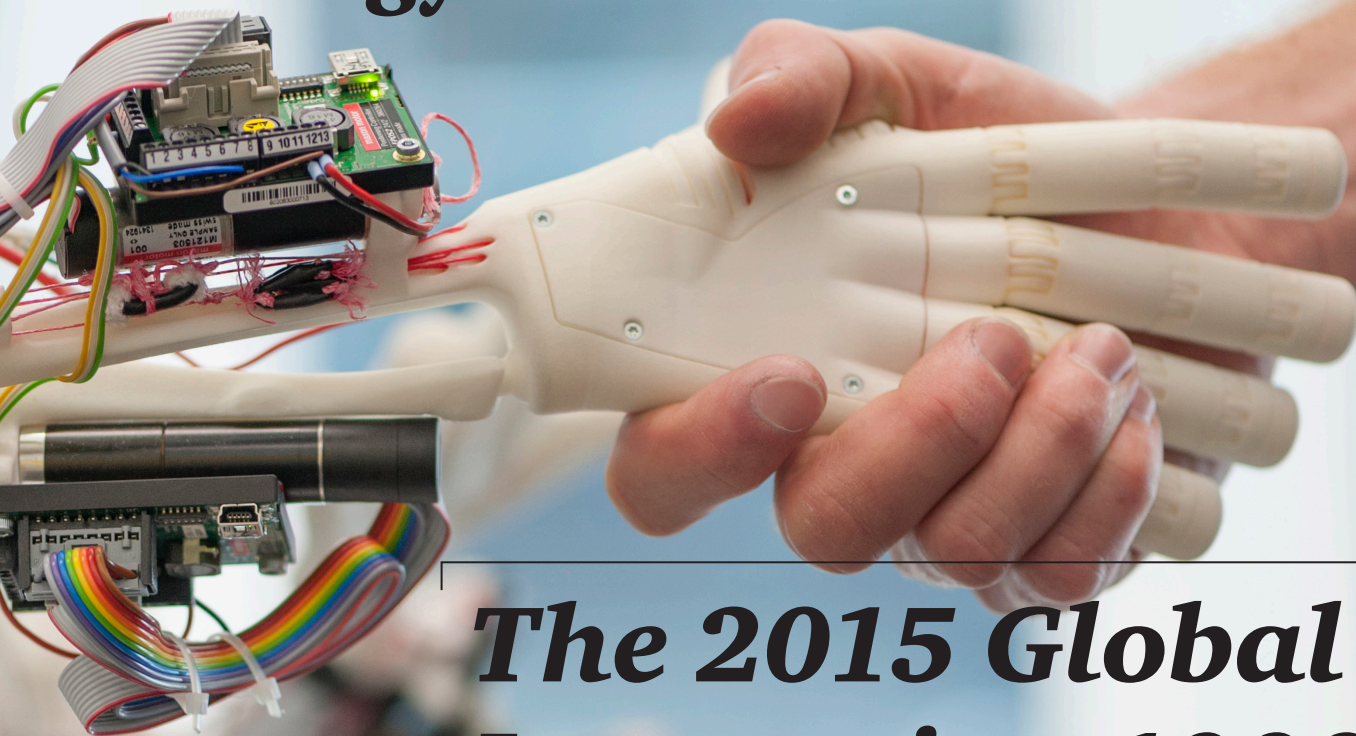


strategy&



The 2015 Global Innovation 1000



**Innovation's new
world order**



In the 2015 Global Innovation 1000 study, Strategy&, PwC's strategy consulting business, analyzed the flows of R&D spending among companies and countries worldwide. We found that the geographic footprint of innovation has expanded dramatically in the years since our 2008 study, when we first charted the globalization of R&D. The new landscape reflects significant regional shifts, as more companies pursue innovation programs abroad in search of access to top talent and high-growth markets.

Led by dynamic growth in China and India, Asia is now the number one region for corporate R&D spending.

- More corporate in-region R&D is now conducted in Asia (35 percent) than in North America (33 percent) and Europe (28 percent), which is a change from 2007, when Europe was the top region for R&D spending and Asia was third.
- Massive growth in China and India propelled Asia to the top position. From 2007 to 2015, R&D imports to China grew 79 percent, helping to make it the second-largest destination for in-country R&D. India also saw imports increase 116 percent, making it the third-largest destination for imported R&D.

The U.S. holds its position as the largest corporate in-country R&D spender, importer, and exporter.

- The U.S. is the largest spender on in-country R&D, but its lead is narrowing because its growth isn't as robust as that of some Asian countries, specifically China. From 2007 to 2015, in-country R&D spending increased 120 percent for China but only 34 percent for the U.S.
- Although the U.S. is shifting more of its R&D exports to low-cost countries in Asia such as China and India, most R&D imports are from Europe, which provided 63 percent of the U.S. total in 2015.

Europe falls from largest to third-largest region for corporate R&D spending.

- A large increase (46 percent) in R&D exports out of Europe, and low growth in domestic and imported R&D spending (2 percent and 18 percent, respectively), caused Europe to drop from the largest to the third-largest region for R&D spending.
- Most of Europe's drop in in-country R&D spending was attributable to Western Europe, where net exports (exports minus imports) grew 352 percent between 2007 and 2015.

Globalization of R&D spending has paid dividends.

