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The Innovation Imperative in Manufacturing

How the United States Can Restore Its Edge

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Note to the Reader

"Nothing is more important than innovation. The minute we stop innovating, we die." This remark, made by one of the manufacturing company executives we interviewed for this report, mirrors our own opinion and the urgency of our findings. In these challenging economic times, business innovation is more than ever a critical strategic imperative.

This report assesses the state of innovation in the United States; describes the most effective tools for promoting innovation, according to the respondents to our innovation assessment survey; and explores how stakeholders—company executives and policymakers alike—can take practical steps to move toward the shared goal of encouraging and sustaining innovation. We hope this report helps to enhance the state of manufacturing innovation in the United States.

About the Authors

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Introduction

More than ever before, business innovation is a strategic imperative. A critical driver of growth, competitiveness, and shareholder value, innovation is cited by senior executives around the world as integral to their companies' success. And innovation benefits countries as well. In those with thriving industries, people have higher incomes, a better quality of life, and a higher standard of living than in less robust nations.

In today's global economy, the need to stay one step ahead of the competition is even more urgent—especially for industries in the United States. The emergence of challengers from rapidly developing economies such as India, China, Brazil, and Eastern Europe has transformed the playing field.[1] With high-quality inexpensive products flooding the market from every corner of the globe, competing on cost alone is a losing battle for most U.S.-based manufacturers. According to a recent study, the United States has aggregate structural costs that are 17.6 percent higher than those of its nine largest trading partners, putting U.S. companies at a significant disadvantage.[2] This imbalance puts the 13.8 million manufacturing jobs in the United States at risk as production increasingly threatens to move offshore.[3] The current economic downturn makes circumstances even more dire.

To stay in the game, companies in the United States must differentiate themselves through innovation: new products and services, new ways of working, new ways of going to market. And government—at both the national and the local level—must support these efforts through effective policies. Now is the time for companies and countries alike to focus on strengthening their competitive position. Only those nations that continue to invest in innovation and its enablers, such as a highly skilled and talented work force, will stay competitive in the long run.

With this in mind, BCG, NAM, and The Manufacturing Institute sought to assess the current state of innovation at U.S. companies and how the United States ranks as an innovation leader relative to other countries. What factors make companies successful at innovation? And what role does government policy play in supporting innovation? To find the answers, we conducted a detailed innovation assessment with three components:

- *A survey of NAM corporate members across all industries, representing a wide range of company sizes.* The survey focused on three areas: the use of innovation tools and processes, innovation results, and the impact of public policy. We received 1,032 responses, 78 percent from high-level executives—most in general management or business development and strategy.

- *A series of one-hour follow-up interviews with 30 senior executives to identify common concerns, best practices, and ways to improve the innovation climate.* The questions focused on two main issues: approaches to and experiences with innovation and how the United States ranks as a center of innovation.

1. See *The 2008 BCG 100 New Global Challengers: How Top Companies from Rapidly Developing Economies Are Changing the World,* BCG report, December 2007.

2. Jeremy A. Leonard, *The Tide Is Turning: An Update on Structural Cost Pressures Facing U.S. Manufacturers,* National Association of Manufacturers and The Manufacturing Institute, November 2008.

3. U.S. Bureau of Labor Statistics, http://data.bls.gov/PDQ/servlet/SurveyOutputServlet?series_id=CES3000000001&data_tool=XGtable.

- *A comparison of the "innovation friendliness" of 110 countries and all 50 U.S. states on the basis of their government policies and performance.* Using these data, we developed the International Innovation Index, which includes more countries than other previous such compilations, and the first National Innovation Index, which addresses both innovation inputs and outputs.

Not surprisingly, we found that innovation drives the relative success of companies and countries alike. Countries with the most innovative companies and industries tend to have a larger gross domestic product per capita than those that are less forward-looking. Because of this strong link between innovation and growth, many governments are committing resources to support innovation. China and India, for instance, have both declared innovation to be a strategic national priority and have dedicated significant resources to meet their goals in science and technology. China has developed a 15-year plan for science and technology, and India is increasing investment in research and development by an average rate of 40 percent per year.[4] By comparison, our interviews suggest that the United States may be falling short in its commitment to innovation and in its innovation performance.

The survey and analyses on which this report is based differ from previous research in addressing both the business outcomes of innovation and government's ability to encourage and support innovation through public policy. The interdependence of government and business, and the mutual need for success in this critical area, came into sharp focus as we analyzed our findings. In this report, we will outline the actions that companies can take to become more innovative, and parallel steps that governments can take to support those efforts.

To understand the drivers and enablers of innovation, we used metrics that capture a wide array of innovation results. We evaluated those metrics by assigning weights to each of their component elements on the basis of a poll of expert practitioners and executives. We also collected data, including innovation-specific measures and broader economic and social measures, from third-party research sources, including the World Bank, Unesco, and the World Economic Forum. We then ranked countries and grouped states according to their index scores. Finally, by adding interview data to our survey data, we gained a deeper understanding of the state of innovation within companies and of how executives view the innovation climate globally.

4. "China's 15-Year Science and Technology Plan," *Physics Today,* December 2006; "India and China Wise Up to Innovation," *BusinessWeek,* January 30, 2007.

What Is Innovation?

Once narrowly defined as simply the development of new products, innovation is now understood to apply to all aspects of a business. One executive we interviewed summed up this evolving definition: "We've expanded our thinking on innovation. We used to focus on new-product development, but now we see that products are only one aspect. We look upstream and downstream for other applications, including the business model, enterprise structure, value chain, proprietary processes, channels, service, brand, and customer experience."

In accordance with this broader definition, our innovation assessment took into account two types of innovation output:

- *Tangible Outcomes.* New products, knowledge, formulas, designs, and expertise that are easily quantified and can be legally protected through patents or other intellectual-property vehicles.

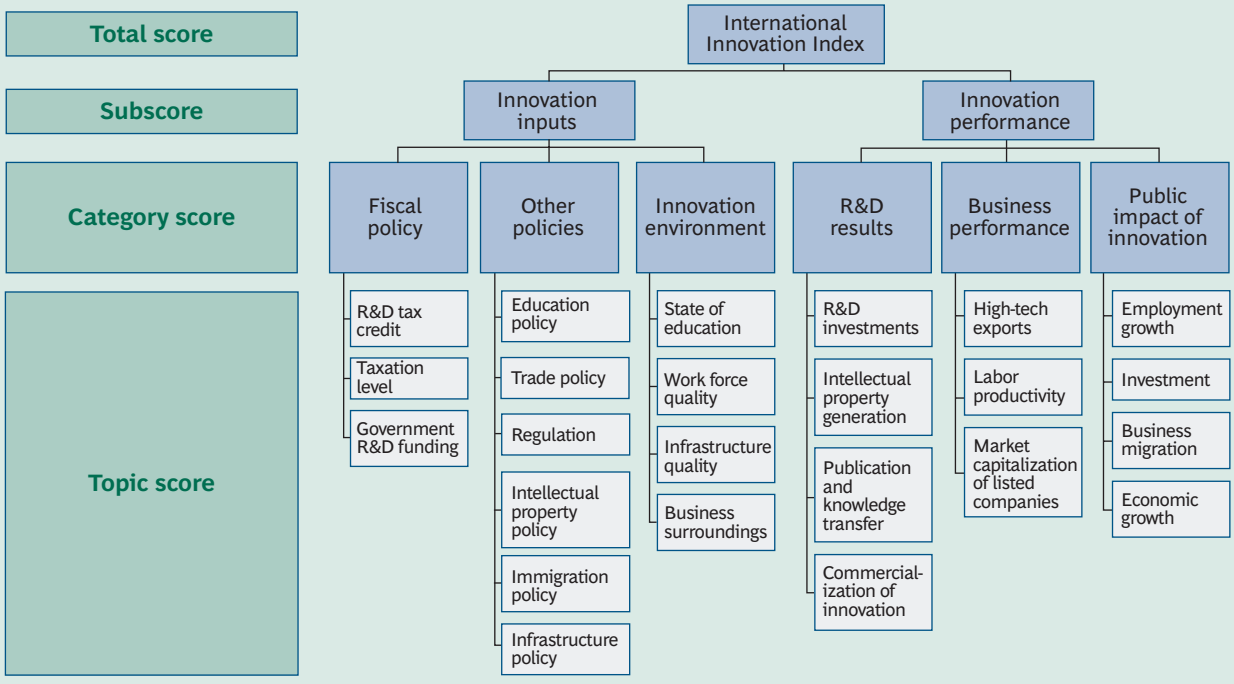
- *Intangible Outcomes.* New processes or ways of doing business that lead to a competitive advantage, such as a new companywide production process that results in higher quality and greater productivity. Intangible outcomes aren't themselves easily quantified but can have a major impact on quantifiable results, such as overall business performance. They generally cannot be legally protected.

