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The power of innovation

Our worldwide index discovers how nations have responded to the challenges of globalisation

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The world's top innovators

Globalisation has pushed innovation to the top of the agenda, but which countries respond best to the new challenges?

BY Soumitra Dutta, INSEAD, and Simon Caulkin

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IN ASSOCIATION WITH BT

Which nations and regions respond best to the challenge of innovation? In recent years, innovation has pushed itself to the very top of policy-making and senior executive agendas. What has put it there can be summed up in one word: globalisation. Now INSEAD and *World Business* have developed the Global Innovation Index (GII) to measure the shock of the new.

When all economies are interdependent and interconnected, the "waves of creative destruction" described by economist Joseph Schumpeter show no respect for national boundaries, rolling with impunity over the whole planet. And technological change is accelerating – US futurologist Ray Kurzweil has noted that "in the first 20 years of the 20th century, we saw more advancement than in all of the 19th century. And we won't experience 100 years of progress in the 21st century – it will be more like 20,000 years of progress at the current rate."

Simply doing the same as before – only more intensively – is a losing strategy; there is nowhere left to hide. Instead of trying to wring diminishing returns from today's array of goods, services and processes, prosperity urgently demands that companies quickly shift to creating fresh value from new ones.

A recent report from the US' Council on Competitiveness declared: "Innovation will be the single most important factor in determining America's success in the 21st century. Where once we optimised our organisations for efficiency and quality, now we must optimise our entire society for innovation." In Europe, 2000's Lisbon Agenda challenged the EU to make itself "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs, and greater social cohesion" by 2010.

The emerging economies are racing towards the

RANK	COUNTRY	SCORE*
1	US	5.80
2	Germany	4.89
3	UK	4.81
4	Japan	4.48
5	France	4.32
6	Switzerland	4.16
7	Singapore	4.10
8	Canada	4.06
9	Netherlands	3.99
10	Hong Kong	3.97
11	Denmark	3.95
12	Sweden	3.90
13	Finland	3.85
14	UAE	3.81
15	Belgium	3.77
16	Luxembourg	3.72
17	Australia	3.71
18	Israel	3.68
19	South Korea	3.67
20	Iceland	3.66
21	Ireland	3.66
22	Austria	3.64
23	India	3.57
24	Italy	3.48
25	Norway	3.48
26	Malaysia	3.47
27	Spain	3.38
28	New Zealand	3.35
29	China	3.21
30	Kuwait	3.14
31	Estonia	3.12
32	Czech Republic	3.10
33	Chile	3.03
34	Thailand	3.01
35	Slovak Republic	2.97
36	Hungary	2.88
37	Mexico	2.88
38	South Africa	2.87
39	Portugal	2.86
40	Brazil	2.84
41	Tunisia	2.84
42	Malta	2.82
43	Slovenia	2.81
44	Barbados	2.79
45	Turkey	2.75
46	Cyprus	2.73
47	Lithuania	2.71
48	Indonesia	2.71
49	Greece	2.69
50	Latvia	2.67
51	Costa Rica	2.66
52	Jamaica	2.63
53	Jordan	2.61
54	Russian Federation	2.60
55	Croatia	2.59
56	Poland	2.53
57	Colombia	2.50
58	El Salvador	2.49
59	Panama	2.47
60	Mauritius	2.46
61	Kazakhstan	2.45
62	Romania	2.44
63	Argentina	2.41
64	Azerbaijan	2.40
65	Vietnam	2.38
66	Philippines	2.38
67	Uruguay	2.37
68	Guatemala	2.36
69	Peru	2.35
70	Dominican Republic	2.29
71	Sri Lanka	2.27
72	Nigeria	2.27
73	Pakistan	2.24
74	Egypt	2.24
75	Ukraine	2.24
76	Morocco	2.23
77	Venezuela	2.22
78	Kenya	2.22
79	Namibia	2.21
80	Tanzania	2.14
81	Bulgaria	2.12
82	Moldova	2.11
83	Algeria	2.11
84	Burkina Faso	2.10
85	Mongolia	2.08
86	Armenia	2.07
87	Macedonia	2.06
88	Uganda	2.05
89	Bosnia & Herzegovina	2.05
90	Ecuador	2.03
91	Honduras	2.02
92	Nicaragua	2.01
93	Georgia	2.00
94	Tajikistan	1.95
95	Cambodia	1.94
96	Cameroon	1.92
97	Guyana	1.84
98	Bangladesh	1.82
99	Nepal	1.79
100	Albania	1.78
101	Kyrgyzstan	1.76
102	Bolivia	1.72
103	Mozambique	1.72
104	Ethiopia	1.71
105	Lesotho	1.68
106	Paraguay	1.66
107	Angola	1.53