- Companies with dispersed global R&D footprints continue to perform as well as or better than companies with a focused footprint, suggesting that there are material advantages to exporting R&D and that multinationals are able to coordinate successfully across many global sites.

R&D spending gets back on trend after its post-financial crisis dip.

- In 2015, R&D spending by the Global Innovation 1000 increased by more than 5 percent to US\$680 billion, the largest year-over-year increase since 2012.
- Software & Internet had the highest year-over-year growth rate (27 percent) of all the industries in our analysis, which propelled it past the industrials sector to become the fourth-largest industry by R&D spending in 2015.
- In 2015, Apple and Google remained the two most innovative companies, according to our survey respondents, and Tesla jumped to third place, pushing Amazon down to fifth. Toyota rejoined the ranking at number 10 after a two-year hiatus.

The 2015 Global Innovation 1000 study maps R&D spending worldwide

In this year's study, we wanted to examine where R&D is being conducted — and to determine whether those destinations have changed since our 2008 study, when we first charted the global flows of corporate R&D. To analyze these flows among regions and countries, we researched the innovation

activities of 207 companies in 23 countries conducting R&D at 2,041 R&D sites in more than 60 countries. This sample of major innovators accounts for 71 percent of the total Global Innovation 1000 R&D spending. The following are the results of this analysis.

Asia becomes the number one region for corporate R&D spending; Europe falls to third

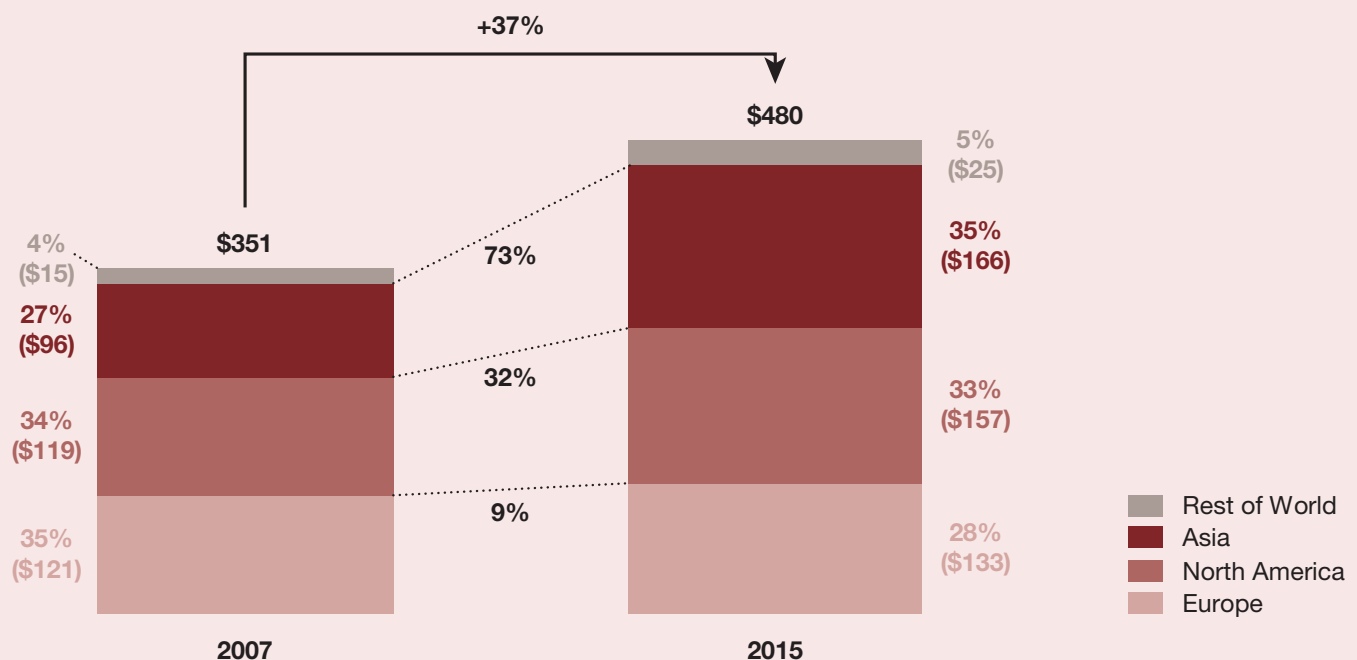
Asia experienced the most dramatic change in innovation spending, as companies sought out high-growth markets and geographic advantages such as proximity to manufacturers and suppliers.

- In 2015, Asia accounted for 35 percent of total corporate in-region R&D spending, surpassing both North America (33 percent) and Europe (28 percent) (see Exhibit 1). This is a complete reversal from 2007, when Europe was the top region and Asia ranked third.
- Asia's rise as the top in-region R&D spender was driven by strong domestic spending, which increased 60 percent to \$79 billion between 2007 and 2015, and imports, which increased by 86 percent to \$86 billion.
- China and India were the main drivers of

Asia's rise: China's strong growth in imports helped propel it past Germany and Japan to become the second-largest destination for in-country R&D (\$55 billion). India's 115 percent increase in in-country R&D spending to \$28 billion was powered by a 116 percent increase in imports.¹ Both countries received imports mainly from the U.S.

- Our survey respondents stated that the most important advantages of moving R&D functions to Asia, specifically China, are proximity to a high-growth market (71 percent), followed by proximity to key manufacturing sites (59 percent), proximity to key suppliers (54 percent), and lower development costs (53 percent).