Which Countries and States Are the Most Innovative?

To rank the 110 countries in our International Innovation Index and compare the innovation status of the 50 U.S. states, we analyzed the impact on innovation performance of inputs such as government and fiscal policy, education policy, and the innovation environment. (See Exhibit 1.) These inputs drive performance by either supporting or hindering the efforts of companies and industries. To evaluate innovation performance, we measured outputs such as patents, technology transfer, and other R&D results; business performance, such as labor productivity and total shareholder returns; and the broader public impact of innovation on business migration and economic growth. We examined these factors across countries and on a state-by-state basis. (See the sidebar "The State of the States.")

The United States ranks eighth overall and second among the 20 largest countries (measured by GDP) on the Inter-

Exhibit 1. The International Innovation Index Is Based on a Variety of Inputs and Performance Factors



Sources: BCG, National Association of Manufacturers, and The Manufacturing Institute, innovation indexes, 2008.

national Innovation Index. (See Exhibit 2 and the Appendix.) Although still a top-tier player, it has fallen behind such countries as Singapore, South Korea, and Switzerland as an innovator. The United States is disadvantaged in several key areas, including work force quality and economic, immigration, and infrastructure policies. (See the section "The Role of Government" for a discussion of some of these issues.)

The executives we interviewed believe that the United States is losing its distinction as an innovation leader and may be underinvesting in its future. The comments we heard included the following:

- "I am concerned that the state of manufacturing and education in the U.S. is taking away the innovative spirit and diminishing the entrepreneurial sense that has long been the country's greatest strength."
- "The U.S. lacks uniqueness; innovation is now found everywhere, not exclusively or even prominently in the U.S."
- "The U.S. has moved into a situation of parity with the rest of the world."
- "It's like sports: athletes get old and new players step up to the plate."
- "The U.S. is becoming a victim of its own success; people are content with their standard of living and less motivated to improve their situation."

The United States is losing its distinction as an innovation leader.

Despite these concerns, the United States is still perceived as having valuable and unique attributes. In our interviews, we consistently heard comments such as the following:

- "The U.S. has a culture that encourages innovation. We don't punish those who have tried and failed; instead we look at it as a learning experience."
- "The U.S. attracts global talent, and that melting pot of ideas makes for a great climate for innovation."

Exhibit 2. Other Countries Have Surpassed the United States in Innovation

Overall ranking			Large-country ranking		
Ranking	Country	Score	Ranking	Country	Score
1	Singapore	2.45	1	South Korea	2.26
2	South Korea	2.26	2	United States	1.80
3	Switzerland	2.23	3	Japan	1.79
4	Iceland	2.17	4	Sweden	1.64
5	Ireland	1.88	5	Netherlands	1.55
6	Hong Kong	1.88	6	Canada	1.42
7	Finland	1.87	7	United Kingdom	1.42
8	United States	1.80	8	Germany	1.12
9	Japan	1.79	9	France	1.12
10	Sweden	1.64	10	Australia	1.02
11	Denmark	1.60	11	Spain	0.93
12	Netherlands	1.55	12	Belgium	0.86
13	Luxembourg	1.54	13	China	0.73
14	Canada	1.42	14	Italy	0.21
15	United Kingdom	1.42	15	India	0.06
16	Israel	1.36	16	Russia	–0.09
17	Austria	1.15	17	Mexico	–0.16
18	Norway	1.14	18	Turkey	–0.21
19	Germany	1.12	19	Indonesia	–0.57
20	France	1.12	20	Brazil	–0.59

Sources: BCG, National Association of Manufacturers, and The Manufacturing Institute, innovation indexes, 2008.
Note: Countries in the large-country ranking are the top 20 countries in the world by GDP. Because of rounding, two or more countries may appear to have the same overall score. For the purposes of these rankings, Hong Kong is considered a national entity.

- "U.S. tech capabilities are very high and will sustain successful innovation in the near term."
- "American universities are among the top in the world for education and research."
- "Everyone wants to study and teach in the U.S."

Because of these strengths, companies value the United States as a center for basic research—now and in the future. "We are invested in maintaining the U.S. as our hub of innovation," said one executive. Another noted, "While manufacturing will go to low-cost countries, innovation centers will stay in the U.S."

Although the United States still has great appeal as an innovation center, some companies are in fact moving selected innovation efforts elsewhere—often setting up R&D centers abroad to capitalize on leading-edge talent and lower-cost scientists and engineers or to better meet local market needs. An executive at one large company explained, "We have created research centers internationally—for example, in Singapore—to be closer to our international customers, who are becoming more and more important." Indeed, companies are expanding their global footprint—a reflection of the changing nature of business. "Thought leaders in many industries are no longer predominantly based in the U.S.," observed one executive we interviewed. "To maintain the current trend, we need to create a global network."

In fact, innovation is becoming a two-way street. Just as it is following customers abroad, innovation is also increasingly being imported into the United States. "Our labs in Asia are starting to come up with ideas that not only apply to their local customers but also are useful back here in the U.S.," noted one U.S.-based executive. "We are no longer solely an exporter of innovation but also an importer."

The State of the States

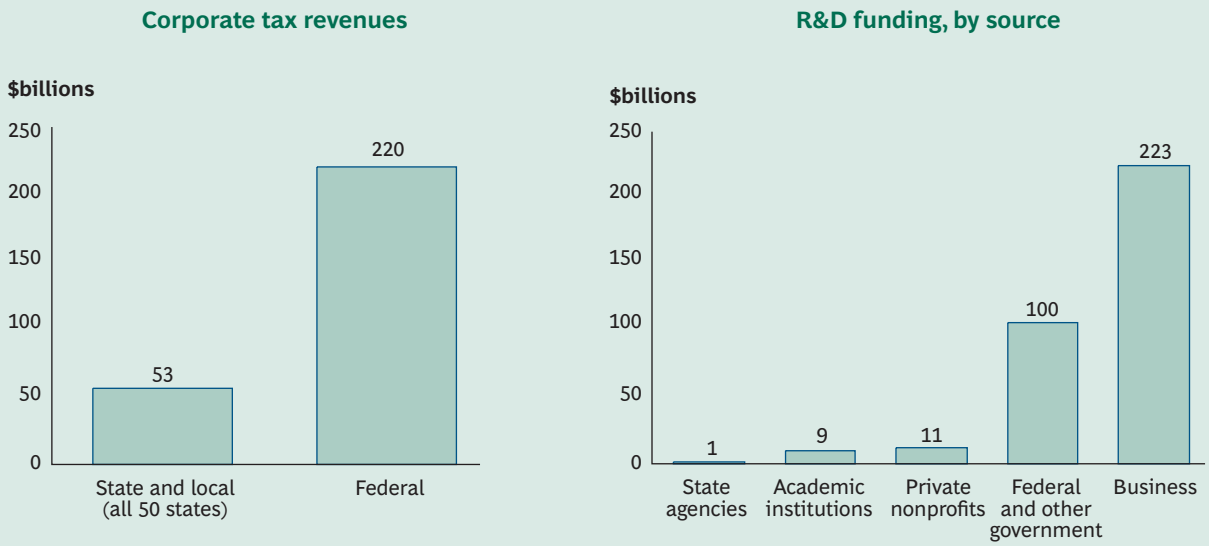
The 50 U.S. states are quite similar to one another in their innovation performance, especially when compared with the 110 countries on the International Innovation Index, which vary considerably. This similarity stems from two factors. First, federal policies, such as those relating to immigration, trade restrictions, and intellectual property protection, are the same across all the states. Federal corporate taxes and R&D spending dwarf state taxes and spending, further reducing state-to-state differences. (See the exhibit "State-Level Fiscal Policy Is a Relatively Insignificant Factor.") Second, a single "American culture" pervades the country's overall business climate, overriding many differences among regions, industries, and ethnic groups.