*The maximum score possible is 7

The US leads the second most innovative nation by almost a full point, putting it in a league of its own as far as global innovation is concerned

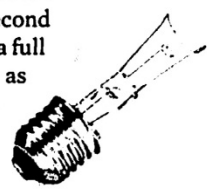
same goal. Since the late 1990s, China has boosted its R&D spending by 50%. Now, led by president Hu Jintao, Beijing wants to raise it to 2.5% of GDP – $115 billion – annually. Even in Africa, governments are attempting to use technology as a springboard for innovation and development. Ethiopia, one of the poorest countries in the world, is committed to bringing a broadband connection within reach of all its 74 million population by 2007, and little more than a decade after the horrors of 1994, Rwanda is working to create a knowledge-intensive, technology-enabled business environment *(see box)*.

Innovation is about much more than generating new ideas. Translating these ideas into value-adding products and services requires flexibility of attitude and willingness to adapt to, and welcome, unprecedented levels of change on the part of individuals, organisations and society as a whole. So who is doing it best? What are the conditions for doing so? Can we pin down the catch-all notion of innovation in ways that can be quantified and normalised to generate meaningful comparisons?

It was to answer questions like these that *World Business* commissoned INSEAD Business School to develop the GII. Our starting point is the belief that response-readiness is directly linked to a country's ability to adopt, and benefit from, leading-edge technologies, expanded human capacities, better organisational and operational capability, and improved institutional performance.

We have brought together for the first time a number of related and complementary indicators into a holistic framework for measuring innovation performance *(see box)*. Using this framework, we can not only rank the world's best and worst-performing economies in terms of innovation, but also provide insights into countries' strengths and weaknesses in their innovation-related policies and practices.

The results are revealing – and in some cases surprising. For example, while the presence of the US at the top of the table is predictable, the great extent of the lead is less so. Typically, differences between consecutively ranked nations are marginal (remember, these are relative scores). However, the US leads the second most innovative nation (Germany) by almost a full point, putting it in a league of its own as far as global innovation is concerned. This is confirmed by the top ranking that the country garners in both 'input' and 'output' sections of the model. The US is unique in being consistently among the top eight performers on all the measures used in the GII.



Also less than obvious is Germany in second place. Indeed, with five countries in the top 10 – the UK, France, Switzerland and the Netherlands alongside Germany – and 11 in the top 20, old Europe puts in a collective performance that belies the conventional hand-wringing over supposed sclerosis. It also puts in a new light this year's critical Aho Report (named after its chairman, former Finnish prime minister Esko Aho) to the European Commission, which noted that Europe had fallen behind the US in key measures such as average growth rates of real GDP, labour productivity and total factor productivity (ie, management). Taken as a whole, the GII shows on the contrary that Europe's innovation performance is both impressive and an optimistic sign for the future.

Nevertheless, for those wanting to know where the future lies, the direction is clear: look east. While Japan comes in at a highly creditable fourth overall – a rebirth of the Asian powerhouse after the doldrums of the 1990s – followed by Singapore (7th), Hong Kong (10th) and South Korea (19th), perhaps even more significant is the appearance of India and China at 23rd and 29th respectively. With the burgeoning and technology-hungry middle classes of these two countries adding to existing strengths, Asia is set to redefine many aspects of innovation. Already South Korea is the most advanced broadband society in the world; China has more than 300 research centres, second only to the US, and this number is steadily increasing. Perhaps the biggest global challenge for international firms will be to find ways to tap into and leverage these emerging Asian drivers of global innovation.