Exhibit 1
Change in Corporate R&D Spending by Region, 2007–15 (US\$ Billions)



Source: Strategy& 2015 Global Innovation 1000 analysis

The U.S. continues to dominate, but with a narrowing lead

The U.S. remains the largest corporate R&D spender, importer, and exporter, as companies continue to be attracted to its steady economic environment and strong innovative culture.

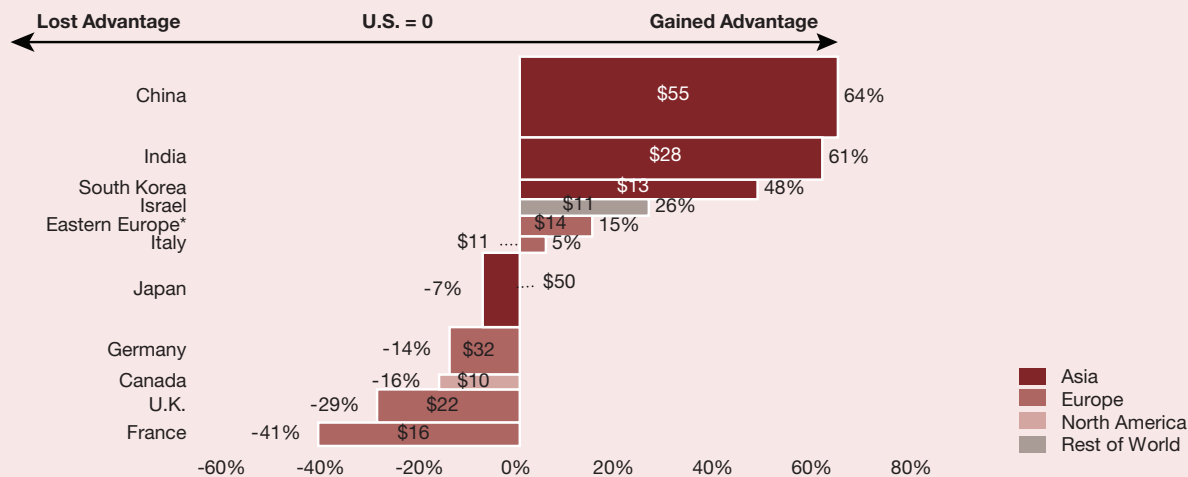
- The U.S. held its position as the top location for innovation, with in-country R&D spending of \$145 billion in 2015. However, other countries (i.e., China) increased their R&D spending by greater proportions than the U.S., which caused it to lose some of its relative advantage (*see Exhibit 2*).
- The U.S. increased imports by 23 percent to \$53 billion in 2015. But the second-largest importer, China, increased imports by 79 percent, bringing its total to \$44 billion — narrowing the U.S.'s lead.
- The U.S. is seeing an increase in imports from Europe, specifically from companies headquartered in Germany, Switzerland, and France, which are seeking a large market and access to Silicon Valley.
- The increase in imports is balanced out by the increase in exports, as U.S.-headquartered companies increased exports by 51 percent, to \$121 billion, between 2007 and 2015.
- The U.S. is exporting more R&D to low-cost countries like China and India, which each account for 15 percent of U.S. exports in 2015. This is a change from 2007, when the UK was the top destination for U.S. R&D exports (accounting for 10 percent).²



Exhibit 2

Change in Corporate In-Country (Domestic and Imported) R&D Spending Relative to the U.S. U.S., 2007–15.

Height of bar = 2015 In-Country R&D Spending (\$US, Billion)



* Eastern Europe includes: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Turkey

Source: Strategy& 2015 Global Innovation 1000 analysis



Asia, North America, and Europe are continuing to send R&D to low-cost Asian countries, but Europe is now also sending it to high-cost countries like the United States. Executives tell us that they want to tap into the more innovative culture of the U.S., as well as its more flexible operating environment.

— Barry Jaruzelski, Principal, Strategy&, PwC's strategy consulting business

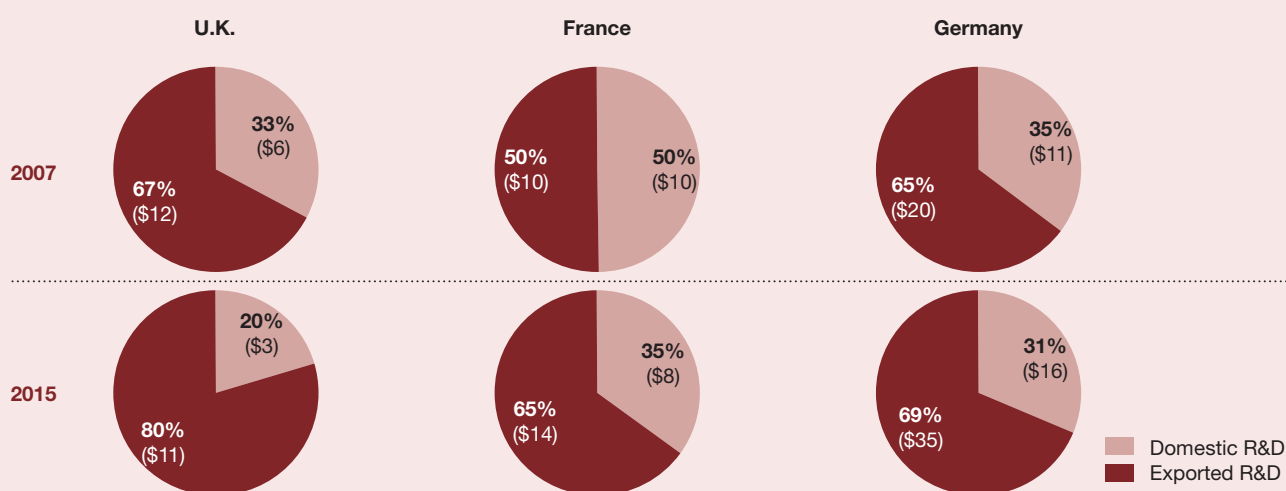
Europe falls to third place among the top destinations for corporate in-region R&D spending

