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2012

ADVANCING R&D COMPETITIVENESS WITH METRICS

The Characterization Of Innovation

Bradford L. Goldense

June 12, 2012

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ADVANCING R&D COMPETITIVENESS WITH METRICS

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ADVANCING R&D COMPETITIVENESS WITH METRICS

The Playing Field

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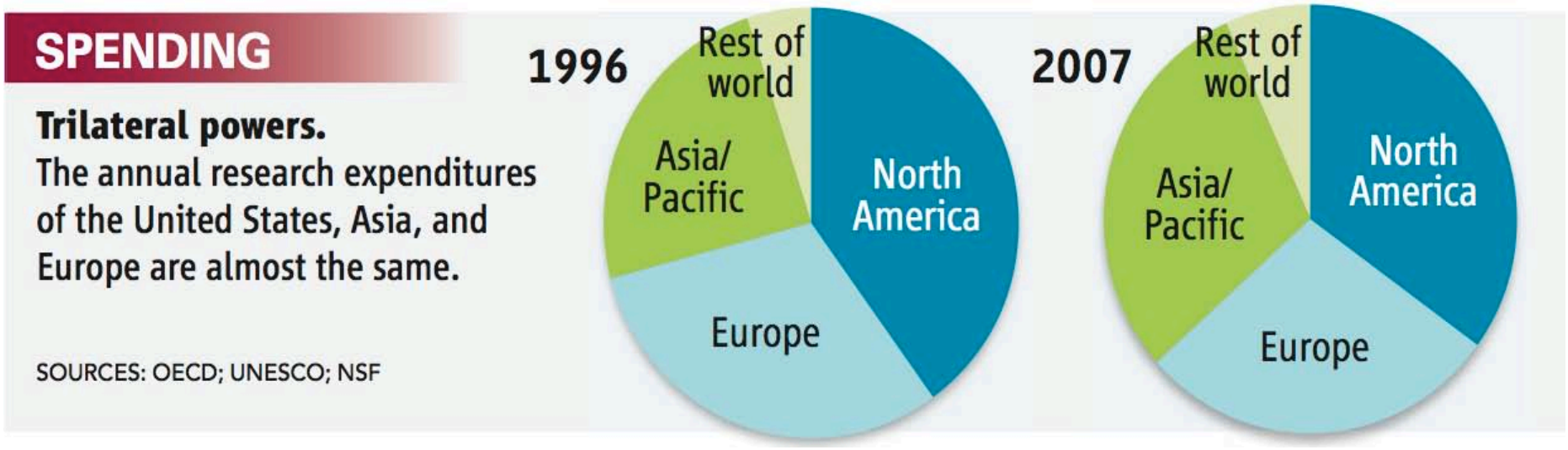
ADVANCING R&D COMPETITIVENESS WITH METRICS

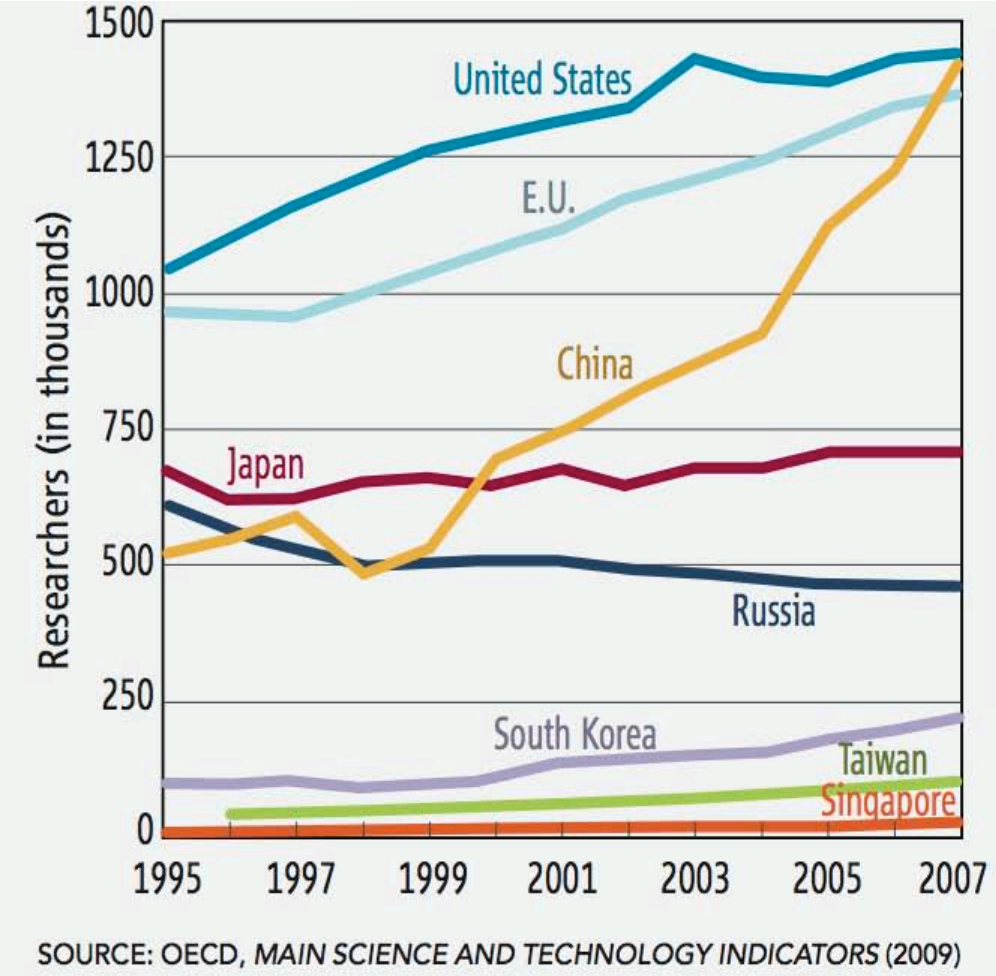
Playing Field: Research Spending [Pre Product Development]



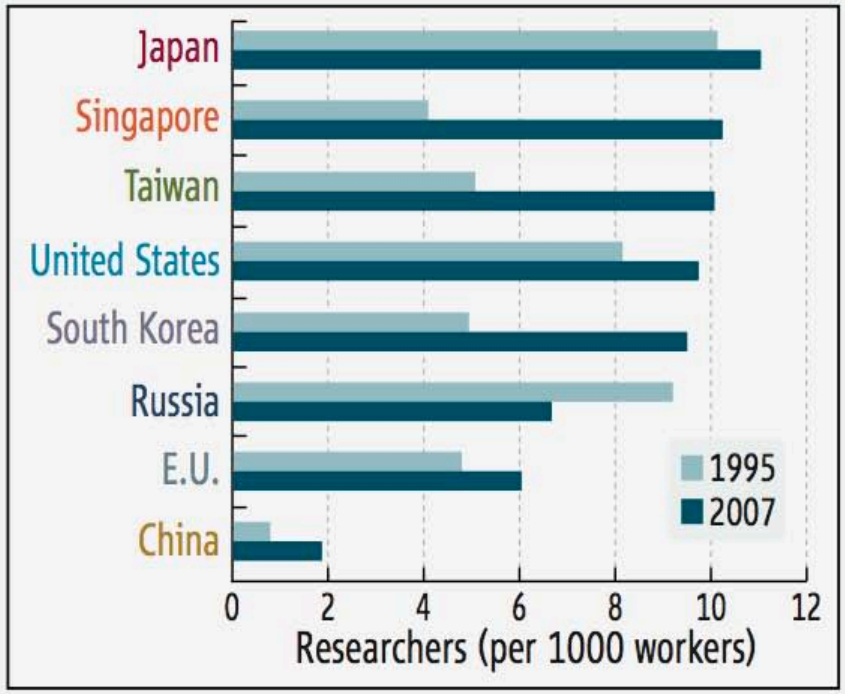
Source: Jeffrey Mervis, "Science Indicators: Trends Document China's Prowess," Science Magazine, American Association For The Advancement Of Science [AAAS], 1200 New York Avenue NY, Washington, DC, USA, ISSN 0036-8075, Volume 327, January 22, 2010, Page 407, Chart: Spending.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Playing Field: Research Workforce [Pre Product Development]



SOURCE: OECD, *MAIN SCIENCE AND TECHNOLOGY INDICATORS* (2009)

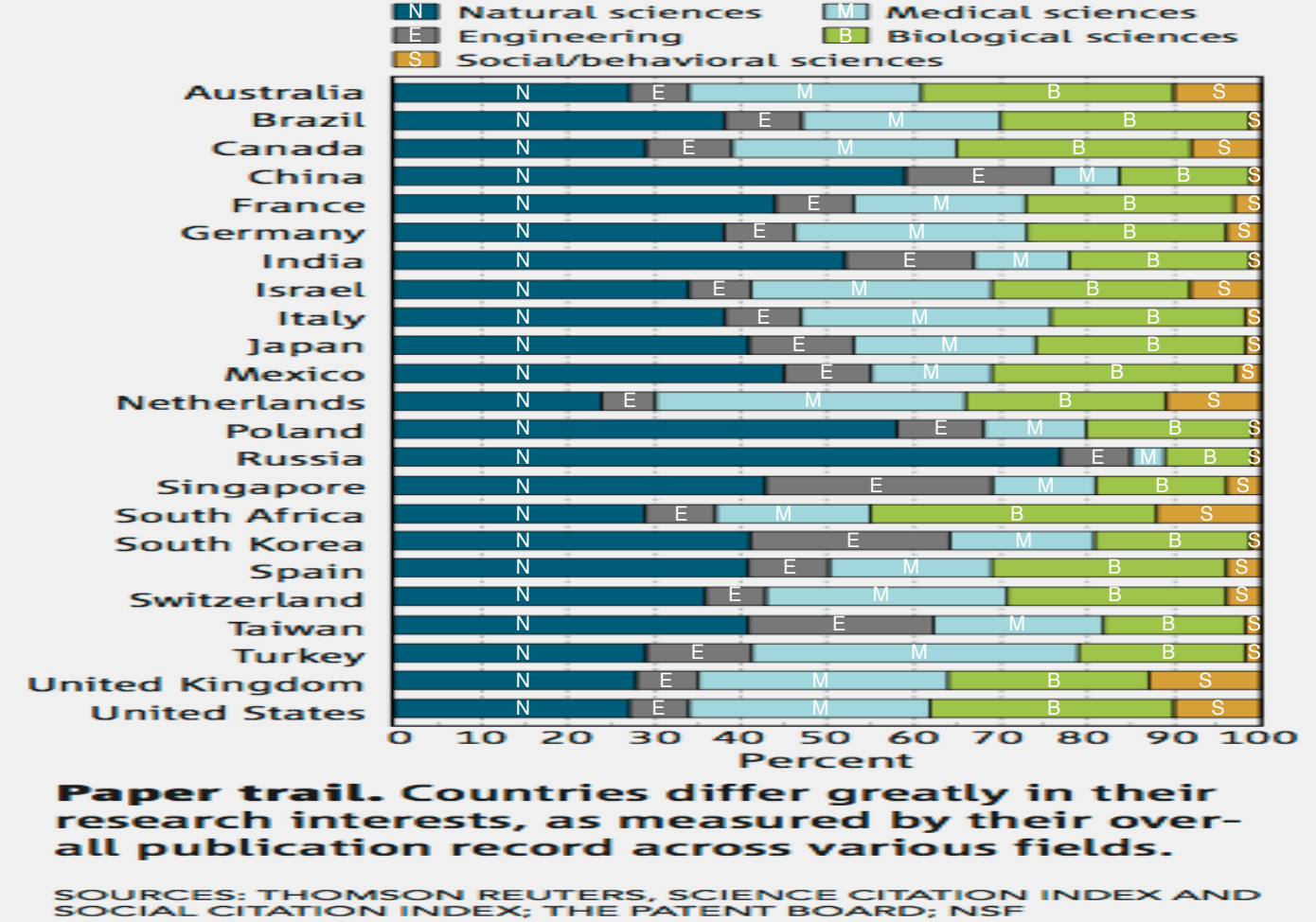


Staffing up. The size of China's scientific work force now equals that of the United States and the European Union, although it still trails in the number per 1000 workers.

Source: Jeffrey Mervis, "Science Indicators: Trends Document China's Prowess," Science Magazine, American Association For The Advancement Of Science [AAAS], 1200 New York Avenue NY, Washington, DC, USA, ISSN 0036-8075, Volume 327, January 22, 2010, Page 407, Chart: Workforce.

ADVANCING R&D COMPETITIVENESS WITH METRICS

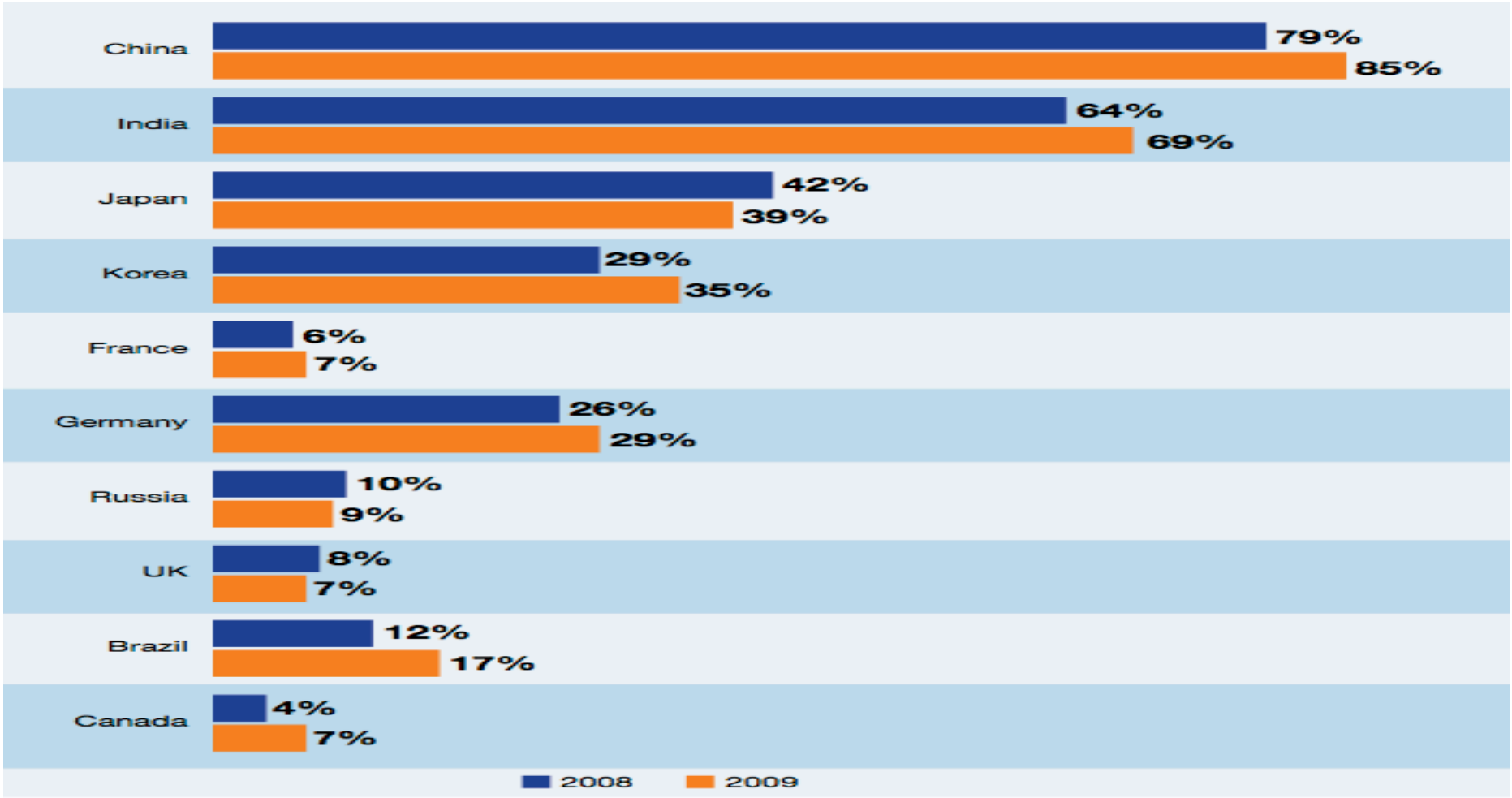
Playing Field: Research Publications [Pre Product Development]



Source: Jeffrey Mervis, "Science Indicators: Trends Document China's Prowess," Science Magazine, American Association For The Advancement Of Science [AAAS], 1200 New York Avenue NY, Washington, DC, USA, ISSN 0036-8075, Volume 327, January 22, 2010, Page 407, Publications.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Playing Field: Country Technology Gains By 2014



Source: Martin Grueber [Battelle] and Tim Studt [Advantage Business Media], "2010 Global R&D Funding Forecast: Reinvigorating India's R&D," Advantage Business Media, 100 Enterprise Drive, Suite 600, Rockaway, NJ, 07866, USA, December 2009, Page 30, Chart: Which Countries Will Make The Largest Tech Gains By 2014?.

