Globalization of Japanese Engineering Research and Development: Option or Imperative?
Eric Lau and Sreedhar Vangavolu also contributed to this Perspective.
EXECUTIVE SUMMARY

Japan remains an economic powerhouse. Generous spending on engineering research and development (ER&D) over the decades has created some of the world’s largest and best-known companies, renowned for their dedication to innovation and quality. Those companies may become vulnerable, however, as the strongest growth in the world economy shifts from mature markets to emerging ones. Potentially billions of new customers, rising out of poverty, present rich opportunities. However, the kind of products these customers are demanding and the way those products must be engineered requires a new approach to the product development cycle.

To get closer to those markets, Western companies are setting up ER&D centers in emerging nations such as China and India. Companies based in emerging nations, meantime, are becoming far more adept at ER&D. This presents a serious challenge for Japan, which not only has kept ER&D close to the vest and close to home but also is undergoing a demographic shift that will make homegrown engineering talent increasingly hard to come by. The need for Japan to become less insular and more global with its ER&D is urgent.
Evidence of Japan’s engineering research and development prowess is everywhere. Automobiles, televisions, and mobile phones are just some of the ER&D-intensive Japanese goods that are much respected around the world. Over the decades, Japanese companies such as Toyota, Honda, Panasonic, and Canon achieved a sterling reputation for high-quality engineering. The country’s position as the world’s second largest ER&D spender—the United States is the largest—testifies to its commitment. Japanese innovations are advancing a wide range of cutting-edge trends. Green technology, device convergence, and next-generation organic light-emitting diode (OLED) displays provide just a few recent examples.

How Toyota’s recent spate of recalls will affect the company’s reputation for high quality is not yet clear. A history of consumer goodwill accumulated through longstanding satisfaction with Japanese products will help the company recover from a temporary hit to its reputation—so long as systemic problems are quickly resolved. In any case, a huge share of trailblazing new technologies will continue to originate from Japan, just as in the past.

According to the latest Booz & Company innovation database, Japan is expected to hold its position as the second largest ER&D spender through the next decade, with automotive and high-tech giants leading the way (see Exhibit 1).
Exhibit 1
Japan’s Spending in ER&D

GLOBAL ER&D SPEND BY GEOGRAPHY

<table>
<thead>
<tr>
<th>Year</th>
<th>Rest of World</th>
<th>U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>49%</td>
<td>38%</td>
</tr>
<tr>
<td>2020</td>
<td>52%</td>
<td>35%</td>
</tr>
</tbody>
</table>

Total: ~US$1,100 B

Total: US$1,350–$1,400 B

JAPANESE ER&D SPEND BY COMPANY

<table>
<thead>
<tr>
<th>Company</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>7%</td>
</tr>
<tr>
<td>Toyota</td>
<td>5%</td>
</tr>
<tr>
<td>Honda</td>
<td>4%</td>
</tr>
<tr>
<td>Panasonic</td>
<td>4%</td>
</tr>
<tr>
<td>Sony</td>
<td>4%</td>
</tr>
<tr>
<td>Nissan</td>
<td>4%</td>
</tr>
<tr>
<td>Takeda Pharmaceutical</td>
<td>4%</td>
</tr>
<tr>
<td>Hitachi</td>
<td>2%</td>
</tr>
<tr>
<td>Toshiba</td>
<td>2%</td>
</tr>
<tr>
<td>NEC</td>
<td>2%</td>
</tr>
<tr>
<td>Denso</td>
<td>3%</td>
</tr>
<tr>
<td>NTT Communications</td>
<td>3%</td>
</tr>
</tbody>
</table>

Total: ~US$123 B

Source: Booz & Company’s Global Innovation 1000 database; Booz & Company analysis
ROLE OF EMERGING MARKETS

Emerging markets represent an interesting contrast to Japan’s cutting-edge focus and present a unique challenge to Japanese companies. Around the world, companies have been turning to emerging markets for future growth, and the current recession in mature markets has accelerated this trend. By 2050, emerging markets are expected to account for 61 percent, or US$84 trillion, of the world’s GDP (see Exhibit 2).