European companies send corporate R&D offshore in search of higher growth markets, skilled labor, and more flexible operating environments.³

- Europe's fall was the result of low growth in domestic R&D (2 percent compared to 40 percent in North America and 60 percent in Asia), low growth in imported R&D (18 percent), and high growth in exported R&D (46 percent).
- The R&D flows out of Europe are happening mostly in Western Europe, where net exports of R&D to other countries (exports minus imports) grew 352 percent. The three largest economies in Europe — the U.K., France, and Germany — all increased their share of exported R&D (see Exhibit 3).
- R&D is most noticeably flowing out of France and Germany. The former saw both domestic and imported R&D decrease (20 percent and 21 percent, respectively) between 2007 and 2015, and exports increase 46 percent. While Germany did increase its domestic R&D (48 percent), imports declined (2 percent) and exports increased a staggering 76 percent from 2007 to 2015.
- Although some European countries are sending exports to low-cost countries (LCCs) in Asia and Eastern Europe, the majority of exports are going to high-cost countries (HCCs) such as the U.S. and Japan, as Europe seeks a more flexible operating environment, according to some senior executives.

Exhibit 3
Corporate R&D Allocation of Europe's Three Largest Economies

R&D Allocation by Country 2007 vs. 2015, US\$ Billions



Source: Strategy& 2015 Global Innovation 1000 analysis

“Europe went from being the number one location for the execution of corporate R&D to number three, falling behind Asia and North America — it's the hollowing out of Europe.
Barry Jaruzelski, Principal, Strategy&, PwC's strategy consulting business

Auto industry shows strongest increases in corporate R&D exports

- Out of the three largest industries by R&D spending — auto, healthcare, and computing and electronics (C&E) — the one that was the strongest driver of export growth globally was the auto industry. From 2007 to 2015, companies in this sector increased exported R&D by 45 percent, while the healthcare and computing and electronics industries increased exports by only 23 percent each.
- The auto and healthcare industries increased exports the most to the U.S. and China; the computing and electronics industry increased exports to China and India.
- While the U.S. remains the largest importer of auto R&D, accounting for 34 percent of total imports in 2015, China (14 percent) has replaced Germany (6 percent) as the second-largest importer.
- China is the largest importer of C&E R&D, accounting for 20 percent of total imports in 2015. India (13 percent) replaced the U.S. (10 percent) as the second-largest importer.
- The U.S. is the largest healthcare R&D importer, accounting for 21 percent of total imports in 2015. China replaced the UK as the second-largest importer (14 percent) and Japan passed Germany and Canada to move into third (9 percent).

“A lot of the major automotive players still have a central product development approach — everything still goes out of their headquarters country. However, some are starting to recognize the benefit of a globalized footprint by sending R&D to other locations and are building up regional R&D centers.
— Volker Staack, Principal, Strategy&, PwC’s strategy consulting business