Another sign of the shifting tectonic plates of the world economy is the appearance of the United Arab Emirates at 14th in the global list. The brightest star in the Middle East – four places above Israel – UAE has benefited from government leadership that sets it apart from its neighbours through policies explicitly designed and implemented to attract skilled workers and technology-intensive companies. The result, particularly in Dubai, has been growing clusters of innovative companies.

These are the headline findings from the rankings, but many other intriguing plots and subplots lurk in the details of the model. As shown, the eight innovation 'pillars' in the GII framework are grouped in two separate categories: 'inputs', factors that underpin innovative capacity such as institutions and policies, human capacity,

ABOUT THE INDEX

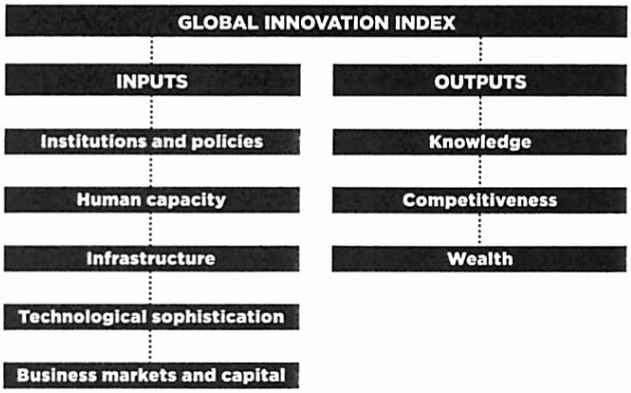
The Global Innovation Index (GII) was conceived at INSEAD as a formal model to help show the degree to which individual nations and regions currently respond to the challenge of innovation. This response-readiness is directly linked to a country's ability to adopt and benefit from leading technologies, increased human capacities, organisational and operational developments, and enhanced institutional performance. The GII is intended to serve not only as a means for determining a country's relative response capacity, but also gives a clearer picture of its strengths and deficiencies in respect to innovation-related policies and practices.

The framework of the GII model rests relies on eight pillars (see right), which underpin the factors that enhance innovative capacity and demonstrate results from successful innovation. The model uses a combination of objective data drawn from a variety of public and private sources, such as the World Bank and the International Telecommunications Union, and subjective data drawn from the World Economic Forum's annual Executive Opinion Survey. The latter helps to capture concepts for which objective (or hard) data are typically unavailable.

Before calculating the final rankings, 17 countries were dropped from the study due to inadequate or limited data availability. The index ranks and scores the final set of 107 countries. For further information on the methodology, see www.worldbusinesslive.com.

EIGHT PILLARS OF INNOVATION

Eight pillars underly the INSEAD Global Innovation Index. Five input pillars represent aspects that enhance the capacity of a nation to generate ideas and leverage them for innovative products and services. Three output pillars define the benefits of successful innovation to the citizens and organisations of the country.



INNOVATION PILLAR LEADERS

INSTITUTIONS AND POLICIES

RANK	COUNTRY	SCORE
1	Singapore	6.28
2	UK	6.25
3	Denmark	6.11
4	Switzerland	6.05
5	US	5.96

BUSINESS MARKETS AND CAPITAL

RANK	COUNTRY	SCORE
1	US	6.23
2	UK	5.16
3	Germany	4.63
4	Japan	4.36
5	France	4.31

HUMAN CAPACITY

RANK	COUNTRY	SCORE
1	Singapore	6.31
2	Finland	5.83
3	US	5.70
4	Canada	5.50
5	UAE	5.46

KNOWLEDGE

RANK	COUNTRY	SCORE
1	US	6.01
2	Germany	5.03
3	Japan	4.70
4	UK	4.42
5	Switzerland	4.07

INFRASTRUCTURE

RANK	COUNTRY	SCORE
1	Denmark	5.61
2	Iceland	5.53
3	Switzerland	5.35
4	Netherlands	5.30
5	Germany	5.26