ADVANCING R&D COMPETITIVENESS WITH METRICS

The Right Strategy

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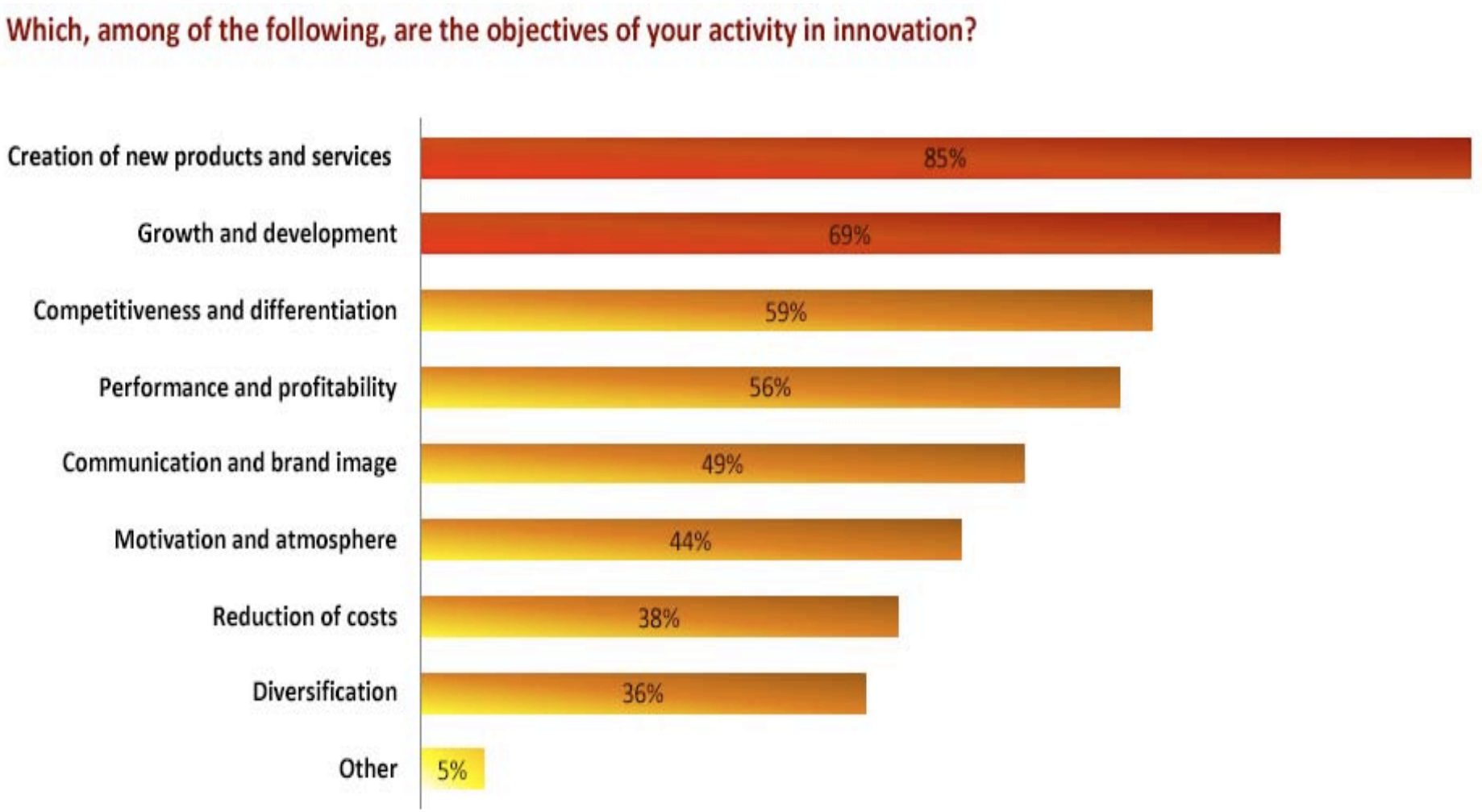
ADVANCING R&D COMPETITIVENESS WITH METRICS

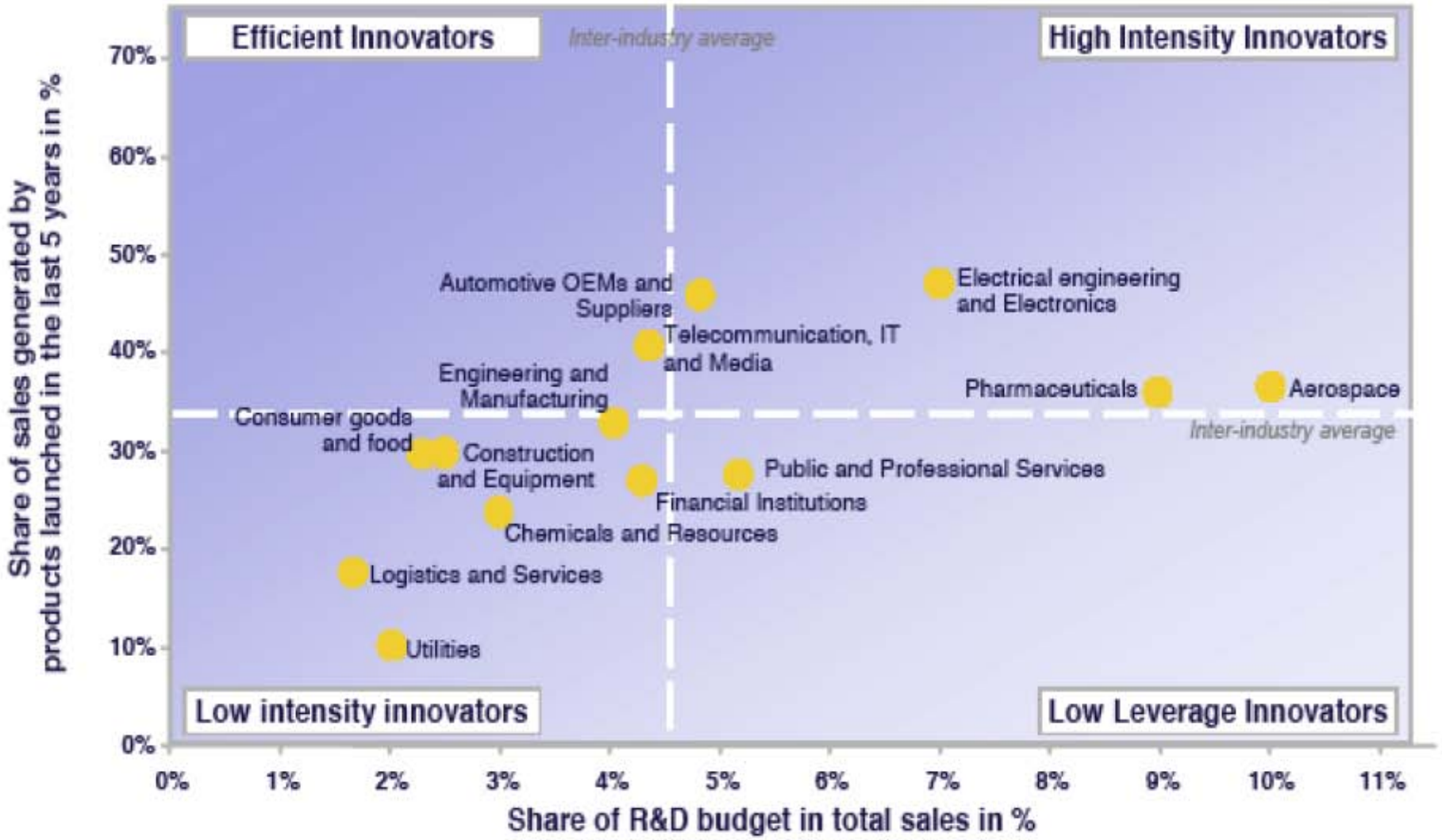
Right Strategy: Choose Your Innovation Strategy For Reasons



Source: Brice Challamel, et al., "The Corporate Innovation Function: Key Findings and Detailed Results," Act One, 6 Rue de Seze, 75009 Paris, France, December 2010, Page 13, Chart: The Objectives of Innovation.

ADVANCING R&D COMPETITIVENESS WITH METRICS

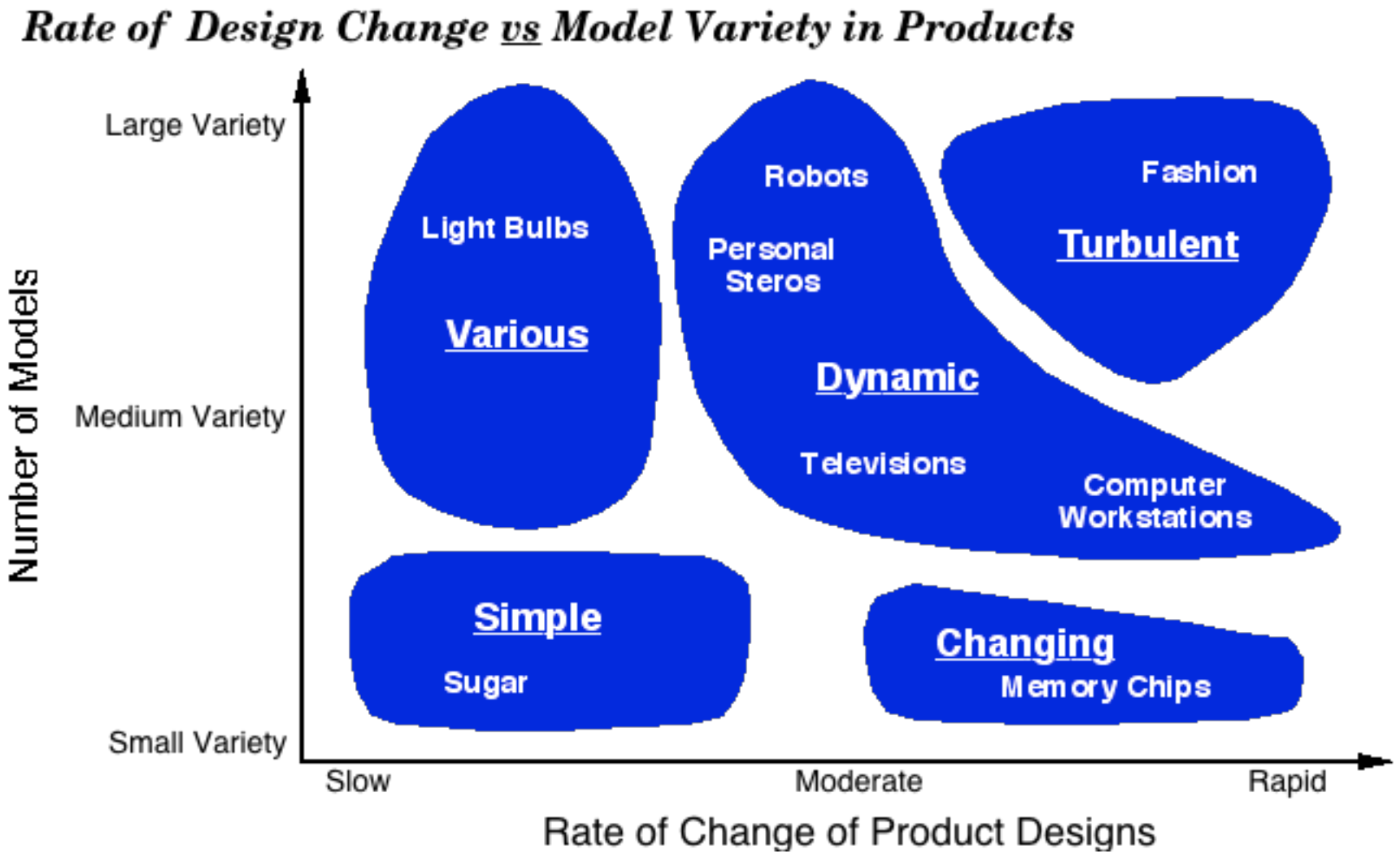
Right Strategy: Spend More Productively Than Your Competitors



Source: Press Release, *Innovation Excellence Study 2005, Exhibit 1: Innovation investment and new product share by industry cluster.,* Arthur D. Little, May 25, 2005, Page 2.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Strategy: Know Your Operating Envelope



Source: P.R. Nayak, *Managing Rapid Technological Development,* Arthur D. Little, August 1990.

ADVANCING R&D COMPETITIVENESS WITH METRICS

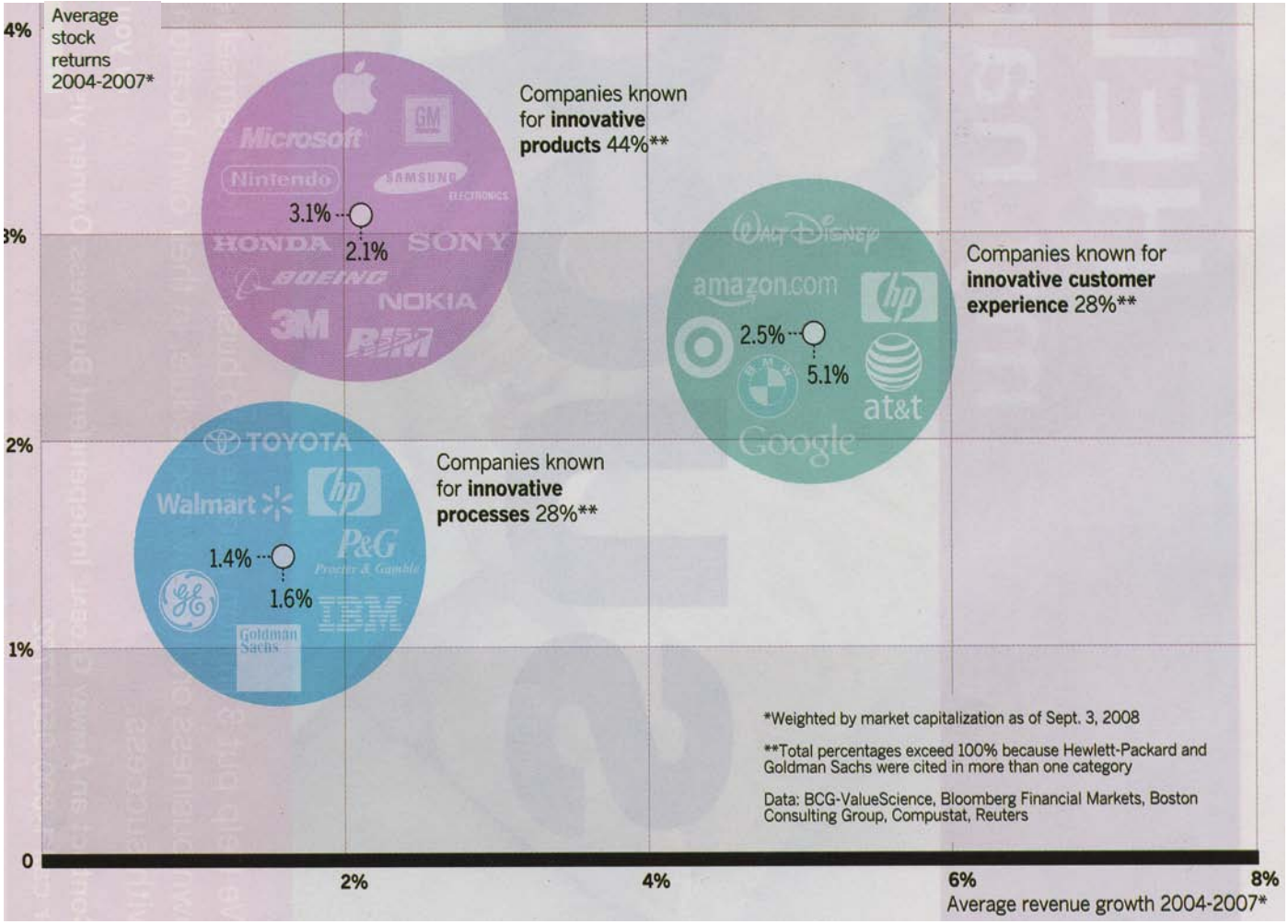
Right Strategy: Determine Your Primary Basis Of Competition

INNOVATION: THE BIGGEST BANG FOR THE BUCK

Creating hip devices like the iPhone may not be the most profitable form of innovation. The *BusinessWeek* Innovation Index (businessweek.com/innovate/global_index/) tracks 25 corporations known for their forward-thinking products, processes, consumer experience, or business models. The companies with innovative business models tend to have the highest average stock returns and highest average revenue growth of all the companies in the index.

Companies named within a circle are known for a type of innovation, based on the 2008 BW/Boston Consulting Group Most Innovative Companies survey of nearly 3,000 executives at 2,500 companies.

KEY:
Average stock returns, 2004-2007
Average revenue growth, 2004-2007



Source: Reena Jana, "indata: Innovation – The Biggest Bang For The Buck," Business Week, The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, New York, USA, September 22, 2008, Page 48, Chart.