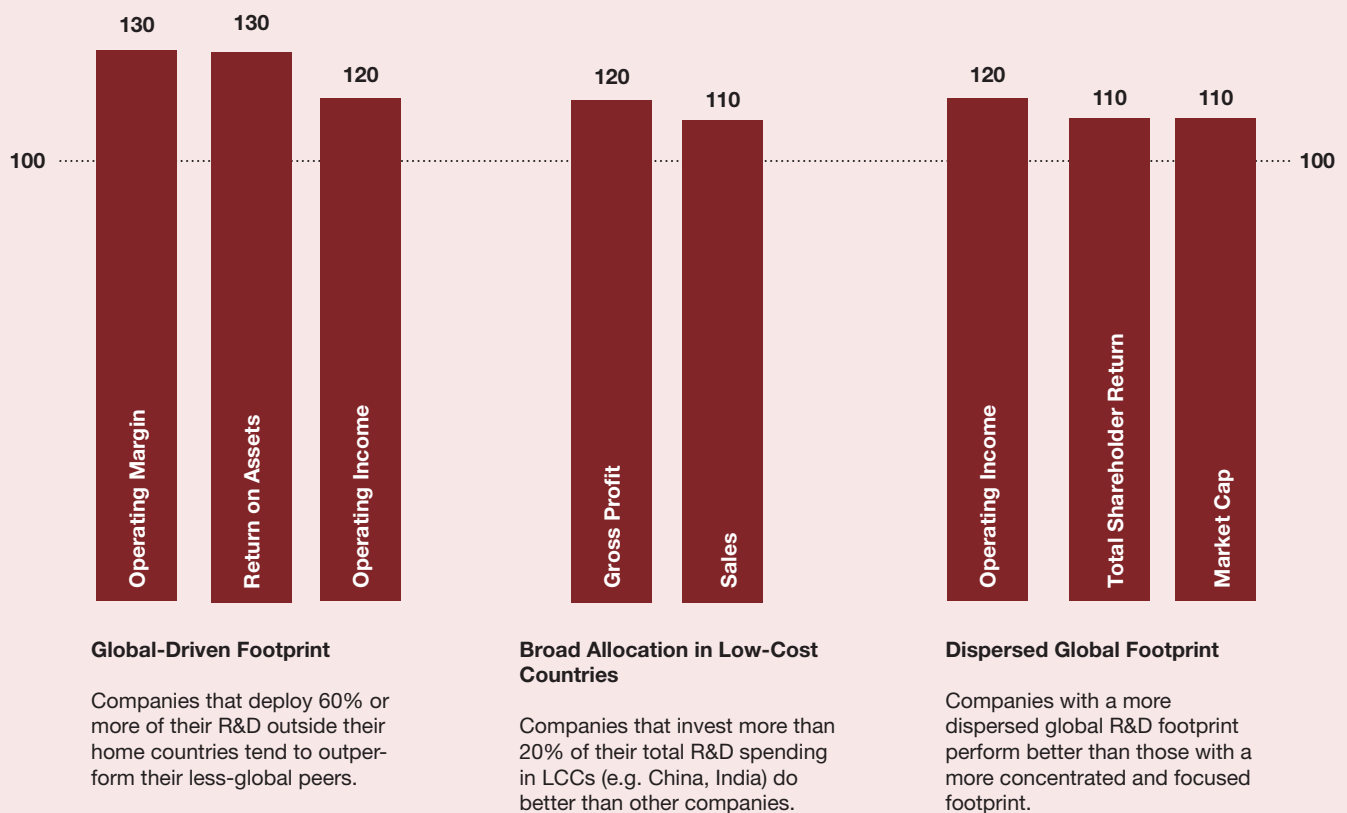
The global advantage

- Companies that deployed 60 percent or more of corporate R&D spending abroad in 2015 earned a premium of 30 percent on operating margin and return on assets, and 20 percent on growth in operating income, over their less outward looking competitors. This finding was similar to the results of our 2008 study, suggesting that there continues to be a payoff from the deployment of capabilities and capacity on a global scale, and greater success in understanding and meeting local market needs (see Exhibit 4).
- Companies that allocate a greater share of corporate R&D spending to LCCs outperform their competitors by 20 percent on gross profit and 10 percent on sales growth.
- Companies with dispersed global R&D footprints perform as well as or better than companies with a focused footprint, suggesting that multinationals have improved coordination across many global sites.



Exhibit 4

The Performance Payoff from a Global R&D Footprint



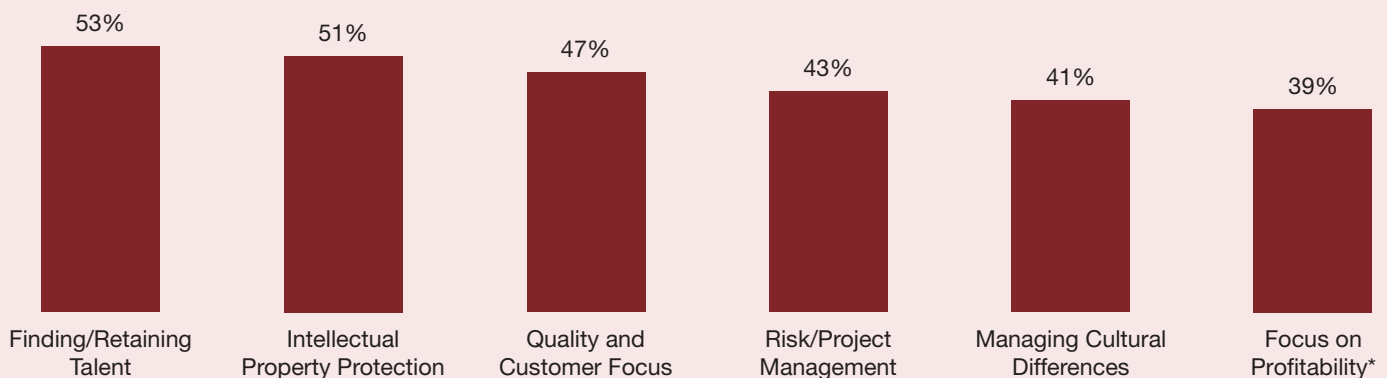
Source: Strategy& 2015 Global Innovation 1000 analysis, Bloomberg data, Capital IQ data

The global challenge

Although clear advantages exist for globalizing a company's R&D footprint, companies must consider numerous factors when deciding where to conduct R&D.

- According to survey respondents, access to technical talent (71 percent), being close to customers (68 percent), and gaining insight into local market needs (64 percent) are the most important factors when choosing where to conduct R&D, all of which help in the better design of products for local customers.
- The most challenging aspects of conducting R&D outside the home country are finding/retaining talent (according to 53 percent of survey respondents), protecting intellectual property (51 percent), and maintaining quality and a customer focus (47 percent) (see Exhibit 5).
- Almost half (49 percent) of survey respondents think software design is the best function for R&D centers in LCCs to perform, followed by data analysis/gathering (34 percent) and customer service (30 percent); however, almost one-quarter (24 percent) do not think R&D functions are best performed in LCCs.

