile method is now in use in numerous programs across GEHC. The international CRM system is now being enhanced on a regular release schedule, and dozens of additional country deployments are in the works.

After celebrating, Dodd summarizes:

It's been said that constraints drive innovation. This project certainly forced the team to innovate. From the selection of boutique system integrators to the decision to adopt agile for a packaged application to the implementation of the "garden wall," the team was continually pushing

the envelope and redefining its own comfort zone. Just like the GEHC product teams who are constantly pushing the envelope of new medical technologies, IT can also innovate and change how solutions are delivered. With the right team members, a strong methodology, and good tools, anything is possible.

Recap

Take any of the grand challenges we listed in Chapter 2, and GE appears to relish signing up for them. In a world focused on light innovation around social networks and mobile devices, GE is making industrial innovation fashionable again.

The thousands of PhDs in its labs are converging technologies to come up with complex new solutions. Its solutions seamlessly bring products together from multiple business units. Its internal IT innovates on its own and coaches its business unit on intellectual property and technology contracting issues as the businesses increasingly embed technology into their products. Looked at from multiple dimensions, GE is clearly a polymath that many others should emulate.