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GE Global Research Center

Notes and Analysis from the GE Technology Investor Meeting held on March 11, 2015.

- While academic research has traditionally found little or no justification for conglomerates, GE is showing through its concept of the GE Store that technological advances can be shared across its businesses, enhancing the company's market position, revenues and profits.
- Over the past 15 years, GE has expanded its research efforts globally and recently within key verticals, such as software (industrial internet) and oil & gas. It expects to spend $5 billion on R&D in 2015, equal to about 5% of industrial revenues, consistent with recent spending levels.
- These initiatives are facilitating key new product launches including the LEAP jet engine, the H-Class air-cooled gas turbine, the Tier 4 locomotive, the Predix industrial internet software platform and others, which should boost industrial revenues in 2015 and beyond.
- GE's R&D efforts enable product upgrades and raise service revenues, enhancing the value of its installed base. They also help to lower costs. Management anticipates a 50 basis point benefit in gross margin from these efforts in 2015.
- With its concept of the "brilliant factory," which represents the marriage of advanced manufacturing with the industrial internet, GE anticipates further gains in productivity. A 1% improvement in productivity represents $500 million in annual savings for GE.
- While the stepped up pace of innovation will help drive growth, it also presents certain challenges, including the risk of compromising product quality. GE management has acknowledged this possibility by listing product quality as one of four critical risk focus areas.

Over the years, one of the key competitive advantages of General Electric has been its research and development capability. Through the application of innovative technology, GE has been able to innovate at scale, reduce product costs and reap additional value from its installed base (through upgrades and service revenues). More recently, GE has been using analytics to improve the productivity of machines in its installed base and inform its R&D efforts.

Recent examples of GE's technological prowess include:

- The LEAP jet engine. Designed by CFM International, a joint venture of GE and France's Snecma (a subsidiary of the Safran Group), the LEAP is a high-bypass turbofan engine that incorporates new technologies and the best in existing designs. It utilizes a higher proportion of composite materials, like ceramic matrix composites (CMCs), which are lighter and can operate at higher temperatures than metal. This helps LEAP to achieve 15% greater fuel efficiency. GE estimates that the LEAP will reduce annual fuel costs by as much as $1.6 million per plane. LEAP engines are also quieter and more environmentally friendly.

- The H-class gas turbine. GE's H Class offers the industry's most cost-effective conversion of natural gas into electricity and the lowest life cycle cost per megawatt (MW). Last year, GE introduced the 9HA.02, which at its capacity rating of 510 MW in simple cycle configuration, is the world's largest high-efficiency air cooled gas turbine. When partnered with a steam turbine in a combined cycle design (to capture and convert excess heat), the 9HA.02 can convert fuel to electricity at 61.8% efficiency. GE's H Class (steam cooled) fleet has logged more than 220,000 operating hours.

- The Tier 4 locomotive. GE is the first to introduce a locomotive that achieves Tier 4 EPA emissions requirements (which became effective January 2015). Most significantly, GE's locomotive meets the EPA's Tier 4 specs without the use of after-treatment systems, which would have added as much as 4,000 lbs. (equivalent to a full size SUV) to each locomotive and raised annual industry operating costs by an estimated $1.5 billion. In 2014, GE booked 1,355 orders for its Tier 4 locomotive. Its primary competitor, Caterpillar, now says it will not introduce its Tier 4-compliant locomotive until the second half of 2016 at the earliest.

In 2015, GE has played up the concept of the "GE Store" to symbolize the benefits that its businesses get from sharing technological advances and incorporating them into their product designs. In this way, the company has been able to share breakthroughs in materials science among its business. For example, advances in materials science, such as CMCs, developed by GE Aviation now appear in GE's gas turbines. GE has also adapted diagnostic technologies, such as x-rays, developed at GE Healthcare to Oil & Gas, where they are used to monitor the condition of pipelines.

Besides this cross fertilization, GE's Global Research Center (GRC), has developed and expanded its capabilities globally. From a single complex in Niskayuna, New York (near Albany), it has opened research centers in Bangalore, India (1999), Shanghai (2000), Munich (2004), Rio de Janeiro (2010) and Tirat Carmel, Israel (2012). In 2009, it opened an Advanced Manufacturing and Software Technology Center in Detroit. In 2011, it opened a Software Center of Excellence in San Ramon, CA (in the heart of Silicon Valley). In 2013, it added an Oil & Gas Technology Center in Oklahoma City (which is the site of this year's annual shareowners' meeting). Today, GE Global Research leads a team of 50,000 engineers, equal to nearly one out of every six GE employees.

GRC has a much broader mission that now includes:

- The launch of GE's newest distributed power business –silver oxide fuel cells – which are the nucleus of environmentally friendly, on-site power plants ranging from 1-10 MW. When combined in a hybrid solution with GE Jenbacher generators, these plants can operate at 65% efficiency. GE says that capturing waste heat has the potential to raise the efficiency of these plants to as high as 95%. These hybrid systems are designed to serve remote communities in developing nations, utility substations, industrial and commercial centers (such as factories and data centers) and to replace back-up systems that are currently powered by gas engines.