 **Exhibit 5**
Most Challenging Attributes When Conducting R&D Outside Home Country




* Focus on profitability includes those who voted for "Currency risk" and "Return on investment"

n=369

Based on a scale of 1-5 where 1 = Not at all challenging and 5 = Extremely challenging. Percentages based on those who rated a "4" = Challenging and "5" = Extremely challenging.

Source: Strategy& 2015 Global Innovation 1000 survey data and analysis

 **Strategic reasons, such as access to local market insights and global talent, are what determine where R&D is conducted. Labor cost savings and tax advantages, though not irrelevant, are secondary considerations.**

— Kevin Schwartz, Principal, PwC US Management Consulting

The three innovation models

When comparing the advantages and challenges of a global R&D footprint across the three innovation models used in prior Global Innovation 1000 studies, Need Seekers, Market Readers, and Technology Drivers agreed across most attributes, with only a few exceptions:

- Need Seekers (85 percent) and Technology Drivers (68 percent) agree the most important attribute in determining where to conduct R&D is access to talent, whereas Market Readers believe it's proximity to customers (73 percent) — reflecting the advanced technological needs of the former innovation models.
- Need Seekers say the top challenges of conducting R&D outside the home country are intellectual property protection (56 percent) and quality control (56 percent), which are of vital importance to the first-to-market innovation model; Technology Drivers and Market Readers say it is finding/retaining talent, named as the top challenge by 55 percent and 51 percent, respectively.


Our study classifies companies into one of three groups based on behaviors:

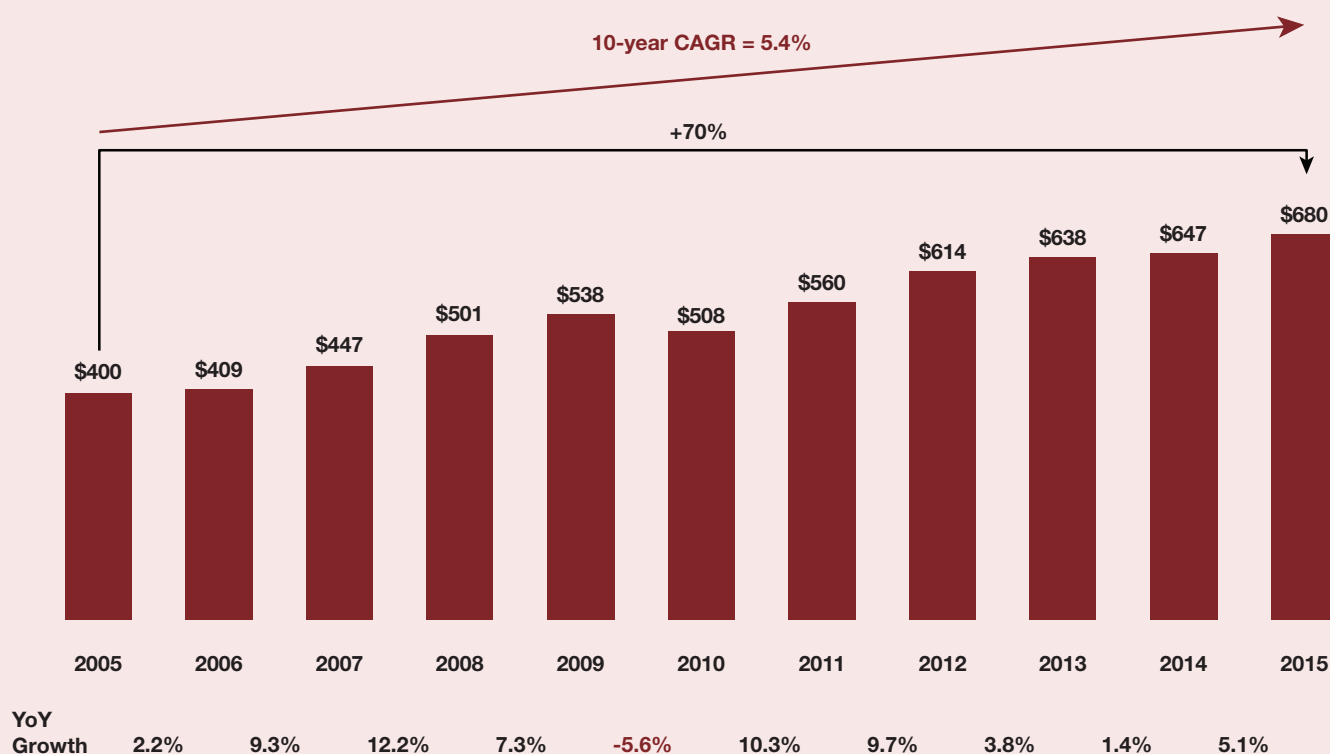
- ***Need Seekers:*** Companies that are Need Seekers tend to engage consumers directly to generate new ideas, and then develop original products and services addressing unarticulated needs and get them to market first.
- ***Market Readers:*** Companies defined as Market Readers are fast followers. They typically generate ideas by closely monitoring their markets, customers, and competitors, focusing largely on creating value through incremental innovations to current products.
- ***Technology Drivers:*** Companies that are Technology Drivers depend heavily on their internal technological expertise to develop new products and services, driving both breakthrough innovation and incremental change to meet the needs of their customers via new technology.