In light of this similarity, instead of compiling an absolute ranking—which might have distorted the importance of the relatively small differences that do exist—we grouped the states into clusters on the basis of their innovation inputs and tangible and intangible performance outcomes. (See the exhibit "The States' Innovation Performance Falls into Five Clusters.") We used the same methodology as we did for the international index, drawing on the advice of experts as well as on third-party and government data, to develop the metrics and assign weights to each element. After computing the input and performance scores for each state, we plotted the results to develop the clusters shown.

As on the International Innovation Index, the single biggest driver of success on the National Innovation Index is the innovation environment. Thus California, Connecticut, Massachusetts, and other states with available venture capital and a more skilled work force (likely resulting from a very strong education system) do well. And since work force quality is the key component of an environment conducive to innovation, the ability to attract, train, and retain science and engineering graduates with advanced degrees is critical. Fiscal policy plays an important but lesser role, in part because of the relatively minor impact of state policy. (This underscores the importance of a strong and consistent federal agenda. State governments may find it in their best interests to work together to promote federal legislation that supports innovation.)

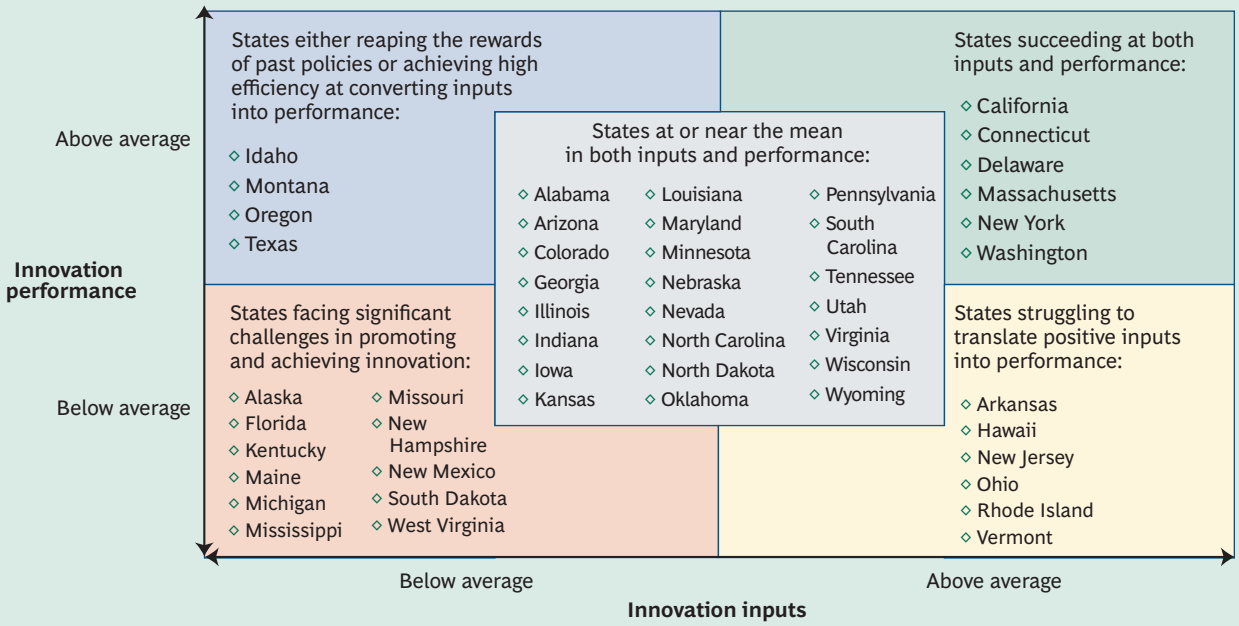
Two unexpected findings emerged from the national assessment. First, some states with "less attractive" busi-

State-Level Fiscal Policy Is a Relatively Insignificant Factor



Sources: U.S. Census Bureau; U.S. Government Printing Office; Unesco Institute for Statistics.
Note: All funds were allocated in fiscal year 2006.

The States' Innovation Performance Falls into Five Clusters



Sources: BCG, National Association of Manufacturers, and The Manufacturing Institute, innovation indexes, 2008.

ness climates—such as California, New York, Connecticut, and Massachusetts—scored well on the index. One reason may be that the most important factor in evaluating the attractiveness of a state's business climate—the structural cost burden (including taxes and other costs of doing business)—was of secondary importance to the National Innovation Index, which focuses on factors that specifically affect innovation. It may also be that the most innovation-friendly states can "afford" to have weaker business climates. Places such as California's Silicon Valley and the area around Boston have given rise to such a critical mass of innovation that companies are unlikely to move away merely because costs are lower elsewhere. Still, a higher cost structure may prevent new centers of innovation from arising—a negative long-term effect.

The second unexpected finding was the high score achieved by Delaware, a state not typically considered a center of innovation. This may be attributed to the effect of secondary, intangible measures of innovation, such as the number of businesses that incorporate there or migrate to the state, and their total shareholder returns. However, Delaware also ranks high on the quality of its work force and education—key drivers of innovation.

What Drives Innovation Success?

While most U.S. companies understand the importance of innovation, few are satisfied with their innovation performance, and most see room for major improvement in their innovation processes. In an ongoing executive innovation survey conducted by The Boston Consulting Group and *BusinessWeek* magazine, fewer than half of the most recent respondents said they were satisfied with the financial return on their innovation investments. (See Exhibit 3.) But companies dissatisfied with their innovation performance can take specific steps to improve it. In the course of our assessment, four key success factors emerged: idea generation, structured processes, leadership, and skilled workers. By understanding these factors, companies can develop the tools they need to become more innovative, and governments can more effectively help the businesses within their borders succeed.

Idea Generation

Good ideas matter. Generating and developing ideas are the first step toward better innovation performance, and companies deemed "excellent" in this area use a variety of tools. (See Exhibit 4.) Those cited most often include making a bigger investment in idea generation (this is especially relevant to larger companies with more resources); developing a deep understanding of customers; increasing management focus; and establishing a company culture that supports innovation.