Consumers in emerging markets are quickly growing in terms of wealth and disposable income. Yet as companies rush to capture their share of this opportunity, they quickly discover that the route to success is starkly different from the course they have taken in mature economies. Instead of high-tech, feature-rich products, emerging market customers want basic, low-cost products specifically designed to meet their needs.

Innovation takes on a different meaning in these markets, which present challenges like converting a $10,000 stationary electrocardiograph machine to a $1,000 portable device that can be carried around by doctors in rural India. Known as “frugal engineering,” this value-oriented approach to product development is driving the shift in ER&D spending toward emerging markets, especially India and China. The contribution of Asia, excluding Japan, to global ER&D has increased by 5 percentage points, from 2 to 7 percent, over the last 20 years; we expect similar growth in the next decade.

Exhibit 2
Emerging Markets’ Contribution to World GDP

Note: Emerging markets are BRIC countries; mature markets are G6 countries; GDP is in $US 2005.
Source: Goldman Sachs BRIC report; Economist Intelligence Unit; IHS Global Insight; Booz & Company analysis
Shifting demography is a looming challenge for Japan, whose population is quickly shrinking and aging. The country’s birth rate is well below the replacement level. According to Japan’s National Institute of Population and Social Security Research, today’s population of 127 million will decline at an alarming pace to 95 million by 2050. Meanwhile, the portion of the population ages 65 and older is expected to grow from 23 percent today to 42 percent by 2050. As a result of these two trends, the working-age population is expected to fall from 81 million today to 46 million in 2050, a 43 percent decrease (see Exhibit 3). This shrinking talent pool is a fearsome trend for Japanese companies: Replacing retirees with new qualified workers will be increasingly difficult.

Exhibit 3
Japan’s and India’s Working-Age Populations, 1990–2050

Note: “Working-age” includes ages 15 through 64.
Source: Economist Intelligence Unit; Booz & Company analysis
Japanese companies have been relatively slow to develop a global ER&D network. Starting in the 1980s, Japan readily embraced a global manufacturing footprint, but a similar shift has not happened in ER&D. India and China have become major ER&D destinations: India now has a 20 to 25 percent share, China 15 to 20 percent. Japan’s relatively timid approach can be seen in India, a country that boasts more than 300 ER&D centers for multinational companies and over 80 independent third-party engineering services providers. Japan, despite its high ER&D spending, ranks in the last quartile of companies with an ER&D footprint in India. Based on the latest research by Booz & Company, Japan accounts for only 3 percent of the global engineering work performed in India. U.S.-based companies, on the other hand, account for more than 64 percent (see Exhibit 4).

Exhibit 4
Japan’s Place in ER&D Spending, Globally and in India

Note: “Other” represents countries with less than 1% of share.
Source: Booz & Company research & analysis
Indian companies have established a strong reputation for low-cost value engineering in emerging markets, developing products such as the groundbreaking $2,200 Tata Nano. Potentially, India could help offset Japan’s demographic crisis, given its young, fast-growing population and deep working-age talent pool. The lower wage scales in emerging markets could also provide significant cost savings for Japanese companies.

The reasons for establishing a global engineering footprint vary by region (see Exhibit 5). Cost, capability, and local market access are just a few of the factors that multinational players weigh when deciding to expand their global engineering footprints. To remain competitive, Japanese companies will need to catch up, quickly.

Japanese companies that have offshored successfully, such as Yokogawa and Nissan, are at least as effective as their Western counterparts, and often more so because of the strong management discipline and dedication to quality control found at most Japanese companies. Select Japanese companies have proven able to offshore at price points 15 to 20 percent lower than their Western counterparts. They accomplished this not by cutting the margins of suppliers but by taking out inherent cost. Too few companies, however, have adjusted to the new realities of offshore ER&D.

Yokogawa shows how it can be done. The process control and automation company executes many offshore projects with 90 to 95 percent of its resources located outside Japan. Responsibilities such as lead engineering, application programming, factory acceptance testing, and on-site commissioning are often performed by engineers from low-cost countries. The Japanese engineers focus on project management and technical liaisons with customers.