COMPETITIVENESS

RANK	COUNTRY	SCORE
1	US	6.48
2	Germany	5.47
3	Japan	4.92
4	UK	4.81
5	India	4.72

TECHNOLOGICAL SOPHISTICATION

RANK	COUNTRY	SCORE
1	US	6.48
2	Japan	5.42
3	UK	5.12
4	Germany	5.10
5	Switzerland	5.08

WEALTH

RANK	COUNTRY	SCORE
1	US	4.65
2	Germany	3.78
3	UK	3.72
4	France	3.66
5	Italy	3.34

> Top-notch institutions, abundant funding and bright minds don't by themselves add up to a winning formula in a worldwide battle for talent

infrastructure, technological sophistication, and business markets and capital; and 'outputs', the benefits that a nation derives from the inputs in terms of knowledge creation, competitiveness and wealth generation.

The rich quantitative and qualitative data generated under each pillar allow us to get under the surface of the raw rankings and begin to interpret how and why countries respond to the innovation dynamic (care is needed here: this is a first snapshot – definitive trends will become clearer as the data accumulates in subsequent years).

The US' top ranking on both input and output scores suggests why it is so far ahead of rivals: relative to others, it has both a better environment for innovation and is more effective at exploiting it. Central to its leading position is the magnetism it continues to exert, building constantly on its human capital. Leading universities and research establishments attract and actively encourage the best and brightest minds from around the world, and generous funding opportunities help create a virtuous cycle in which the best minds seek the best mentors.

However, top-notch institutions, abundant funding and bright minds don't by themselves add up to a winning formula in a worldwide battle for talent – witness the unwillingness of some European countries to tap talent from emerging economies. It also takes a culture of diversity, optimism and meritocracy, in which individual background is much less important than the desire to succeed.

The US has other important input strengths. Take the two complementary pillars: technological sophistication and business markets and capital – with savvy investors and some of the most efficient markets and capital flows in the world, great ideas in the US have no trouble finding backing. US venture capital totals dwarf those anywhere else by orders of magnitude, creating a supportive environment for entrepreneurship and job creation. Meanwhile, US firms are adept at deploying technology and promising processes in operations – studies suggest that smart application of technology accounts for up to 80% of US productivity gains over the last decade. In turn, the demanding customer base is one reason why the US technology sector is so vibrant and innovative.

But the US also faces question marks, both political and economic, at home and abroad. With the emergence of India and China as economic powers in their own right, the shape of the global competitive landscape is changing. Until now, the

GEOGRAPHIC LEADERS

THE AMERICAS

RANK	COUNTRY	SCORE
1	US	5.80
8	Canada	4.06
33	Chile	3.03
37	Mexico	2.88
40	Brazil	2.84

EUROPE

RANK	COUNTRY	SCORE
2	Germany	4.89
3	UK	4.81
5	France	4.32
6	Switzerland	4.16
9	Netherlands	3.99

ASIA / PACIFIC

RANK	COUNTRY	SCORE
4	Japan	4.48
7	Singapore	4.10
10	Hong Kong	3.97
17	Australia	3.71
19	South Korea	3.67

MIDDLE EAST

RANK	COUNTRY	SCORE
14	UAE	3.81
18	Israel	3.68
30	Kuwait	3.14
41	Tunisia	2.84
45	Turkey	2.75

AFRICA

RANK	COUNTRY	SCORE
38	South Africa	2.89
72	Nigeria	2.27
78	Kenya	2.22
79	Namibia	2.21
80	Tanzania	2.14

European innovation is less balanced than in the US: Germany, France, Ireland, Spain and Italy form a group that does better on the output side than input

US has managed to camouflage the shortcomings of its primary and secondary education by attracting overseas talent. Now it faces the need to produce more scientists and engineers from within, just as it must improve the quality of an ageing communication and transportation infrastructure.