- The development of machines and systems that operate in extreme conditions, such as subsea. Subsea oil & gas operations utilize all departments within the GE store, including software, advanced controls, diagnostic software imaging, advanced materials, power conversion and advanced turbine technology, among others. Despite the challenges presented currently by the

low price of oil, GE sees increasing demand for its subsea products and services over time, as the quest for oil pushes exploration further into harsh environments.

- Biopharmaceuticals manufacturing. Although it did not say much about this emerging opportunity at the recent investor meeting, GE intends to develop and maybe operate advanced manufacturing facilities for biopharmaceuticals. It appears that it will concentrate its efforts in the areas of separation, processing (enrichment), expansion (growth), harvesting and quality assurance/control.

- The Industrial Internet. Through its San Ramon Software Center of Excellence (CoE) and in some cases through joint ventures, GE is playing a leading role in developing and implementing analytics, algorithms and machine intelligence to achieve greater reliability and achieve new insights that will lead to better product designs. Despite the hype, these initiatives are still in the early stages. GE is currently applying these technologies across all of its industrial businesses and with a few select customers. Last fall, it opened its Predix platform to third party developers. Yet, GE managed to generate $1.4 billion in revenues from Predictivity software solutions in 2014. This business will undoubtedly grow over the next few years and may be unbundled from GE products and offered as a separate service outside GE in the future.

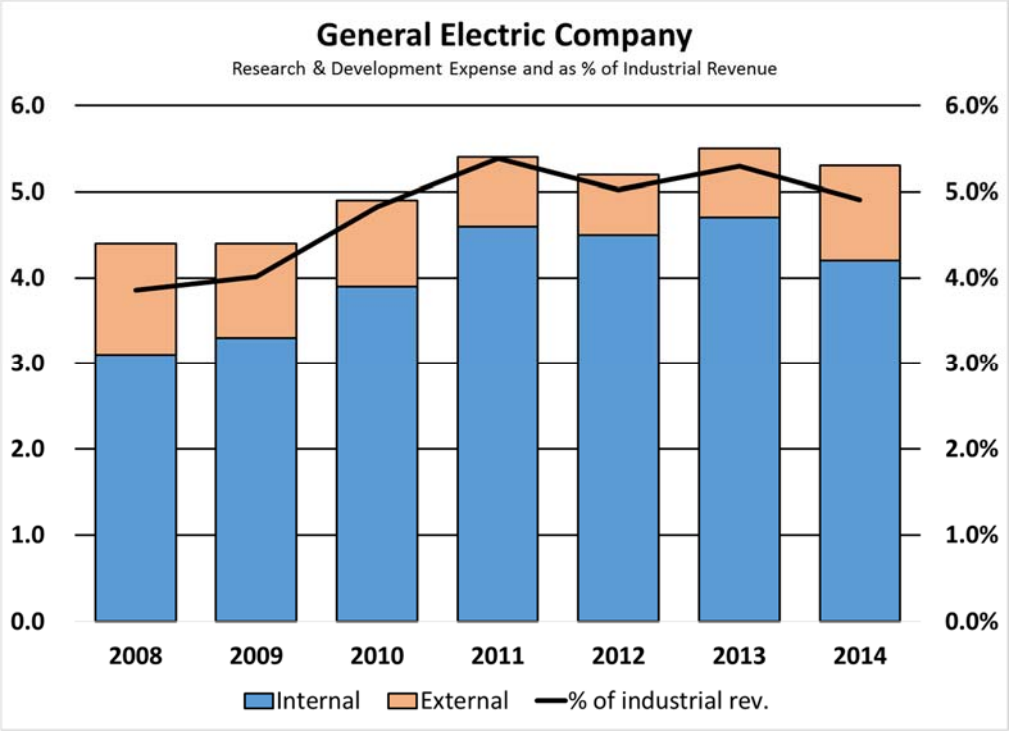
In order to accelerate the innovation process, GE has adopted the Fastworks framework. Fastworks is a "lean start-up" methodology, designed to speed up time to market by working directly with customers and suppliers in an iterative process to develop, test, measure and recalibrate product development. It starts with a statement that describes the typical customer's problem and a potential solution. It then identifies assumptions that need to be validated in order to achieve that solution. This is followed by a series of tests, with specified benchmarks, that are designed to validate or refute those assumptions. Once the results of those tests are in, decisions are made whether to continue to pursue, adjust or abandon the potential solution. The process then advances to the next stage of development and begins a new iteration. Fastworks speeds up the development process by focusing on key criteria, benchmarks and mileposts and bringing customers and suppliers into the development process early on.

Although it is obvious that Fastworks speeds up the development process, it also in my mind increases the risk of overlooking potential problems with the new product that might have been discovered in a more deliberative process. Obviously, the complexity of the product raises the risk of an oversight. GE management seems to be well aware of this risk. This may be a primary reason why the company has identified product quality as one of the four critical risks facing the company.[1]

Nevertheless, GE is committed to the Fastworks concept. According to the Harvard Business Review and GE's own disclosures[2], the company trained 1,000 of its executives in Fastworks principles in 2013 and was planning to train another 5,000 executives in 2014.