By contrast, most other Japanese companies in the industry utilize offshore engineering resources only for support activities, such as graphics, process control, logic testing, and validation. The ability to fully utilize a global delivery model has allowed Yokogawa to offer to clients globally a compelling value proposition in cost, quality, and time to market.

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**Exhibit 5**

Differences in Drivers of Offshoring by Region

<table>
<thead>
<tr>
<th>DRIVER</th>
<th>NORTH AMERICAN COMPANIES</th>
<th>EUROPEAN COMPANIES</th>
<th>JAPANESE COMPANIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Realize Cost Savings</td>
<td>![Most Important]</td>
<td>![Least Important]</td>
<td>![Least Important]</td>
</tr>
<tr>
<td>Gain Access to New Technologies</td>
<td>![Most Important]</td>
<td>![Least Important]</td>
<td>![Least Important]</td>
</tr>
<tr>
<td>Leverage Industry Best Practices</td>
<td>![Most Important]</td>
<td>![Least Important]</td>
<td>![Least Important]</td>
</tr>
<tr>
<td>Provide Additional/Flexible Capacity</td>
<td>![Most Important]</td>
<td>![Least Important]</td>
<td>![Least Important]</td>
</tr>
<tr>
<td>Gain Access to Emerging Markets</td>
<td>![Most Important]</td>
<td>![Least Important]</td>
<td>![Least Important]</td>
</tr>
<tr>
<td>Decrease Time to Market</td>
<td>![Most Important]</td>
<td>![Least Important]</td>
<td>![Least Important]</td>
</tr>
<tr>
<td>Manage Technology Proliferation</td>
<td>![Most Important]</td>
<td>![Least Important]</td>
<td>![Least Important]</td>
</tr>
</tbody>
</table>

Source: Booz & Company analysis
Booz & Company has identified four major requirements for successful implementation of global ER&D networks:

1. **Choose the right project.** The best candidates for offshore engineering are jobs whose processes are well delineated in scope and whose roles and responsibilities are clear. These jobs require carefully documented task maps and testing procedures and minimal face-to-face interaction between clients and offshore resources. They do not require interaction between offshore resources and end customers and do not involve proprietary or classified activities.

2. **Identify the appropriate business model.** Many models are available for companies seeking a bigger stake in remote operations while maintaining adequate management control over R&D activity. Besides vendor and captive sites, other possible approaches include captive sites with staff augmentation; closed joint ventures; tripartite joint ventures; open joint ventures (joint ventures within a company); build-operate-transfer, or BOT, in which a third-party engineering services company builds a remote operation and transfers control to the company over a period of time; and reverse BOT, or R-BOT, in which the company builds the remote operation and later transfers it to an engineering services company.

3. **Team up with the right vendors.** When selecting global partners, the capabilities of engineering services companies matter more than price. A thorough capabilities assessment through a carefully designed request for quotation or request for proposal is essential. In addition, detailed pilot projects and site visits, along with numerous rounds of discussion...
ADDITIONAL LEVERS FOR JAPANESE COMPANIES

Given the unique operating environment of Japanese companies, we recommend five additional levers:

1. Establish a strong governance structure. Governance is perhaps the most important of the five levers. Strategic and cost initiatives such as engineering outsourcing are better managed when supervised by a high-ranking project champion—the vice president for engineering or product development, for example. But governance structure must go beyond a single individual. The most effective setup includes a steering committee comprising key executives of both the client and vendor companies; a program management office made up of senior managers from IT, finance, engineering, and purchasing whose duty is to review the project monthly or quarterly; and, at the bottom of the pyramid, execution teams including the client’s project managers and the vendor’s project team to oversee daily and weekly activities.

with management and technical staff, are key.