More insidiously, the traditional US mood of openness to all-comers has changed since 9/11. Is the hostility that greeted the Dubai Ports World (ultimately unsuccessful) takeover of six US ports and the banning of (foreign) online poker companies evidence of a growing economic nationalism? If so, then it is a bad sign for an economy that has thrived on its acceptance of economic migration from whatever quarter.

Pillar performance also tells some significant stories about Europe. At the top level, the presence of Germany, the UK and France (ranked 2, 3 and 5 respectively) at the innovation top table is reassuring. But it is striking that, apart from the UK, European innovation performance is less balanced than in the US. Germany, France, Ireland, Spain and Italy form a group that does better on the output side than input. The countries do well in terms of knowledge and wealth creation with the capacities they have, but they would benefit from improving their innovation underpinnings in market-friendly institutions and policies. For instance, it takes an average of 24 days to start up a business in Germany, a substantial institutional burden, and the country also suffers from employment rigidity.

Self-imposed hurdles are particularly high on human capacity. Only France of the larger European countries scrapes into the top 10 on the human capacity measure, while the UK, Germany and Spain rank 16, 25 and 47 respectively. Although Europe provides high-quality basic education, it has failed to develop enough world-class universities, research institutions and business schools. The UK aside, no European country can boast universities that rank among the very best in the world. Similarly, economies such as Germany have not done enough to promote diversity and free up internal labour markets.

On the other hand, another group of countries, with the Nordics to the fore, currently do relatively better on inputs than outputs, suggesting that they have the potential to move up the overall table as the results of their investments feed through. Finland, for example, has put most of the ingredients of the future networked society in place by focusing on innovation, education and IT. Unlike the rest of Europe, it scores very highly on human capacity. Finland was the first country in the

THE BRICS' POTENTIAL

In 2001 Goldman Sachs caused a stir by predicting that by mid-century China would be the world's largest economy, and that India, Brazil and Russia would also figure among the global top 10. What is the story of the Brics, as Goldman Sachs called them, as told by the innovation tables?

The first point is that they are not yet among the global innovation leaders overall, and although India and China (23 and 29 respectively) run neck-and-neck at the top of the second quartile, there is a clear difference between the emerging Asian powerhouses and Brazil (40) and Russia (54). Perhaps predictably, all of them fare better on the output than input measures. For example, India ranks an excellent 7th on outputs and China 9th, both hoisted by good competitiveness and respectable knowledge scores.

However, the Brics possess huge innovative potential; for example, China and India turn out thousands of engineers and science graduates a year. But to get the full benefit of this human capacity, they must tackle several challenges. Both suffer from significant regulatory and cost barriers in many areas of capital and labour markets – often market entry to foreign firms is controlled, hindering competition.

Although absolute numbers of graduates are high, there is inadequate focus on state-of-the-art R&D – in India, the ratio of professionals employed in research to the total labour force is 157 per million compared with 4,099 in the US, 2,800 in South Korea and 589 in China. Both countries are held back by poor infrastructure, scoring lower on this pillar than middle-ranking Brazil and even Russia. India is in the global top 10 for business and markets, and a respectable 24th in institutions and policies, but China comes in at a dismal 81st for the latter pillar.

Russia and Brazil also have solid human potential. Although Brazil enjoys better business and markets than Russia and China, all three are handicapped in innovation terms by their awful institutions and policies. While some progress has been made, corruption is endemic and intellectual property and legal systems weak. If and when these issues are addressed, the Brics will be a formidable part of the global innovation network.

Rank	Country	Score
23	India	3.57
29	China	3.21
40	Brazil	2.84
54	Russia	2.60

> Singapore has been engaged in a concerted effort to leverage the power of human capital and technology for innovation and growth for two decades

world to conceive of the idea of a national innovation system to feed into policy formulation. Leadership comes from the very top, with the Finnish prime minister chairing the science and technology council, which also has seven other ministers among its members. Finland's investment in R&D, at 3.4% of GDP, is one of the highest in the world.

A less expected trendsetter is Estonia, 31st in the overall ranking. Since independence in 1991, it has been engaged in an ambitious attempt to drive innovation by bringing the country into the digital age. Estonia has one of the most modern telecommunications networks in Europe, low connectivity costs and high rates of computer literacy, which have led to an explosion of innovative service applications, notably in banking, education, health, transport and public administration.