Global R&D spending and R&D intensity experience record gains, but revenue declines

- In 2015, R&D spending by the Global Innovation 1000 increased 5.1 percent to \$680 billion, the largest year-over-year increase since 2012 (see Exhibit 6).
- Revenues declined 1.0 percent — mostly owing to declines in the chemicals and

energy sector from falling oil prices — causing R&D spending as a percent of revenue (intensity) to have a one-year growth rate of 6.1 percent, the highest since 2005.

 **Exhibit 6**
Total Global Innovation 1000 R&D Spending, US\$ Billions



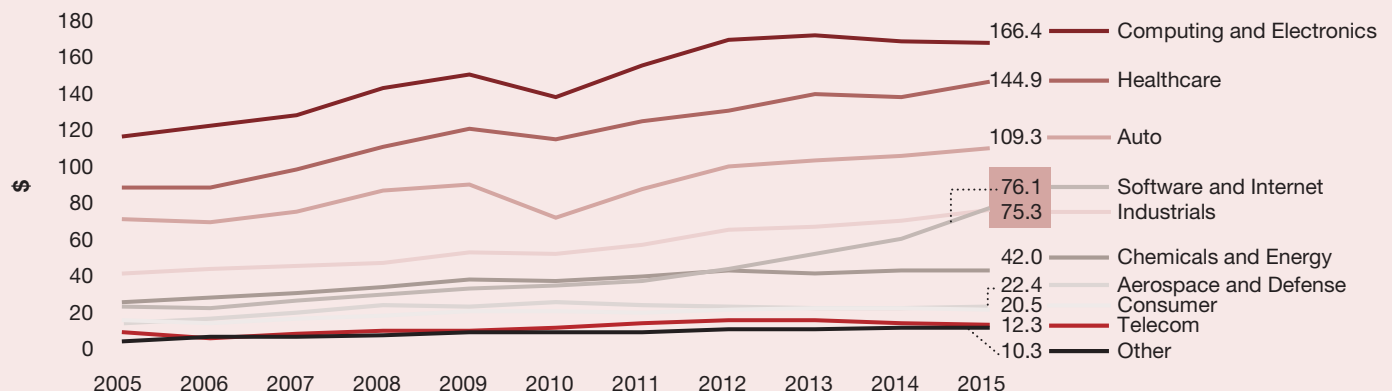
Source: Strategy& 2015 Global Innovation 1000 analysis, Bloomberg data, Capital IQ data

R&D spending rises for most industries

The computing and electronics industry remains the largest spender on R&D, but it is losing ground.

- The computing and electronics (C&E) industry accounts for the largest amount of R&D spending (25 percent) by the Global Innovation 1000, spending \$166 billion; however, growth declined 0.7 percent in 2015.
- The healthcare industry is closing its gap on C&E, growing 6 percent in 2015 to \$145 billion. Given C&E's negative growth, we believe healthcare could become the largest industry based on R&D spending by 2019 (see Exhibit 7).
- Software and Internet (27 percent) had the highest growth rate of all the industries between 2014 and 2015; this was unsurprising as the thirst for digital technologies drives demand. This growth propelled software and Internet past the industrials sector to become the fourth-largest industry by R&D spending in 2015.

Exhibit 7
Corporate R&D Spending by Industry (US\$ Billions)



Source: Strategy& 2015 Global Innovation 1000 analysis, Bloomberg data, Capital IQ data

“Although software and Internet surpassing industrials as the fourth-largest industry in terms of R&D spending is not a surprise, it is a milestone. It is software (the new economy) and rust-belt industrials (the old economy) trading places.

— Barry Jaruzelski, Principal, Strategy&, PwC’s strategy consulting business

Companies shift positions in Global Innovation 1000 rankings

- Leading the 2015 Global Innovation 1000 Top 20 R&D Spenders were Volkswagen, Samsung, Intel, Microsoft, and Roche, which held the same first five positions as last year.
- Apple makes its first appearance ever in the

Top 20 R&D Spenders list in 2015, despite being an efficient innovator and spending only 3.3 percent of its revenues on R&D, compared with an average 12.5 percent for the other 19 companies on the list (*see Exhibit 8*).



Exhibit 8

The 2015 Top 20 R&D Spenders

Rank	Company	Industry	2015 R&D Spending (US\$ billion)	Intensity (R&D spending as a % of revenue)
1	Volkswagen	Auto	\$15.3	5.7%
2	Samsung	Computing and electronics	\$14.1	7.2%
3	Intel	Computing and electronics	\$11.5	20.6%
4	Microsoft	Software and Internet	\$11.4	13.1%
5	Roche	Healthcare	\$10.8	20.8%
6	Google	Software and Internet	\$9.8	14.9%
7	Amazon	Software and Internet	\$9.3	10.4%
8	Toyota	Auto	\$9.2	3.7%
9	Novartis	Healthcare	\$9.1	17.3%
10	Johnson & Johnson	Healthcare	\$8.5	11.4%
11	Pfizer	Healthcare	\$8.4	16.9%
12	Daimler	Auto	\$7.6	4.4%
13	General Motors	Auto	\$7.4	4.7%
14	Merck	Healthcare	\$7.2	17.0%
15	Ford	Auto	\$6.9	4.8%
16	Sanofi	Healthcare	\$6.4	14.1%
17	Cisco Systems	Computing and electronics	\$6.3	13.4%
18	NEW Apple	Computing and electronics	\$6.0	3.3%
19	GlaxoSmithKline	Healthcare	\$5.7	15.0%
20	NEW AstraZeneca	Healthcare	\$5.6	21.4%