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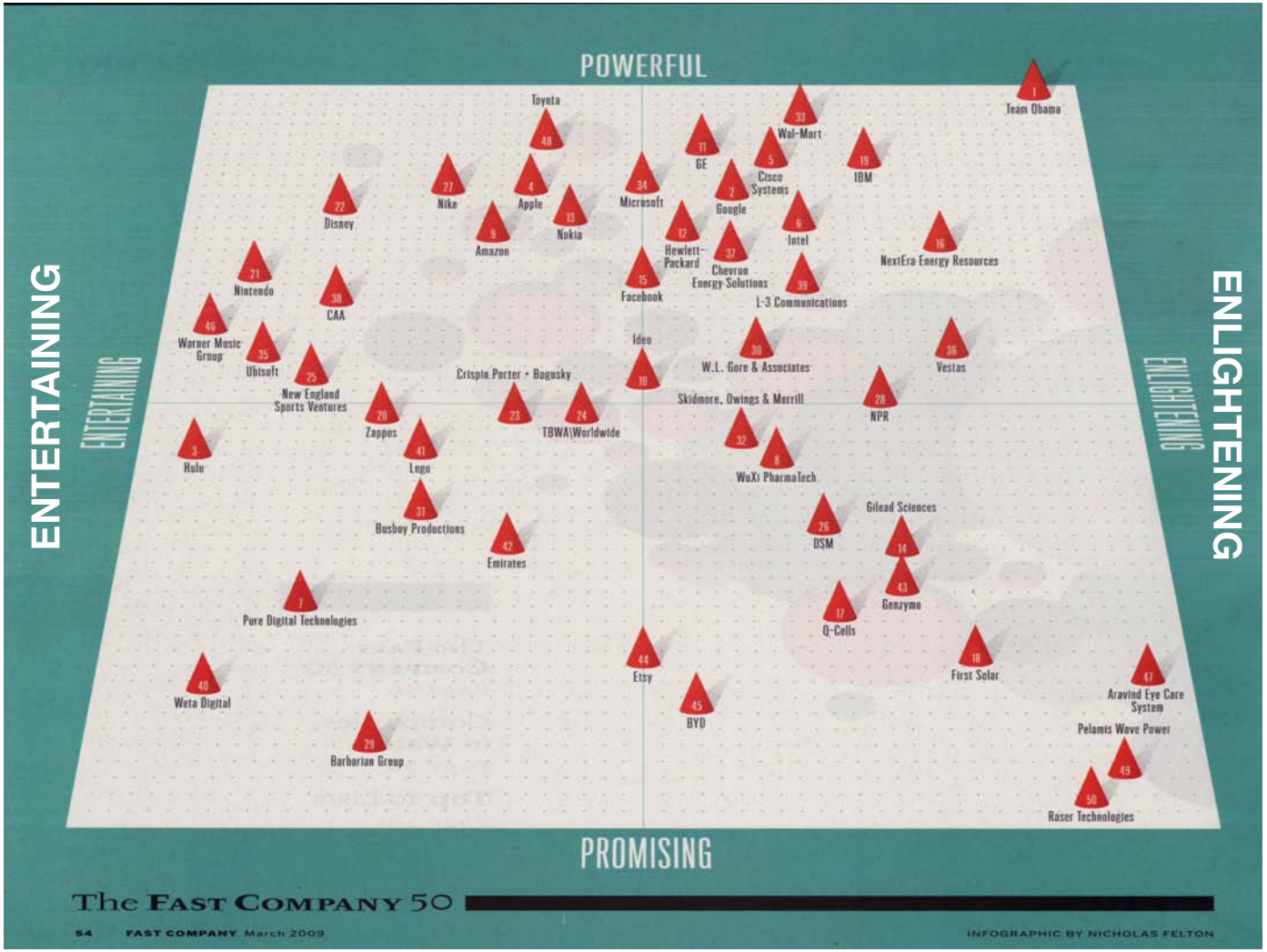
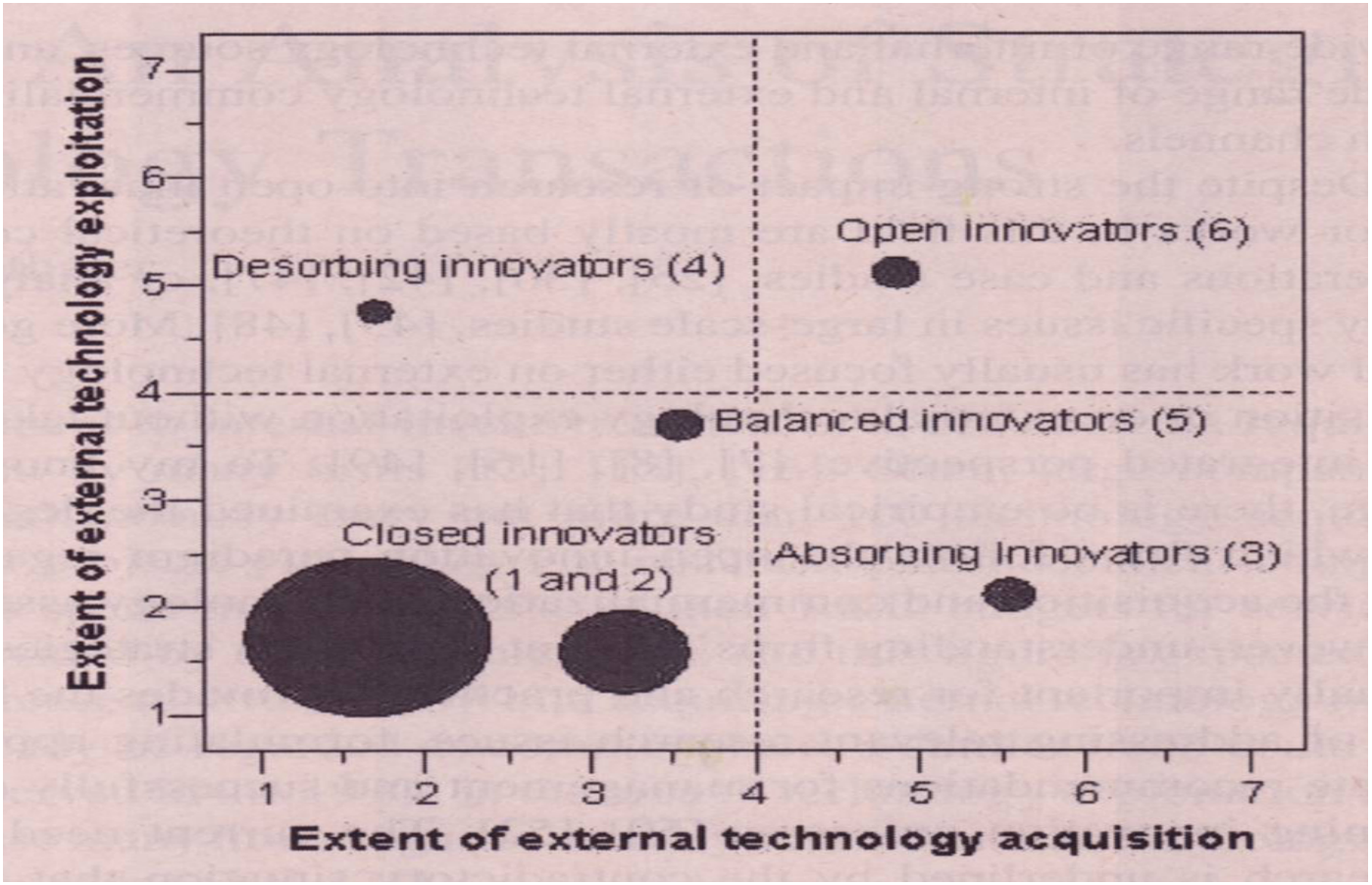
Right Strategy: Determine Your Brand Reputation & Product Performance Objectives



Source: *The Fast Company 50*, Fast Company, Mansueto Ventures, LLC, 7 World Trade Center, New York, NY 10007, Issue Number 133, March 2009, Page 54, ISSN 1085-9241.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Strategy: Determine Your R&D Tactics - Organic vs. Open & Make vs. Buy

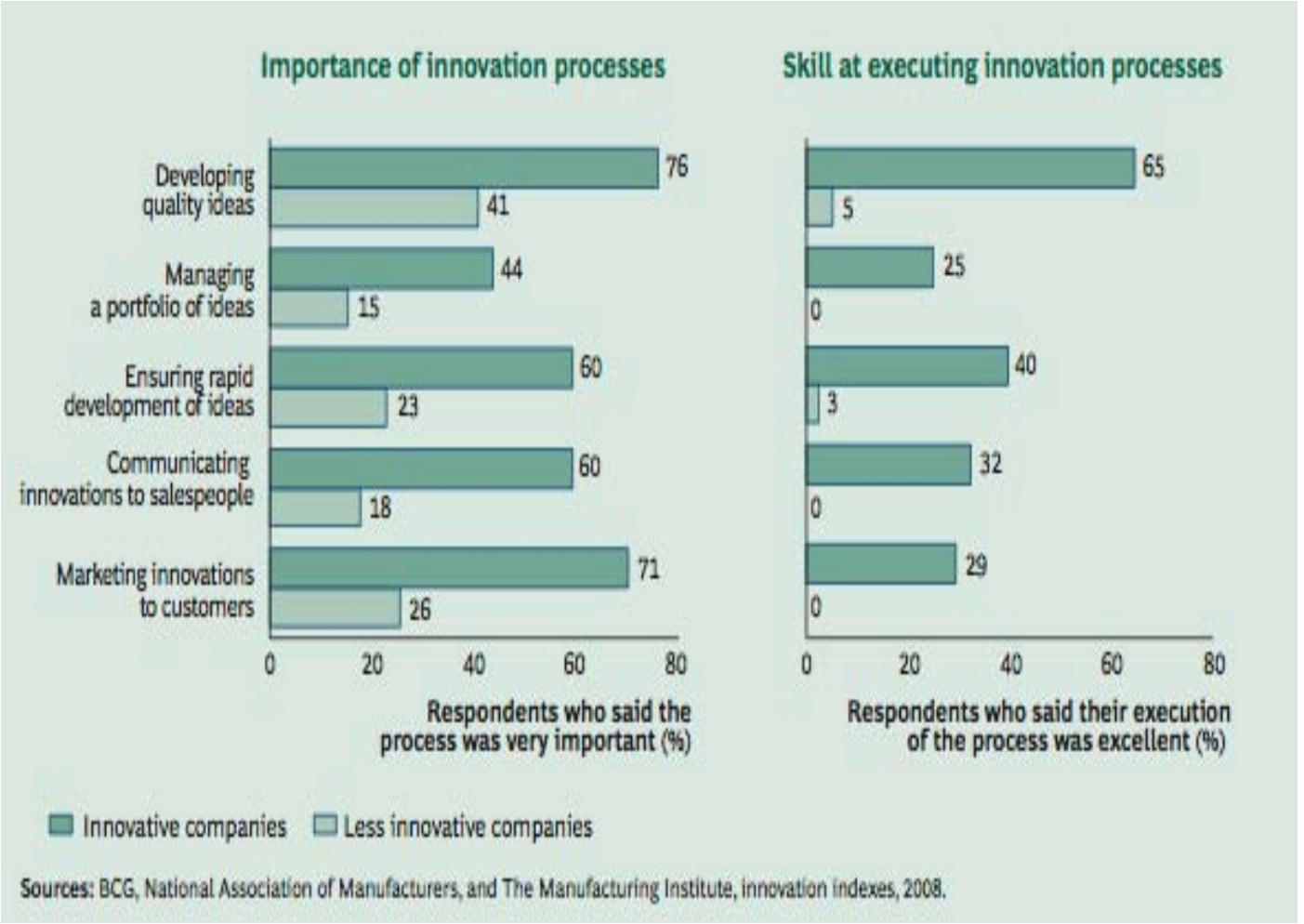


Source: Ulrich Lichtenthaler, "Open Innovation In Practice: An Analysis of Strategic Approaches to Technology Transactions," IEEE Transactions on Engineering Management, A Publication Of The IEEE Technology Management Council, 312 Technology Management Research Center, 111 Washington Street, Newark, New Jersey 07102, USA, February 2008 Volume 55 Number 1 IEEMA4, ISSN 0018-9391, Pages 150, Figure 1. Illustration of results of cluster analysis (Ward's method with standardized variables and squared Euclidean distance).

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Strategy: Address Your End-To-End R&D Gaps

SIGNIFICANT GAPS EXIST BETWEEN THE "IMPORTANCE OF" AND THE "SKILL AT"



Source: James P. Andrew, Emily Stover DeRocco and Andrew Taylor, "The Innovation Imperative In Manufacturing: How The United States Can Restore Its Edge", The Boston Consulting Group, Exchange Place, 31st Floor, Boston, MA., USA, March 2009, Page 16, Exhibit 5: Top Innovators Have A Greater Appreciation For Innovation Processes And Execute ...

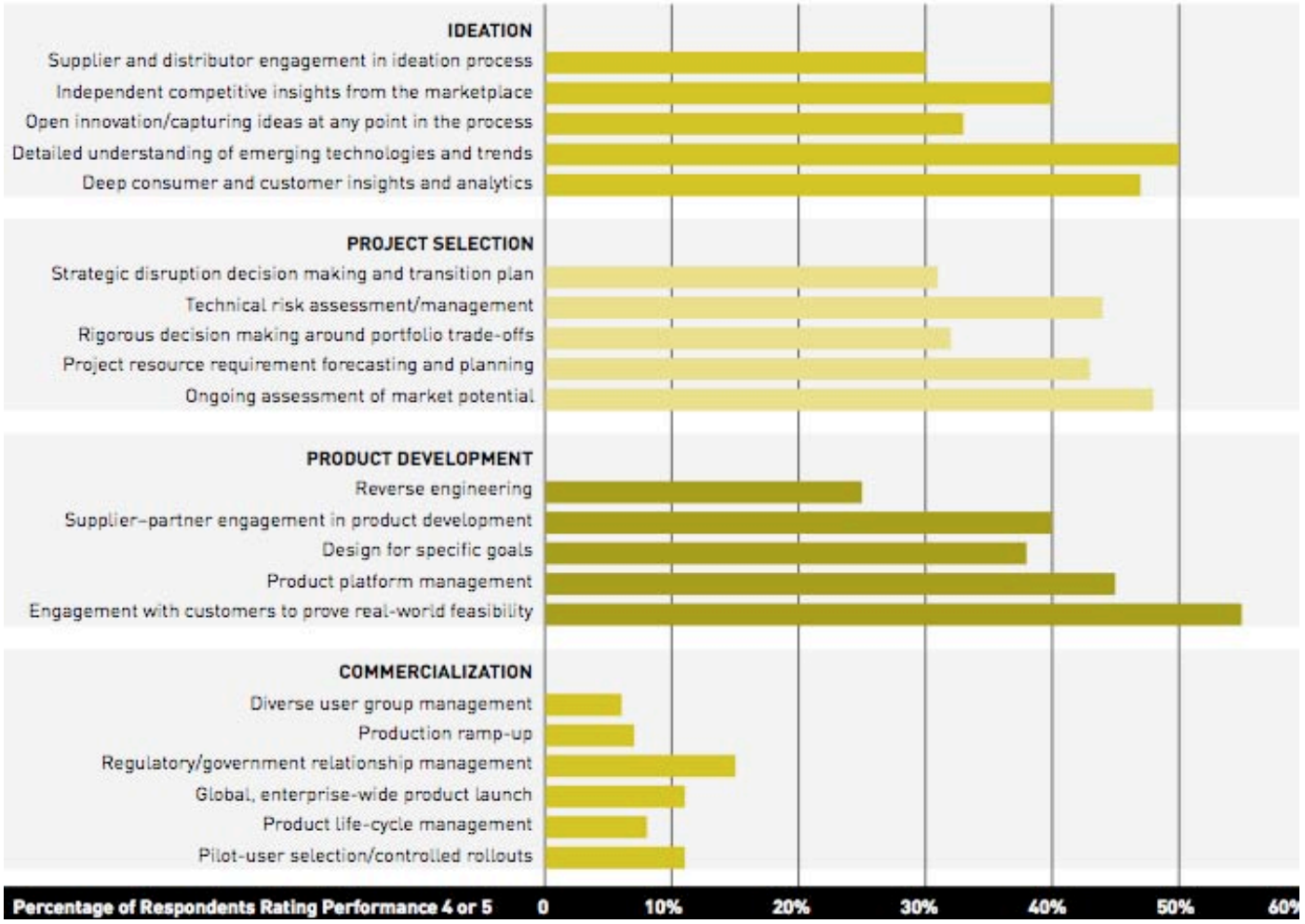
ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Strategy: Address Your End-To-End R&D Gaps - Commercialization Especially

Respondents were asked to rate their companies' performance on critical capabilities on a scale of 1 to 5.

At the ideation, project selection, and product development stage of the innovation process, companies gave themselves generally good marks.

The survey, however, revealed a general shortcoming at the commercialization stage, where companies agreed that their efforts were falling apart.



Source: Barry Jaruzelski and Kevin Dehoff, "The Global Innovation 1000: How The Top Innovators Keep Winning", Booz & Company Inc., 101 Park Avenue, 20th Floor, New York, New York, 10178, USA, Issue 61, Winter 2010, Page 11, Exhibit 10: Innovator's Performance On Critical Capabilities.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Strategy: Create A Business Model

By the late 1990s, Apple's initial pathway to growth was running out of steam. The company's proprietary approach to designing both hardware and software limited it to being a niche player and hampered its ability to compete on price. In 2001, Apple began introducing a series of successful new products and services—the iPod, the iTunes online music service, and the iPhone—that propelled the company to the top of its industry. But the shift wasn't only a matter of product innovation. Apple's success resulted from its ability to define a workable business model for downloading music—something that had eluded the music industry for years.

This combination of product innovation and business model innovation (BMI) put Apple at the center of a market approximately 30 times larger than its original market. It also helped expand the company's share of the traditional computer market, as new customers became so attached to their iPods that they took another look at Apple's computers.[1]

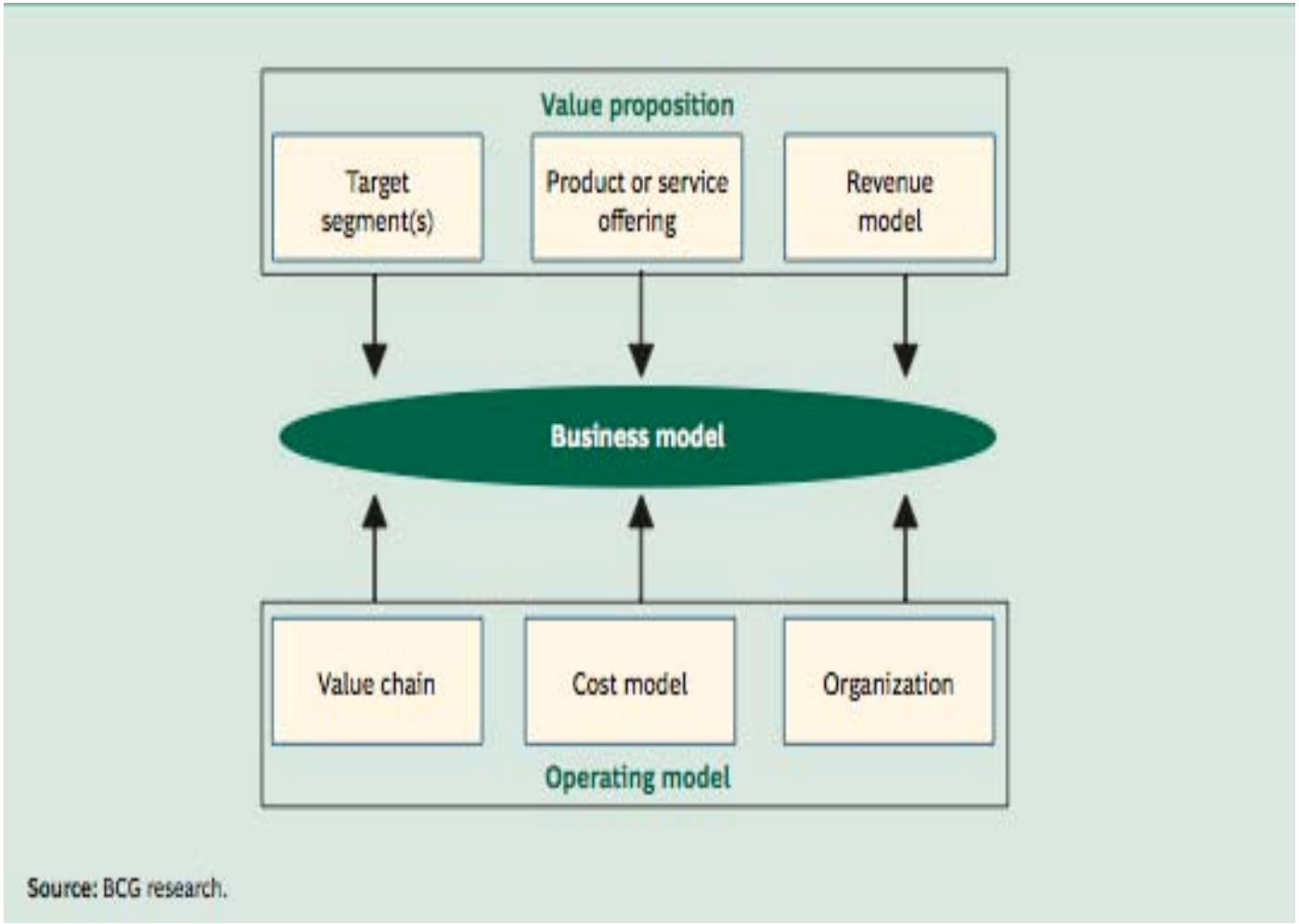
The greater frequency of disruption and dislocation in many industries is shortening business model lifecycles. New global competitors are emerging. Assets and activities are migrating to low-cost countries. Systemic risk is growing as global business becomes increasingly interconnected. Social and ecological constraints on corporate action are emerging. All these factors require businesses to bolster and accelerate innovation. The discipline of BMI offers a fresh way to think about renewing competitive advantage and reigniting growth in this challenging environment.