We have already noted the attempts by Ethiopia and Rwanda to take hold of their destiny through a similar digital roadmap. Other governments are also investing heavily in human, institutional and technology inputs as a way of hauling themselves up the economic value chain. One of the earliest and most ambitious movers was Singapore (7th in the overall table), which has been engaged in a concerted effort to leverage the power of human capital and technology for innovation and growth for two decades. Led by a government that paved the way for recruiting worldwide talent by creating high-quality educational institutions and which has since formulated successive versions of national technology and innovation plans, Singapore has succeeded in combining a unique multicultural society with a pervasive service-oriented culture.

Another example is Israel, which has a sparkling economic story to tell in human capacity and technological sophistication inputs. Strong ties to Silicon Valley and US academic and research institutions are important advantages, and successive governments have invested heavily in education – reinforced by large-scale immigration – to build human capital. As part of a close collaboration with business, successive governments have also developed effective investment incentives, fostered the highest spending on R&D of any industrialised nation (4.6%) and overseen incubator and venture capital programmes to convert research into new businesses.

Israel has the highest number of engineers per capita in the world (twice that of the US and Japan), a supportive culture of risk-taking and a powerful drive to succeed. Against that, it is

THE WAR FOR GLOBAL TALENT

As with capital flows, for half a century the US has run a 'deficit' in engineers and technologists that has been made up by inflows from the rest of the world. In the 1940s and postwar years, a braindrain from Germany and Western Europe bolstered advances in US science and space research; in the 1980s and 1990s, Asian students flocked to California to study and stayed to make their fortunes in IT.

But in an article in the *Financial Times* earlier this year, Intel chairman Craig Barrett (above) warned that that was no longer the case, as tightening security considerations at home and entrepreneurial opportunities abroad redrew the global map of human capacity. On its own, he said, the US was incapable of meeting its needs for science and engineering graduates. "In a global, knowledge-based economy, businesses will naturally gravitate to locations with a ready supply of knowledge-based workers," Barrett wrote. "The hard fact is that if we cannot find or attract the workers we need here, the company – like any other business – will go where the talent is located."

Pressures such as these, coupled with falling productivity in traditional corporate R&D labs, are leading to more 'distributed' patterns of innovation, in which companies cross porous national boundaries in search of specialist creativity – for example, software in India, manufacturing research in China. The idea can be taken even further: in Procter & Gamble's 'open innovation' model, the company has committed itself to a goal of leveraging its own capabilities by sourcing half its new ideas from outside the company.

Such trends have implications for national policies and programmes. In the UK, the Advanced Institute of Management Research (AIM) argues that just as well-chosen offshoring delivers benefits to both parties, international trade in innovation is potentially a strong positive-sum game. The aim, therefore, should not be to protect national 'fortresses' of competitive innovation, but to gain leverage by developing skills in cooperation and joint research.

"China and India provide opportunities for innovation and scientific collaboration that can benefit the UK and the wider world," says AIM, adding that institutional factors – property rights, transparency in public funding, excellent universities and effective regulatory regimes – can be a powerful enabler of knowledge transfer and integration.

> More than a simple ranking measure, the GII is the jumping-off point for studying some of the most important questions facing the world economy today

dragged down by a poor competitiveness rating (41st), partly as a result of the horrible political situation.

There is no shortage of entrepreneurial spirit or tradition in the Middle East. It seems a long shot today, but it is intriguing to wonder whether, in time, given some breaks, the innovative economies of the region might be able to do what politics hasn't and tow the countries towards positive economic, rather than destructive battlefield, competition.

We believe that over time the index will prove to be an effective framework for evaluating the innovative capacity and performance, and making meaningful comparisons between nations and regions across the globe. The most important stories, however, are not static positions on a list, but dynamic ones, about learning and improving, and how advantage shifts over time. More than a simple ranking measure, the GII therefore is the jumping-off point for studying some of the most important questions facing the world economy today.