↑ ↓ Increase or decrease within Top 20 ranking compared to 2014

Source: Strategy& 2015 Global Innovation 1000 analysis, Bloomberg data, Capital IQ data

Companies shift positions in Global Innovation 1000 rankings (Continued)

- In 2015, Apple and Google remain the two most innovative companies. Tesla jumps to third place, pushing Amazon down to fifth. Toyota rejoins the ranking for the first time since 2012 at number 10 (see Exhibit 9).
- This year marks the first time two automotive companies are in the 10 Most Innovative Companies list (Tesla at number three, Toyota, number 10).



Exhibit 9

The 10 Most Innovative Companies

Company	Industry	2015 R&D Spending (US\$ billion)
Apple	Computing and electronics	6.0
Google	Software and Internet	9.8
↑ Tesla	Auto	0.5
Samsung	Computing and electronics	14.1
↓ Amazon	Software and Internet	9.3
3M	Industrials	1.8
General Electric	Industrials	4.2
Microsoft	Software and Internet	11.4
IBM	Computing and electronics	5.4
NEW Toyota	Auto	9.2

↑ ↓ Increase or decrease within Top 10 ranking compared with 2014

Source: Strategy& 2015 Global Innovation 1000 survey data and analysis

Methodology

As it has in each of the past 10 editions of the Global Innovation 1000, this year Strategy&, PwC's strategy consulting business, identified the 1,000 public companies around the world that spent the most on R&D during the last fiscal year, as of June 30, 2015. To be included, companies had to make their R&D spending numbers public. Subsidiaries that were more than 50 percent owned by a single corporate parent during the period were excluded if their financial results were included in the parent company's financials. The Global Innovation 1000 companies collectively account for 40 percent of the entire world's R&D spending, from all sources, including corporate and government sources.

In 2013, Strategy& made some adjustments to the data collection process in order to gain a more accurate and complete picture of innovation spending. In prior years, both capitalized and amortized R&D expenditures were excluded. Starting in 2013, we included the most recent fiscal year's amortization of capitalized R&D expenditures for relevant companies in calculating the total R&D investment, while continuing to exclude any non-amortized capitalized costs. We have now

applied this methodology to all previous years' data; as a result, historical data referenced in the studies from 2014 onward will not always align with previously published figures for the 2005 through 2012 studies.

For each of the top 1,000 companies, we obtained from Bloomberg and Capital IQ the key financial metrics for 2010 through 2015, including sales, gross profit, operating profit, net profit, historical R&D expenditures, and market capitalization. All sales and R&D expenditure figures in foreign currencies were translated into U.S. dollars according to an average of the exchange rate over the relevant period; for data on share prices, we used the exchange rate on the last day of the period.

All companies were coded into one of nine industry sectors (or "other") according to Bloomberg's industry designations, and into one of five regional designations, as determined by their reported headquarters locations. To enable meaningful comparisons across industries, the R&D spending levels and financial performance metrics of each company were indexed against the average values in its own industry.

Methodology (Continued)

To understand the global distribution of R&D spending, the drivers of that distribution, and how the distribution affects the performance of individual companies, we researched the global R&D footprint of the top 100 companies in terms of their 2015 R&D spending, plus the top 50 companies in the largest three industries (auto, healthcare, and computing and electronics) and the top 20 companies in the industrials and software and Internet sectors. The total number of companies for which we assessed the distribution of R&D spending across countries was 207, reflecting overlap in the top 100 and the five selected industries. These 207 companies are headquartered in 23 countries and conduct R&D activities at 2,041 R&D sites spanning more than 60 countries.

When geographic breakdowns were not publicly available, we collected data on the location of

R&D facilities, the product segments each facility supports, the year each facility was established, the number of people it employs, its sales by product segment, and the global distribution of sales. This data was used to allocate total R&D dollars to the countries where facilities were located.

Finally, to understand how global R&D is and will be conducted at companies across multiple industries, Strategy& conducted a separate online survey of 369 innovation leaders around the world. The companies participating represented over US\$106 billion in R&D spending, or 16 percent of this year's total Global Innovation 1000 R&D spending, all nine of the industry sectors, and all five geographic regions.

Endnotes

¹ In-country includes both R&D spending by local companies (domestic) and R&D spending in other regions (imported).

² All countries with an average engineering wage of less than or equal to \$35,000/year, such as China and India, are low-cost countries (LCCs). Countries with an average engineering wage that is greater than \$35,000/year, such as Japan and the U.S., are high-cost countries (HCCs).

³ Offshore refers to a geographic area outside the designated region's geographic border.

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Barry Jaruzelski is a thought leader on innovation for Strategy&, PwC's strategy consulting group. Based in Florham Park, N.J., he is a principal with PwC US. He works with high-tech and industrial clients on corporate and product strategy and the transformation of core innovation processes. He created the Global Innovation 1000 study in 2005, and in 2013 was named one of the "Top 25 Consultants" by *Consulting* magazine.
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