Business model innovation means more than a brilliant insight coming at the right place and the right time. To confer a reliable competitive advantage, BMI must be systematically cultivated, sufficiently supported, and explicitly managed. In this paper, we will argue that BMI is highly relevant in the current business environment, describe some of the circumstances in which BMI has proved valuable, identify common pitfalls, and discuss how companies can develop a competitive capability in BMI.

Source: Zhenya Lindgardt, Martin Reeves,George Stalk and Michael S. Deimler, "Business Model Innovation: When The Game Gets Tough, Change The Game," The Boston Consulting Group, Exchange Place, 31st Floor, Boston, MA., USA, December 2009, Page 1.

ADVANCING R&D COMPETITIVENESS WITH METRICS

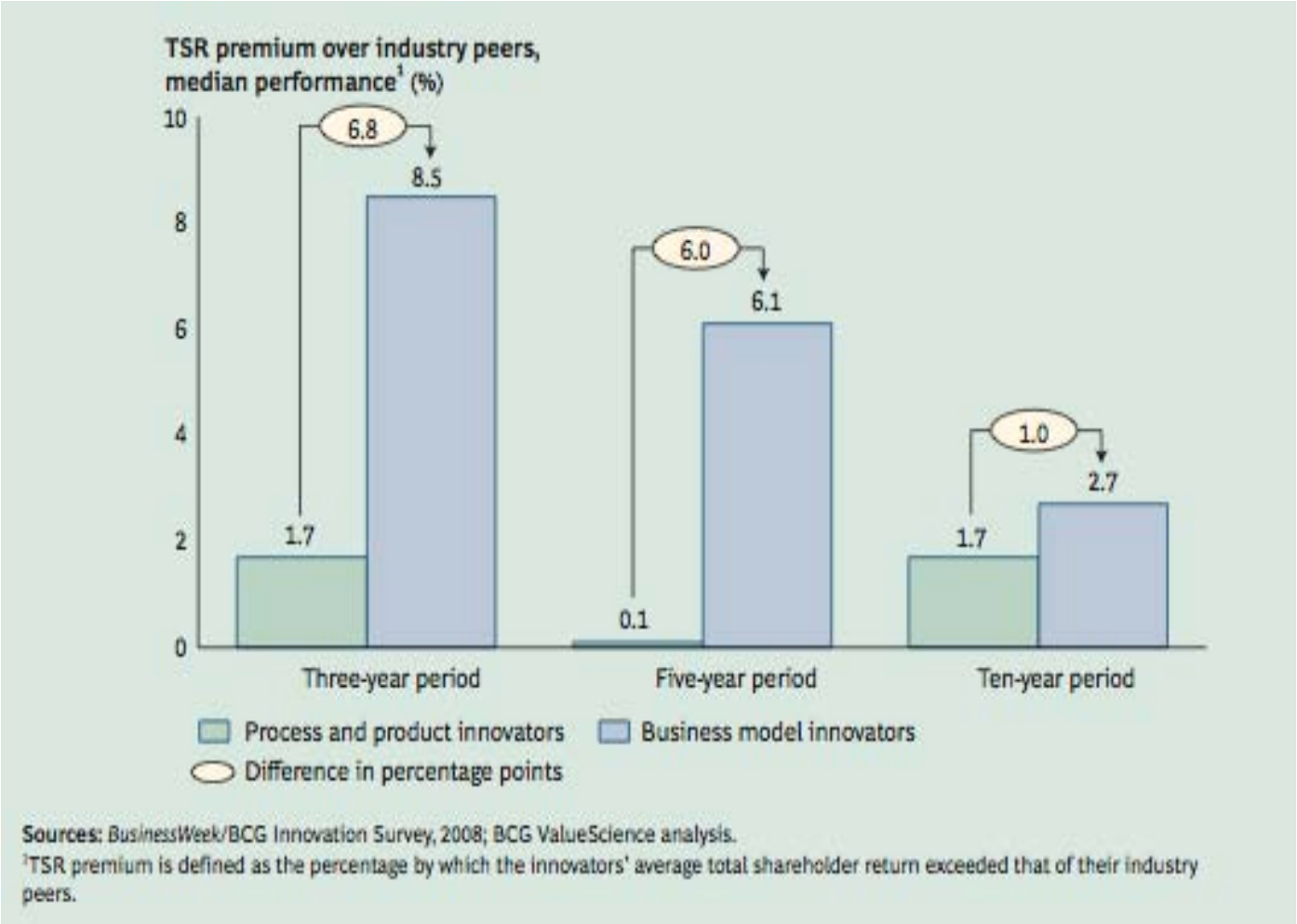
Right Strategy: Create A Business Model - Major Components



Source: Zhenya Lindgardt, Martin Reeves,George Stalk and Michael S. Deimler, "Business Model Innovation: When The Game Gets Tough, Change The Game," The Boston Consulting Group, Exchange Place, 31st Floor, Boston, MA., USA, December 2009, Page 2, Exhibit 1: A Business Model Typically Consists Of Six Components.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Strategy: Create A Business Model - Results



Sources: *BusinessWeek*/BCG Innovation Survey, 2008; BCG ValueScience analysis.
[1]TSR premium is defined as the percentage by which the innovators' average total shareholder return exceeded that of their industry peers.

Source: Zhenya Lindgardt, Martin Reeves,George Stalk and Michael S. Deimler, "Business Model Innovation: When The Game Gets Tough, Change The Game," The Boston Consulting Group, Exchange Place, 31st Floor, Boston, MA., USA, December 2009, Page 3, Exhibit 2: Business Model Innovators Out Perform Traditional Innovators Over Time.

ADVANCING R&D COMPETITIVENESS WITH METRICS

The Right Places

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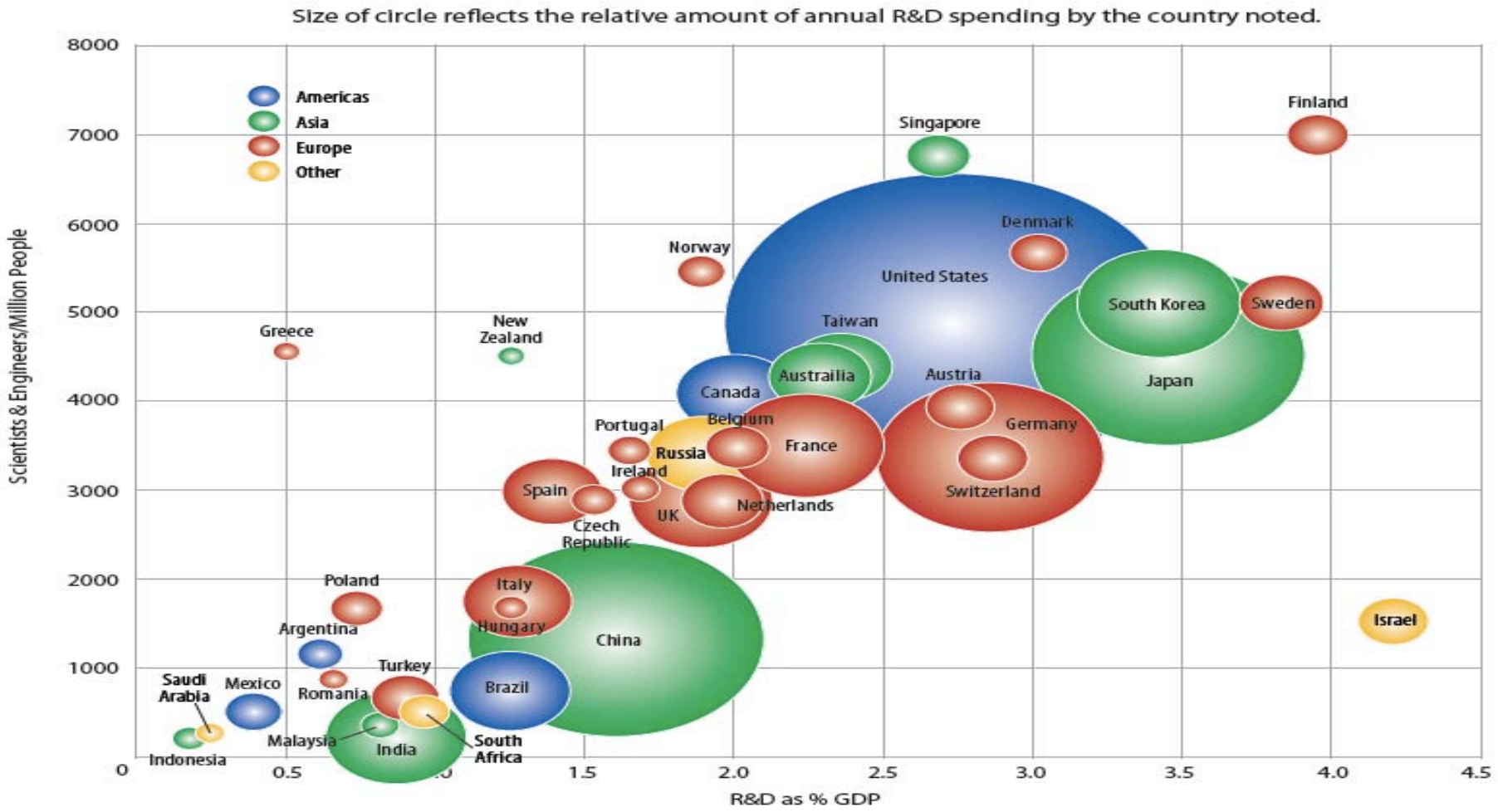
ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Places: The World Of R&D In 2011



Source: Martin Grueber [Battelle] and Tim Studt [R&D Magazine], "2012 Global R&D Funding Forecast: R&D Spending Growth Continues While Globalization Accelerates," Advantage Business Media, 100 Enterprise Drive, Suite 600, Rockaway, NJ 07866, December 2011, Page 4, Graph 1: World of R&D 2011.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Places: International Innovation Index

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.

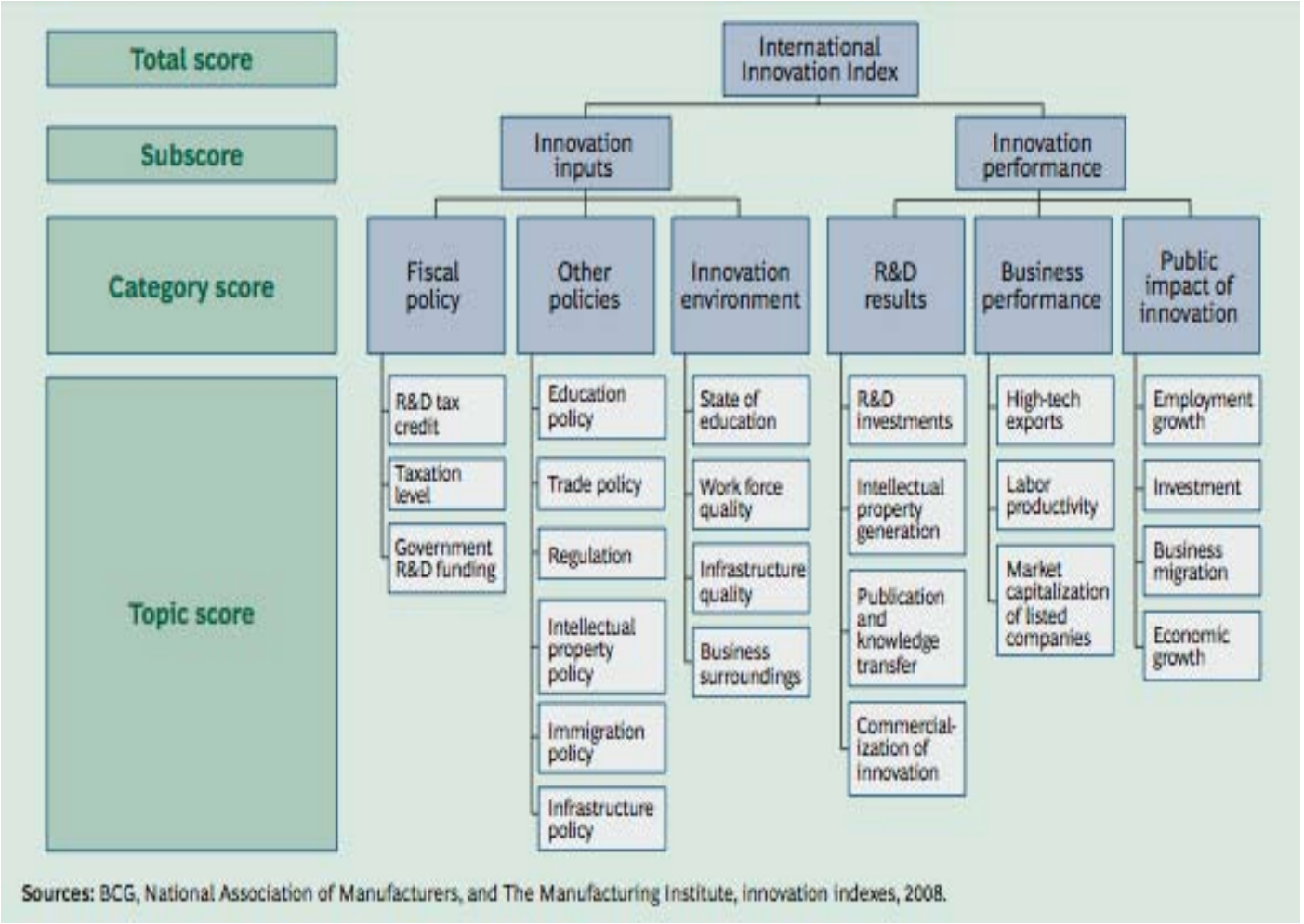
• A series of one-hour follow-up interviews with 30 senior executives to identify common concerns, best practices, and ways to improve the innovation climate. The questions focused on two main issues: approaches to and experiences with innovation and how the United States ranks as a center of innovation.

• 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.