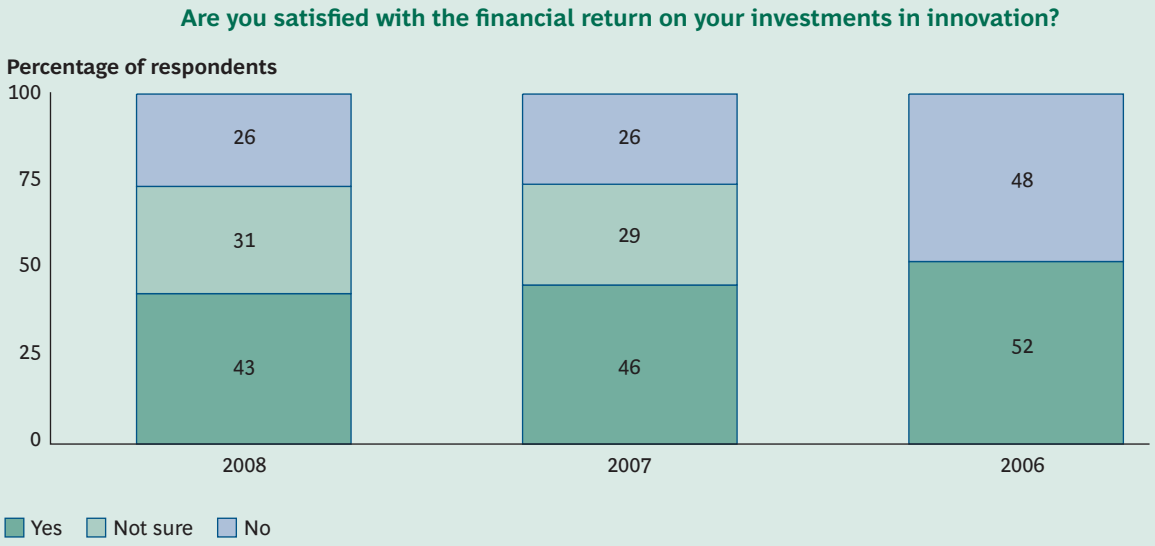
Outside sources of ideas are important to innovation. For example, working closely with customers can help generate new ideas while deepening existing relationships. Said one executive, "We help customers by identifying needs and solving them. This often means that we create a custom solution just for them, which in turn expands our own capabilities and expertise." Another explained, "Saying yes to customer requests drives innovation. We endure a trial by fire when we commit to something we don't actually have yet." Customer-driven innovation can lead to higher-margin products. It also adds customer value, which can make it easier to compete with low-cost producers.

One executive we interviewed described how his company improved its deicing salt products after a local municipality complained about damage caused by salt to roads, vehicle windshields and paint, and the environment. The company researched a variety of ways to change the product and ultimately discovered that coating the salt with an organic compound caused less harm to the environment and prevented the salt from bouncing on the road, which is what damages vehicles. Coated-salt products now account for a growing percentage of sales in the United States and the United Kingdom. "It's actually a better product," noted the executive. "Not only does it solve the customer's problems, it deices better than traditional rock salt."

Suppliers are another valuable, efficient, and cost-effective source of new ideas. As one auto manufacturer said, "We drive innovation through the supply chain. Seventy to eighty percent of our innovation value comes from suppliers in some way." Another executive claimed, "Many of our key suppliers are also small, creating a peer relationship that encourages collaboration." Partnerships with suppliers can also diffuse risk and lighten the capital investment needed for development.

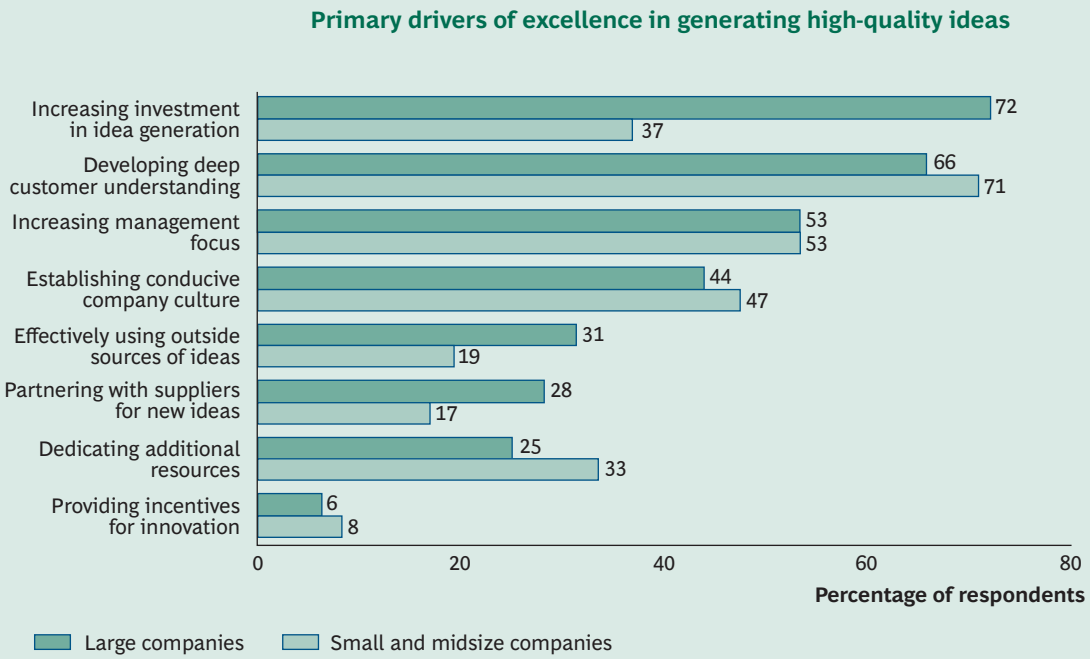
Sometimes partnering with a supplier can be a cost-effective and relatively low-risk way to improve a product. One

Exhibit 3. Only 43 Percent of Companies Are Satisfied with Their Innovation Performance



Sources: Innovation 2008 *BusinessWeek*/BCG survey; Innovation 2007 *BusinessWeek*/BCG survey; Innovation 2006 *BusinessWeek*/BCG survey.
Note: "Not sure" was not offered as an option in 2006. Because of rounding, not all totals equal 100.

Exhibit 4. Top Innovators Generate Ideas by Using a Wide Range of Tools



Sources: BCG, National Association of Manufacturers, and The Manufacturing Institute, innovation indexes, 2008.
Note: Respondents were from companies deemed "excellent" at generating and developing ideas.

executive told us about a supplier that had an idea for a new way to incorporate its component into the company's product. By working closely together, the two came up with a new technology that the supplier allowed the company to patent in the United States as a sign of goodwill. "By partnering with our supplier, we cut down our own R&D time and expenses," noted the executive.

Structured Processes

The most innovative U.S. companies in our study are those that excel at generating and benefiting from new ideas. In addition, they have a greater appreciation for the value of processes and execute at a higher level than unsuccessful companies. (See Exhibit 5.) They design structured, standardized processes for generating ideas, developing them, and bringing them to market, and they believe that process discipline is integral to their success. Respondents from top-performing companies consistently made statements such as the following: "We have a very disciplined, deliberate, and consistent process-oriented approach to innovation" and "Our rigorous innovation approach is well known."