GE has stepped up its R&D efforts in 2010 and has held it at roughly 5% of industrial revenues over the past few years. The company expects to spend about $16 billion in R&D from 2013 through the end of 2015, about equal to the total from 2010 to 2012.

[1] See GE 2014 10-K, page 16.
[2] See "How GE Applies Lean Start-Up Practices", Harvard Business Review, April 23, 2014 and also "The Biggest Startup: Eric Ries and GE Team Up to Transform Manufacturing" in GE Reports, December 9, 2013.



This high level of R&D spending has facilitated many upcoming key product launches including the LEAP jet engine, the H-class gas turbine, the Tier 4 locomotive, the Predix industrial internet analytics software platform and the SIGNA PET/MR full body scanner in healthcare.

The Brilliant Factory

The convergence of the physical factory floor and the digital industrial internet has given rise to GE's concept of the "Brilliant Factory." For many years, GE has used sensors to capture detailed information about various aspects of product performance. Through the industrial internet, it now has the tools to analyze this rapidly increasing fire hose of data, which GE calls the digital thread, and disseminate relevant subsets to service technicians, engineers and suppliers as needed to gain new insights. This facilitates continuous improvement in manufacturing costs, productivity and quality.

These capabilities also allow GE to climb the learning curve quickly. In the Brilliant Factory, GE says it can raise initial yields on new parts and product components from less than 25% to greater than 95%.

GE is turning its Greenville SC turbine manufacturing plant, which makes gas turbines and parts for wind turbines, into a Brilliant Factory by digitizing more than 200 process steps. Through this initiative, it has identified $100 million of potential savings in product design, manufacturing, supplier sourcing, quality and others. Greenville expects to realize this savings over the next three years at a total cost, including operating and capital expenses, of $21 million.

The Brilliant Factory includes new technologies and applications. One such technology is additive manufacturing (aka 3D printing) which gives GE the ability to make complex parts in less time and at substantially lower cost. Instead of traditional methods, like machining, drilling and grinding which remove material in the fabrication process, additive manufacturing builds the product up layer by layer. In many cases, it allows GE to design parts that could not be made cost effectively before. With additive

manufacturing, GE is creating parts that improve performance significantly and weigh less. By creating parts directly and quickly from computer-aided designs, additive manufacturing also shortens the time to new product introduction.

Two examples highlight the gains that are available at the Brilliant Factory: Drilling small holes in gas turbine parts allows the units to run hotter (and thereby achieve better performance); but drilling those holes is time-consuming and prone to errors which reduce parts yields. In response, GE put sensors on the drill bits to improve accuracy, avoid errors and reduce cycle times. It says that these sensors have helped improve yields by 50% or more.

Servicing older machines from GE's installed base can be tedious because each machine has its own distinctive pattern of wear. These variations complicate the process of automating certain service tasks. In response, GE has introduced *adaptive welding*, which increases the speed and reliability of welding operations by recognizing changes in the geometry of welded joints and directing robots only to areas in need of repair. GE says that adaptive welding can increase efficiency by as much as 70% and productivity as much as 4X.

Real time factory and supply chain information facilitates predictive maintenance and helps GE assess supplier performance. For example, it gives GE the ability to track the timing, flow and quality of parts through GE's supply chain and the factory floor.

While the classifications of cost and productivity savings can be standardized, how those savings can be realized will differ among factories. GE is assembling a set of internally developed and externally sourced applications (i.e. an "app store") that can deliver customized solutions to each of its factories. No two Brilliant Factories will therefore be alike.

H Gas Turbine

The Power & Water segment is GE's largest. In 2014, it reported revenues of $27.6 billion, 25% of the total for GE's industrial businesses, and profits of $5.4 billion, 30% of the total. The five businesses within the Power & Water segment are: Power Generation Products and Services, which houses GE's heavy-duty gas turbine business, Renewable Energy (including wind turbines and solar power), Distributed Power, Water Process Technologies and Nuclear.

GE is the industry leader in heavy duty gas turbines. The 4,500 units in its fleet have generated over 190 million operating hours. This fleet exceeds industry averages in reliability by 0.4 percentage points and in availability by 1.5 percentage points.

GE believes that the business has good growth potential for the next decade. Various sources[3] have predicted that global demand for electricity will grow at an annual compound rate of 3.0%, net of efficiency gains, to 31,000 terawatt hours (TWh) by 2023. Owing to lower operating costs and a better environmental footprint, gas-fired generation is expected to grow at a 4.1% annual rate to 7,600 TWh.

In order to achieve those demand projections, those same sources estimate that the power industry will need 2,800 gigawatts (GW) of additional generating capacity, net of 500 GW of retirements. The largest

[3] World Bank, IEA, IHS, EIA, EPRI, Navigant, Brattle and GE Marketing.

proportion of these capacity additions, 30% of the total, is expected to be gas-fired. This translates into average annual gas-fired capacity additions of 84 gigawatts.