Source: James P. Andrew, Emily Stover DeRocco and Andrew Taylor, "The Innovation Imperative In Manufacturing: How The United States Can Restore Its Edge", The Boston Consulting Group, Exchange Place, 31st Floor, Boston, MA., USA, March 2009, Page 6 and 7.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Places: International Innovation Index - Based On A Variety Of Factors



Source: James P. Andrew, Emily Stover DeRocco and Andrew Taylor, "The Innovation Imperative In Manufacturing: How The United States Can Restore Its Edge", The Boston Consulting Group, Exchange Place, 31st Floor, Boston, MA., USA, March 2009, Page 9, Exhibit 1: The International Innovation Index Is Based On A Variety Of Inputs And Performance Factors.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Places: International Innovation Index - Large Country & LCC Rankings

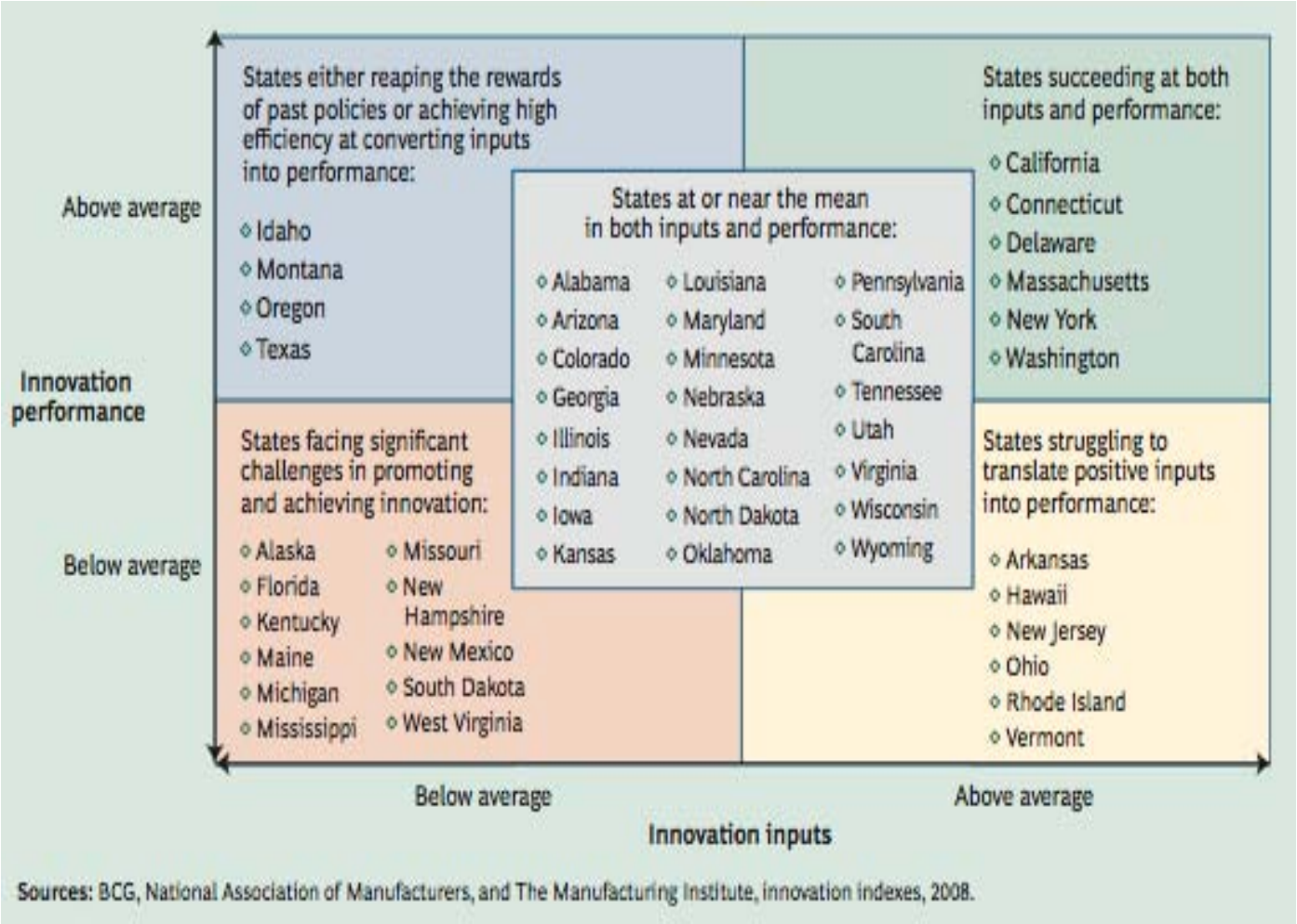
Overall ranking			Large-country ranking		
Ranking	Country	Score	Ranking	Country	Score
1	Singapore	2.45	1	South Korea	2.26
2	South Korea	2.26	2	United States	1.80
3	Switzerland	2.23	3	Japan	1.79
4	Iceland	2.17	4	Sweden	1.64
5	Ireland	1.88	5	Netherlands	1.55
6	Hong Kong	1.88	6	Canada	1.42
7	Finland	1.87	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.

Source: James P. Andrew, Emily Stover DeRocco and Andrew Taylor, "The Innovation Imperative In Manufacturing: How The United States Can Restore Its Edge", The Boston Consulting Group, Exchange Place, 31st Floor, Boston, MA., USA, March 2009, Page 10, Exhibit 2: Other Countries Have Surpassed The United States In Innovation.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Places: International Innovation Index - States Are In Five Clusters



Source: James P. Andrew, Emily Stover DeRocco and Andrew Taylor, "The Innovation Imperative In Manufacturing: How The United States Can Restore Its Edge", The Boston Consulting Group, Exchange Place, 31st Floor, Boston, MA., USA, March 2009, Page 13, Illustration: The State's Innovation Performance Falls Into Five Clusters.

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The Right Intellectual Property

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ADVANCING R&D COMPETITIVENESS WITH METRICS

Right IP: Recognize The Long Run Importance - Integral To Doing Effective Business

WHAT'S INSIDE WD-40
THE SLIPPERY SECRET FORMULA

The recipe for this superlube has long been a closely guarded trade secret—until now. **WIRED** sent a can to the lab and got the ingredients. —*Patrick Di Justo*

THE RESULTS

Our lab analyzed WD-40 with gas chromatography (GC) and mass spectroscopy (MS). GC separates chemicals based on size, boiling point, and other factors, releasing them one by one over time. MS then blasts the molecules with an electron beam and tells what's what by the mass of the ionized fragments.

MINERAL OIL

Seriously. WD-40 is mostly a mix of baby oil, Vaseline, and the goop inside home-made lava lamps.

DECANE

WD-40 contains an abundance of alkanes—hydrocarbons that match the formula C_nH_{2n+2}, usually in a long, zigzagging chain. This one, $C_{10}H_{22}$, which is also a common ingredient of gasoline, helps WD-40 remain a liquid at cold temperatures. Decane doesn't freeze until around −21 degrees Fahrenheit.

NONANE

Another alkane. One reason these molecules are so handy here: Their hydrogen atoms don't hold a charge, so they can't connect to the hydrogen or oxygen in water, which makes alkanes water-repellent. WD-40, after all, stands for "water displacement, 40th attempt."

TRIDECANE AND UNDECANE

Freeze-resistant? Check. Water-repellent? Check. Contains an alkane that is the major product of the red-banded stinkbug's scent gland? Check! Many alkanes are naturally produced by living creatures. Undecane, part of the pheromone trail left by cockroaches and ants, is present.

TETRADECANE

Another alkane! *Zzzzzz.*

DIMETHYL NAPHTHALENE

Here's the thing: This stuff ($C_{12}H_{12}$) comes in 10 forms, called isomers. One of them is a harmless hormone given off by potatoes. Another is used in high-performance engineering plastics. Our analysis can't determine which ones are present here, but if you're using it as a solvent, as is likely the case with WD-40, they all work just fine.

CYCLOHEXANE

That *cyclo* prefix means that unlike standard alkanes, which come in chains, this one's a ring. The shape gives cycloalkanes a higher melting point. And huffing them will knock you out cold. (Or so we're told.)

CARBON DIOXIDE

The WD-40 company claims that by using this gas as a propellant, it avoids using smaller gaseous alkanes (possibly butane and propane), which can be hazardous to the environment. As if CO_2 isn't.

Source: Wired, "What's Inside WD-40: The Slippery Secret Formula," Conde' Nast Media Publications, 4 Times Square, New York, New York, 10036, USA, May 2009, Page 36.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right IP: IPRI - Study To Measure Ten Variables [From 6 Different Sources]

1) **Legal and Political Environment (LP)**
   - Judicial Independence
   - Rule of Law
   - Political Stability
   - Control of Corruption

2) **Physical Property Rights (PPR)**
   - Protection of Physical Property Rights
   - Registering Property
   - Access to Loans

3) **Intellectual Property Rights (IPR)**
   - Protection of Intellectual Property Rights
   - Patent Protection
   - Copyright Piracy

Source: Anne Chandima Dedigama, 2008 Hernando de Soto Fellow, "International Property Rights Index 2009 Report," Property Rights Alliance, 1920 L Street, NW Suite 200, Washington, DC, USA, February 1, 2009, Page 13, Exhibit 1: Structure Of The IPRI.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right IP: IPRI - Country Ranking By Quintile

strongest ↓ weakest

Top 20%	2nd Quintile	3rd Quintile	4th Quintile	Bottom 20%
Finland	Spain	Costa Rica	Egypt	Nepal
Netherlands	South Africa	Kuwait	Sri Lanka	Montenegro
Denmark	Korea (South)	Slovenia	Burkina Faso	Cameroon
New Zealand	Estonia	India	Tanzania	Macedonia
Sweden	Malta	Uruguay	Philippines	Ethiopia
Germany	Chile	Latvia	Dominican Republic	Armenia
Norway	Israel	Thailand	Honduras	Serbia
Switzerland	Qatar	Panama	Vietnam	Nicaragua
Australia	Taiwan	Poland	Uganda	Bolivia
Austria	Hungary	Turkey	Argentina	Moldova
Iceland	Slovakia	Malawi	Guatemala	Albania
Singapore	Cyprus	Trinidad and Tobago	Mozambique	Nigeria
Ireland	Malaysia	Morocco	Madagascar	Paraguay
Canada	Italy	Bulgaria	Ukraine	Azerbaijan
United Kingdom	Czech Republic	Croatia	Kenya	Bosnia-Herzegovina
United States	Greece	Colombia	Peru	Chad
Japan	Tunisia	El Salvador	Kazakhstan	Venezuela
Belgium	Jordan	Mali	Russia	Guyana
Hong Kong	Lithuania	Romania	Indonesia	Burundi
France	Botswana	Mexico	Zambia	Zimbabwe
Luxembourg	Bahrain	Jamaica	Pakistan	Angola
Portugal	Mauritius	Mauritania	Algeria	Bangladesh
United Arab Emirates		Benin	Ecuador	
		China		
		Brazil		

Source: Anne Chandima Dedigama, 2008 Hernando de Soto Fellow, "International Property Rights Index 2009 Report," Property Rights Alliance, 1920 L Street, NW Suite 200, Washington, DC, USA, February 1, 2009, Page 22, Exhibit 4: IPRI Ranking By Quintile.

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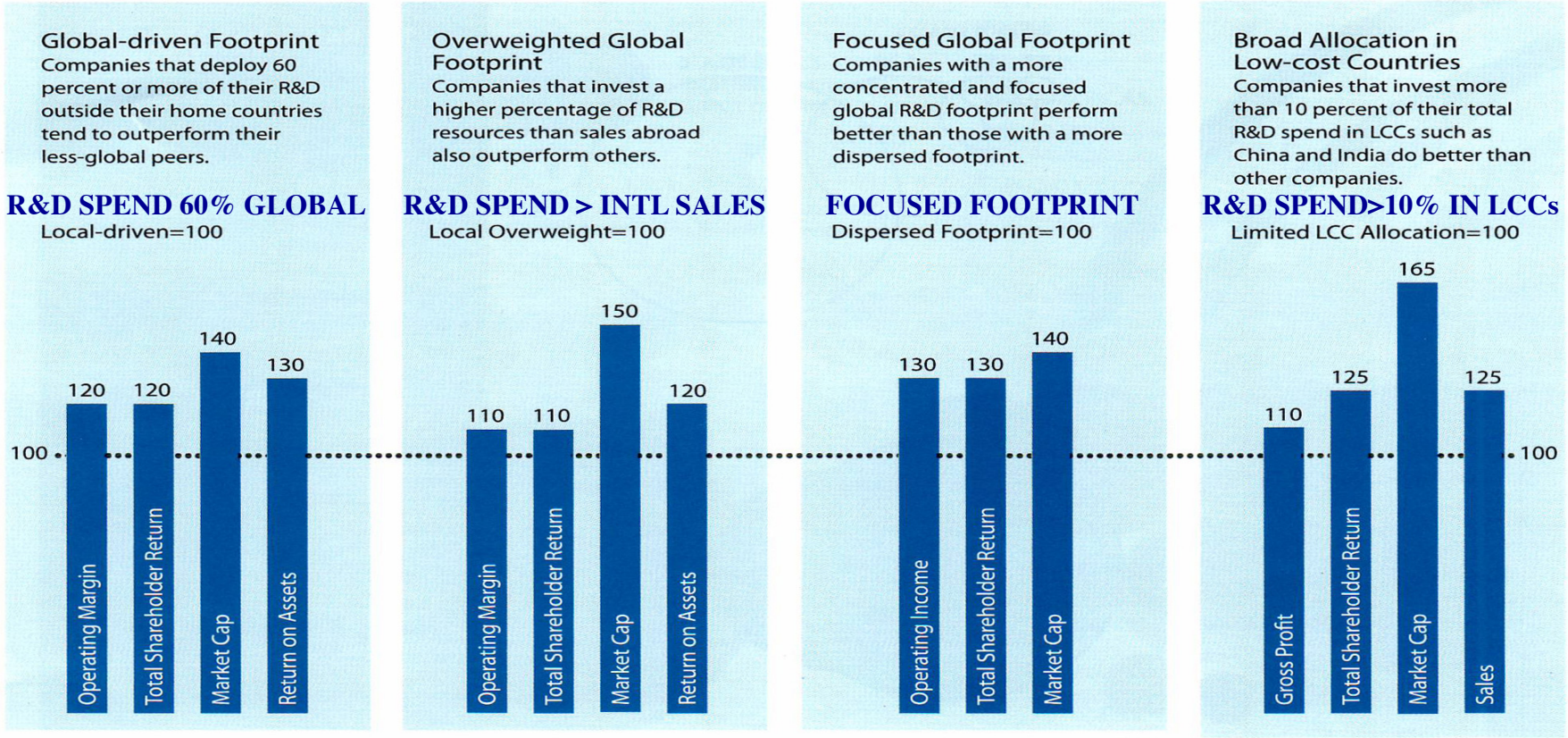
ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Organization: 4 Global Winning Approaches

The global "footprint" of a company's R&D spending appears to affect its financial performance.



Note: Average performance, 2005–07, is based on gross profit, growth in market capitalization, operating margin, return on assets, and total share-holder return, for a sample of 184 top spenders on R&D, accounting for 71 percent of the Global Innovation 1000 total.

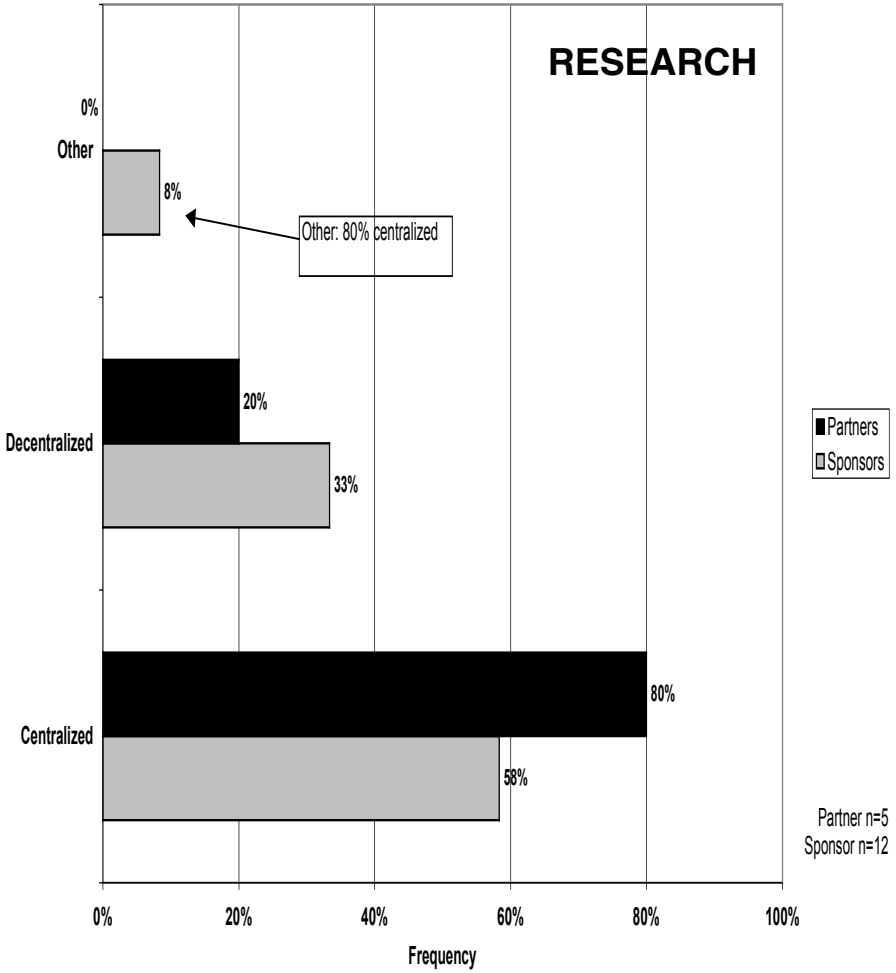
SOURCE: Booz & Company analysis

Source: Barry Jaruzelski and Kevin Dehoff, "Booz & Company 2008 Report: Beyond Borders -The Global Innovation 1000 Study Reveals A Global Shift In R&D Spending," Visions Magazine, PDMA – Product Development & Management Association, October 2009, Page 30, Exhibit 2: The Performance Payoff Of Global R&D.

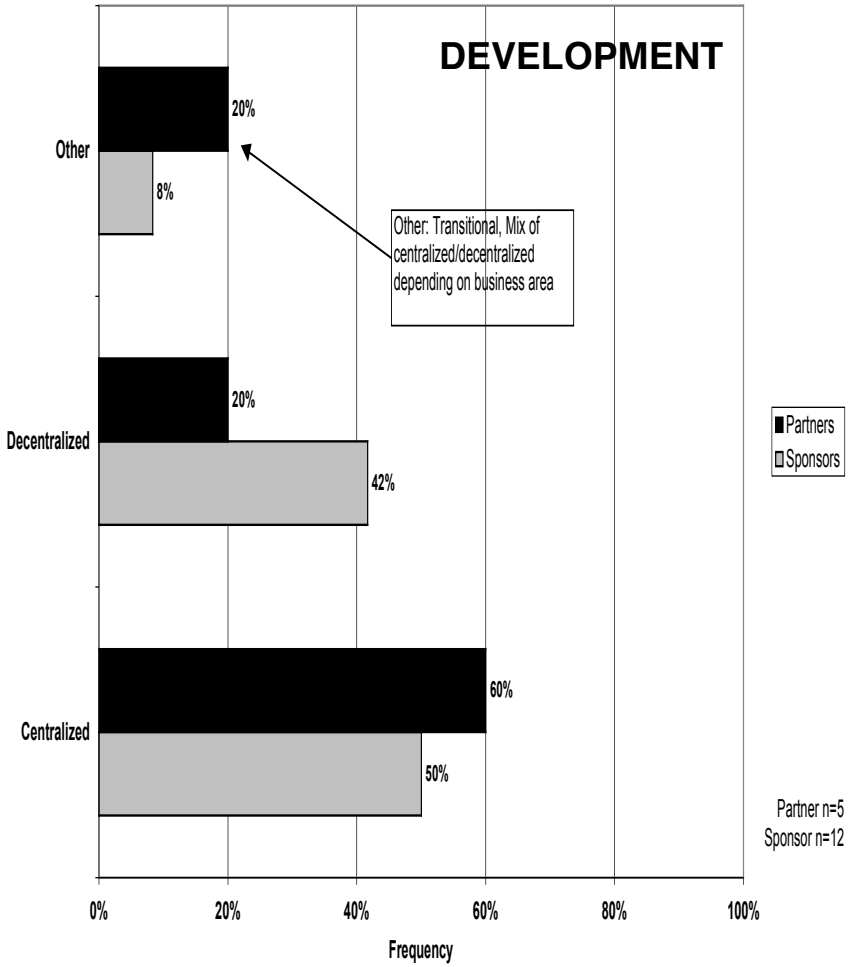
ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Organization: High R&D Productivity Is Often Slightly More Centralized

Which of the following best describes the structure of the Research operation with respect to the organization overall?



