ADAPTING TO THE NEW NORMAL

A confluence of trends and events are challenging old assumptions, requiring bold thinking and new strategies. This issue explores what’s ahead and what’s required to remain competitive.

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The “eerie calm” that had prevailed in the business world since the Great Recession seems to be over. Many new market, economic, and geopolitical forces at work today are creating new challenges and wreaking havoc with planning in both the private and public sectors. Chief among them is the steep drop in the price of oil over the last 12 months, the consequences of which will ripple through the global economy for years to come. China’s economic slowdown is another disruptive force, which heralds the end of a 15-year commodity supercycle—the fifth such supercycle since 1900.

But lower raw material prices are hardly the only challenge businesses face. China’s stock market correction, the impact of Greece’s debt on the stability and cohesion of the eurozone, the rise of the Islamic State, uncertainties associated with the Iranian nuclear deal, the increase in large cyber attacks—are all conspiring to raise business risk and market volatility.

Welcome to The New Normal. This issue of IHS Quarterly explores some of the causes and consequences of heightened uncertainty to explain today’s market dynamics and provide insights into the future.

In Oil at the crossroads, I write about the four trends shaping the long-term demand and supply of energy. In Mapping the geopolitics of lower oil prices, my IHS Energy colleague Carlos Pascual, former US ambassador to Ukraine and Mexico, discusses the implications of lower oil prices for Iran, Mexico, Russia, and Venezuela. Lessons from the fading commodity supercycle examines where prices may be heading next. And Formula for success: Analyzing energy at the extremes evaluates the impact lower oil prices are having on capital investment in the chemical industry.

We also cover national security issues with a look at the future of NATO, and shifting defense spending from West to East. And we examine cyber security and actions companies can take to mitigate the risk of attack, as well as the emergence of cyber warfare as a new budget line item.

While new technologies pose a danger if used maliciously, they can of course create lasting positive change. Lifting the fog on shipping costs explains how advanced data analytics is improving forecasts of freight rates. Gauging the opportunities for battery storage on the grid looks at how companies like Tesla can be catalysts for change in old industries. And our interview with Michael Schaeffer, Siemens’ vice president of organizational development, discusses how systematizing innovation can produce remarkable and enduring results.

I hope you find the insights within the pages of IHS Quarterly valuable as you adapt to The New Normal. It’s representative of the information, analytics, and expertise resident within IHS.
These are historic times for the shipping industry and the companies that rely on its services. The governments of both Panama and Egypt are poised to inaugurate canals that are wider and deeper, and will operate more efficiently. These expansion efforts promise to reduce freight costs, increase transit speed, and potentially change the competitive balance between the two canals.

The Suez and Panama canals redefined global trade when they were completed in 1869 and 1914, respectively. However, as ships have increased in size, the canals have come to be viewed as a hindrance to the expansion of trade. Now, their expansion is shaking up the status quo.

While attention has focused on Panama—where the expanded canal is expected to be open for business in April 2016—Egyptian President Abdel Fattah al-Sisi has executed a vision of transformational growth for his country. He accelerated a proposed five-year development plan for a second Suez channel and insisted that work be completed in one calendar year. The new channel will reduce both transit time and unit cost of cargo.

Work to construct an entirely new 72-km section of the canal and deepen existing sections has involved all major dredging companies and more than half the world’s largest dredging vessels. Remarkably, after many months of frantic activity, the canal is nearing completion, with the first transits expected in August of this year.

This will have an immediate impact on trade. The shipping lane from Asia-Pacific to Europe has been a driver of China’s economic growth for the past 20 years. However, the development of larger ships—carrying containers, dry bulk, crude oil, liquefied gas, cars and trucks, refined products, chemicals, and cruise passengers—has placed increasing strain on canals, ports, and associated infrastructure. President Sisi’s new canal will allow larger ships to transit and ease the flow of trade on this vital east-west route.

It will also inspire new strategic thinking for shippers. While the largest container ships—currently with a capacity to carry 20,000 teu (20-foot-equivalent units)—can transit Suez, the dimensions of the expanded Panama Canal will only allow ships of about 12,200 teu to transit, with some Panama-specific designs pushing the limit to 13,000 teu. So, it is possible that mega-ships running from China via Singapore and Suez to the Mediterranean could continue across the Atlantic and serve US East Coast ports, taking cargo from the Panama Canal.

US ports are not yet ready for mega-ships, so Suez will not be a threat to Panama for several years, which gives Panama time to figure out how to respond.

By Richard Clayton, chief maritime analyst, IHS Maritime & Trade

For more information, visit on.ihs.com/Q23SuezCanal
Even before the recent Chinese stock market turmoil, Asian economic growth had been slowing. The 9.3% and 8.6% growth rates achieved in 2007 and 2010—the pre- and post-global recession peaks, respectively—are now painfully out of reach: IHS is projecting this year’s growth for Asia, excluding Japan, at 5.6%.

In other parts of the world, governments would respond to the threat by trying to nurture their industries with new trade barriers. But in Asia, the protectionists haven’t barred the gates. Instead, diplomats are doing what most macroeconomists say they should do: negotiating even more free trade agreements.

The motives and destinations, however, are changing. China and South Korea, for example, once mostly pursued free trade agreements with wealthier countries to gain access to bigger markets for their exports. Now that they are global industrial powerhouses, however, their domestic labor costs have risen, adding a new rationale for the pursuit of free trade: relocation of manufacturing production to lower-cost countries.

Chinese manufacturers, for instance, see bargains all around them. In 2001, the average Chinese worker earned about 73% of what a Thai did. By 2006, Chinese average wages exceeded the Thai equivalent; by 2013, they were 81% higher. Similarly, China’s manufacturing wages are 159% higher than Vietnam’s, and 256% higher than Indonesia’s.

As good as offshore production can be for Chinese and Korean manufacturers, it may be even more important for countries with cheaper labor markets, such as Vietnam and India—both may be in for the kind of growth opportunity China and South Korea experienced over the past three decades. Already, Vietnam is benefiting from heavy investment and technology transfer by Samsung, the South Korean tech giant. Thanks to Samsung’s investment, Vietnam’s top exports are no longer clothing and footwear but telephones and related components.

In addition to these new opportunities for labor arbitrage and technology transfer, IHS expects to see a gradual shift in the trade agenda toward more service-related agreements. Liberalization and integration in this area will soon become a necessity if Asia’s increasingly complex multi-country value chains are to be managed effectively.

So far, at least, this seems to be the regional game plan. New trade initiatives, such as ChAFTA (the China-Australia Free Trade Agreement) and the ASEAN Economic Community, will place a much greater emphasis on easing barriers in areas beyond merchandise trade such as investment and services—precisely where it would help the most. If these initiatives stay on track, adequate follow-through and proper implementation of a new wave of trade agreements could unleash a new era of rising productivity in Asia.

By Simona Mocuta, director, global economics, IHS Economics

For more information visit on.ihs.com/Q23AsiaTrade
Taking a new look at US light-vehicle industry paradigms

For the US new-vehicle market, the analytical methods employed by new-vehicle makers need to include accurate representations of actual marketplace entities and behavior. However, at least two instances are present where this is clearly not happening, including the luxury/non-luxury and car/light truck splits.

One case involved a pickup—selling for an estimated transaction price of $48,048—claiming to be the most popular luxury vehicle in the country. However, IHS Automotive declined to approve the claim, as the product was marketed by a non-luxury make. IHS Automotive and others split the industry based on segment—using three dimensions including the make, body type, and size—with IHS classifying 12 segments as luxury and 19 as non-luxury vehicles. Using either make or segment as the determinant, the pickup in question does not qualify as a luxury vehicle. Should the vehicle’s make and segment then be the only determinant of luxury or non-luxury?

Perhaps price should also be a basis, which can override other factors in certain circumstances. For instance, the 2015 Jeep Grand Cherokee SRT now sells for an estimated transaction price of $71,834—above not only lower-end luxury products, but also many mid-level premium products. Yet as a Jeep, the Grand Cherokee is still classified as a non-luxury truck.

These examples would suggest that analysts looking at the non-luxury market may be including in their universe products that, arguably, are luxury. IHS Automotive is in the process of creating a price database including current prices of all models on the US market down to the trim level; this will increase the ability to properly place models—and, in some cases, isolated trim levels—in the proper position on the non-luxury/luxury spectrum.

The industry also continues to split models based on a car/light truck division created decades ago, when light trucks consisted solely of frame-based pickups, even though over half of all light trucks now on the market are unibody crossovers. Many crossovers now on the market bear little resemblance, from any perspective, to frame-based pickups or SUVs. Instead, they owe more allegiance to cars, based on architecture, sheet metal, suspension, and powertrain, among other things.

One solution would be to change the structure of the industry from the existing car/light truck split to an all-new, four-way structure that isolates cars, utilities, vans, and pickups. Using this paradigm, crossovers and frame-based SUVs would be slotted in utility, leaving the car bucket for the traditional sedan, coupe, and convertible body types. True, this is more cumbersome than the simpler car/light truck split, but the reclassification more accurately reflects the different vehicle configurations of the more than 350 models now on the US automotive market.

By Tom Libby, manager, loyalty solutions and industry analysis, IHS Automotive

For more information, visit on.ihs.com/Q23AutoMarket

What defines a luxury vehicle?

Sample of five high-priced non-luxury models and five low-priced luxury models (US$)

<table>
<thead>
<tr>
<th>Non-luxury models</th>
<th>Estimated transaction price</th>
<th>Luxury models</th>
<th>Estimated transaction price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 Jeep Grand Cherokee SRT</td>
<td>$71,834</td>
<td>2015 Mercedes-Benz CLA Sedan</td>
<td>$35,664</td>
</tr>
<tr>
<td>2015 Chevrolet Suburban</td>
<td>$60,941</td>
<td>2015 Volvo S60 Sedan</td>
<td>$35,603</td>
</tr>
<tr>
<td>2015 Nissan Armada</td>
<td>$53,570</td>
<td>2015 BMW 320i Sedan</td>
<td>$35,452</td>
</tr>
<tr>
<td>2015 Chevrolet SS Sedan</td>
<td>$45,284</td>
<td>2015 Acura ILX Sedan</td>
<td>$31,085</td>
</tr>
</tbody>
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Source: Edmunds.com; 26 and 29 June, 2015
The Greek exit: Bad for Greece; uncertain for Europe

Following the high drama of late June—when Greece entered arrears with the International Monetary Fund loan and its eurozone membership was in serious doubts—in early July Greece and its eurozone lenders began negotiations on a new bailout plan, the third since 2010.