GE believes that it is well-positioned to capture more than its fair share of the projected growth. The company boasts that its 2015 product catalog offers greater output and efficiencies across the entire portfolio than competitive offerings, from its reliable B- and E- class turbines, which range in capacity from 44 MW to 143 MW to the mainstay F-Class turbines, with capacities ranging from 51 MW to 299 MW to its newly introduced high efficiency H-Class turbines, with capacities of 275 MW to 510 MW.

GE's ability to innovate at scale is evident in its H Class gas turbine. The H-Class is considerably larger than its predecessor, the F-Class. One H-Class turbine is roughly equivalent in output to two F-Class turbines. The H-Class delivers greater efficiency – currently about 62% with an attached steam turbine - in part because it runs hotter. That extra heat will require more maintenance and replacement parts, which increases the value of the installed base and its associated services revenue stream. Yet, GE anticipates that each H-Class will save a customer $60 million in capital expenditures, $16 million in annual fuel costs and achieve twice the level of operating hours (because it will be used more often as baseload electricity production) than the equivalent amount of F-Class capacity.

The H-Class has been well-received by potential customers around the globe. So far, customers have selected H-Class technology in 45 project designs, 15 of which are far enough along in the development process to allow GE to book them as orders and include in backlog. A total of 84 units are currently in some stage of the bidding process. GE anticipates shipping at least 24 H-Class units in 2015 and 2016.

The H Class turbine development process has utilized some aspects of the Fastworks framework. At its test facility in Greenville SC, a single H-Class unit has operated off grid at full speed and with a full demand load for 200 hours. It has therefore operated beyond "real world" limits for an extended period of time. GE sees this as a comprehensive validation of the technology, more valuable than operating 500 units under normal operating conditions for a full year. This form of stress testing has led to quick acceptance of the H-Class by customers, insurers and bankers and given GE a leg up on competitors.

While the rollout of the H-Class is just underway, GE already has plans in place to stay ahead of the competition. It will use all of its skills, know-how and newly-acquired technologies, in areas like advanced combustion, additive manufacturing and CMCs, to raise the efficiency of H-Class turbines from about 62% to 65% steadily over the next decade.

While the pace of new product introductions (NPIs), like the H-Class, has quickened, GE has aimed simultaneously to accelerate the decline in production costs. When NPIs were slower, the company was content to bend the cost curve down gradually over time. Now, it uses lifecycle centers of excellence, part of its Fastworks initiative, to identify and seize opportunities to come out of the starting gate with the lowest possible production costs. It then has a formal process, dubbed "should cost," to drive costs down as quickly as possible after introduction, in stair step fashion, by setting specific cost targets at set intervals. Shortly following the analyst meeting, GE was scheduled to meet with suppliers to gain their commitments to achieve its production cost targets for the H-Class turbine.

The HA model of the H-Class will launch at a cost per kilowatt ($/k) 10% below its predecessor, the 7F.05. The cost of the 7F.05 declined by 22% from 2013 to 2015. GE believes that it will be able to reduce the $/k of its new 7HA.02 model by 20% over the next 12 months.

Over the next few years, GE's believes that its $2 billion investment in H-Class technology and its focus on cost leadership will allow the H-Class to capture one-third of the heavy-duty gas turbine market. Yet, GE is remains committed to its smaller B-, E- and F-Class gas turbines. It will utilize many of the technological advances in the H-Class to upgrade its entire product line, which will support future sales of these smaller turbines and modernize its large installed base.

Aviation: Commercial Engines

GE's Commercial Engines (CE) business, a part of GE Aviation, has performed well, growing revenues at 8% per year since 2011. Revenues were $8 billion in 2014, about 1/3 of Aviation's total. Together with service-related revenues, CE was a $17 billion business in 2014, or 70% of Aviation's total. The business ended the year with a record backlog of 13,000 engines, valued at $27 billion. In 2014, GE delivered 2,571 commercial engines, up 8.1%. At that rate, the backlog represents five years of future deliveries. GE anticipates that CE's revenues will be flat in 2015 and its ending backlog will be flat to up slightly.

In what is anticipated to be GE's busiest decade for CE product launches, Aviation is focused on three upcoming product rollouts. This year, it will launch the GE Passport, followed by the CFM LEAP in 2016 and GE9X in 2020. In order to maximize the opportunities presented by these NPIs, GE will focus on gearing up its supply chain to meet the expected demand, including industrializing new manufacturing and materials technologies, and operationalizing its industrial internet capabilities to raise supply chain and customer productivity. All of this will help CE achieve its volume and profit margin objectives.

These are the best of times for the commercial aviation business. Passenger demand is high and still rising. The International Air Transport Association predicts 7.0% growth in revenue passenger kilometers in 2015, so load factors will remain high. The added push of declining fuel costs is helping to lift industry profits to record levels. These favorable industry dynamics should lead to 3% compounded annual growth in commercial jet engine sales and 5% average annual growth in the in-service fleet for the balance of the decade for GE and its Engine Alliance and CFM joint ventures.