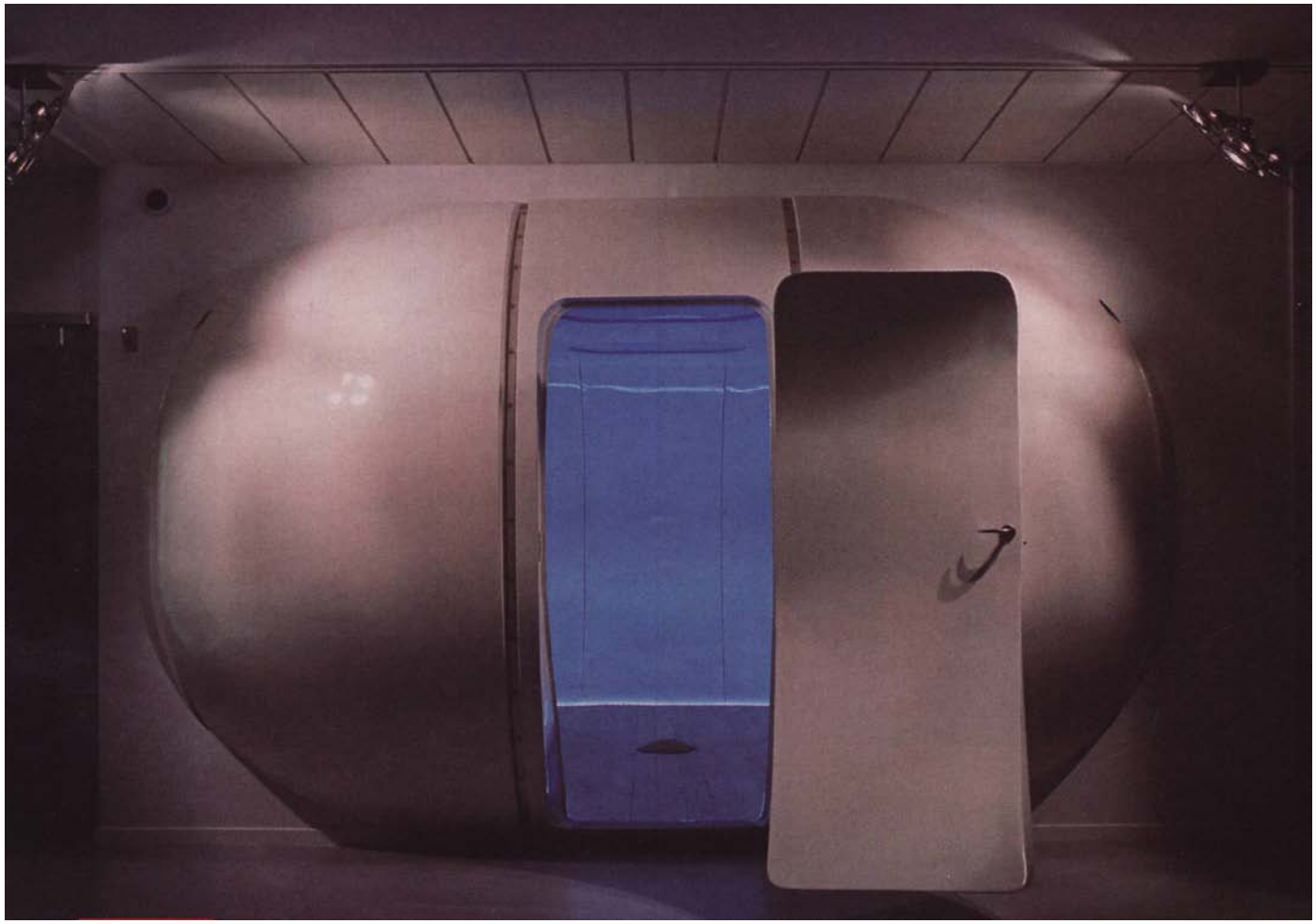
Which of the following best describes the structure of the Development operation with respect to the organization overall?



Source: APQC, "R&D Productivity Study: Understanding the Drivers and Enablers," Consortium Learning Forum Best-Practice Report, 2005, Pages 29-43.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Organization: High R&D Productivity Is Influenced By The Facility



Source: Chris Morrison, "What's Cool: Stuff That Makes the Job Less Of A Chore. Work. Eggheads." *Business 2.0 Magazine*, Time, Inc., 1225 Avenue Of the Americas, New York, New York 10020, August 2007, Page 91, ISSN 1538-1730.

ADVANCING R&D COMPETITIVENESS WITH METRICS

The Right Tactics

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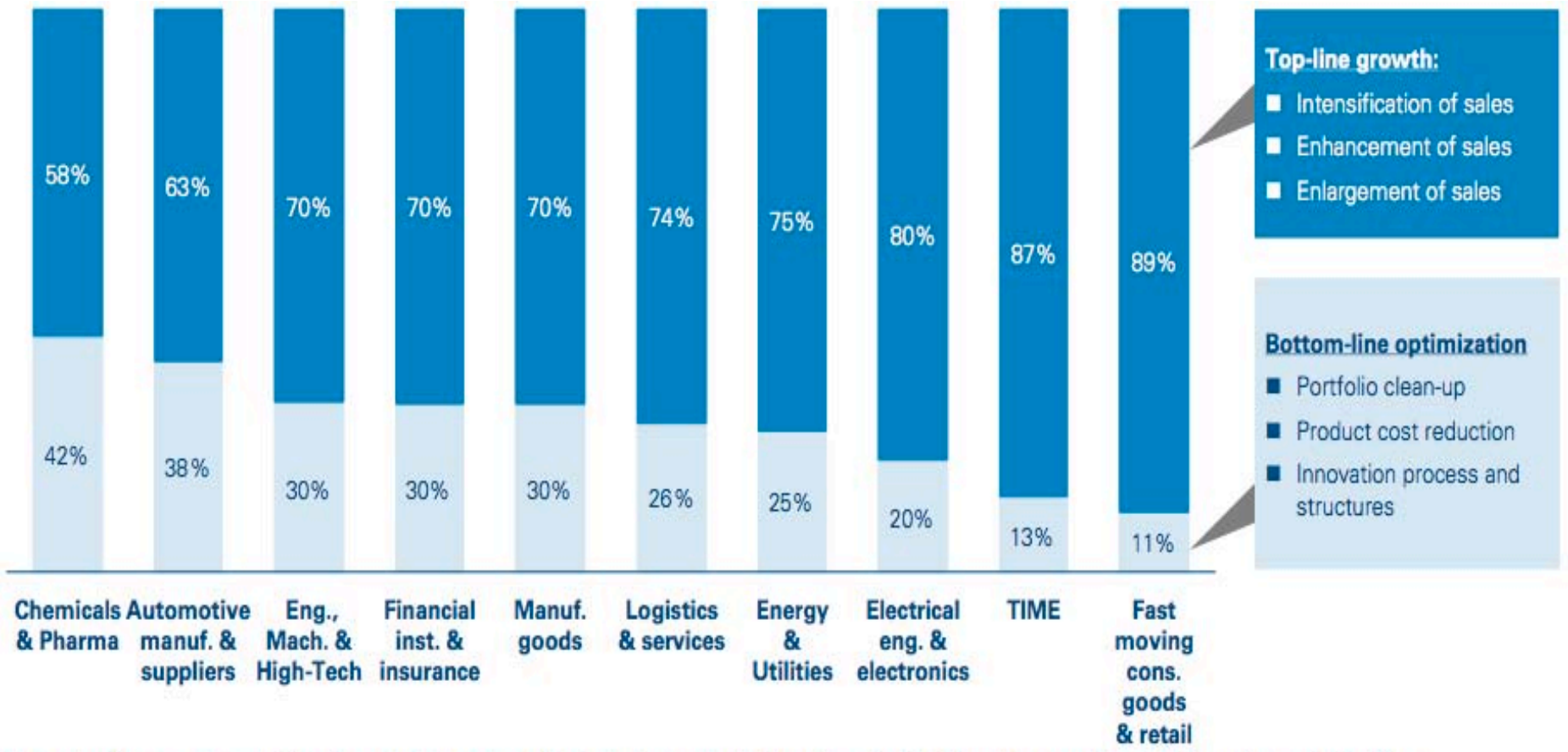
ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Tactics: Restructuring vs. Innovation R&D Model

Source: Volker Bellersheim, Volker Kirchgeorg, and Markus Achtert, "Defying Downturn Through Innovation," Arthur D. Little, 125 High Street, High Street Tower, 28th Floor, Boston, MA, USA, January 2009, Page 2, Figure 1: Combine Restructuring And Innovation.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Tactics: Restructuring vs. Innovation - Industry Averages



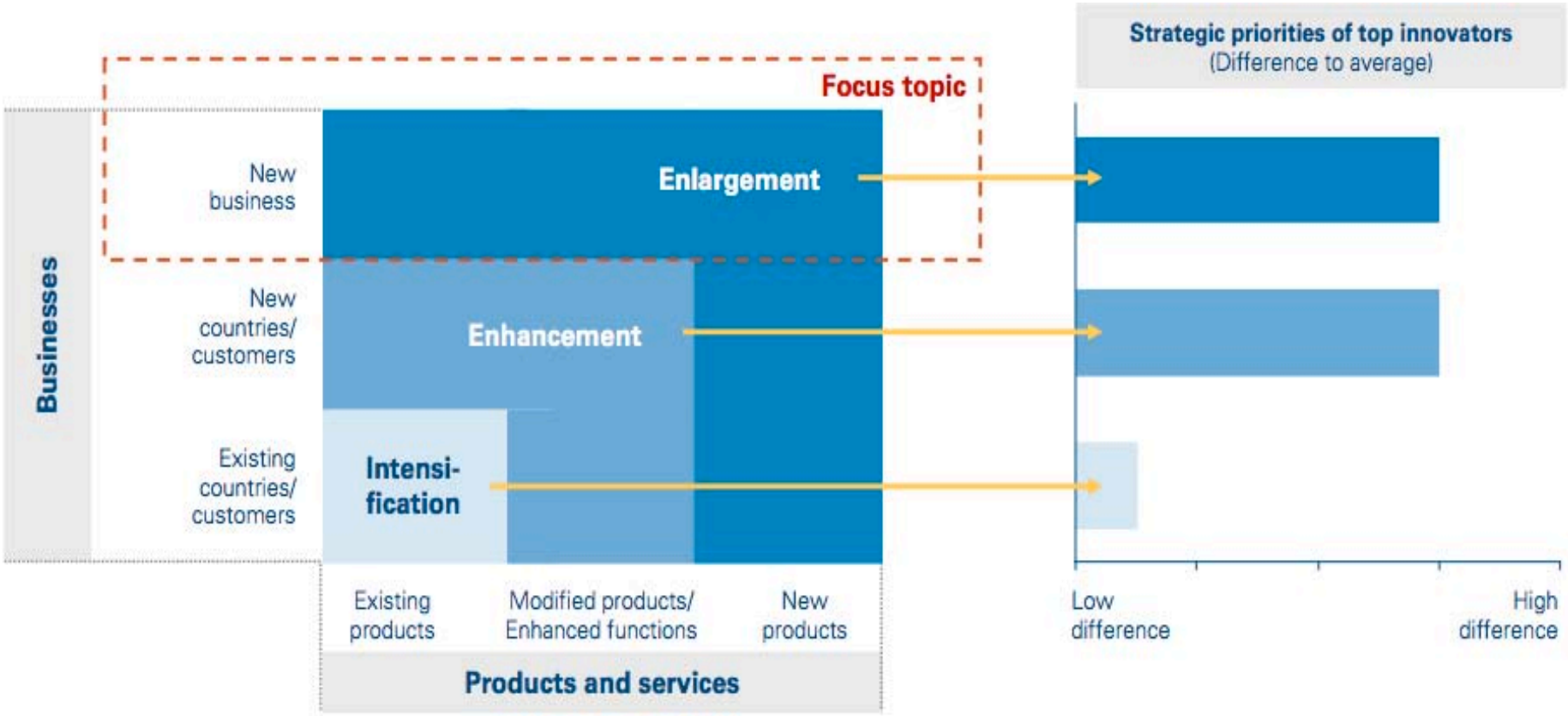
The value from such activities strongly depends on the industry and whether the priority is top-line growth or bottom-line optimization.

Source: Arthur D. Little Innovation Excellence 2009/2010

Source: Per I. Nilsson, Markus Achtert and Hanno Groseschmidt, "Pathways To Innovation Excellence: Results Of A Global Study, Arthur D. Little, March 2010, Page 6, Figure 3: Primary Strategic Value Of Innovation Activities.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Tactics: The Innovation Side



All activities targeting innovation and growth can be mapped to Arthur D. Little's Innovation & Growth Matrix, top innovators focus on activities with a higher degree of innovation.

Source: Arthur D. Little Innovation Excellence 2009/2010

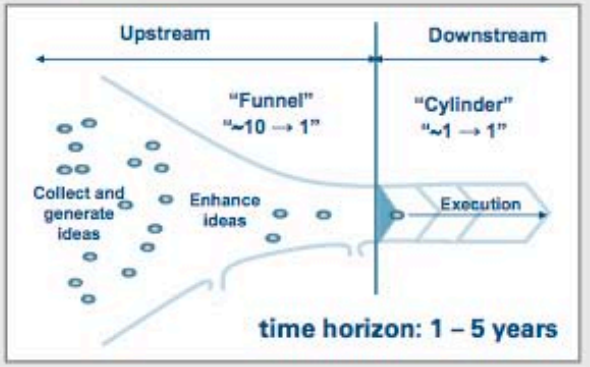
Source: Per I. Nilsson, Markus Achtert and Hanno Groseschmidt, "Pathways To Innovation Excellence: Results Of A Global Study, Arthur D. Little, March 2010, Page 5, Figure 2: Innovation And Growth Matrix.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Tactics: The Innovation Side - Alternative Innovation Engines

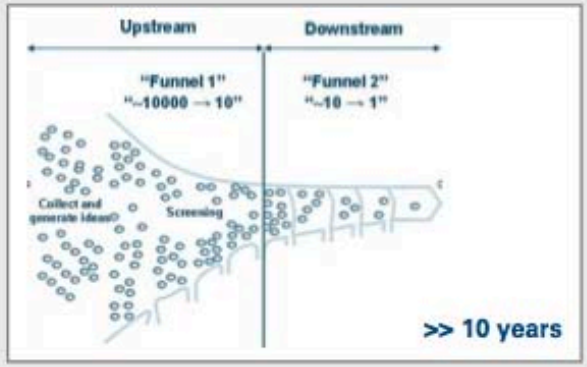
Idea-driven innovation engine

- Innovation engine is fed and driven by a large number of ideas
- One idea corresponds (more or less) to one product or service
- Product/project portfolio management is about picking the winners – non-promising projects are discontinued
- Initiated downstream development projects are seldom stopped
- Most suitable for industries that are largely driven by idea management, e.g.
  - Fast-moving consumer goods
  - Services
  - Telecom operators
  - Chemicals



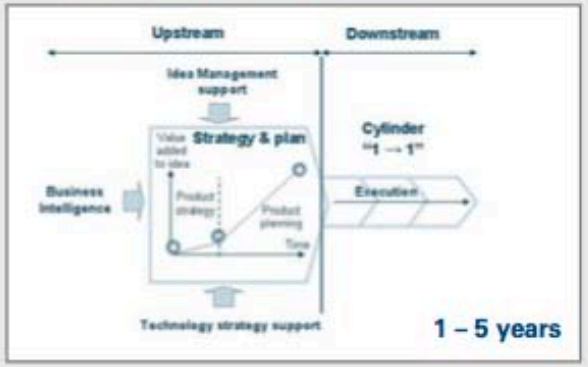
Research-driven innovation engine

- Innovation engine is fed and driven by a huge number of ideas generated from research
- One idea corresponds (more or less) to promising components/targets in a future product/site
- Product/project portfolio management is picking the winners among the huge mass of promising ideas/ targets – non-promising ideas/targets are discontinued
- A majority of projects in downstream development will be stopped before launch
- Most suitable for industries that are largely research driven, e.g.
  - Pharmaceuticals
  - Oil and gas exploration



Analysis-driven innovation engine

- Innovation engine is fed and driven by an analytical top-down approach
- Selecting which products to take to market follows a thorough analysis of the market, competitors, and internal capabilities
- Product strategy and product life cycle plan determine which projects to execute when
- Ideas are fragments of a complete product or service
- Initiated downstream development projects are seldom stopped
- Most suitable for industries that are mainly strategy and analysis driven, e.g.
  - Automotive and manufactured goods
  - Telecom equipment
  - Software, MedTech etc.