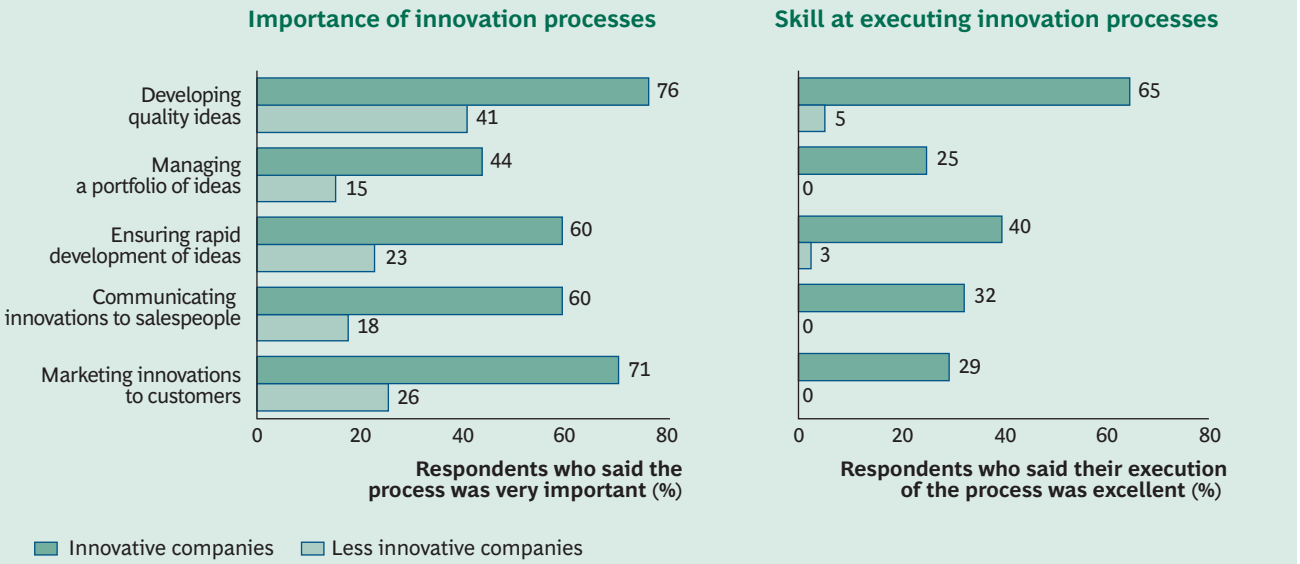
But small and large companies can differ in the rigor of their approach. The inherent complexity of large organizations demands a stricter approach to innovation. Small companies often manage innovation efforts less formally because there are fewer projects to track and fewer resources to allocate, and leaders can have a bigger impact. Moreover, smaller companies tend to place less value on portfolio management and rapid idea development, perhaps because they tend to have fewer projects under way at any given time. Still, most successful companies—even small ones—have good processes and recognize the importance of discipline to those processes.

While structured processes have traditionally been considered the enemy of creativity, the most innovative companies strike a balance between discipline and freewheeling creativity so that neither overwhelms the other. "We aren't overly prescriptive," said one executive. "We provide project managers with the tools they need to meet objectives, then let them figure out how to do it." Added another, "Structural buildup as companies age can slow things down, reduce spirit, and stifle innovation. It's important not to let that happen."

Leadership

Strong, focused leadership is a differentiating factor in U.S. companies that are top innovators, and the execu-

Exhibit 5. Top Innovators Have a Greater Appreciation for Innovation Processes and Execute Them More Skillfully



Sources: BCG, National Association of Manufacturers, and The Manufacturing Institute, innovation indexes, 2008.

tives we interviewed emphasized its importance. Leaders must develop disciplined, well-structured innovation processes, hold management accountable for outcomes, and create a company culture that embraces and encourages innovative thinking. Specific approaches to leadership include benchmarking, setting an example, and demonstrating real interest in innovation. As one executive explained, "Most people don't wake up thinking, 'How am I going to innovate today?' It's a leader's job to get them thinking that way."

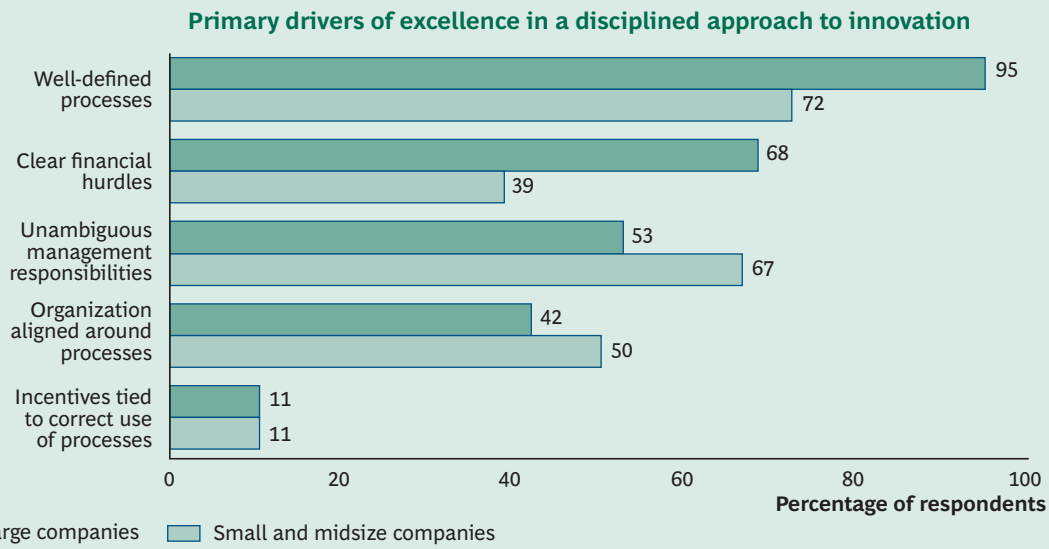
Vocal support of innovation by leadership helps build an innovative culture. Our respondents felt strongly about the importance of this factor. One of them observed, "You need to be serious about creating a good culture that encourages excitement, success, problem solving, questioning, and the celebration of success. You cannot just pay lip service to the idea." Another executive promotes an innovative culture by actively showing his interest in innovation: "I encourage innovation by walking around and talking to people who have been noted for good ideas—it demonstrates that you are interested in innovation and it motivates the employees."

Sometimes small companies have an advantage. As one executive explained, "It's easier to encourage a culture of innovation in a small company like ours, since everyone interacts with leaders and engineers. We make a point of listening to everybody." Executives also reported that establishing an innovative culture was a challenge, given how hard it is to find the right mix of creative, enthusiastic, and achievement-oriented people.

Encouraging management to focus on innovation efforts is crucial. Leaders do this in several ways. First, they make sure that innovation objectives are aligned with business objectives. Then they make tools available, build knowledge and expertise, and use performance metrics to track progress.

It is also the role of leadership to establish and maintain the discipline that leads to better innovation performance. To this end, the companies that excel use a number of best practices, such as developing well-defined processes, setting clear financial hurdles, and assigning unambiguous management responsibility for outcomes. (See Exhibit 6.) Regular meetings and updates ensure that innovation teams keep their eyes on the ball. Successful companies also use proven product-development approaches. As one respondent noted, "All incoming ideas are pushed through a portfolio management funnel to be evaluated strategically."

Exhibit 6. Establishing Processes, Financial Hurdles, and Responsibilities Leads to Discipline in Innovation



Sources: BCG, National Association of Manufacturers, and The Manufacturing Institute, innovation indexes, 2008.
Note: Respondents were from companies deemed "excellent" at taking a disciplined approach.

Skilled Workers

According to our 1,000-plus respondents, a skilled, educated work force is the single most critical element of innovation success—and the hardest to acquire. The truth of this claim is supported by both of our innovation indexes, which indicate that a large number of researchers with advanced degrees, particularly in science or engineering, is the greatest predictor of success. Put simply, innovation requires capable and skilled people. (See the section "The Role of Government" for more on this topic.)

U.S. executives ranked the difficulty of finding high-quality talent among their top "pain points," citing a lack of skilled workers at both the engineering and the basic-skills level. One problem is that U.S. students are not being encouraged to pursue science and technology-related fields. An executive described the challenge: "We offer scholarship programs to the children of our employees. At a dinner honoring this year's recipients, only one planned to go into engineering. The others said their parents—our employees and engineers—told them not to pursue the field."

Even attracting foreign talent, including people educated in the United States, is an issue. Said one executive, "The U.S. is the only country in the world where it is easier to get citizenship as a laborer than as a PhD." Although the United States remains a center of higher education, many of its most talented graduates are forced to go elsewhere because they are not U.S. citizens. Janet Napolitano, the new secretary of homeland security and then governor of Arizona, summarized the situation in a February 2007 address to the National Press Club: "We need scientists and engineers.... After a successful background check, I believe that every one of them should have a green card stapled to their diplomas."