GE is the only jet engine manufacturer to play in all three segments of the commercial aircraft market: widebody, narrowbody and regional/business. Of the nine airplane models actively for sale, GE and its affiliates are the sole source engine supplier in six and have greater than 50% market share in the remaining three. The company has strengthened its leading market position over the years by focusing relentlessly on customer needs (e.g. fuel efficiency, reliability, cost of ownership, emissions and noise), while drawing on the unique and extensive capabilities of the GE Store (and its technology toolkit) to create a steady and timely stream of differentiated products.

The success of this effort can be seen in this decade's rollout of new commercial jet engine models. When it was launched in 2011, the GEnx had 15% better fuel efficiency than its predecessor (and 3% better than its primary competitor). So far, the 19 airlines flying the GEnx have logged more than three million operating hours with it. In 2014, GE sold 287 GEnx's, up 60% from 2013.

With the success of the GEnx, the company turned its attention to designing an engine for the next generation of narrow body aircraft. Airline operators liked the fuel efficiency of the GEnx, but they were concerned that the high utilization rates of single aisle, narrow body aircraft, which are the workhorses of operators like Southwest Airlines, would keep maintenance costs high, more than offsetting the savings in fuel.

GE's CFM joint venture responded to these concerns with the LEAP jet engine, which is scaled and designed for higher cycle utilization. The LEAP will enter into service in 2016. Since it was announced, it has been chosen as the exclusive engine for Boeing's 737-Max and Comac's (The Commercial Aircraft Corporation of China) C919. It also has a 54% share of the Airbus's A320neo business. So far, the LEAP has captured 79% of the narrow body market.

The GE Passport, a high bypass, turbofan engine, will launch in 2015. It has been designed for long haul, large cabin business aircraft, like the Bombardier 7000 and 8000, and also for the regional aircraft market. It includes many of the same features built into the CFM LEAP. So far, the Passport has achieved ½% better fuel efficiency than its initial design specifications, which gives GE greater confidence that the engine will meet its overall performance objectives.

The GE9X is slated to replace the GE90-115b, an industry workhorse. Through the increased use of advances materials, it is being scaled and designed for higher thrust (i.e. higher performance) with greater operating and fuel efficiency. Product launch is currently expected in 2020.

There are four primary technologies that have given the newest generation of GE jet engines their performance advantages:

Carbon-Fiber Composites (CFCs). GE has been using carbon-fiber composites since the 1980s. It has been using CFCs in the manufacture of fan blades since mid-1990s. CFCs reduce weight, increase durability and thus improve engine component performance. They are also a primary contributor to improved fuel efficiency. The LEAP will utilize 3D woven RTM (Resin Transfer Molding) CFCs for its fan blades and casing. This will enable blade geometries that are difficult to achieve with titanium, lower the engine's weight by 500 lbs. and reduce maintenance requirements.

Ceramic-Matrix Composites (CMCs). GE started using CMCs in turbine blades and will expand their use to shrouds, nozzles, combustors and other parts over time. CMCs have twice the thermal capability and 1/3 the weight of metal, which significantly enhances durability and efficiency. The company thinks that CMCs are so important to its technology roadmap that it has vertically integrated its CMC supply chain back to the fiber source.

Compression Technology. GE has a long history of developing efficient, stall-free engines. Compression technology has also been key to gains in fuel efficiency. GE has already achieved compressor pressure ratios of 23-1 in the GEnx and 22-1 in LEAP and Passport and has set a highly ambitious target of 27-1 for the GE9X. If it succeeds, the GE9X's compression technology will confirm the ability of this next generation engine to meet its (higher thrust and efficiency) performance objectives.

Combustion Technology. GE has been on a 20 year quest to improve combustion science, materials and manufacturing. Its most recent advance is the Twin Annular Pre-Mixing Swirler (TAPS) which controls the mix of air and fuel to optimize combustion and heat levels and reduce CO2 and especially NOx emissions. Future generations of TAPS (i.e. TAPS II and TAPS III) are slated to appear in the LEAP and GE9X engines.

As 2016 approaches, the Commercial Engines business will be primed for the launch of the LEAP. GE has appointed an executive to lead the new product introduction. It believes that the LEAP's lower specific fuel consumption, weight and noise levels will allow it to maintain its market share lead over its primary competitor, Pratt & Whitney's PW1100G. GE is focused on both customer and supplier readiness for the

launch. While LEAP will enjoy declining production costs as volume ramps up, GE has also put in place an enterprise cost team and 11 "Lean Labs" to ensure that the LEAP meets its cost reduction objectives.

GE Healthcare: Ultrasound

GE's Healthcare business segment generated revenue of $18.3 billion and profit of $3.0 billion in 2014. Both have been flat for the past two years. Orders were also essentially flat at $18.3 billion in 2014, but the backlog was up 2.5% to $16.5 billion, due entirely to a 10% increase in the equipment backlog to $5.5 billion. GE expects modest growth in equipment revenues in 2015, reflecting in large part gains in market share.

The Healthcare segment is composed of three businesses: Healthcare Systems, which includes both diagnostic imaging systems, such as x-ray, computed tomography (CT) and magnetic resonance (MR) and clinical systems, like ultrasound, electrocardiography (ECG) and patient monitoring. Healthcare Systems accounted for 70% of total segment revenues in 2014.