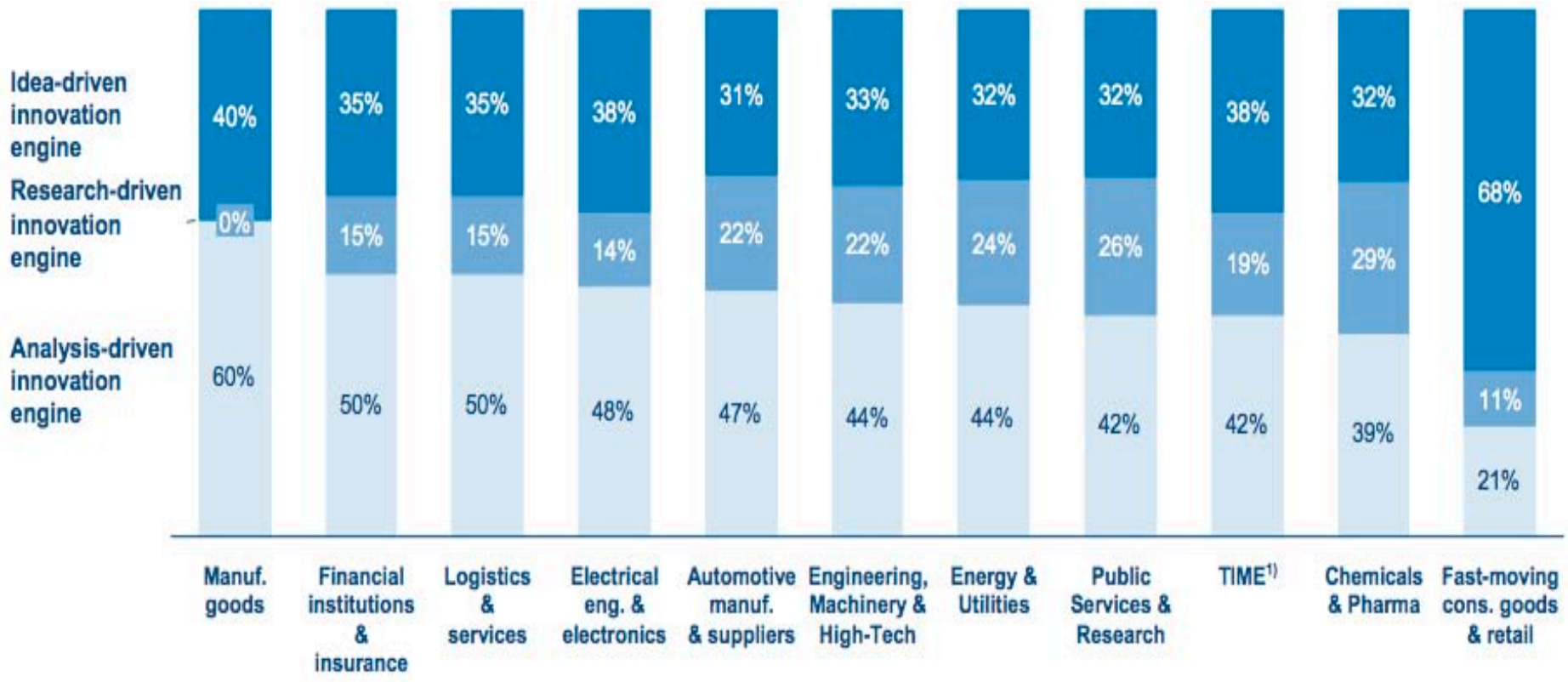
Arthur D. Little expected each industry sector to prefer a single innovation engine.

Source: Arthur D. Little Innovation Excellence 2009/2010

Source: Per I. Nilsson, Markus Achtert and Hanno Groseschmidt, "Pathways To Innovation Excellence: Results Of A Global Study, Arthur D. Little, March 2010, Page 8, Figure 5: Innovation Engines.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Tactics: The Innovation Side - Industry Averages - Innovation Engines



Different "innovation engines" used for innovation management can be found across all companies and industries.

1) TIME: Telecommunications, IT/software and media
Source: Arthur D. Little Innovation Excellence 2009/2010

Source: Per I. Nilsson, Markus Achtert and Hanno Groseschmidt, "Pathways To Innovation Excellence: Results Of A Global Study, Arthur D. Little, March 2010, Page 10, Figure 7: Innovation Engine Per Industry Cluster.

ADVANCING R&D COMPETITIVENESS WITH METRICS

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ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Metrics: Pipeline Yield

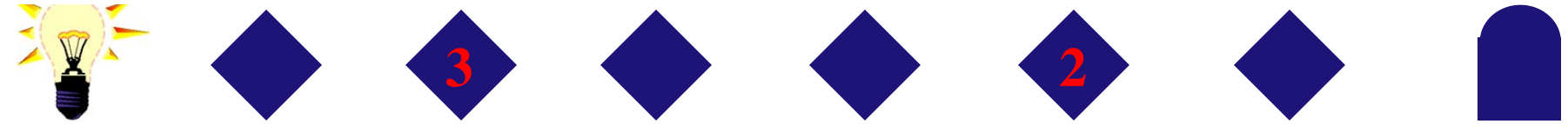
CONCEPT	DEFINITION	DESIGN	DEVELOP	LAUNCH	COMMER-CIALIZE	SUPPORT

SOURCE: **A. Griffin, *Drivers of NPD Success: The 1997 PDMA Report***

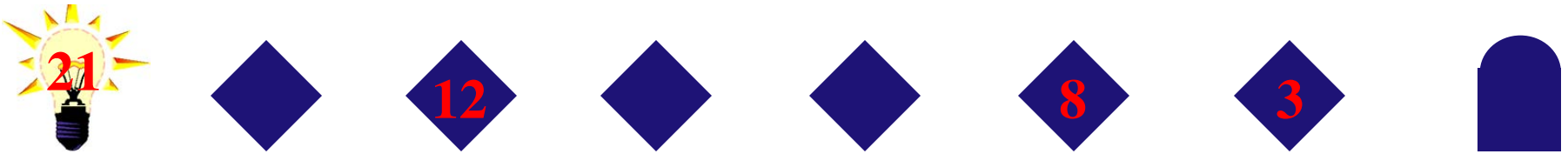
(Chicago, Illinois, USA: Product Development & Management Association, 1997)

SOURCE: **B. Goldense, *2000 Product Development Metrics Survey***

(Needham, Massachusetts, USA: Goldense Group, Inc., 2000)



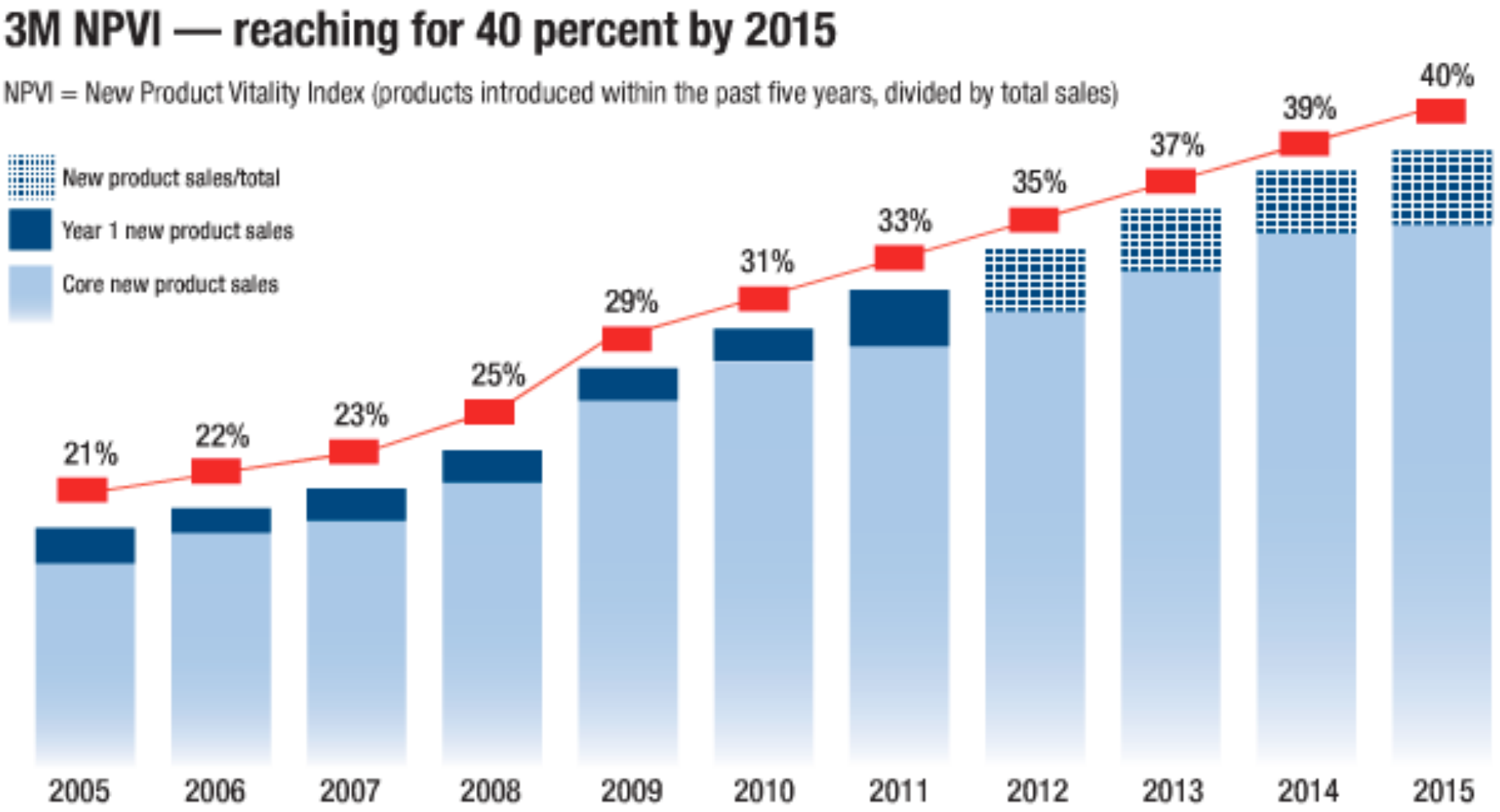
COMPOSITE RESULT:



CAPTURE CONCEPT	APPROVE DEVELOPMENT	LAUNCH PRODUCT	ACHIEVE SUCCESS	RETIRE PRODUCT

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Metrics: CYS/PDTPRITP"N"Y - 3M New Product Vitality Index [NPVI]

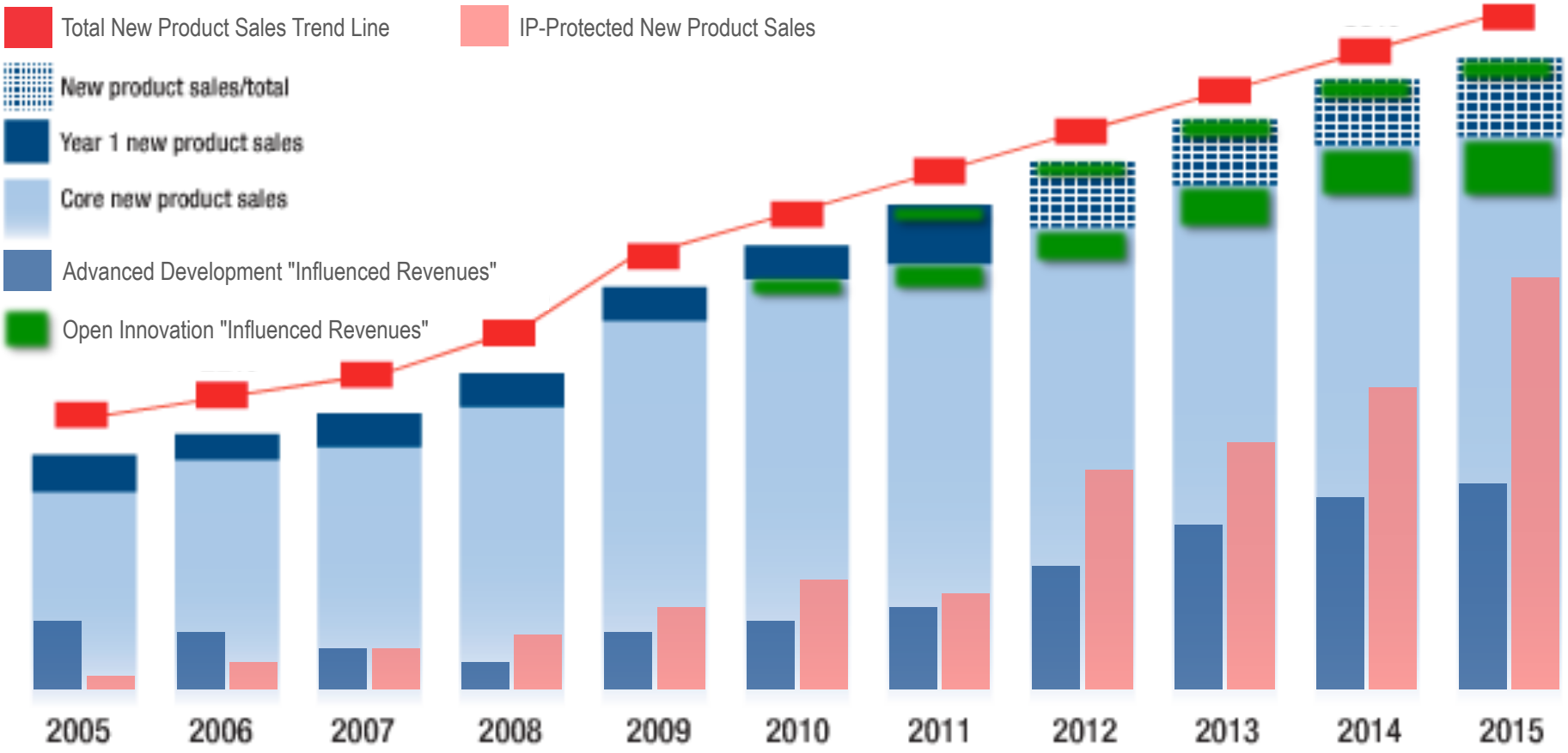


Source: Editorial Staff, "Driving The New Product Vitality Index," 3M Stemwinder, 3M Corporate Headquarters, 3M Center, I-94 at McKnight Road, St. Paul, Minnesota, 55144, USA, May10-23, 2011, Page 1, Inset.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Metrics: CYS/PDTPRITP"N"Y - 3M New Product Vitality Index [NPVI]

INCLUDE ADDITIONAL INNOVATION METRICS:



Source: Goldense Group, Inc. "Additional Innovation Metrics" text and artwork overlay [not to scale] **and** Editorial Staff, "Driving The New Product Vitality Index," 3M Stemwinder, 3M, May10-23, 2011, Page 1, Inset.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Metrics: Return On Innovation [ROI]

Return On Innovation [ROI]

Alternative: Research & Development Effectiveness Index [RDEI]

Also Called "PBT Group," Profit Before Tax.

$$ROI = \frac{\text{Cumulative N-Year Net Profits From New Products}}{\text{Cumulative N-Year Expenditures On New Products}}$$

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Metrics: Return On Innovation - Products Include Advanced Development

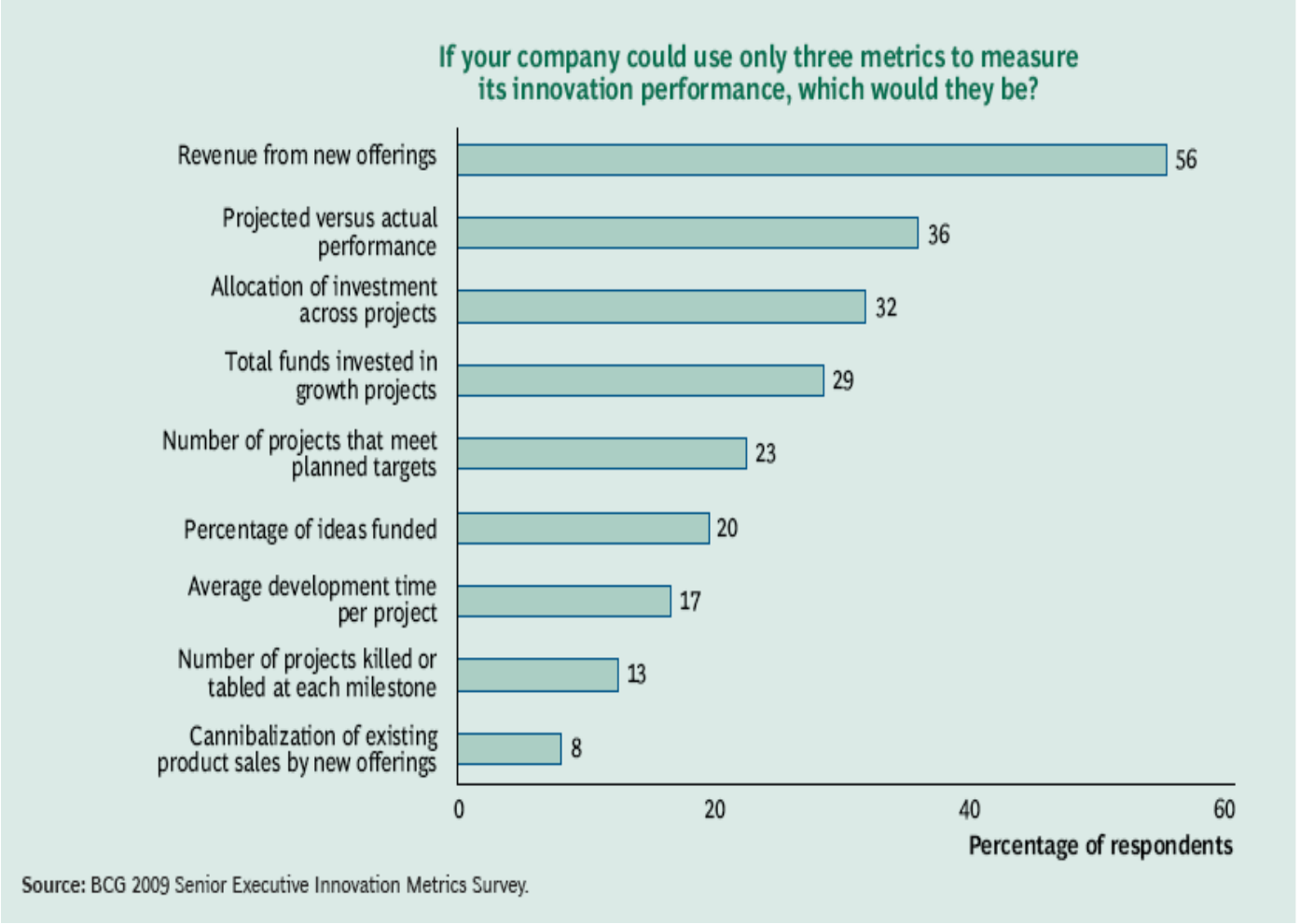
Advanced Development Return On Innovation [ADROI]