With a crisis averted and a late-August deadline looming, the risks of Greece leaving the eurozone over the short term have diminished. But the possibility of a “Grexit” remains, which would have consequences for other eurozone members and the global economy.

Indeed, there is no scenario for a Greek exit from the euro that would not have a significant impact on its economy and society. However, with regard to the rest of Europe, the political and economic implications of a Greek exit could be either profound or transitory.

If Greece were to leave the European Union and abandon the euro, there would be a sharp increase in inflation. The introduction of a new currency would raise the burden of Greece’s euro debt.

A euro exit and sovereign default go hand in hand. That is, any improvement in Greece’s export performance would be offset by the difficulty in obtaining financing from international credit markets. Greek exporters would suffer.

Withdrawal, combined with the inevitable disruptions, would trigger broad anti-government protests and radicalize groups on both the left and right. In such a turbulent climate, reform would become increasingly difficult, and problems of corruption and tax evasion would worsen.

For Europe, a Greek exit could play out in one of two ways. In the first scenario—“without contagion”—Greece’s exit results in a new bout of financial market stress. However, a weaker euro, which makes exports more competitive, would mitigate the stress, particularly in countries where exports account for a large share of GDP, such as Germany and Ireland. Europe’s security environment and risk of social unrest would remain unaffected.

Nevertheless, there is a second scenario—“with contagion”—in which Greece’s exit generates intense speculation about other debt-laden countries, namely France, Italy, Portugal, and Spain. This would increase political instability in those states and encourage them to use the threat of withdrawal to argue for the softening of fiscal reforms.

There has been an overall rise in support for anti-austerity and anti-EU parties across Europe. And in this scenario parties at the political fringes will gain ground, creating economic and political instability across a broad swath of society.

By Diego Iscaro, senior economist; with contributions from Raj Badiani, senior manager; Jan Gerhard, analyst; Blanka Kolenikova, senior analyst; and Keerti Rajan, head of political risk, IHS Economics & Country Risk

For more information, visit on.ihs.com/Q23GreekExit

World GDP growth (%), baseline forecast compared to two scenarios for a Greek exit from the EU, 2013-17

Source: IHS
The impact of low oil prices on the future of biofuels

The announcement by OPEC in November 2014 that it would maintain oil production at 30 million barrels a day sent world oil prices plummeting to five-year lows. While prices have since strengthened, OPEC’s decision in June to maintain existing output levels has practically ensured lower oil prices will be with us at least for the short term.

This new reality is the latest in a series of challenges that have negatively impacted the global biofuels industry in the last five years. They include the loss of political appetite for investment in biofuels after the 2008–09 Great Recession, coupled with chronic overcapacity, rising feedstock prices, and falling biofuel prices. Even the environmental benefits of biofuels have been harshly criticized, as biofuel production has been blamed for driving up food prices and causing civil unrest.

In Europe, the European Commission recently proposed amendments to the Renewable Energy Directive, capping the contribution of conventional biofuels to renewable energy targets and incorporating the controversial Indirect Land Use Change effects into life-cycle analysis of greenhouse gas emissions. In the United States, the Environmental Protection Agency released in May the long-awaited proposals for the 2014, 2015, and 2016 Renewable Fuel Standard volume requirements. While the standards increase volume requirements for biofuel consumption, the proposals fall short of the original targets set by Congress in the Clean Air Act.

Are low oil prices the final nail in the coffin for an industry? Perhaps not. While oil prices are a factor, the consumption of biofuels is increasingly driven by national policies and political agendas. Argentina and Indonesia, for instance, have increased biodiesel blending mandates to 10% to support local industry. Brazil has increased its ethanol and biodiesel mandates to 27% and 7%, respectively. Germany has replaced volume mandates altogether with reduced greenhouse gas emission targets.

Overall global consumption of biofuels is forecast to grow by 2.5–3.5% a year over the next five years, with higher-than-average growth expected in Asia and South America. In the United States, the low oil price environment has reignited demand for gasoline, which will lift ethanol demand this year.

The greatest concern for the biofuels industry is the lack of investment in next-generation technology. Case in point: BP’s 2014 decision to exit the cellulosic ethanol business, after having invested more than $750 million since 2008.

At the G7 summit in June, climate change was once again top of the agenda. Biofuels—particularly second-generation renewable fuels—can be a major contributor to reducing greenhouse gas emissions and meeting national targets. However, until governments make concrete commitments and mandate favorable energy policies, the industry will remain cautious about making the large-scale investments needed to develop new technologies.

By Adam Bland, associate director, specialty chemicals, IHS Chemical

For more information, visit on.ihs.com/Q23Biofuels

Click here to view Adam’s video on the state of the biofuels market
New medicines, new headaches: how to pay for innovation

The global R&D factory of the pharmaceutical industry is churning out new, innovative medicines at an unprecedented rate—an incredible record-breaking 44 new medications were approved by the US Food and Drug Administration (FDA) last year alone, with major new advances in treatment for hepatitis C, skin cancer, diabetes, multiple sclerosis, and other maladies seeing the light of day. This year we expect to see two major new treatments for cholesterol management reach the market.

This is welcome relief for an industry that had a few tough years between 2009 and 2013, when major patents were expiring. Consider Gilead Sciences, which developed the hepatitis C cure Sovaldi, seen as the most successful launch in industry history and generating sales of $10.4 billion in its first year. Sovaldi and other new drugs are bringing benefits to a broad range of patients, while allowing their developers to refill their coffers and generate new revenue streams.

However, cracks are beginning to appear in the overall development model for new medicines. The science is becoming so good, and is developing at such a rapid rate, that regulators are struggling to keep up. The average time to market for new pharmaceuticals in key European markets declined by 52% between 2011 and 2015, according to IHS.

Healthcare budget holders around the world are grappling with how to fund so many new treatments, which are also usually sold at a higher price point than their predecessors. The backlash over the pricing of Sovaldi created a groundswell of criticism from many quarters, not least of all from the US Congress.

The Sovaldi pricing conundrum highlights diverging philosophies in funding healthcare. In the United States, insurance companies and payers waited for competition to reach the market. Once it did, discounts became the name of the game as Sovaldi’s competitors sought to secure exclusive contracts with the biggest pharmacy benefit managers. In response, Gilead expects to discount its hepatitis C franchise by an average of 46% in 2015, more than double the discounts from the year before.

In Europe, government price negotiations are the favored approach, producing significant price differentials between countries. Countries with strong pricing systems secured prices for Sovaldi roughly one-third below the cost of the drug in the United States, exclusive of discounts.

While Sovaldi might be the most celebrated recent example, it is by no means a unique situation, where a highly effective treatment is finding it difficult to find a price acceptable to payer and manufacturer: the last five new innovative treatments in diabetes care, for instance, have failed to reach the German market because of disputes over price between the industry and government.

The pricing of new drugs is an area fraught with ethical issues on how to ensure patients get access to the best treatment. If the current rate of innovation continues, scientific advances may outrun society’s ability to pay for the fruits of these innovations.

By Gustav Ando, senior director, IHS Life Sciences

For more information, visit on.ihs.com/Q23Pharma
Power, revenue, and profitability drive groundswell of consolidation in semiconductor industry

A number of high-profile acquisitions by top semiconductor suppliers in the last few months has raised both interest and concern among customers and suppliers alike on the evident accelerating pace of consolidation in the semiconductor industry.

In May, Avago Technologies announced plans to acquire Broadcom for $37 billion, the largest acquisition deal in the history of the technology industry. Avago began growing its business through acquisition with its purchase of LSI in 2014. However, the Broadcom buy is a much larger deal, with Avago acquiring a company larger than itself. Avago said great cost synergies could be realized in the merger, and anticipates saving $750 million annually in 18 months.

The Avago announcement followed a wave of significant mergers and acquisitions (M&A) among top chip suppliers, including NXP and Freescale Semiconductor; Infineon and International Rectifier; Cypress Semiconductor and Spansion; Qualcomm and CSR; Globalfoundries and IBM Microelectronics; and Avago and Emulex. Shortly after the Avago-Broadcom news broke, Intel announced plans to acquire Altera.

Overall, the semiconductor industry has seen a steady increase in consolidation among the top 10 suppliers since the 2008 economic downturn. Based on announced M&A plans, IHS Technology projects that the top 10 this year will capture 55.3% of the industry’s $366.7 billion in estimated annual revenue, up from 44.3% in 2008. Meanwhile, the top 25 in 2015 will capture 74% of total semiconductor revenue, leaving nearly 270 companies to chase the remaining 26%.

One notable benefit of increasing the size of a company is the associated growth in average profit margins as a result of economies of scale, which is essential for an industry that IHS expects will see slower growth in coming years.

The highest level of consolidation can be found in the memory and microcomponent chip segments, with the top five companies accounting for nearly 90% of total revenue in these markets. In comparison, the analog IC, discrete, optical, and sensor markets have seen either minimal consolidation or outright deconsolidation, even though analog ICs could be next to see growth in consolidation activity.

Several factors have driven M&A activity in recent years. Companies are restructuring product lines and market focus, creating a stronger presence in target market segments, and pursuing synergies in creating solutions-oriented offerings. For example, Freescale and NXP ranked third and fourth, respectively, in semiconductor revenue from automotive products in 2014. While Freescale is a leading supplier of microcontrollers for automotive applications, NXP is a top supplier of analog application-specific standard products and discrete components for automotive. Together, however, their complementary portfolios will let both players deliver systems solutions to customers. Their merger could also vault them to the top, displacing Renesas Electronics, the current market-share leader in automotive semiconductors.

By Dale Ford, vice president, thought leadership, IHS Technology

For more information, visit on.ihs.com/Q23Semiconductors
Oil sector focuses on optimizing costs through greater capex and opex discipline

Many oil companies began shifting their focus to capital discipline more than a year ago, recognizing cost as one of the key industry challenges and announcing lower spending budgets than in their initial 2014 plans. The effect of lower oil prices on cost and activity further accelerated these efforts, forcing operators to increase their focus on reducing capital and operating costs (capex and opex), rationalizing investment budgets, and boosting operational efficiency.

IHS predicts global upstream capital spending this year will decline 17% from 2014 levels, followed by a further 13% decline in 2016, before rebounding in 2017. With companies no longer able to rely on high oil prices to ensure profitability, many need to quickly adapt their strategies.

A key component of developing these strategies is to improve the accuracy of cost estimation in the due diligence process for field transactions, when developing new wells, and during strategy reviews, especially at the early concept-evaluation stage. Sophisticated analytical tools enable companies to more accurately predict costs. Understanding forward costs is also important for cost reduction. In some cases, bespoke indices can be beneficial during contract escalation and planning.