Besides Healthcare Systems, the segment includes Life Sciences, which serves the drug discovery, biopharmaceutical manufacturing and cellular technologies markets, and Healthcare IT, which provides enterprise and departmental IT solutions to healthcare services companies.

In recent years, the uncertainties precipitated by the Affordable Care Act (ACA) in the U.S. combined with global efforts to reduce healthcare costs have put pressure on all healthcare equipment and services providers, which has increased competition. GE has responded by focusing on ways to help it and its customers improve productivity and reduce costs. In 2014, GE was able to offset the drag from lower product pricing through increases in sales volume and productivity.

Consistent with the realities of the marketplace, GE Healthcare's technology imperatives include (1) developing products with improved outcomes, (2) lowering product costs, (3) growing software enabled platforms and (4) squeezing more margin out of services.

GE's Global Research Center (GRC) has developed and maintained the Healthcare technology framework that has facilitated NPIs and driven growth and expansion into adjacencies. Among these core technologies are materials science, sensors, nanotechnology, miniaturization, micro-electro-mechanical systems (MEMS), signal processing, image analytics and computer vision. With this playbook, the GRC led the revolution in computed tomography and e4D cardiac ultrasound (which uses electronic ultrasound equipment to create four dimensional images (i.e. 3D + time)). With the GRC's toolkit, GE Healthcare is among the leaders in the drive toward personalized medical treatment.

Ultrasound, one of the big success stories within GE Healthcare, is a template for future growth. With a steady series of product advances, including ever smaller and affordable scanners, the business has grown at a 14.2% annual clip for the past 19 years, from $200 million in revenues in 1995 to $2.5 billion in 2014. GE is now the global leader in ultrasound and is number one in all geographies. It is also the innovation leader, spurred by internal development and insights gained from customers. Ultrasound has the broadest and deepest product portfolio and innovates at speed, with 10 or more NPIs each year, refreshing its entire portfolio every 3-4 years. As its focus has shifted from big to small systems, it has been able to introduce new products routinely at lower price points, while increasing profit margins.

GE's ultrasound innovations, especially the more vivid and time-sequenced displays that are now available, are increasingly in demand from patients and healthcare providers. Widespread adoption is aided by the equipment's real time availability, safety, portability, ease-of-use and low cost.

At the same time, Healthcare has been able to drive ultrasound margins higher by creating a "culture of cost out" using every page of GE's playbook: materials science, supply chain management, value engineering and design and Fastworks, to name a few.

While Ultrasound's success is clearly result of the efforts of GE's people, technology and business know-how, it was also built with the input of its customers. It is a business model and record of success that all of GE's businesses would like to replicate.

Power Conversion

The Power Conversion (PC) business is part of GE's Energy Management segment. GE has built the business around Converteam, a French company that it acquired for $3.2 billion in September 2011. Converteam makes conversion systems, automation systems and high-efficiency power electronics, motors and generators. Through the acquisition, GE got a great product portfolio, technology base and team of technologists. It was especially interested in Converteam's variable speed and inverter technologies. Since completing the acquisition, Joe Mastrangelo, the GE veteran who now runs the business, has tapped into GE's technology base and talent pool to help PC deliver the investment returns that GE shareholders deserve.

In 2014, Energy Management reported $7.4 billion in revenues, 7% of the total for GE's industrial businesses, down 3.3% from the prior year. It generated profits of only $246 million, 1% of the industrial total, but more than double 2013's.

The PC business generated $2 billion in revenues in 2014, or 28% of Energy Management's total revenues. GE believes that the business is positioned for growth. It expects a big boost in backlog in 2015, which should lead to faster growth in revenues and margins in 2016 and beyond.

Besides Power Conversion, Energy Management's businesses include Industrial Solutions, which distribute and control electric power, and Digital Energy, whose products are designed to modernize and protect the electric grid.

According to the IEA's World Energy Outlook, electricity demand is expected to grow by 2.3% annually over the next 25 years. That is net of energy efficiency gains of about 1.2% per year. Much of that new demand will be met from new power generating sources and the growth of micro-grids. Increasing diversity in power generation, transmission and distribution systems combined with the ongoing drive for energy efficiency will raise demand for advanced power conversion and energy management products and systems.

GE's power conversion products help customers utilize power efficiently. Its increasingly sophisticated technologies and software applications help drive conversion efficiency. For example, Converteam's variable-speed conversion technologies help industrial electric power users meet their fluctuating power needs more efficiently than traditional fixed speed conversion equipment. Its inverters help solve intermittency problems in wind and solar farms, increase electricity throughput and reduce capital and operating costs.

Power Conversion products convert motion into electricity, electricity into electricity and electricity into motion. For example, generators convert wind power into electricity. Inverters convert the variable direct current (DC) electrical output of a solar cell into alternating current (AC) suitable for utility power grids. Other products convert standard electricity to non-standard frequencies that are used by micro-grids that serve railroads and offshore oil platforms. Onboard electric generators drive ship propulsion systems. In desalination plants, electric pumps push water through membranes at high speeds to remove salt. Thus, PC products serve energy-intensive industries, such as marine, oil & gas, mining, renewable energy, railroads and water utilities.