World development officials, for example, will closely follow IT and innovation-based initiatives to judge whether they provide a more effective path to the elusive goals of development and poverty elimination than traditional methods. Government ministers will want to know how 'planned', officially-sponsored, input-driven innovation stacks up against the market-generated US variety; whether the innovation-powered flywheel that has driven the US economy for the past 30 years can be replicated.

Alternatively, now that some of the engineering and entrepreneurial diaspora of China and India is returning home, it may be that the US will have to devote time and energy to rebuilding the input pillars that the market is incapable of repairing, such as education. Another intriguing question is how multinational companies will cope with this shifting competitive map. They already outsource many back-office processes and R&D to India and other low-cost countries. Now they have made it clear that they may have no choice but to go where the talent is, wherever that may be.

As these larger issues suggest, the pressures of global innovation are already changing the face of the planet. Year by year, the index will chart how they do it. ■

Soumitra Dutta is the Roland Berger chaired professor of business and technology at INSEAD

PROGRESS IN AFRICA

The interesting stories aren't always to be found at the top of the innovation league table. For example, the most ambitious science and technology-based national innovation programmes are taking place not in northern Europe or even Asia, but in poverty-stricken, conflict-riven Africa, which has just one country in the top 50 (South Africa) and no more than eight in the top 100. Take Rwanda: in 2000, six years after 800,000 people perished in a fearful genocide, including many of Rwanda's educated citizens, just one school in the small, landlocked, mainly agricultural, country had a computer. Of a population of 8 million, fewer than 100,000 possessed a phone of any kind.

But turning the disadvantages on their head, the government drew up a bold plan called Vision 2020, which sought to leapfrog the country into the 21st century through technology. Six years later, pupils at half of Rwanda's primary schools have access to a computer. Internet cafés are multiplying, even in the countryside, and mobile numbers are up to 300,000. All the five main population centres will soon be linked by fibre-optic cable. A former army barracks in the capital has become the Kigali Institute of Science, Technology and Management, turning out teachers, instructors and technicians.

Private investment is also being targeted. The capital is home to an 'ICT park' offering rent-free accommodation and utilities for hi-tech companies. "The aim is to make Rwanda the hub of the region," says President Paul Kagame. Other African countries have made the same calculation.

Ethiopia (104th in the list and one of the poorest countries in the world) is laying a 4000km fibre-optic network that will bring all the country's 74 million population within a few kilometres of a broadband access point by 2007, and will invest more than $100 million in computers for schools and government offices. Government officials admit that IT is expensive, but less so than ignorance, and plays a crucial part in the war against poverty.

Mozambique, similarly, is using IT to improve governance and public administration, while providing citizens with the benefits of access to the global knowledge base. In all these countries, technology is driving innovation by unleashing creative thinking to solve problems and opening up the promise of unprecedented opportunities.

There's a long way to go, but technology-based innovation may change the face of Africa in ways that 50 years of conventional methods have failed to do.

REVIEW OF REVIEWS: THE LATEST IN MANAGEMENT THINKING 24 February 2007

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In association with INSEAD – The Business School for the World

Global Innovation Index: More on methodology

Source: The World Business/INSEAD Global Innovation Index (GII)
Reviewed: 17-Jan-07

The Global Innovation Index (GII) was conceived at INSEAD as a formal model to help illuminate the degree to which individual nations and regions are currently responding to the challenge of innovation.

This response-readiness is directly linked to a country's ability to adopt and benefit from leading technologies, increased human capacities, organizational and operational developments, and enhanced institutional performance. The GII brings together a number of complementary concepts aimed at providing a holistic framework for measuring innovation.

The GII is intended to serve not only as a means for determining a particular country's relative response capacity, but also gives a clearer picture of a country's strengths and deficiencies with respect to innovation-related policies and practices.

The framework upon which the GII model rests relies upon eight pillars made up of five inputs and three outputs (see below) that underpin the factors that enhance innovative capacity and demonstrate results from successful innovation.