In addition to managing capex in this lower-cost oil environment, companies are also reducing their opex. This means looking beyond the decision of shutting down operations when production costs exceed oil revenues or cutting back on non-essential maintenance operations. It requires a balanced understanding of labor rates, actions and reactions by competitors, short- and long-term market trends, and greater efficiencies and innovations in operations.

For supply chain managers, the goal is to improve efficiencies, which can be achieved by standardizing and consolidating commodity purchasing, aggregating purchases, and ordering higher volumes at more opportune times in the market. Such practices typically yield lower unit costs across business lines and projects. Discerning the trajectory of labor, material, and equipment costs will also boost productivity.

Strategically applying new technology is another way companies can look to control costs. An example in the exploration and production of unconventional shale oil plays is to drill longer lateral lengths, which eliminates the cost of drilling a vertical portion of a new well, while also improving productivity of the existing well.

Another technique is “super fracking,” which injects a high intensity of fluids to release the oil. While super fracking adds cost, the end result is proportionately higher output and increased well productivity.

There are no easy answers when trying to cut costs to adapt to the new world of low oil prices. However, the need for detailed information to make strategic and savvy cuts will be constant, and will most likely involve a combination of tried-and-true practices alongside innovative ideas when evaluating commodity markets, upstream supply chains, procurement practices, and technology.

By Bill Redman, senior director, research, IHS Energy; with contributions from Dan Fosse and Bjorn Hem, research managers, IHS Energy

For more information, visit on.ihs.com/Q23OilCapex

Source: IHS
Relentless Innovation: A cornerstone of Siemens

As vice president of organization development at Siemens AG, Dr. Michael Schaeffer is tasked with providing intelligence on Siemens’ markets as the basis for strategic development, and to support global growth of the company’s businesses. Those markets include energy, building technology, transportation, manufacturing, and healthcare, and span a multitude of technologies. Throughout its 168-year history, Siemens has been a leader in the development and commercialization of technological innovations and today is ranked as one of the most valuable brands in the world.

Mack Brothers, vice president of industry services and consulting at IHS, sat down with Dr. Schaeffer to discuss Siemens’ commitment to “relentless innovation.”
Q. At a recent IHS event, you talked about relentless innovation as a company value and how it’s part of the company’s culture. What do you mean by relentless innovation?

Innovation is one of the key values of Siemens that is well-founded in the company’s history, stemming back to 1847 when Werner von Siemens and his partner, Johann Georg Halske, established the company in Berlin, Germany.

Werner von Siemens laid the foundation for the company with his invention, in 1846, of the pointer telegraph. This new generation of telegraphing technology automatically synchronized movements of the transmitter and receiver, making it faster and more reliable than any other device of its kind. Siemens & Halske built Europe’s first electric telegraph line from Berlin to Frankfurt. Other breakthrough innovations followed, such as the first dynamo generator in 1866, the first electric locomotive in 1879, implantation of the first fully implantable pacemaker in 1958, development of the high-speed inter-city express train in 1985, and development of the world’s most efficient combined cycle turbine in 2006.

More recent innovations include the Totally Integrated Automation Portal, which enables users to manage complex automation systems quickly and intuitively, thus eliminating the time-consuming and costly integration of additional software packages that was previously required; the world’s largest rotor for 6-megawatt offshore wind turbines; the use of sensor networks in an advanced parking management solution that will contribute to ease the increasing parking space crisis in cities; or the Vectron multi-locomotive system.

Over its history, Siemens has been driven by sustained innovation, which is an underlying value for the development of the company. This value drives the company today and enables employees to push innovative projects that continuously renew and reinvent Siemens.

The ability to continuously and sustainably innovate as well as the commitment to question current approaches, processes, products, and business models are at the core of relentless innovation.

Q. How do you know that innovation has become part of the corporate culture? What are the elements necessary to elevate it to culture status, and how hard is it to maintain the commitment over time?

Even the best strategy can’t succeed unless it’s supported by a strong culture. At Siemens, employees push and pursue innovations because they share the same values. This is highly important for the long-term success of the company.

Innovation is in our view tightly related to our culture of ownership that encourages every individual to give her or his best in order to help build Siemens’ long-term success. Our ownership culture follows five principles:

- Leadership: Managers should serve as role models for the company’s strategic direction by inspiring and empowering their teams to give their best for the company.
- Entrepreneurial behavior: Entrepreneurial behavior should be the standard and foundation for how we act at Siemens. This applies to each individual in the company—since only then can behaviors constantly evolve and improve.
- Values: If everyone in the company acts responsibly, achieves excellent results, and is innovative, they will personally contribute to the sustainable success of Siemens. Responsible, excellent, and innovative—these values are the foundation of our ownership culture.
- People orientation: We strive for a people-oriented approach that values and clearly fosters diversity of experience and expertise. If this is reflected in all that we do, we’ll improve the performance of our company.
- Equity: We strongly believe that employee shareholders act responsibly and are oriented to the long term when they directly participate in their company’s success.
Our ownership culture creates a trusted environment in which continuous innovation is possible and supported by values, processes, and incentive systems. One of the big challenges is the trade-off between short-term success and investment in mid- or long-term innovation. Especially in difficult times, it is hard to maintain this commitment when external pressure to improve short-term results rises. A value-based innovation approach gives an organization the strength to also pursue innovation activities in such a difficult environment.

Q. Siemens holds over 56,000 patents and employs nearly 30,000 research and development (R&D) employees worldwide. What characteristics do these employees share, and how are they motivated to be relentless?

Siemens employees live our ownership culture—especially those colleagues involved in research and development, who are recognized as major contributors to the development of our company and work at the very heart of Siemens’ innovation activities.

Initiatives, such as our Inventor of the Year award, highlight achievements of individuals involved in R&D and focus attention on the importance of innovation for the company. At the same time they motivate other employees to go the extra mile to lead their innovation projects to success. Examples of the Inventors of Year are:

- Preventing blackouts: Matthias Kereit, project manager, developed programs for protection devices that monitor high-voltage power lines. The programs allow the protective devices to switch off lines in case of dangerous short circuits.
- Efficiently illustrating metabolism: Metabolic illnesses can affect any organ in the human body, and are difficult to isolate. Alexander Hans Vija, director of engineering, and his team have developed an application that qualitatively improves SPECT—single-photon-emission computed tomography—analyses. Subsequent developments can reduce the dose of radiation—or the time the diagnosis takes by three-quarters.

An important aspect to enable people to innovate is to take the fear out of failure. When Joe Kaeser became Siemens CEO in August 2013, he made two points. “The first point: if you make a mistake and you can draw lessons from it, you will have no trouble. If you have any trouble, you should seek our help. The second point: if you do not know how to do a thing or your superior does not tell you how to do it, you should do it with a sense of ownership.”

Especially when it comes to fostering innovation, such a value base is crucial. Of course, measuring success of innovation activities has to be individually tailored to the specific opportunity. Depending on its maturity, innovations have to be treated differently. Especially in the case of early-stage innovations and disruptive technologies, it is important not to focus too early on financial measures such as revenue or profit margin, but to use agreed-upon milestones such as development of a prototype or winning a key customer. In such cases, strategic importance is rated
higher than immediate financial performance. As an innovation matures, it is important to gradually shift to the standard performance measurement to ensure that the innovation is economically feasible.

Another important aspect is to try to fail early in order to focus your resources on the most promising projects. At Siemens we try to empower our businesses to build spaces in which such innovation opportunities can be pursued.

Q. Collaboration across business lines and across the globe is an important component of an innovation culture, but it is easier said than done. How does Siemens encourage and nurture collaboration to “connect the dots” in the pursuit of innovation? How are these practices formalized?

Again, let me emphasize the high relevance of our ownership and innovation culture to nurture collaboration in innovation activities of our businesses. At the same time it is necessary to create structures and processes to nurture these values.

R&D activities are carried out by both our Divisions and our Corporate Technology (CT) department. The businesses focus their R&D efforts primarily on the next generations of their products and solutions. In contrast, the aim of CT is to be a strong innovation partner for operational units and to help secure our technology and innovation future while strengthening Siemens as a technology company. Corporate Technology is both a creative driver of disruptive technologies and a partner to Siemens’ businesses, providing high-quality research and development services. CT also creates organizational contexts in which disruptive innovations can be pursued and supports innovations that involve multiple divisions, business units, as well as external partners.

One example for such an organizational context is the Siemens Technology to Business Centers (TTB) that practice “outside-in” innovation for Siemens, seeking out the latest technology innovations from startup companies, individual inventors, universities, and research labs. For instance, TTB scouts learned from a Columbia University doctoral student the
technology for optimizing the quality of service on computer networks. They were able to deliver that knowledge to the appropriate parties, including to the factory communications business. That group aspired to meet the customer need for guaranteed real-time traffic over wireless local area networks (WLAN). As a result of the TTB’s diverse external network, Siemens was able to release the first-ever WLAN product focused on factories with real-time guarantees and become a leader in that market.

Q: Siemens has identified five long-term trends—digital transformation, globalization, urbanization, demographic change, and climate change—that are driving the company’s innovation in a wide variety of industries, from medical imaging to power generation. Looking out to 2020 and beyond, what are some high-priority areas of innovation Siemens is pursuing that address some of these trends?

With our positioning along the electrification value chain, we have known how that extends from power generation to power transmission, power distribution, and smart grid to the efficient application of electrical energy. And with our outstanding strengths in automation, we’re well-equipped for the future and the age of digitalization.

Siemens Vision 2020 defines an entrepreneurial concept that will enable our company to consistently occupy attractive growth fields, sustainably strengthen our core business, and outpace our competitors in efficiency and performance. It’s our path to long-term success.

Across the areas of electrification, automation, and digitalization, there are concrete growth fields—fields in which we see major potential. We’re rigorously aligning ourselves to exploit this potential in order to achieve long-
term success. Our setup reflects this aspiration.

• Flexible and small gas turbines: In the area of power generation, the trend is increasingly toward decentralized energy supply. Customers worldwide are demanding tailor-made solutions. As a result, we see major growth potential in the field of flexible and small gas turbines—potential that we intend to rigorously exploit.

• Digital-twin software: The virtual and real worlds are merging more and more. Already today, our software solutions are helping customers develop products much faster, more flexibly, and more efficiently. For example, they can now perform endurance tests even before a single bolt is tightened in the real world. Not only products, but also the plants in which they’re produced have digital twins that can be used to coordinate and integrate product changes are emerging—changes to which we’re optimally gearing our healthcare business.