Also Called "PBT Group," Profit Before Tax.

$$ADROI = \frac{\left[\text{Cumulative N-Year Net Profits From New Products Containing Advanced Development Content}\right]}{\left[\text{Cumulative N-Year Expenditures On New Products Containing Advanced Development Content}\right]}$$

ADVANCING R&D COMPETITIVENESS WITH METRICS

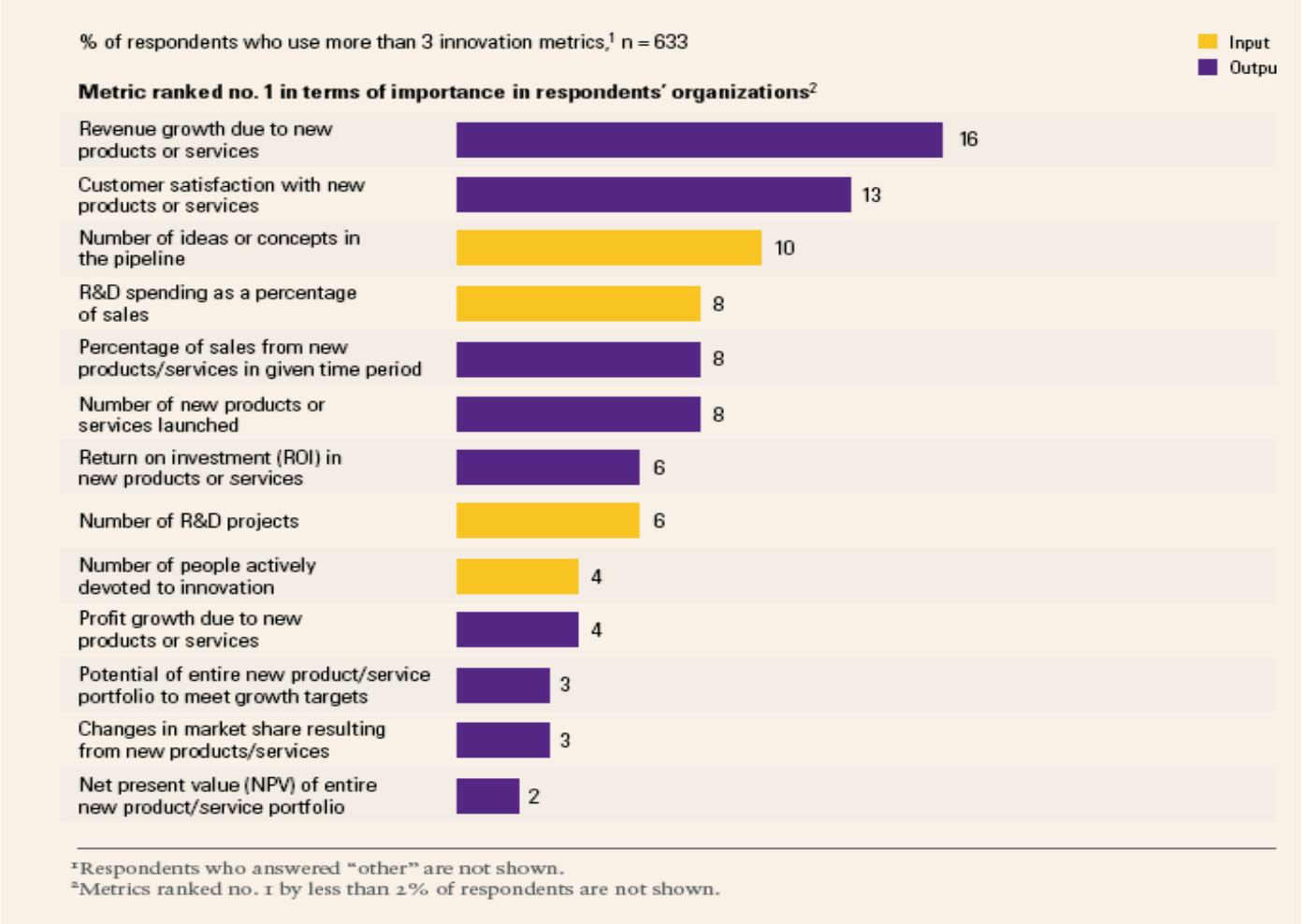
Right Metrics: Top Innovation Metrics Per Boston Consulting Group



Source: James P. Andrew, Knut Haanaes, et. al., "Measuring Innovation 2009: The Need For Action," The Boston Consulting Group, Inc. [BCG], One Beacon Street, Boston, Massachusetts, USA, April 2009, Page 12, Exhibit 8 - Revenue from New Offerings Is Considered the Most Indispensable Metric.

ADVANCING R&D COMPETITIVENESS WITH METRICS

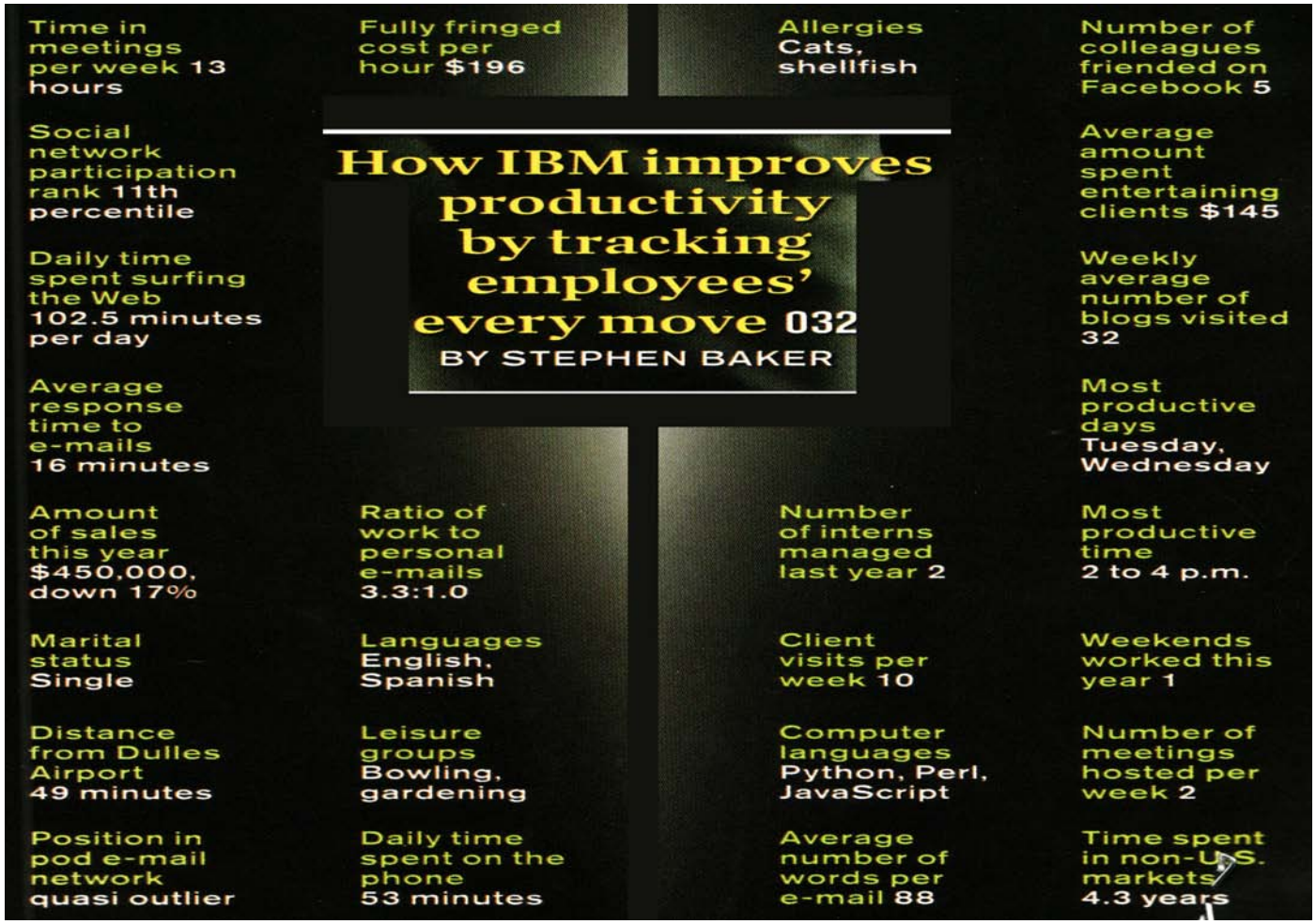
Right Metrics: Top Innovation Metrics Per McKinsey



Source: The McKinsey Quarterly, "McKinsey Global Survey Results: Assessing Innovation Metrics," McKinsey & Company, 55 East 52nd Street, Floor 21, New York, New York, USA, November 2008, Page 4, Exhibit 3 - Outcome metrics are in wide use.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Right Metrics: Track Employee Activities Closely To Improve Productivity



Source: Stephen Baker, "How IBM improves productivity by tracking employees' every move. – By building mathematical models of its own employees, IBM aims to improve productivity and automate management.," Business Week, The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, New York, USA, September 8, 2008, Cover.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Summary

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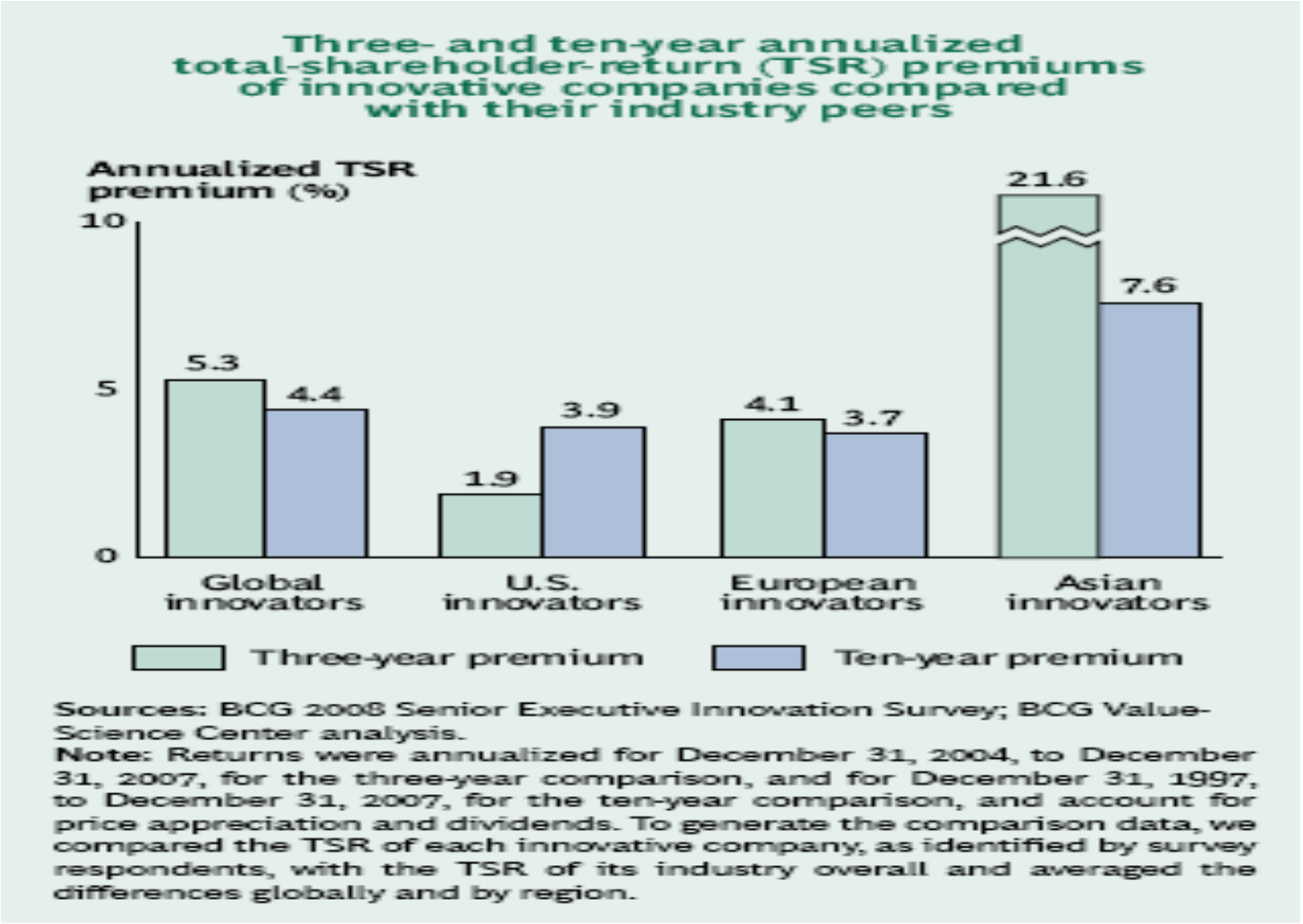
ADVANCING R&D COMPETITIVENESS WITH METRICS

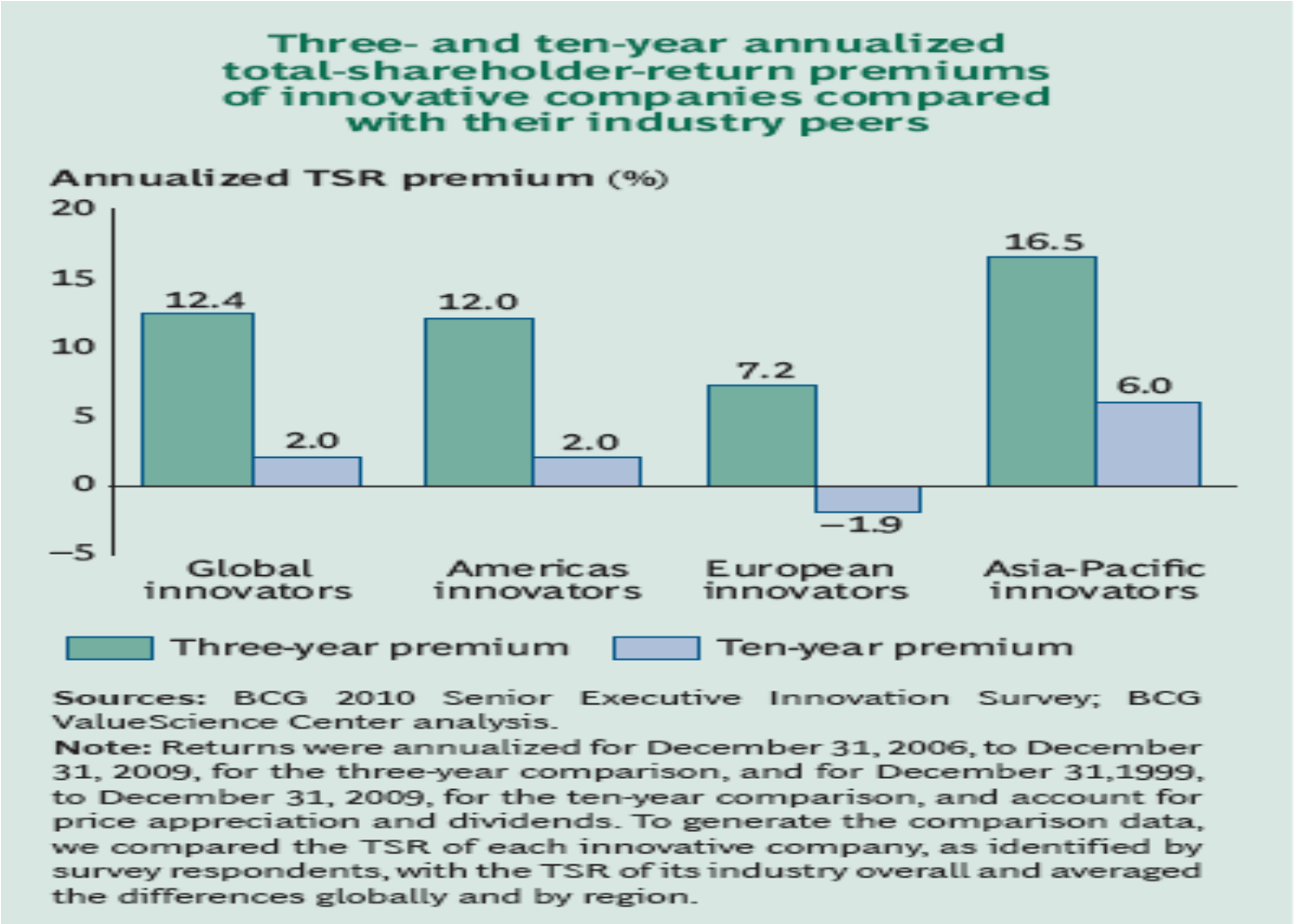
Summary: BCG Study 2008 - Results Of Innovation For Shareholders



Source: James P. Andrew, Knut Haanaes, et. al., "Innovation 2008: Is The Tide Turning - A BCG Senior Management Survey," The Boston Consulting Group, Inc. [BCG], One Beacon Street, Boston, Massachusetts, USA, August 2008, Page 10, Exhibit 4 - Innovation Pays Off for Shareholders.

ADVANCING R&D COMPETITIVENESS WITH METRICS

Summary: BCG Study 2010 - Results Of Innovation For Shareholders



Source: James P. Andrew, et. al., "Innovation 2010: A Return To Prominence-And The Emergence Of A New World Order," The Boston Consulting Group, Inc. [BCG], One Beacon Street, Boston, Massachusetts, USA, April 2010, Page 7, Exhibit 2: Innovative Companies Typically Generate Superior Returns For Shareholders.

END
DOCUMENT