Adding to the problem is the negative perception of technical training and education among U.S. students today. "We treat those pursuing technical careers as second-class citizens," said one respondent. "We have a program in my city called the Career Development Center, or CDC, for those pursuing technical careers. The kids call it 'Come Dumb Children.' If you don't think technical education results in viable careers, take a look at your next plumbing bill."

All of these problems weaken the work force—and the ability of the United States to innovate. The executives we spoke to believe that many of them stem from a decline in the country's education system, and many had strong opinions in this area. One respondent observed, "We've been building workarounds because employees can't do basic math. We'd rather have smart people thinking on their feet, but we've had to automate." Another said, "I even need floor employees. You would be shocked at how many I see who can't read and write." One executive summed up the problem: "The quality of our schools is slipping because they are not accountable to any real quality standards."

The education deficit creates a talent deficit in the United States.

This education deficit creates a talent deficit. The executives we surveyed and interviewed reported having difficulties finding and keeping capable employees. The following comments were typical: "The average engineer's tenure is under one year." "I've had an ad up for an entry-level engineering job for three to four months. Even in this economy, I've had no qualified hits." "As school budgets are cut, they often eliminate classes like shop, so students don't realize that this type of work is an option for them. They think that if they aren't good at book-based academics, then they'll just drop out. They don't realize there is a need for those skills." And finally, "Too many poets, not enough engineers."

Manufacturing itself may have a tarnished reputation in the United States, making it hard to attract good talent. "Americans associate manufacturing with the auto industry and its current strife," explained one executive. Said another, "No one wants to work in a factory. People think it's dirty and backbreaking manual labor. I own a factory; it's sparkling clean and every employee has a computer."

The Role of Government

Our research suggests that governments—both national and local, in the United States and around the world—can support companies in three major ways: by boosting their payback on innovation, by supporting their innovation activities, and, most important, by improving the innovation environment. In addition, governments can play a role by encouraging the development of industry clusters, which can improve the innovation environment.

Boosting Company Payback on Innovation

Innovation is necessary for long-term survival but can be unprofitable in the short term—a major challenge for companies and one that fiscal policies can address. Governments can help improve innovation profitability by lowering companies' costs or increasing their revenues.

R&D tax credits are among the most common ways to lower innovation costs. Our analysis showed a strong positive relationship between R&D tax programs, GDP, and performance on the International Innovation Index. Of the top 20 developed economies by GDP, 19 have R&D tax-relief programs. Interestingly, the size of the credit seems to have little impact—primarily because innovation is such a business necessity that companies rarely change their innovation activities on the basis of the availability of tax credits. (See Exhibit 7.) As one executive explained, "While helpful, R&D tax credits are not a deciding factor in investment decisions. They are a 'thank you' instead of a motivator."

Not that tax credits are unimportant. In fact, they are highly appreciated. In our survey, executives at both large and small companies ranked R&D tax credits as their preferred form of government support. More important than size is their dependability. According to our respondents, the inconsistency of tax credits in the United States diminishes their value because they can't be counted on and planned for. "It's like a guillotine hanging over our neck every year," remarked one executive. "Will they give them to us or won't they?" Added another, "Technologies take time to develop, and it's very difficult to plan when business policy is likely to change multiple times during the course of a [multiyear] project." Given how long the innovation process can take, consistent and ongoing government support and policies are important.

In addition to lowering costs through tax credits, governments can help boost company profitability by supporting revenue streams. Most countries have policies to register and protect intellectual property. The risk of losing the rights to an invention or product because of a lack of policy or poor enforcement is a top issue for business executives and can lead to loss of revenues. As a result, companies operating in countries where intellectual property protection is limited are likely to conduct their innovation activities elsewhere.

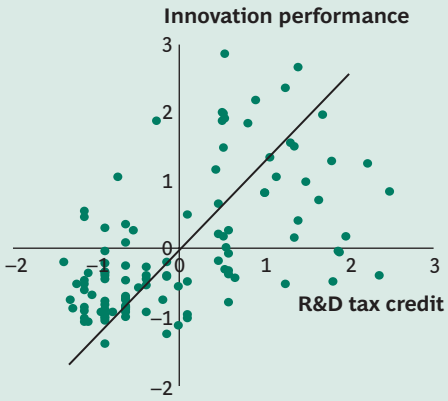
Supporting Innovation Activities

Many countries, and many U.S. states as well, choose to engage directly in research activities, primarily through government grants or government-funded laboratories and research centers. These activities can lead to increased innovation performance. (See Exhibit 8.)

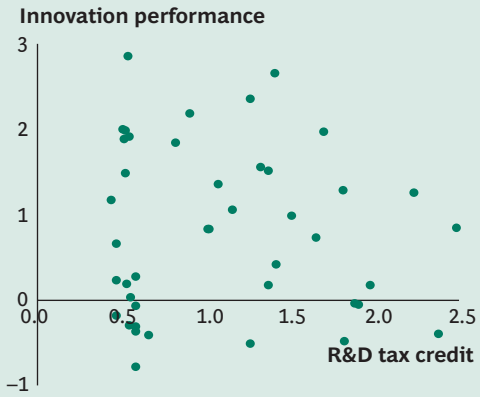
But the impact of direct funding on innovation is limited when the available funds are not substantial or when government support is dwarfed by other sources of fund-

Exhibit 7. Tax Credits Matter, but Their Size Has Little Impact on Innovation Performance

There is a positive relationship between R&D tax credits and innovation performance...



...but the size of the tax credit has minimal impact on performance



Sources: BCG, National Association of Manufacturers, and The Manufacturing Institute, innovation indexes, 2008.
Note: Scale is a weighted cumulative distance from the mean.

Exhibit 8. Government Investments in R&D Help Drive Innovation Performance

Effect of government funding of R&D on innovation performance

Sources: BCG, National Association of Manufacturers, and The Manufacturing Institute, innovation indexes, 2008.
Note: Scale is a weighted cumulative distance from the mean.

ing. For example, small countries and individual U.S. states face a significant challenge in achieving critical mass in R&D funding. In the United States, total state funding of R&D amounts to less than 0.3 percent of the total pool of funds earmarked for R&D, making state investments of minimal importance.

Especially when funds are limited, governments at all levels may find it advantageous to engage in partnerships with businesses, nonprofits, or educational institutions to increase the scale of their support for innovation and achieve greater results. The challenge is to profit from these partnerships by commercializing the results.

Many of the U.S. executives we surveyed reported some difficulty capitalizing on these relationships. As one executive put it, "The government needs to be much more thoughtful about how government, universities, and companies collaborate on joint research projects. It needs to get away from the schizophrenic mentality, be more efficient, and improve project management to produce better results."

Improving the Environment for Innovation

Work force quality is the primary indicator of innovation success. (See Exhibit 9.) It is therefore not surprising that one of the top concerns of business executives is finding high-quality talent. Governments can take many actions to improve work force quality, including but not limited to investing in education and effectively addressing immigration issues.

While education and work-force-development reforms can take many years to have an impact, some reforms yield results much more quickly. For example, better integration of academic and technical education in secondary schools can ensure that graduates are ready for work or college. When academic and technical programs are aligned with industry needs and standards, students gain recognized credentials and companies gain skilled workers.

Countries and states can also improve the business climate by lowering the structural costs related to fiscal

Exhibit 9. Work Force Quality Is Highly Correlated with Innovation Performance

Sources: BCG, National Association of Manufacturers, and The Manufacturing Institute, innovation indexes, 2008.
Note: Scale is a weighted cumulative distance from the mean.

policy, regulation, and energy. Although our assessment did not directly address these factors, they have a major impact on the decisions that executives—particularly in manufacturing—make about production locations. And because so much innovation occurs on the shop floor rather than in the R&D lab, maintaining a manufacturing presence is critical for countries and states alike.