• Business analytics and data-driven services, software, and IT solutions: We have a comprehensive understanding of our customers’ business processes. In the future, we want to leverage this knowledge even better by analyzing the data generated in these processes, providing recommendations for improvement and action, and

Matthias Kereit developed programs that prevent blackouts. The software enables protective devices in high-voltage power lines to switch off the lines and prevent dangerous short circuits.

• Offshore wind power: Siemens has the No. 1 position in the fast-growing offshore wind market and the clear priority to remain the world leader through innovation and industrialization.

• Distribution grid automation and software: Energy management is becoming increasingly vital—for distribution grids as well as industrial and private energy producers and consumers. Energy management systems make it possible to integrate increasingly decentralized power supplies into the energy cycle, while mitigating the negative impact of the fluctuations that occur when power is generated from renewable sources—thus improving the utilization of existing power grids. Our intelligent, integrated automation solutions offer customers decisive added value.

• Key sectors in process industries: Some industry sectors, such as food and beverage, are growing at above-average rates. We want to participate in this growth. That’s why we’re bundling our expertise to drive the adoption of technologies in process industries.

• Image-guided therapy and molecular diagnostics: The increasing use of molecular biological methods and progress in the life sciences is accelerating technological change in healthcare. To improve quality and efficiency, societies worldwide are also demanding new solutions for next-generation healthcare. Against this backdrop, fundamental thus creating value. The resulting competitive advantages for our customers are increasingly derived from cloud-based solutions and services powered by data-analytics software. A clear example is our cross-unit remote service, which we’re continuously expanding.

Dr. Michael Schaeffer is vice president, organization development, at Siemens AG, based in Munich, Germany. He is responsible for companywide organizational development, economic analysis, and market intelligence to support the global growth of Siemens’ businesses. Dr. Schaeffer joined Siemens Management Consulting in 1995. He has since worked for Siemens’ telecommunications business; was head of Siemens Trango Software in Toronto, Canada; and had global responsibility for Siemens’ Wireless LAN business, before assuming his current position in 2007.
Defensive moves

The balance of defense spending is shifting from the West to the East, a trend that is expected to accelerate in the coming years. China and India, ranked second and fourth in 2020, respectively, are both investing in defense and will account for 23% of total spending of the top 20 nations by the end of the decade. China’s defense spending will double between 2010 and 2020, and India’s will rise by 60%. North America and Europe combined will account for less than half of total global defense spending in 2020, down from about two-thirds in 2010. Russia’s spending is expected to decline in the next five years as it battles an economic recession and international sanctions.

US REMAINS THE DOMINANT SPENDER, BUT CHINA, INDIA, AND SAUDI ARABIA ARE SHIFTING THE BALANCE

Top 20 defense budgets, 2010, 2015, and 2020 (constant 2015 US$ billions); legend order of countries corresponds to 2020 ranking

<table>
<thead>
<tr>
<th>2010</th>
<th>2015</th>
<th>2020</th>
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<tr>
<td>United States</td>
<td>India</td>
<td>Russia</td>
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<td>$1.066Bn</td>
<td>$905Bn</td>
<td>$828Bn</td>
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NATO VERSUS THE WORLD

Defense budgets for the top 100 defense-spending nations in the world, comparing 25 of the 28 NATO nations (excluding Albania, Luxembourg, and Iceland) to 75 non-NATO nations in Asia (20), Europe (7), Latin America (9), Middle East and North Africa (18), Russia and CIS nations (6), and Sub-Saharan Africa (15); 2010–20 (constant 2015 US$ billions)

20 FASTEST RISING AND FALLING DEFENSE BUDGETS

Average annual percentage change in defense spending, 2010–20 (%)

3 are Asian and 6 are MENA nations

11 of the 20 are NATO members
MOSU NATIONS WILL INCREASE SPENDING THIS DECADE

Average annual percentage change in defense spending, 2010–20 (% and constant 2015 US$)

### EUROPE

Defense spending is increasing in the East, decreasing in the West

- **8%** Annual percentage growth rate in defense spending for the three Baltic states of Estonia, Latvia, and Lithuania, 2010–20

- **-0.4%** The 10-year percent decline in the UK’s defense spending, the largest spender in Europe and third largest in the world

### ASIA

As China’s defense spending increases, so does its neighbors

- **$6.1Bn** The amount by which Japan’s defense budget is expected to shrink by 2020 from its peak in 2013

- **77%** Percent of Asia’s spending in 2020 by China, India, Japan, and South Korea

### RUSSIA + 5

Commonwealth of Independent States

- **$53Bn** Russia’s defense spending in 2015, projected to decline by $5.3 billion by 2020

### SUB-SAHARAN AFRICA

All but two nations will post growth this decade

- **$7Bn** The projected defense budget of the region’s top spender, Angola in 2020, up from $5.4 billion in 2015

### LATIN AMERICA

Brazil dominates in spending, Mexico leads in growth

- **-$5.3Bn** Decline in Venezuela’s spending from a peak of $7.3 billion in 2013 to an estimated $2.0 billion in 2020

### MIDDLE EAST & NORTH AFRICA

Iraq leads in growth, Saudi Arabia in spending

- **$62Bn** Saudi Arabia’s spending in 2020, a steady increase from $32 billion in 2010

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Source: IHS
The 65-year-old alliance is at an inflection point as attention shifts from distant conflicts in Central Asia to those in Europe. Required is a new model for the structure and mission of NATO that will address threats that were not imagined in the 1950s.

By Tate Nurkin
“The primary colors are all mixed up. The whole numbers are broken down. The big situations cease to excite.” —W.H. Auden, The Age of Anxiety

In early 2015, the US European Command announced that 12 A-10 Thunderbolt II aircraft were deploying to Europe for a six-month rotation, beginning at the end of February. The move is operationally relevant—the A-10’s tank-killing and close-air support capability is in demand by Eastern European NATO allies concerned that an emboldened Russia may seek to challenge NATO elsewhere along the alliance’s frontier.

This was followed by the announcement in June that the United States was sending military equipment, including tanks, artillery, and other gear, to storage sites in Bulgaria, Estonia, Latvia, Lithuania, Poland, and Romania.

These deployments have strong symbolic value and are part of a broader US effort to signal to both Russia on the one hand, and Eastern European allies on the other, the depth of US commitment to its allies during a time that former NATO secretary general Anders Fogh Rasmussen in April 2014 called the “greatest crisis to European security since the end of the Cold War.”

As intense and affecting as the current crisis in Ukraine and prospects of growing tension with Russia are for NATO, its challenges run much deeper and are more complex than even those posed by an irredentist Russia driving unrest in Eastern Europe.

Over the past 18 months, NATO and its member states have been confronted by a rapidly shifting strategic context—one in which the primary colors have been mixed up. Assumptions buttressing Western-led and global security frameworks are being challenged and exposed, driving multi-dimensional crises in Iraq, Libya, and Syria. This has
generated broader instability and proliferation concerns in the Middle East and increasing strategic competition in the Western Pacific, which the United States is seeking to join more fully. In addition, asymmetric threats, such as cyber threats and disruptive innovations in technology and tactics, are enabling more actors to affect the threat environment facing NATO.

All of this is taking place against the backdrop of NATO transitioning from 12 years of combat operations in Afghanistan. Deterioration of the security environment in Afghanistan in 2015 and afterward—likely or possible, according to many expert analyses—will raise difficult questions for NATO and its partners as they consider increasing insecurity and instability in Central Asia, the borders of which have moved closer to Europe as the result of Europe expanding its influence eastward.

This changed and changing strategic context has brought NATO to an inflection point, requiring an evaluation of roles, missions, structures, capabilities, and membership of an alliance that can no longer simply pivot the old alliance to meet novel threats, or rejuvenate old structures and behaviors to meet tensions that are difficult to resolve. These threats, challenges, and tensions must be addressed as part of the creation of a realistic vision about what the alliance can—and should—be for NATO to maintain efficacy as a constructive and robust force, shaping European and transatlantic security in an increasingly anxious age.

**Perceptions, priorities, and interests**

The most affecting, demanding, and potentially inhibiting of these challenges will be reconciling the differing perceptions and prioritization of the threats facing NATO among its 28 member states—especially the perceptions of the threat posed by Russia.

For NATO’s Eastern and Baltic allies, the annexation of Crimea and the ongoing conflict in Ukraine have played into existential concerns and validated pervasive and long-standing perceptions of Russia as vengeful, resurgent, and rapacious, seeking to roll back NATO, shatter the European Union, embarrass the United States, and reassert itself in the former Soviet space.

Disquiet in Eastern Europe, though, is rooted not just in the “what” of Crimea’s absorption and conflict in Ukraine, but also in the “how” of Russia’s efficient implementation of “hybrid warfare” tactics to achieve its objectives. This approach combines, among other things, the innovative use of the following:

- Covert and information operations
- Varying techniques of internal subversion
- The provision of advanced conventional weapons and asymmetric electronic warfare weapons to proxy militias
- Direct intervention of Russian troops

On this last point, Lt. Gen. Ben Hodges, the commanding general of US Army forces in Europe (USAREUR), estimated that 12,000 Russian troops were in Ukraine in early March and 29,000 were in Crimea.
To NATO members bordering Ukraine and Russia, this is an approach that could plausibly be replicated in states with large Russian minorities, particularly Latvia, Lithuania, and Estonia. It is also clear that this is an approach for which NATO was, and still is, not fully prepared. As one senior Latvian defense official noted during a high-level international conference on the Ukraine conflict held in the southern Ukrainian city of Dnipropetrovsk in February, one of the most notable surprises of the Ukraine crisis has been “the extent to which NATO’s strategy seems incapable of dealing with Russia’s ‘proxy’ or ‘hybrid war’.”

Many in Western and Southern Europe also maintain more sanguine views of Russia itself that are tempered by economic engagement with Russia, especially in energy commerce, and by relative geographic distance from Russia. Indeed, in early March of 2014, the European Commission released a controversial draft version of a policy document, entitled “Toward a New Neighbourhood Policy,” that appeared to advocate for more strategic engagement with Russia. Using relatively vague language, this suggested that the current European Neighbourhood Policy—which provides a framework for engagement with 16 states on the periphery of the EU—should be expanded to “allow for more flexible ways of working with the neighbors of neighbors” and posed more direct queries of what measures could be taken to “ensure greater coherence between the European Neighbourhood Policy and the EU’s relations with Russia and with partners in Central Asia.”