Despite the superior growth prospects for variable speed technology, Converteam was not performing up to its potential, according to GE; so GE set about making improvements in Converteam's service and fulfillment capabilities. Since the acquisition, GE has improved Converteam's on-time delivery rate from 25% to the low 90s and has a path to get to the high 90s. It has also simplified engineering by reducing the number of design tools from 300 to 30 and eventually to less than 10.

GE has also been working variable speed technology into its existing PC products and scaling up Converteam's operations outside of Europe. Since 2011, Converteam's sales have doubled and Europe now accounts for less than 50% of sales.

The Power Conversion business has upgraded other parts of its product line. Its priorities have centered on expanding its high efficiency power density and power quality products. It has also focused on developing integrated mechanical, electrical and software solutions that can serve multiple industries. Recent NPIs include medium voltage low power drives and large, high speed induction motors. PC is also conducting sea trials for its SeaStream Dynamic Positioning System that allows a seaborne vessel to maintain a predetermined heading and position by controlling propulsion units that automatically counteract the effects of wind, waves and sea currents.

PC is working on advanced induction motors that incorporate several technological advances. These include: magnetic bearings from the GRC which enable oil free operation; shaftless rotors from Converteam, advanced rotor dynamics from GE aviation that boost speeds by a factor of 6X and honeycomb casings from GE Oil & Gas that weigh 30% less. By shrinking the size and weight of the power conversion devices and improving their performance, GE also reduces capital and operating costs for the structures that its customers build to house this equipment.

The combination of advanced technologies, lean process improvements at Converteam and the GE Store will help to drive growth in PC revenues and profits over the next several years. Overall, the Energy Management business is starting from a low revenue, profit and margin base, which suggests significant room for improvement.

Turbomachinery Solutions

GE's Oil & Gas segment, of which Turbomachinery Solutions (TS) is a part, reported revenues of $18.7 billion in 2014, up 10% from 2013 and profit of $2.6 billion, up 18.7%. Through a combination of acquisitions and internal growth, the segment has grown revenues and earnings at compounded annual rates of 18.6% and 16.4%, respectively, over the past four years.

Besides Turbomachinery Solutions, the other Oil & Gas businesses include Drilling & Surface, Measurement and Controls, Subsea Systems and Downstream Technology Solutions. Turbomachinery

Solutions accounted for 27% of segment sales in 2014 and is expected to grow revenues and backlog modestly in 2015.

This rate of expected growth, though modest, is still somewhat surprising given the sharp drop in oil prices and the chilling effect that it has had on oil & gas drilling activity. Production levels for most exploration and production companies will remain elevated in 2015, in large part due to hedges that locked in selling prices many months ago; but drilling activity is slowing sharply and production will likely begin to fall in late 2015 and early 2016, if oil prices do not recover meaningfully by then.

In this environment, TS remains committed to its long-term growth goals, but like all of GE businesses, it remains intensely focused on delivering positive near-term results. The business is using all of the tools in the GE toolkit to innovate, reduce costs, deliver value to customers and boost returns.

TS has what it believes is a compelling portfolio for gas infrastructure, developed with the assistance of the GE Store, that includes aeroderivative gas turbines, heavy duty and industrial gas turbines, LNG and pipeline compressors, electric motors & generators and controls & sensors. It also offers customers access to GE Capital's financing solutions to deliver total cost of ownership alternatives that are quite competitive. The business has adopted a modular approach and turnkey solutions for the upstream, onshore and offshore natural gas, pipelines and LNG markets that are quick and cost competitive. Its solutions are also targeted to solve common problems for its customers, like project delays, subpar productivity, cost overruns, wasted flared gas and exploration in difficult terrains.

A prime example of TS's ability to tap into GE's expertise and know-how is the NovaLT16, a 16MW gas turbine designed for gas compression applications. The NovaLT16 uses technology from GE's Aviation business to achieve best-in-class efficiency and reduced emissions. It was created using a FastWorks approach that brought the turbine from concept to its first engine test in only 30 months. NovaLT16 customers will benefit from using Predix's asset performance management solutions to boost performance and reduce maintenance costs. From a standing start in 2013, TS expects more than $1 billion of orders for this gas turbine by the end of 2017.

The Tier 4 Locomotive

GE's Transportation booked revenues of $5.7 billion and earnings of $1.1 billion in 2014. Its performance has been essentially flat over the past three years but up sharply from the initial years following the 2008 financial crisis. Locomotives and Locomotive Services are the primary businesses within Transportation, accounting for nearly 70% of 2014 segment revenues. Other Transportation businesses include Mining (mining equipment and services) and Marine, Stationary & Drilling (motors for drilling rigs, marine diesel engines and stationary power diesel engines).

Transportation is focused on maintaining its leading product and technology position, growing services and globalizing its platform. New product launches include the Tier 4 locomotive, a Tier 4 marine diesel engine and a 400 ton mining truck. The business ended 2014 with a $6 billion backlog, twice the 2013 level; so it expects significant growth in revenues in 2015.