4. Create ironclad performance metrics. The performance of contract companies must be measured and assessed. Two approaches to metrics should be employed: service-level agreements (SLAs), which include incentives for good performance and penalties for underachievement, and key performance indicators (KPIs). It is critical that SLAs and KPIs are planned, negotiated, and agreed on before the contract is finalized. Contracts should also include clear and concise definitions of expected work and performance levels; quantifiable and measurable benchmarks; identification of who tracks performance, when, and how; how frequently these agreements are reviewed and perhaps renegotiated; and, in the case of SLAs, incentives and penalties.
2. **Develop an integrated on-site/off-site operating model.** Japanese companies typically work very closely with their suppliers—so closely that most suppliers are physically located nearby. Developing a global ER&D network requires a healthy mix of global resources near or inside headquarters and resources located in emerging markets. At U.S.-based companies that have proven adept at engineering offshoring, the vast majority (about 95 percent) of resources for low-complexity work are in offshore locations. The rest are in high-cost locations, primarily to coordinate activities. For Japanese companies, greater on-site presence is required to ensure appropriate communication because of their traditional approach to engineering quality as well as culture and language.

3. **Build Japanese language capability for global ER&D employees.** Though a cornerstone of successful execution of offshore strategy, a focus on language skills is often ignored by companies aiming to establish a global footprint. ER&D knowledge is often “tribal” within a company. Creating successful products and sound engineering solutions requires a lot of in-person and over-the-phone interaction. Japanese companies need to invest in teaching the engineering staff in other countries a working knowledge of the Japanese language and the basics of their culture. A major Japanese industrial automation company, for example, puts each of its technical employees in India through a mandatory three-month Japanese language total immersion course—eating, drinking, sleeping Japanese. Within three months, Indian nationals are able to speak basic Japanese, and within six to 12 months, they can execute projects in Japanese. As a result, the company has been able to ramp up its technical workforce in India to more than 1,000 employees and complete entire projects in India, minimizing oversight from Japan.

4. **Change the management and engineering mind-set.** Controlling most aspects of a product’s engineering and design process is integral to the culture at most Japanese compa-
nies. Given fast-evolving technology and the need to develop a global talent pool, successful companies are increasingly relying on partners thousands of miles from headquarters. To remain competitive, Japanese companies must actively embrace this change. The move must be deliberate, yet be made carefully and systematically by applying the right governance mechanisms and checks and balances, to ensure that the advantages of a global network come without the loss of the core skills and operating disciplines that reside in the company.

5. Change the mind-set around design QRD. Over the last 40 years, Japanese manufacturers have largely built market positions through their firm commitment to robust quality, reliability, and durability (QRD). As the companies made their way up market, gaining market share and building strong global brands, their engineering design quality evolved. Companies designed and tested the initial technologies and products in Japan, then iteratively improved them and shipped the enhanced designs to other developed markets, like North America and Europe. With price premiums founded on brand strength, they reaped large profits from cost-competitive designs. This formula worked great when developed markets were growing in the 1990s and 2000s.

Now, emerging markets represent the richest growth opportunities. Demands in those markets differ greatly from what Japan experienced in the past. Japanese companies cannot expect to simply take their homegrown designs to India or China and win over customers: That would cater only to the thin layer of the upper market. Nor can they strip down current designs to offer cheap alternatives to address the bigger midmarket. Such products will not satisfy local needs, and heavy fixed costs layered into the products from expensive Japan-centric ER&D would make existing products too pricey for the market. Perhaps most critical, Japan has yet to prove it can reduce its high standards of engineering design quality without risking product liability risk.

Japanese companies cannot expect to simply take their homegrown designs to India or China and win over customers.
Japanese companies now operate in a world where business paradigms are increasingly defined by companies from countries that historically have not been known or well regarded for innovation: South Korea, China, and India. New competitors, once written off in the developed world, will continue to redefine the marketplace and address new demand, especially in emerging markets. As these companies gain experience, they are bound to reduce the QRD advantage that Japanese companies have considered their most compelling competitive advantage. Market structure changes combined with demographic challenges in Japan create a “perfect storm” that Japanese companies need to navigate. Leveraging the increasingly sophisticated human capital that exists outside Japan might be one of the few options left for Japanese companies to ensure the continuation of their well-earned legacy in quality, innovation, and product development.

**CONCLUSION**

New competitors will continue to redefine the marketplace and address new demand, especially in emerging markets.
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Endnote

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Today, with more than 3,300 people in 60 offices around the world, we bring foresight and knowledge, deep functional expertise, and a practical approach to building capabilities and delivering real impact. We work closely with our clients to create and deliver essential advantage.

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