Such policy initiatives lack unanimous support among Western and Southern European states,
but they do reinforce a growing perception of a Europe divided in its views of Russia and its intent and objectives. This view was provocatively and starkly conveyed by a Polish politician speaking at a Europe-Ukraine summit in Lodz, Poland, on 17 February (quoted in Jane’s Defence Weekly). He observed that, “European security is drifting in three opposite directions: the Northern Europeans are afraid of what [Russian President Vladimir] Putin’s success in proxy war bodes for them; the Western Europeans, motivated by financial self-interest, think that Russia won’t be a menace as long as they pretend it isn’t; the Southern Europeans are, country by country, trying to make the best deal they can with Moscow.”

Differing perceptions and threat priorities also have a transatlantic dimension, especially as the US military leadership has articulated an increasingly unambiguous perception of Russia as a state determined to test NATO, undermine alliances, and actively oppose US interests and leadership. As Gen. Martin Dempsey, the soon-to-depart chairman of the Joint Chiefs of Staff, noted in his testimony to the Senate Armed Services Committee on 4 March, Russia’s activities in Eastern Europe are “designed to create uncertainty among our allies.”

**Missions, credibility, and capabilities**

The ongoing debate around threat perception and prioritization will have implications for how NATO interprets its core mission of ensuring the stability, security, and sovereignty of its member states; who will be responsible for doing so; and what capabilities the alliance and its member states can bring to bear in support of this mission.

The debate over the future mission of NATO is frequently framed as being between prioritizing regional deterrence, as NATO stressed for 45 years, and prioritizing out-of-area operations to disrupt threats before they get to NATO’s borders, as the alliance has done since 2002. Currently, however, NATO has a credibility gap that will hinder its ability to carry out either mission, much less both as may be required. NATO was unable to deter Russian adventurism in Ukraine, which has led to significant unease among NATO’s Eastern and Baltic allies over the credibility and deterrent value of NATO’s foundational Article 5 collective security commitments.

In addition, NATO may be forced to consider a scenario in which traditional concepts of deterrence do not work with a Russia that thinks about its strategic alternatives and objectives differently from its Soviet predecessor and from the previously prevailing perceptions...
of Russia’s preferences and proclivities. For example, a proud and plausibly vengeful Russia that blames the United States and NATO for causing its prolonged decline is apt to behave in ways that may upset NATO’s strategic calculations and generate genuine strategic surprise, placing a premium on developing a more complete and nuanced understanding of attitudes and assumptions of Russia’s elite that are challenging NATO and its members.

Moreover, a review of recent out-of-area deployments to Afghanistan and Libya reveal operational successes for NATO, but struggles to leverage these successes to achieve the strategic objectives of enhanced political and societal security and stability.

Even if NATO is able to emphatically establish renewed credibility as a strategically effective, cohesive, and active military alliance—and deploying A-10s and the discussed deployment of a US armored brigade to Europe are a strong start—questions will remain about military capabilities, especially in the strategic context in which the United States is likely to be balancing its sequestration-restricted resources among Europe, the Western Pacific and Indian Ocean, and the Middle East.

NATO member states possess highly competent forces and advanced military technologies and capabilities, but declining defense budgets among Europe’s largest militaries lead ineluctably to two credibility and cohesion-sapping outcomes: diminished European capabilities, and a growing gap in capabilities between the United States and its allies.

While allies in Eastern Europe and the Baltics—Bulgaria, the Czech Republic, Estonia, Latvia, Lithuania, Romania, and Slovakia—resolved in the wake of the Ukraine crisis to dedicate a bigger percentage of GDP to defense spending, these welcome incremental investments in defense are unlikely to fundamentally improve NATO’s ability to deal with the full suite of threats facing the alliance and its members if Western European militaries continue to experience declines in, or flat, spending.

According to IHS Jane’s, Western European defense spending overall has decreased from $267.7 billion in 2009 to $237.7 billion in 2014, while NATO as a whole has 13 of the top 20 fastest-declining defense budgets worldwide in the past two years, including the United States. By 2019, the alliance will constitute less than half of the global defense spend for the first time.

Spending more will be a critical first step to ensuring the capabilities required for Western and Southern European powers to continue to play up to their expectations, to the expectations of the United States, and to the expectations of the Eastern allies. Still, capability development requires more than mere spending. It requires smart spending, opening an opportunity for the new NATO to be creative in balancing increased threats with fiscal and economic realities: for example, by encouraging a more collaborative and collective approach to procurement that emphasizes the coordinated development of national specializations in capabilities critical for NATO’s collective security.

NATO has been a remarkable and resilient alliance. Over 65 years, it has played a leading role in shaping transatlantic and global geopolitics and security, and has demonstrated the capacity to recalibrate, to take on new missions in response to sudden and emphatic shifts—the end of the Cold War and the terrorist attacks on the United States in 2001—in the transatlantic strategic context.

Today’s realignment challenge is more daunting. NATO now has to meet competing and novel external threats occurring in new geographies with new kinds of actors and new kinds of capabilities in a way that it never experienced before.

Subtle and provocative thinking that balances responses to immediate exigencies with longer-term strategic objectives and visions is critical both to avoid an alliance that is overextended, fragmented, tiered, retrenched, or even hollow; and to develop compelling frameworks for bounding this new and complex strategic context, as well as better understanding the priorities, proclivities, and perceptions of the actors operating in it. Ultimately, NATO will need a compelling vision about what NATO can—and should—be in this environment, at least until the next series of game-changing challenges and opportunities emerge.

Tate Nurkin is senior director, thought leadership, IHS Aerospace, Defense & Security

For more information, visit on.ihs.com/Q23NATO
Cybersecurity: Building an arsenal to defend against invisible enemies

With the proliferation of interconnected devices and virtually anything of import accessible from the internet, the threat of cyberattacks is ever present. What cybersecurity strategies do global companies and governments need to adopt to protect themselves?

By Thomas Lynch, Dennis Murphy, and Christoforos Papachristou
In the recent high-profile security breach that was stunning in its scale and audacity, the US government revealed in June that sensitive information had been stolen in not just one, but two, separate rounds of cyberattacks—breaches that officials say involve restricted data pertaining to millions of federal employees as well as intelligence and military personnel.

The two hacks occurred at the Office of Personnel Management (OPM). One cyberattack targeted a federal personnel database that contained information on at least 4 million past and present employees, with some officials suggesting the number could go as high as 14 million. The second breach infiltrated a security-clearance database, which authorities now fear could compromise employees working at the CIA, National Security Agency, and military special operations.

Taken together, the cyberattacks—attributed by US officials to the Chinese, a charge Beijing denies—are the largest security ruptures ever suffered by Washington. In both cases, the incursions revealed catastrophic lapses by the OPM for failing to take basic steps to secure its computer networks.

The OPM assault follows in the wake of a spate of cybersecurity hacks in the corporate world—much-publicized events that shamed and hurt giants like JP Morgan Chase, Target, Sony, and healthcare provider Anthem. Given the increasing frequency and virulence of cyberattacks, at no time has there been greater attention paid to cybersecurity—or the damaging fallout that can ensue for failing to do so.

Broad and expansive in its reach, cybersecurity encompasses tools, policies, security concepts, best practices, and technologies—all of which can be deployed in concert to protect both the virtual data and physical infrastructure forming an organization’s assets. Against a backdrop of persistent and unrelenting threats in cyberspace, cybersecurity’s mandate is to defend and secure an organization’s assets to ensure their continued availability, integrity, and confidentiality.

The cybersecurity market remains small at present—just $589 million was spent in 2013 worldwide on industrial cybersecurity systems, a small subset of the entire cybersecurity market (see figure, p30). However, the potential for growth is significant,
especially as the world begins to craft coherent cybersecurity strategies to combat increasingly dangerous cyberattacks. Overall, the global cybersecurity market is estimated at $80 billion in 2015, rising to more than $140 billion by 2019.

**Cyberthreats and emerging technologies**

Cyberattacks are increasingly sophisticated as their destructive incursions seek new ways to breach security and inflict damage. In an age of increasingly porous digital borders, three areas pose grave challenges in the cybersecurity wars:

- The all-things-connected phenomenon known as the Internet of Things (IoT)
- Cloud computing or the online storage and repository of data
- The continuous churn of enormous amounts of information being gathered and sifted for specific purposes, otherwise known as Big Data

**The Internet of Things**

In the coming years, billions of new devices ranging from cars to household appliances will be fitted with computer chips that enable interconnectivity with the internet. Experts estimate there will be nearly 50 billion connected devices by 2020, with an average of more than six connected devices per person. This is the vast universe making up the IoT, and the interconnected nature of such a massive system significantly raises cybersecurity risk factors. Because IoT devices are designed for connectivity and not security, they are vulnerable to malware attacks. Each device is a potential portal through which a cyberattack can gain entry, and then proliferate throughout the chain.

In the IoT universe, cyberattacks can hit anywhere. No industry is exempt, including banks and financial institutions; healthcare and medical facilities; utilities and critical infrastructure; oil and gas refineries and chemical plants; insurance and their carriers; retail and consumer data; automotive and connected cars; and telecommunications and satellites.

**Cloud computing**

Cloud computing enables convenient, on-demand access for individuals and businesses to a shared pool of computing resources, including networks, servers, data storage, and other applications. However, these very advantages represent an attractive target for cyberattacks. This is because an attack on a stand-alone system is ultimately less dangerous than one on a networked model like the cloud, which could result in a cascade of failures across the network.

The finance industry is especially vulnerable to the inherent threats of cloud computing. Trading brokerages, banks, and credit

![Global revenue for industrial cybersecurity will more than double from 2013 to 2019](image-url)
unions all highlight their 24/7 online availability for consumers to check their accounts, conduct transactions, and monitor financial activity as key selling features. Yet this type of ubiquitous access, heavily reliant on cloud computing, renders the paradigm susceptible to attack.

**Big Data**

Big Data exploits the massive reams of data flowing over the internet—driven in large part by the growth in social media apps and mobile devices—to identify underlying patterns and trends. From a corporate security perspective, Big Data allows companies to observe the larger threat picture against enterprises, incorporating internal and external threats alike. By pooling internal data and relevant outside information to correlate high-priority alerts across monitoring systems, companies can cut down on the white noise and false alerts endemic to existing monitoring tools.

For these reasons, Big Data is not so much another vulnerability but a tantalizing new opportunity for corporate players to take proactive measures against cyberthreats. A Big Data paradigm can efficiently log information, events, and activities occurring within a preselected tracking environment; consolidate the data in a central location; and then use advanced analytics to help identify patterns that no individual monitor can do on its own, in the process creating a holistic picture to analyze and investigate security-related issues.

One potential concern, however, for the broader application of Big Data is the scarcity of data scientists specializing in

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**A cautionary tale: Sony’s embarrassing hack and public shaming**

In an unprecedented attack that grabbed headlines and made lurid tabloid fodder, Sony Pictures Entertainment in November 2014 was forced to take its computer networks and systems offline for an extended period after being hacked in spectacular fashion.