Promoting Industry Clusters

Governments can also support innovation by encouraging the development of industry clusters. Clusters are groups of related, interdependent companies within the same industry that are concentrated in a geographic area. By attracting or establishing groups of manufacturers in specific industries, national governments can help drive innovation performance and sharply improve their country's economy.

This approach can be particularly effective for smaller countries—some of which rank high on the International Innovation Index because of the presence of industry clusters—and is likely to enhance innovation in individual states as well. But it is less useful in large countries, where any one cluster is too small on a relative basis—at least initially—to have a real impact. And since clusters account for only a small percentage of overall output, they're often overshadowed by other drivers, such as work force quality, education, and fiscal policy.

Although small countries can bet on specific industries to kick-start innovation (and growth in general), targeted cluster development is not without risk. Concentrated economies, no matter how successful they are for a time, ultimately rise and fall on the results of a limited number of industries. It is a high-risk, high-reward policy. (See the sidebar "A Tale of Two Countries: Lessons from Singapore and Iceland.")

A Tale of Two Countries: Lessons from Singapore and Iceland

The contrasting experiences of Singapore and Iceland illustrate some of the risks and rewards of a policy-driven cluster strategy. Although strong industry clusters can create an excellent climate for innovation, they can also have a downside. Singapore's story shows how industry diversification can decrease vulnerability to widespread economic failure; Iceland's shows the risks of a cluster strategy that is very successful—but only for a time.

Singapore

A small island nation with virtually no natural resources, Singapore became a major trading port and industrial center under British rule. The country's government is largely controlled by the People's Action Party (PAP), which has won every election since independence in 1965, when Singapore officially became a parliamentary republic. PAP leader Lee Yuan Kew, who was prime minister from 1959 to 1990, is largely credited with establishing Singapore's economic infrastructure.

The government's first business mission was to transform Singapore into a manufacturing center. By creating a very attractive, low-risk innovation environment, it hoped to attract foreign manufacturers and their employees. Business-friendly policies have included freedom from licensing fees for multinational corporations with plants in Singapore; tax breaks for expansion projects; tax exemptions on interest from loans; workers' rights and benefits such as sick days, unemployment insurance, and technical training; and an end to discriminatory hiring and firing practices.

At the same time, Singapore has made investments in local infrastructure, cut transportation costs, and focused on developing the work force. To attract skilled workers, the government publicly adopted a pro-immigration stance, with expedited work-visa processes for foreign professionals, executives, shareholders, and potential entrepreneurs, and no visitor-visa requirements for citizens of many countries.

The government has taken other actions that make Singapore an attractive place for companies to innovate. For instance, it allows stem-cell research, spends lavishly to attract the best scientists to government labs (from both within the country and abroad), and encourages universities to produce the science and engineering graduates that those companies require.

All these efforts have created fertile conditions for innovation, which began to take off as clusters of manufacturing plants in different industries generated new ideas. In the 1970s, electronics, automobiles, and petrochemicals were the targeted industries, followed by computers, computer chips, TVs, and VCRs in the 1980s, and semiconductors,

A Tale of Two Countries: Lessons from Singapore and Iceland (continued)

telecommunications, and pharmaceuticals in the 1990s. Singapore's current focus is on building up its technology and biotech sectors.

Today, Singapore's GDP is the fifth largest in the world on a per capita basis. Singapore weathered the Asian financial crisis of 1997 better than most Asian countries because the government took quick action to retain investment in the country. Similarly, a government diversification program protected Singapore from the electronics slump of 2000 and 2001, which could have spelled disaster for such a major electronics exporter. Singapore continues to be a very attractive location for the innovation centers of global companies, ensuring that its economic success will persist.

Iceland

A small island nation off the coast of northwestern Europe, Iceland was a Danish dependency before becoming an independent republic in 1944. Until the 1990s, fishing was the country's largest industry. In 1994, Iceland joined the European Economic Area (EEA), and the government set up business-friendly policies such as allowing free trade with European neighbors, removing major barriers to foreign investment, opening the financial markets, and sharply lowering the income tax, from 50 percent to 18 percent.

In 1991, a group of policies driven by then prime minister Davíð Oddsson set the stage for the development of a finance cluster. These policies, which included market liberalization, widespread deregulation, privatization of the banking sector, and lower corporate and personal tax rates, led to an influx of foreign capital. The high interest rates maintained by the central bank were particularly attractive to the financial sector. Adding to the country's appeal were a sound environment for innovation, cheap energy, a well-educated work force, and a solid infrastructure.

After deregulation and admittance to the EEA, Iceland's banks moved beyond the home market into Europe. Iceland became an attractive banking option for European consumers, mostly because of consistently high interest rates. Innovative financial products, such as online-only banking outside Iceland, allowed Icelandic banks to keep interest rates high and overhead low while bringing in huge amounts of foreign capital. Another lucrative business innovation for Iceland's banks was the offer of loans in foreign currencies, such as the yen or the Swiss franc, in order to leverage favorable foreign-exchange dynamics and encourage domestic borrowers to take out high-interest loans.

In an attempt to better support innovation across other sectors, the government set up the Science and Technology Policy Council in 2003, reorganized and refocused the national network of research centers, and increased spending on research and training. By 2007, Iceland was among the top 15 countries in the world in patents. It made more R&D credits available to companies, granted R&D subsidies to the most attractive projects, and supported joint medical research with the University of Iceland.

These efforts undoubtedly encouraged innovation in other industries besides finance, but they were not enough to stop the derailment of the economy in the wake of the 2008 credit crisis. From the early 1990s to mid-2008, with strong global financial markets fueling Iceland's disproportionately large financial sector, the so-called Nordic Tiger enjoyed steady economic growth and increasing prosperity. But the crisis exposed the risks inherent in Iceland's lack of diversification when the country's GDP collapsed along with the banking industry. Iceland's three largest banks failed, and most of the industry was nationalized. Because bank holdings and foreign debt now far outstrip GDP, Iceland faces possible bankruptcy, and its woes are spilling over to other countries in Europe.

Given Iceland's current problems, why is the country ranked so high on the International Innovation Index? The answer lies mainly in timing. Iceland bet on one sector, and for a time that sector performed very well. Most of the data for the index are from year-end 2007, at the tail of the financial sector's very successful run. But innovation, growth, and profitability have fallen off sharply since then, and we expect Iceland's ranking to drop in the next edition of the index, when new data will be available.

Iceland's experience demonstrates that although the development of clusters can be an effective way for a small country or state to kick-start its economy, a lack of diversification leads to greater vulnerability and risk over time.

An Agenda for Action

Given the tremendous importance of innovation to companies and countries alike, it is critical that they do all they can to encourage, support, and advance it. And while companies are the main drivers of innovation, national and local governments play a major role in enabling and supporting the innovation activities of the businesses within their borders. Although specific policy recommendations are beyond the scope of this report, countries and states can take concrete actions in six areas.

Strengthen the work force. A skilled, educated work force is the most critical element for innovation success, and countries and states with strong education systems do better in the global battle for innovation leadership. The United States has clear shortcomings in this area. In our survey, U.S. executives consistently highlighted a lack of high-quality talent as a major concern.

Lead by example. Vocal and visible support—in the form of R&D funding, tax credits, and policy changes—sends the message that innovation is important. Make innovation a common cause, for the greater good of all. Countries such as South Korea, China, and Singapore, whose governments publicly and actively support innovation, are attracting an increasing share of the world's innovators and innovation.

Make innovation easier. Governments can make the development and commercialization of ideas easier and more efficient. Although U.S. universities and government agencies fund a great deal of innovative science, business executives tell us that gaining access to these resources is very difficult. Governments should ask what companies need and how they can help—and listen to the answers.

Maintain a strong manufacturing base. Process and product innovations happen in and around manufacturing plants. When factories disappear or move offshore, a major source of innovation goes with them. As one U.S. executive observed, "The media cheer when manufacturing leaves my state, but that is so shortsighted. What they don't realize is that jobs and innovation leave with it."