Transportation has enjoyed great success with its Evolution Series of locomotives. Since 2005, it has delivered successive series, from Tier 2 through Tier 4, well ahead of the competition. The Tiers refer to stages of compliance with EPA emissions requirements. Tier 4 compliance was especially challenging because it was commonly believed that the mandated reductions of NOx particulates could not be met

without urea-based treatment. This would add considerable heft to the locomotive – 4,000 lbs. by some estimates – and $1.5 billion in additional infrastructure costs for railroad operators.

To get to the final design for the Tier 4, in 2010, Transportation set up two teams – a red team that focused on simplicity and cost and a blue team that concentrated on efficiency and value. In the end, GE incorporated features from both design teams in the Tier 4.

As the teams worked to complete their designs, management took a curve ball from potential customers who said that they did not need new locomotives because demand for freight was slowing. The company booked fewer than 50 orders for the Tier 4 early on. Transportation then had to lean on corporate to get the funding to continue with the development program.

Luckily, by 2014, the freight market began to turn around, due to increasing oil, intermodal and grain shipments. Combined with the tough winter, which slowed deliveries and locomotive productivity, customers once again came knocking on GE's door. By the end of the year, Transportation had booked more than 1,000 orders for Tier 4 locomotives to be delivered from 2015 to 2017.

As with many GE product launches, Transportation set up a process to field test the units, gain EPA certification, drive cost out early, develop a plan to drive costs down further after launch and secure at least two sources of supply for every part and volume commitments from suppliers. It invested in upgrading its three dedicated manufacturing facilities to incorporate new technologies, including Brilliant Factory processes, to ensure that manufacturing could meet anticipated production schedules.

At this time, it looks like GE has built a huge lead over the competition. Caterpillar, its primary U.S. competitor, now says that it will not begin to deliver its Tier 4-compliant locomotive until the second half of 2016, at the earliest.

Quirky

One innovation process that was not discussed at the Technology Investor Meeting was GE's investment in a start-up called Quirky. According to the New York Times[4], Quirky focuses on community-based (i.e. crowd-sourced) innovation. Its model is adapted from open-source software, like Linux. Quirky utilizes fast, collaborative processes for designing and producing goods. Its recent efforts have been directed to mechanical products that utilize software and the industrial internet, which is right up GE's alley. Many of these are suited for the smart home, including appliances, a business that GE is in the process of divesting. One such GE-Quirky collaboration involves an air conditioner that monitors usage patterns and tracks temperature preferences and can be controlled with a smartphone app. Another is a programmable LED light bulb, which went from initial design to retailer shelves in 100 days.

Quirky is a private company that generated $100 million of revenues in 2014, according to its founder, Ben Kaufman. The collaborative process is a relatively new and low cost way of getting input on new potential products, but it tends to attract inventors and hobbyists who may not be in tune with the broad-based needs and wants of consumers. Quirky is another tool for GE's toolkit, but just how useful and important a tool it will be remains to be seen. It may be more useful as a way to create marketing buzz about upcoming GE consumer products with tech-savvy consumers.

[4] "Turning Ideas into Goods" from page 7 of the Business Section of the New York Times, February 15, 2015.

Gross Margins

GE has been able to lift its consolidated industrial operating profit margin by 140 basis points from 14.8% in 2011 to 16.2% in 2014, but all of the increase has come as a result of reducing its SG&A expense ratio, primarily through restructuring actions, by 450 basis points from 18.5% to 14.0%. During this period, gross margins have actually declined by 150 basis points from 28.0% to 26.5%, which management attributes mostly to business mix.

In order to achieve gross margin improvement, GE has engaged all elements of its organization, by business line and function, applying best practices and realizing synergies wherever possible. GE has been able to raise operating margins on services revenues; but a tough competitive environment has made it difficult to raise margins on equipment sales. Still, GE's relentless focus on reducing costs has given it more flexibility to compete on price in order maintain or gain market share.

GE's on-the-fly restructuring actions have contributed to the improvement in profit margins. In one big change, GE has moved many shared services, such as accounts payable processing, out of the industrial segments and back to corporate, so that its businesses can concentrate on boosting revenues and minimizing controllable costs.

GE has pursued gross margin improvement by attacking all aspects of its product and service costs. For example, it has reduced material costs by identifying "should cost" targets for every product and diversifying suppliers. Labor costs have been addressed by expanding operations in low cost countries and generally running lean. Overhead has been reduced in part by finding new ways of operating, such as multi-modal factories. Service costs have been slashed by reducing downtime and raising field service efficiency. Wherever possible, GE has assigned responsibility for cost reduction targets to specific employees and aligned those targets with compensation. Management is focused on ensuring that the company's operating costs per hour across all of its businesses comes down each year.

Management sees GRC as the glue that brings together all of GE's operations. Technology leadership and shared best practices play an important role in meeting cost reduction targets. Besides innovating on performance, GE is also aggressively pursuing innovations that reduce cost. For 2015, technology initiatives are playing an important role in achieving the company's overall goal of expanding gross margins by 50 basis points.