Instead of appropriating sensitive data for cyber espionage or financial exploitation, the hackers instead sought to bring the company to its knees by effectively obstructing Sony from carrying out daily operations and by destroying valuable corporate property. Malware deployed in the attack essentially wiped clean significant portions of key databases.

The key lesson here is that businesses must invest more in network security and develop an emergency response plan if an attack occurs. Sony appeared flat-footed in the initial days following the first data breach, and did not have an effective crisis-response plan in place to assure employees and communicate with the broader public, including the press. Just as contingency plans are set by companies for other forms of crisis management, protocols for a formal response after a cyberattack should be put in place.

The nature of the Sony attack also led many to believe it was carried out with some assistance from company insiders, highlighting again the importance of background checks on those with access to key networks and databases.

The other major takeaway is that everyone must be careful about what they put on a computer screen, no matter how seemingly safe or private. The most far-reaching damage to Sony may have involved the publication of private email exchanges between senior executives disparaging key figures in Hollywood, including prominent film stars. That old adage, of never including in an email anything that one wouldn’t want to be made public, rings truer than ever.

Thomas Lynch
security issues. In many cases, organizations will need to engage third parties to compensate for the lack of in-house expertise.

**Cyber warfare and the defense sector**

As governments around the world awaken to the impact of cybersecurity breaches, a primary focus remains the prevention of cyberattacks from being deployed as an instrument of warfare by both state and non-state adversaries. Indeed, a quick glance at national defense spending over the past decade bears out the growing investment by governments in cybersecurity.

In the United States alone, spending on cybersecurity at civilian and military agencies will reach nearly $14 billion in the current fiscal year (FY), which includes $5.1 billion for the Pentagon to invest in cyberspace operations. These outlays represent increases over last year’s funding, in an environment that witnessed a general decline in federal spending.

President Obama’s FY2016 budget proposal will increase information technology (IT) spending by $2.25 billion. Total outlays are $86.4 billion, with $49.1 billion in civilian-agency IT spending and $37.3 billion going to defense IT.

Cybersecurity funding as a subset of that overarching IT budget is $14 billion, according to the political website The Hill, representing a $1 billion increase from FY2015 and accounting for 44% of the overall IT increase from last year.

The Department of Defense’s budget allocates $5.5 billion to cyberspace operations in FY 2016, up from $5.1 billion in FY 2015. This funding supports both defensive (cybersecurity) and offensive (cyberattack) cyberspace operations, as well as the development of the US Cyber Command’s Cyber Mission Forces.
None of this is lost in the business world. Witness the growing number of mergers and acquisitions over the past few years, with larger and more established corporate players buying smaller IT firms, especially those with cybersecurity skills. Examples of such corporate deal-making include the acquisition of Mandiant by FireEye; Urgentis Digital Crisis Solutions by Deloitte; Blackbird Technologies by Raytheon; and SilverSky by BAE Systems.

The Obama administration has not only acknowledged the presence of offensively focused teams at the strategic and operational levels, it has also implied the use of such capabilities at the tactical level. Perhaps more significant, active training and military exercises in offensive operations have now become the norm, along with the creation of stand-alone cyberforce organizations, nurturing a new generation of digitally savvy cyber warriors. For instance, the US Army recently established a cyber branch for officers on the same level as traditional infantry or armor specialties.

This growing embrace of holistic cyber capabilities, which integrates defensive attributes with offensive missions in a proactive fashion, is not the only new force shaping cyberspace operations in the defense sector. As national defense increasingly embraces the necessity of investments in cyber programs and personnel, other key trends include the following:

- Infrastructure. Protecting the security of industrial control systems for key elements of critical infrastructure will grow in importance. Also known as Supervisory Control and Data Acquisition (SCADA), these computer systems control activities over multiple sites. A successful attack against SCADA can shut down, destroy, or manipulate infrastructure activities. As the threat magnitude grows, so too will research and development into cyber-defense applications to produce more robust defenses.

- Self-repair. A greater emphasis is anticipated on real-time continuous monitoring and mitigation to defend against persistent threats, which will gradually take the place of the

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**The Anthem hack: A new approach proves highly destructive**

In February, a major cyberattack targeted Anthem Inc., the second-largest health insurer in the United States, with hackers breaching a key IT system and stealing the personal data of current as well as former customers and employees.

The attack affected approximately 80 million people—nearly one in five Americans. While not the first cyberattack suffered by Anthem, this one was particularly worrisome in its acquisition of social security numbers (SSNs), since SSNs could be used to perpetrate other forms of identity theft. Unlike other personal information, SSNs cannot be changed, so the repercussions are severe and long lasting.

Medical data is more valuable to cybercriminals than traditional financial data, and stolen SSNs fetch a higher price in the black market than filched credit-card information. In the wake of the Anthem breach, the healthcare industry as a whole should thoroughly audit data on customers, determine access rights to such data, and explore whether steps like encryption can enhance security.

Data encryption adds cost and can be circumvented if a hacker deciphers the codes, but combined with updated physical data-security infrastructure it can be highly effective at securing organizational assets against the vast majority of cyberattacks.

State-sponsored Chinese hackers were the suspected culprits in the Anthem case. However, the identity of the hackers may not matter much in the end, because all firms must take steps to safeguard their data, regardless of the source of attack.

The Anthem incursion highlighted a new cyberattack approach, moving from a traditional focus on financial institutions to less protected areas like healthcare. And unlike stolen credit and debit cards that can be immediately canceled with minimal damage to consumers, medical identity theft often goes unnoticed for months or even years, giving criminals the luxury of time to exploit purloined data.

Christoforos Papachristou
traditional “react and patch” approach, enabling greater automation and self-awareness in cyber-defense applications. Technological advances will usher in more prominent self-repair network attributes. These capabilities—monitoring, mitigating, and self-repairing—will pave the way for a resilient network ecosystem, which until now has remained in the conceptual and research realms.

- Compliance. From a tactical perspective, network cybersecurity needs will grow as the military becomes fully networked. These networks must be secured, and for the US military this means complying with information assurance accreditation and certification requirements. Cybersecurity opportunities will increase accordingly, as seen in the recent US information security contract awards for the Virginia-class submarine and F-35 fighter.

- Collaboration. The international cybersecurity market will experience significant growth. Rapid evolution is already occurring at the nation-state level, ranging from the routine establishment of national cyber emergency response teams, to the development of cyber forces with potential offensive capabilities. Bilateral and regional cooperation, both in the investment of resources and shared training, is beginning to accelerate. Industry is also joining in, with the establishment of overseas centers of excellence and growing mergers-and-acquisitions activity.

**The way forward**

Cyberattacks have become a permanent and pervasive peril to governments and businesses alike, and managing the risks must become a priority. However, understanding the challenges and implementing appropriate strategies for the long term require resources and expertise. The

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**Industrial cybersecurity presses its case to safeguard manufacturing environments**

Industrial cybersecurity involves the protection of embedded industrial systems from espionage and sabotage, an increasing concern amid growing tension and uncertainty around the world. But in spite of continued growth, the market is small at the moment: The $589 million spent on securing industrial cybersecurity systems in 2013—the latest year for which full figures are available—was equivalent to less than 1% of the total industrial automation equipment trade at $170 billion.

The market is also extremely immature, with more than 160 vendors vying in the space and offering a variety of hardware, software, and services.

Growth over the next few years is expected to be solid but not spectacular, posting a compound annual growth rate of 12% from 2013 to 2019. By 2019, industrial cybersecurity revenue will reach an estimated $1.2 billion, or slightly more than double the 2013 level.

North America and Europe are the largest markets, with the two regions combined accounting for nearly 60% market share of total industry sales.

Services made up the largest share of the industrial cybersecurity market in 2013 in terms of product type, with $240.3 million or 41%. Software was next with $216.7 million or 37%, followed by hardware with $132.1 million or 22%.

Overall, the industrial cybersecurity landscape will continue to be sustained by the high number of legacy systems that need securing.

Over the next 10 to 15 years, demand for on-top or add-on industrial cybersecurity hardware, software, and services is likely to decrease, as fewer compensating controls will be required to safeguard already secure assets.

In particular, a new cybersecurity standard known as IEC 62443 is gaining support among industrial asset owners and vendors alike for offering more robust protection, and addressing issues that were thought to compromise the integrity of systems.

Toby Colquhoun, senior analyst, discrete & process automation; IHS Technology
Government and industry must collaborate to respond to cyberthreats. The time for siloed approaches to defense and deterrence has passed.

Cybersecurity is too important to be left to technology or security specialists alone. Because cyberattacks can go through any portal or user, everyone—from CEOs to front-line workers—should be mindful of cybersecurity best practices and trained to recognize the danger from breaches.

The spate of data breaches against high-profile US entities has shown the reputational damage that can be inflicted by a cyberattack. Indeed, a company’s ability to successfully manage myriad cybersecurity risks could determine how well it is able to navigate and succeed—or flounder and fail—in this new, more dangerous age.

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For more information, visit on.ihs.com/Q23Cybersecurity
Oil at the crossroads

Changing demand patterns, rapidly growing unconventional supplies, and geopolitical issues are reshaping the very foundations—and future—of the oil industry.

By Atul Arya
Over the last several decades, the oil industry’s direction and market trends have been fairly easy to understand and forecast. By keeping tabs on global economic growth, strategies of the international oil companies (IOCs), Organization of the Petroleum Exporting Countries (OPEC) production quotas, and intermittent Middle East political turmoil, most industry watchers could stay current with oil’s key drivers. In the last five years, however, rapid shifts in the global energy landscape have created a dynamic industry that often surprises observers, investors, and insiders alike. Seemingly unrelated factors such as slowing growth in China, geopolitical events like the Arab Spring and Russia-Ukraine tensions, and the rapid growth in North American unconventional oil production have all conspired to influence oil market demand and supply.

To get a clear view of today’s oil industry requires an understanding of a mix of key influences, trends, and activities. IHS has distilled the myriad factors down to four main issues that are expected to shape the future of the oil market over the next five years:

- Slowing oil demand growth
- OPEC’s changing strategy
- Strong supply growth in the Middle East
- Increasing success of unconventional oil production in North America

The oil industry outlook until 2020 is changing. These trends, combined with other industry, business, and market forces, will determine the success of oil companies, the service sector, downstream customers, and investors alike.
Quartet of key trends

Remember the concerns about peak oil? M. King Hubbert’s 1956 theory stressed that once the rate of maximum oil extraction was reached, production rates would fall until resources were depleted. The model rings true for specific fields and regions. However, what Hubbert couldn’t foresee were the changes that might impact the global production and consumption of oil nearly 60 years later. Peak supply is not on the horizon for the foreseeable future. Instead, peak demand—or more precisely plateau demand—is highly likely.