The model uses a combination of objective data drawn from a variety of public and private sources such as the World Bank, International Telecommunications Union (e.g. university enrollment rates, GDP growth rates, the level of penetration of new technologies) and subjective data drawn from the World Economic Forum's annual Executive Opinion Survey. The latter helps to capture concepts for which objective (or hard) data are typically unavailable.

This data, despite its subjective nature, is crucial to an adequate understanding of many essential factors underlying a nation's or region's innovative performance. Examples of the latter include concepts such as the quality of corporate governance, the overall excellence of scientific institutions and the quality of intellectual property rights protections.

The framework groups the eight pillars of innovation into two categories: Inputs and Outputs.

The five Input pillars:
Institutions and Policies
Human Capacity
Infrastructure
Technological Sophistication
Business Markets and Capital

These represent aspects which enhance the capacity of a nation to generate ideas and leverage them for innovative products and services.

The three Output pillars:
Knowledge
Competitiveness
Wealth

These represent the ultimate benefits of innovation for a nation - more knowledge creation, increased competitiveness and greater wealth generation.

Each pillar of the GII model is measured by a number of quantitative and qualitative variables. The averaged scores for the Input and Output pillars together give an overall score - the Global Innovation Index.

Calculating the GII

The Global Innovation Index for any given country is calculated in the following manner:

1. The values of each variable for the country are scaled on a range of 1 to 7.
2. The values of all variables for the country under a particular pillar are averaged to yield a score from 1 to 7 for that pillar for the country.
3. The scores of all five Input pillars are averaged to give an overall score (on a scale of 1 to 7) of the country for the Input dimension.
4. The scores of all three Output pillars are averaged to give an overall score (on a scale of 1 to 7) of the country for the Output dimension.
5. The overall Input and Output scores (steps 3 and 4 respectively above) are averaged to yield the overall Global Innovation Index score (on a range of 1 to 7) for the country.

The five inputs and three outputs (our 'eight pillars'), by which countries' innovative capacity was measured, are listed in detail below.

INPUTS

Institutions and Policies
Independence of judiciary
Demanding regulatory standards
Prevalence of laws relating to ICT
Quality of IPR
Soundness of banks
Quality of scientific research institutions
Quality of management/business schools
Legal obstacles to foreign labour
Time required to start a business
Time required to obtain licenses
Rigidity of employment index
Investor protection index
ICT priority for government

Human Capacity
Brain drain
Quality of human resource approach
Quality of maths and science education
Graduates in engineering
Graduates in science
Population 15-64
Urban population
Schools connected to the internet

General and ICT Infrastructure
Quality of general infrastructure
Quality of national transport network
Quality of air transport
Fixed line penetration

Mobile penetration
Internet penetration
International bandwidth
ICT expenditure
Personal computer penetration
Mobile price basket

Business, Markets and Capital Flows
Access to loans
Sophistication of financial markets
Issuing shares in local share market
Corporate governance
Buyer sophistication
Customer orientation of firms
Domestic credit to private sector
FDI net inflows
Gross private capital flows
Gross capital formation
Extent of clusters
Commercial services imports
Manufactured Imports
Private investment in ICT
Informal economy estimate

Technology and Process Sophistication
Country's level of technology
E-Participation index
E-Government index
Government procurement of advanced technology
Internet use by businesses
Competition among ISP providers
Company technology absorption
Telecom revenue
Secure internet servers per 1,000 people
Spending on R&D
Royalty and license fee payments
Business/university R&D collaboration

OUTPUTS

Knowledge
Local specialized research and training
Nature of competitive advantage
Quality of production process technology
High-tech exports
Manufactured exports
ICT exports
Insurance and financial services
Patents registered (domestic and non-domestic)
Royalty and license fee receipts

Competitiveness
Growth of exports to neighboring countries
Intensity of local competition
Reach of exporting in international markets

Commercial services export
Merchandise exports
Goods exported
Service exports
Listed domestic companies

Wealth
Final consumption expenditure
GDP per capita, PPP
GDP growth rate
Industry, value added
Manufacturer, value added
Services, value added
International migration stock
Value of stocks traded
FDI net outflows