Improve the payback. A major frustration for executives is the failure of investments in new ideas to pay off. If companies can't make a profit, they will either stop investing in innovation or relocate to a state or country where they can make more money. One executive we interviewed stated that "governments need to realize that we have options" when it comes to locating innovation activities and people. Governments can help companies lower costs and boost profits by providing strong intellectual-property protection, tax breaks, and skills training, among other policies.

Be consistent. Innovation takes time and careful planning. Companies will innovate more when they can count on government support in both the short and the long term. Because innovation investments can take up to a decade to bear fruit, tax policies and benefits must be consistent and reliable over the long haul. Similarly, governments must stay the course until education and work force policies deliver results.

Action in these areas is in the mutual interest of companies and governments, helping them to serve their constituents more effectively. It is time for all levels of government to make innovation a top priority and to prove their commitment with concrete action. The stakes couldn't be higher—nothing less than the global competitiveness of countries and companies, secure jobs, and a higher quality of life.

Appendix

International Rankings

Ranking	Country	Overall Score	Innovation Inputs Score	Innovation Performance Score
1	Singapore	2.45	2.74	1.92
2	South Korea	2.26	1.75	2.55
3	Switzerland	2.23	1.51	2.74
4	Iceland	2.17	2.00	2.14
5	Ireland	1.88	1.59	1.99
6	Hong Kong	1.88	1.61	1.97
7	Finland	1.87	1.76	1.81
8	United States	1.80	1.28	2.16
9	Japan	1.79	1.16	2.25
10	Sweden	1.64	1.25	1.88
11	Denmark	1.60	1.55	1.50
12	Netherlands	1.55	1.40	1.55
13	Luxembourg	1.54	0.94	2.00
14	Canada	1.42	1.39	1.32
15	United Kingdom	1.42	1.33	1.37
16	Israel	1.36	1.26	1.35
17	Austria	1.15	1.38	0.81
18	Norway	1.14	1.48	0.70
19	Germany	1.12	1.05	1.09
20	France	1.12	1.17	0.96
21	Malaysia	1.12	1.01	1.12
22	Australia	1.02	0.89	1.05
23	Estonia	0.94	1.50	0.29
24	Spain	0.93	0.83	0.95
25	Belgium	0.86	0.85	0.79
26	New Zealand	0.77	0.79	0.69
27	China	0.73	0.07	1.32
28	Cyprus	0.63	0.64	0.56
29	Portugal	0.60	0.92	0.22
30	Qatar	0.52	0.86	0.13
31	Hungary	0.51	0.80	0.18
32	Czech Republic	0.41	0.88	–0.10
33	Slovenia	0.37	0.47	0.24

International Rankings (continued)

Ranking	Country	Overall Score	Innovation Inputs Score	Innovation Performance Score
34	South Africa	0.33	0.15	0.47
35	Bahrain	0.27	0.78	–0.26
36	Slovak Republic	0.21	0.72	–0.31
37	Chile	0.21	0.36	0.04
38	Italy	0.21	0.16	0.24
39	Malta	0.20	–0.21	0.59
40	Lithuania	0.16	0.71	–0.40
41	Tunisia	0.14	0.57	–0.30
42	Greece	0.12	0.01	0.23
43	Latvia	0.12	0.38	–0.14
44	Thailand	0.12	–0.12	0.35
45	Mauritius	0.06	0.48	–0.36
46	India	0.06	0.14	–0.02
47	Kuwait	0.06	0.46	–0.35
48	Croatia	–0.03	0.21	–0.26
49	Russia	–0.09	–0.02	–0.16
50	Saudi Arabia	–0.12	0.57	–0.79
51	Trinidad and Tobago	–0.12	–0.42	0.20
52	Poland	–0.12	0.22	–0.44
53	Bulgaria	–0.13	0.23	–0.48
54	Philippines	–0.15	–0.76	0.48
55	Oman	–0.15	0.27	–0.56
56	Jordan	–0.15	–0.04	–0.26
57	Mexico	–0.16	0.11	–0.42
58	Turkey	–0.21	0.15	–0.55
59	Lesotho	–0.22	–1.01	0.59
60	Kazakhstan	–0.23	–0.51	0.07
61	Romania	–0.29	0.22	–0.77
62	Costa Rica	–0.39	–0.57	–0.18
63	Panama	–0.43	–0.48	–0.34
64	Ukraine	–0.45	–0.13	–0.73
65	Egypt	–0.47	–0.46	–0.43
66	Botswana	–0.47	–0.50	–0.40
67	Albania	–0.49	–0.58	–0.34
68	Azerbaijan	–0.54	–0.48	–0.54
69	Sri Lanka	–0.56	–0.61	–0.46
70	Morocco	–0.57	–0.55	–0.54
71	Indonesia	–0.57	–0.63	–0.46
72	Brazil	–0.59	–0.62	–0.51
73	Vietnam	–0.65	–1.09	–0.16
74	Colombia	–0.66	–0.95	–0.30
75	Armenia	–0.66	–0.75	–0.52
76	Macedonia	–0.68	–0.13	–1.17
77	Georgia	–0.72	–0.48	–0.88
78	Ethiopia	–0.75	–1.16	–0.27
79	Jamaica	–0.75	–0.72	–0.72

Ranking	Country	Overall Score	Innovation Inputs Score	Innovation Performance Score
80	El Salvador	–0.77	–0.59	–0.88
81	Kyrgyz Republic	–0.78	–0.54	–0.95
82	Honduras	–0.79	–0.64	–0.85
83	Moldova	–0.80	–0.24	–1.28
84	Pakistan	–0.82	–1.04	–0.51
85	Algeria	–0.83	–0.87	–0.70
86	Paraguay	–0.89	–0.63	–1.07
87	Mongolia	–0.90	–0.71	–1.01
88	Nigeria	–0.95	–0.91	–0.90
89	Uruguay	–0.95	–0.76	–1.06
90	Uganda	–0.96	–1.05	–0.78
91	Burkina Faso	–0.97	–1.25	–0.59
92	Argentina	–0.97	–0.96	–0.90
93	Tajikistan	–0.99	–1.04	–0.86
94	Guatemala	–0.99	–0.94	–0.96
95	Kenya	–1.01	–0.91	–1.02
96	Bolivia	–1.02	–1.08	–0.87
97	Syria	–1.03	–0.99	–0.98
98	Nepal	–1.05	–1.23	–0.77
99	Senegal	–1.06	–1.11	–0.91
100	Peru	–1.06	–1.18	–0.85
101	Namibia	–1.07	–1.12	–0.92
102	Ecuador	–1.11	–1.21	–0.91
103	Madagascar	–1.16	–1.15	–1.06
104	Nicaragua	–1.18	–1.22	–1.02
105	Zambia	–1.28	–1.40	–1.03
106	Benin	–1.28	–1.55	–0.89
107	Cameroon	–1.32	–1.77	–0.74
108	Venezuela	–1.37	–1.50	–1.10
109	Burundi	–1.54	–1.82	–1.12
110	Zimbabwe	–1.63	–1.63	–1.48

Note: Because of rounding, two or more countries may appear to have the same overall score. For the purposes of these rankings, Hong Kong is considered a national entity.

For Further Reading

The Boston Consulting Group publishes other reports and articles on innovation that may be of interest to senior executives. Recent examples include:

Innovation 2008: Is the Tide Turning?
A BCG Senior Management Survey, August 2008

Measuring Innovation 2008: Squandered Opportunities
A BCG Senior Management Survey, August 2008

Payback: Reaping the Rewards of Innovation
James P. Andrew and Harold L. Sirkin (Boston: Harvard Business School Press, 2006)

The Secret of Innovation
BCG Perspectives, December 2006

Spurring Innovation Productivity
Opportunities for Action in Industrial Goods, November 2005

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