Significant slowdown in demand growth: IHS forecasts that the demand for oil will slow substantially in the coming decades. Although global economic growth is expected to improve—averaging 3.3% through to 2020, according to IHS—the pace will shift to a more moderate long-term growth rate of 3.0% through to 2040. As demand for oil is closely linked to the economy through the transport of goods and people, as well as energy use, slower economic growth contributes to reduced demand for oil (see figure). However, IHS expects that the link between economic growth and oil demand will weaken gradually as the world increasingly adopts alternatives to liquid fuels, enhances vehicle fuel efficiency, and embraces the sharing economy.

Forecasters also expect industrial overcapacity in China and slowing growth in several other emerging markets to dampen economic growth. For example, China’s gradual shift from export manufacturing to greater domestic consumption will limit demand for diesel fuel. In Organization for Economic Cooperation and Development (OECD) countries, the economic recovery and low oil prices support steadying of
demand in the short term. However, weak demographic trends (such as the aging population in China) and growing consumption efficiencies point to a long-term decline in growth. Overall global oil demand growth is expected to average just 0.6% through to 2040.

**Changing OPEC strategy:** Since it was founded in 1960, OPEC’s mandate has been to unify and coordinate the policies of its members, with a goal of stabilizing oil markets and ensuring steady income for producers. For decades, members seemed to move as one in establishing production targets. When ministers agreed to reduce production targets, oil prices typically rose. With the increase in North American production, US imports from OPEC have been reduced by nearly 50%. Despite requests for production cuts from financially stressed nations, OPEC leaders such as Saudi Arabia argued to let the market determine prices in late 2014. In June 2015, OPEC restated its existing output target of 30 million barrels per day for the remainder of the year. This reaffirms the organization’s determination to defend its volumetric share of the global oil market—even at the price of hurting struggling producers. With OPEC no longer using production targets to achieve market equilibrium, the oil industry faces continued volatility in both prices and production volumes.

**Strong supply growth in the Middle East:** In OPEC, three countries hold the key to future growth in supply: Iran, Saudi Arabia, and Iraq. While each nation is driven by different domestic, regional, and international geopolitical considerations, the net outcome will be an increase in OPEC oil supply. Iran secured a nuclear agreement on 15 July with the five permanent members of the United Nations Security Council plus Germany. A key Iranian motivation for this deal is to lift the ban on its oil exports and earn much-needed revenue. Iran holds a significant volume of oil in floating storage, supplies that could be brought to international markets very quickly. In the medium term, lifting of sanctions will enable Iran to access much-needed capital and technology to develop its vast oil resource base and grow its oil production.

In parallel, Saudi Arabia has undertaken a strategy to maintain or grow its market share. In June, production reached 10.3 million barrels per day, even in the face of excess supply. Regional tensions between Iran and Saudi Arabia will continue to influence oil policies in both countries and could lead to further growth in Saudi supply as the details of the nuclear deal emerge.

In spite of ISIS advances and domestic security issues, oil production in Iraq has continued to rise over the last year. Iraqi production increased from about 2.9 million barrels per day in January 2014 to 3.5 million barrels per day in June 2015. Similar to Saudi Arabia and Iran, Iraq has a very large resource base, and its production is constrained by security and infrastructure issues. Iraq’s rising production and export volumes will potentially result in these three OPEC producers fighting for market share in the short and long term.

**Impact of unconventional oil production:** The rapid development of shale-based oil production, primarily in the United States, dramatically affects the oil industry. Unlike OPEC production operations, which are centrally controlled by the oil ministries of OPEC member countries, there is no “minister of shale”
to oversee production decisions for unconventional oil resources. US exploration and production boasts short and declining cycle times, almost no exploration risk, a highly competitive service sector, and readily available capital markets, even at current low prices. US shale producers are similar to Silicon Valley startup companies in that they have easy access to cash, can make quick and simple business decisions, pay no dividends, and possess an unrelenting focus on growth. Given that they are smaller and more nimble than their international brethren, they can take more risks.

As a result, the US shale market has become an important swing producer in the global oil market. North American crude oil production has increased by 4.7 million barrels per day since 2008. In 2014, thanks in part to shale production, the United States became the largest oil producer in the world (see figure, p39). In effect, $70 per barrel is the new $100 per barrel. IHS estimates that the compound effect of well improvements and service-sector cost reduction will make each dollar spent in 2016 over 60% more capital-efficient than a dollar spent at the end of 2014. By 2017, IHS expects US production to exceed 10 million barrels per day.

**Investment considerations**

Beginning in the late 1990s, the oil industry embraced the "big is beautiful" mantra. The scale and complexity of projects was huge, global reach expanded through outsourcing, and balance sheets became bloated. Today big oil is struggling economically because of diverse factors, such as poor exploration success in conventional fields, cost overruns, and dividend commitments. Will lower oil prices be the final nail in the coffin? Doubtful. Many industry players own conventional fields with vast potential and new efficiencies—including practices borrowed from unconventional operations—that are helping oil companies do more with less. With that in mind, here are several other key issues investors need to evaluate:

**Global deepwater:** Deepwater developments have proven their ability to deliver scale to even the largest portfolios. Yet, moving to ‘Phase 2’ of this industry is challenging for both above-ground and below-ground operations. Some plays within global deepwater require substantial cost reductions to deliver breakeven economics at $60 per barrel. IHS is forecasting a 15% reduction in deepwater costs in 2015, followed by an average increase of 3% in overall deepwater costs between 2016 and 2020. Cost deflation is material in many areas impacting deepwater costs. One question for investors to consider is: how long will it take to complete the restructuring of the deepwater cost base?

**US unconventional:** A large new supply source typically lowers oil prices, and those lower prices invigorate efforts to reduce the cost of developing new production capacity. The current situation—driven by US tight oil production—is no exception. IHS forecasts lower costs for developing new oil production capacity through 2020. By 2016, the IHS Upstream Capital Costs Index (UCCI)—a broad measure of the cost of developing a global portfolio of upstream oil and gas assets—is projected to be 20% below the 2014 level. US onshore development costs may fall even further than the global average. Tight oil plays in North America continue to deliver substantial gains in productivity and cost reduction. But investors will have to make some choices when “sweet spots” are exhausted, cost reductions plateau, and the cost of capital goes up.

**Oil sands:** As global oil prices languish, the economics of higher-cost supply, such as the Canadian oil sands, have come under increasing scrutiny. IHS expects oil sands growth to continue but at a slower pace, with output exceeding 2.9 million barrels per day in 2020. This outlook assumes delays for unsanctioned projects,
a slower pace of construction for some projects underway, and higher decline rates from more “conventional” oil sands production. However, factors such as a more favorable exchange rate, lower natural gas and diluent costs, and narrower price differentials between Western Canadian crudes and those in global markets have cushioned the blow of lower prices for oil sands producers. Most oil sands production is backed by large, well-capitalized companies—firms that are more capable of riding out periods of lower prices. A strategic issue looming large for oil sands investors is how to address carbon emissions associated with production from oil sands.

**Liquefied natural gas (LNG):**
Buyers of LNG have unprecedented opportunities to procure new supply. Both existing projects and those under construction have a substantial amount of uncontracted LNG available, and the number of unsanctioned project proposals continues to grow. The LNG market is expected to move into oversupply in 2016 with the startup of new Australian and US liquefaction capacity. The next wave of LNG investments is expected to encompass multiple new plays, albeit at a much lower scale than the large volumes proposed globally. Later in this decade, the next round of final investment decisions will likely include projects from Mozambique and Western Canada, in tandem with additional US LNG. Brownfield projects in Asia-Pacific and floating liquefaction projects are also expected to come online. Will there be too much supply? Will buyers value diversification more than price? These are some of the issues that IHS will be paying close attention to in the coming months.

**Foundations for success**
Lower oil prices are encouraging oil companies to accelerate strategy and portfolio choices. To support growth, players must rebalance their portfolios and recalibrate operating costs to reflect the reality of lower oil prices. Large exploration and production firms must re-engineer their processes and operating approaches, rethinking their overall business models and standardizing operations. Some companies are taking steps to upgrade their investment portfolio. The Royal Dutch Shell acquisition of the BG Group is a good example of this strategy. Other firms view lower oil prices as an opportunity to shift their focus to a few core capabilities that will deliver sustainable competitive advantage. The sweet spot for each company differs, of course; but once these capabilities are identified, firms are wise to maintain their focus there.

Most importantly, oil companies must be open to new operational methods that support agility. As the linkage between oil demand and GDP growth weakens, the foundations of oil industry success begin to change. Fallout from factors such as the sharing economy, evolving customer behaviors, and climate change will all change the way that the world consumes oil—probably in ways that are more impactful and long-lasting than are apparent today. Companies that take steps to become more agile will be able to respond faster and more effectively to these changes than those that cling to traditional business strategies.

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For more information, visit on.ihs.com/Q23EnergyFuture
Formula for success: Analyzing energy at the extremes

By understanding the impact of low crude oil prices, the resulting effect on demand, and changing competitive market dynamics, chemical companies can confidently make sound capital investment decisions.

By Mark Eramo and Dave Witte
The biggest headlines about reduced oil prices focus on consumers’ relief from pain at the pumps. But the impact of lower-priced oil is much larger and far more complex. The decline in crude oil prices at the end of 2014—compared to the 2010-to-early-2014 period—has introduced a new set of dynamics for global economic growth and is impacting the operating plans for companies in virtually all industry sectors.

In global energy markets, lower crude oil pricing in 2015 placed the United States—not Saudi Arabia—in the key role of regulating global crude oil supply in response to market pricing. No doubt, consumers in some countries are benefiting from lower energy prices, leaving them with more discretionary income. For example, US consumer spending growth accelerated in 2014 from 2.5% in the second quarter to 4.4% in the fourth quarter as oil and gasoline prices were plunging. Policy makers from importing-oil countries are investigating options to exploit the benefits. However, not all countries are experiencing the benefits of lower crude oil prices. Oil-producing nations such as Saudi Arabia and other OPEC nations are exploring how low crude oil pricing will impact spending on domestic programs and budgets that are reliant on higher-priced crude exports.

Lower crude oil prices are also shaping the planning and operations of chemical companies. Each year the industry invests billions of dollars in new and sustaining capital to keep pace with demand growth (see figure, top). Business leaders decide where to invest in new capacity and how to operate and maintain existing assets based in part on energy market dynamics, as well as trends in the manufacturing and consumption of durable and non-durable goods, and overall market profitability. In light of lower oil prices, executives are now debating the viability of investment decisions that were considered must-do projects just 12 months ago. For example, one US-based, non-integrated ethylene-consuming company recently put the brakes on a new ethane-based steam cracker project that last year promised an exceptional return on investment.

The two foundational risks for chemical manufacturers are market supply-and-demand imbalances, and energy-driven changes in production costs. The development of significant imbalances between available capacity and demand growth can, and often does, create boom-and-bust cycles in the chemical industry, directly affecting overall profitability. Companies able to align new capacity with global demand growth are less likely to face oversupply or undersupply conditions (see figure, bottom). In a perfect world, organizations would invest in low-cost capacity with direct access to strong demand growth markets when the global market begins to transition from a period of oversupply to tighter market conditions.

Absent a crystal ball, however, chemicals executives must now make decisions that will impact the future of their companies for decades. To minimize the risks of changing economic trends and energy costs and to maximize profitability over time, chemical companies must develop robust strategic plans that can flexibly adjust to energy market volatility. By understanding the complex and changing dynamics within the petrochemical value chain, firms can more reliably make these adjustments and ensure they produce the right chemical products at the right locations for the right markets. Only then can these companies create business and investment strategies that drive success in periods of extreme cyclicality.
Chemical company executives must now make tough decisions that will impact the future of their companies for decades.

**Investing in turbulent times**
Chemical companies dedicate a substantial portion of their annual budgets to constructing new assets and maintaining or modernizing existing assets to meet market needs, and conforming to strict regulatory and operational standards so they can compete effectively. Boardroom investment decisions are driven by strategic plans that seek to leverage advantage in three primary areas: energy and feedstock costs, proximity to demand growth, and technology.

**Energy and feedstock costs:**
The differential between oil- and gas-based feedstock prices in the highly competitive markets of the Americas, Asia, Europe, and the Middle East divides cost-advantaged from cost-disadvantaged chemicals producers. Whether the analysis focuses on elementary feedstock choices (such as naphtha, ethane, or propane), power costs, or alternative values for use in crude oil refinery products and heating markets, successful producers must exploit opportunities to create competitive advantage. Cost-advantaged producers can capitalize on these conditions through investments in new multibillion-dollar production facilities. Because as much as 75% of the cost of producing petrochemicals is related to hydrocarbon values, companies with a cost disadvantage may choose to invest in lower-cost raw materials (such as a conversion to ethane cracking in the US market) or attempt to relieve competitive cost pressures through product differentiation.

**Proximity to demand growth:**
Demand can drive or stifle the need for new investment. Today, assets that derive margin from a wide gas-to-oil differential—such as those in North America and the Middle East—are experiencing margin declines. Large, capital-intensive projects that are already underway will likely continue in these cost-advantaged regions. In energy environments where the supply-curve is lower and flatter, proximity to demand growth can provide a strong competitive advantage, in which companies leverage freight and logistics costs as a barrier to protect or grow market share.

**Technology advantage:**
In commodity chemical markets, competition is driven by cost, service, and reliability. Non-commodity chemicals derive competitive advantage from their product attributes or the functions they serve. Regardless of the competitive differentiator, technology serves as a clear, important variable. For example, the use of on-purpose propylene technology (PDH, propane-dehydrogenation) in North America currently allows propylene producers to take advantage of excess propane supply in the region to provide low-cost propylene, versus naphtha co-product propylene from a steam cracker. Producers with sustainable technological advantage typically enjoy better performance in terms of volume, profits, and lower margin volatility over the chemical cycle.

Even for the most competitive and strategically placed assets, investment decisions take place against a backdrop of market and political uncertainty. The chemical industry continues to be buffeted by unpredictable and often volatile regulatory, economic, and energy dynamics. For example, 2014 kicked
off with continued momentum in North American shale feedstock volumes and record industry profits for gas-based assets and Chinese coal-based technologies. Downstream industries such as converters that produce many finished or semi-finished consumer goods struggled to absorb relentless price increases, squeezed between the chemical producers on one hand, and consumer products and retail industries on the other (see figure). A fourth-quarter decision from OPEC to let market forces set oil pricing, in the face of both weak petroleum demand and rapidly rising shale supply, resulted in a dramatic reversal in crude oil and chemical pricing by year’s end.

Global economic recovery continues to be uneven. Economic activity in China, Europe, and Brazil, among others, remains sluggish. As a result, chemicals demand is still tepid, and the drop in oil prices has not yet encouraged manufacturers to keep or build inventory. A significant result of lower crude oil prices has been a lower and flatter supply curve. When combined with a stronger US dollar, this flattened supply curve changed the competitive landscape and redistribution of profits, both geographically and throughout the value chain. As a result, downstream markets became more profitable in 2015.

**Understanding shifting energy dynamics**

Energy is the primary cost factor in the manufacture of chemicals, with crude oil and natural gas as the key determinants of production costs. Changes in relative costs of these key energy sources (and the resulting impact on derived feedstocks) play a significant role...
in the competitiveness of various regions and the willingness of chemicals manufacturers to invest.

For example, from 2010 through the end of 2014, significant price differences between North American natural gas-based raw materials and those derived from crude oil transformed that area into a low-cost region for chemical production. This shift has led to rapid stock equity appreciation in line with growing profits. Accordingly, a large number of domestic and international chemical companies are advancing plans to build or expand facilities in North America.

Change in energy markets creates nearly instant responses in chemical prices. Falling energy prices often translate into a buyer expectation of “lower prices tomorrow.” This anticipation creates a collective pause in demand, generating inventory and price reductions as well as market-share battles. Rising energy prices tend to create an opposite expectation of “higher prices tomorrow.” What follows are higher inventories, a demand surge, and rising prices. Both movements can dramatically affect overall supply-and-demand balances, increasing profitability volatility.

The impact of lower-priced crude oil varies. Consider how a $50-per-barrel downturn in oil prices affects global consumers. Petroleum imports are distributed to approximately 90% of the world’s population. Unsurprisingly, Asia-Pacific and Europe are the largest petroleum importers, while Central Asia and the Middle East are the world’s net suppliers. Shale and oil sands have dramatically increased the self-sufficiency of North America, but the region still benefits from the drop in crude oil pricing.

At approximately 80 million barrels a day in global demand, a $50 reduction in the price of oil creates a significant transfer of wealth—trillions of dollars move from oil-exporting countries to oil-importing countries. In addition, there is a transfer of value between oil producers and downstream beneficiaries such as industry, governments, and consumers. The chemical industry is one of the key beneficiaries of that value transfer. Nearly 10% of the global production of energy is consumed into chemicals—mostly as naphtha, which accounts for approximately 500 million metric tons. Another 400 million tons of coal, oil, gas, and gas liquids are consumed, some of which derive a portion of their value from crude oil via various market relationships. In addition, any stimulus to GDP created by a drop in crude oil prices results in an overall benefit to the chemical industry through an increase in overall demand for durable and non-durable goods.

**Correlating low crude oil pricing with investments**

A significant change in the price of crude oil impacts not only short- and medium-term demand but also the relative cost structure and cash margins for many chemical value chains. Marginal-cost producers—those that supply the last high-cost increment of production that satisfies the final ton of demand, and whose cost structure sets the lowest possible limit of pricing—often consume oil-derived hydrocarbons as a primary feedstock. Lower-cost producers that use feedstock based on gas, coal, or gas-liquids—such as ethane or liquid petroleum gas (LPG)—are able to capture the difference in feedstock costs as margin. In an environment of falling crude oil prices, low-cost chemical producers experience a reduction in cash margins as selling prices based on crude oil decline more than their own alternative feedstocks.

The flattening of the cost curve—resulting from lower crude oil pricing—causes the cost structures of higher-cost producers to drop faster than the alternative gas- and coal-based technologies. This dramatically reduces the competitive advantage previously enjoyed when oil was near $100 per barrel. For gas-based producers looking to high-cost markets as a source of demand, this shift is significant. For low-cost producers who access the market via exports, freight, and logistics costs will play a more significant role in competitiveness, modifying regional trade flows.

Lower crude oil prices are encouraging some chemical companies to delay and further assess investments that were dependent upon a significant oil-to-gas (or oil-to-coal) differential. Producers are re-evaluating their investment returns and testing the robustness of their competitiveness assumptions. Offsetting some of the lower oil-gas differentials, however, is an expectation of lower capital expenditure (capex) escalation. For example, IHS is seeing signs that layoffs and reduced capex budgets originating from the upstream shale-related US energy industries are relieving previously tight conditions for skilled labor as well as demand for engineering resources.

**Energy stimulates the upcycle**

Given the current oversupply of crude oil, IHS Energy is forecasting crude oil prices to remain well below $100
per barrel (Brent basis) for the next two to three years. During this time, global energy and chemicals markets will respond to the current crude oil oversupply, and market participants will keenly observe how OPEC will adapt to this new energy market dynamic.

While the near-term outlook remains subdued for chemicals demand and margins, low oil prices are expected to positively impact the industry over time—sowing the seeds for better economic conditions, lower petrochemical prices, and improved global petrochemical demand. Since crude oil acts as the primary driver for feedstocks and serves as the marginal production cost and price-setter for many chemicals, plastics, and fibers, a decline in crude oil prices typically leads to lower product prices. Macroeconomic demand-related effects can expand wealth transfer to the greater global population. In addition, the lower prices of petrochemicals relative to other competing materials—such as glass, paper, and metals—accelerate substitution demand. Reduced plastics prices will also cut demand for recyclable material compared to virgin resins, providing further demand stimulus.

The outlook clearly varies by region and value chain, with some specialty sectors benefiting from the lower pricing likely to see a reversal and others simply so oversupplied that additional demand will not matter. For example, the decline in crude oil prices in the second half of 2014 moderated the advantageous competitive conditions in North America. However, some advantage remains and will continue to provide an incentive for planned investments in the region.

IHS also anticipates that a pause in new project approvals—combined with higher GDP and stimulated demand created by lower energy prices—could result in very tight supply-and-demand conditions in the next five years. Over time, this could lead to a significant upcycle in certain markets, such as the ethylene value chain. Although there will likely be yet unannounced builds, IHS expects investment to slow appreciably from 2017 to 2020 to the lowest levels since the start of the last decade (see figure). Underlying trends in capital access, such as the ability for projects to be financed in emerging markets like China, will contribute to the slowdown in capital investment. The slowing in capital programs related to shale may reduce capex inflation concerns experienced in some markets.

For investors, the primary economics of the chemical industry are still attractive in the current market, even if they are not as rewarding as they were over the last three years. Experienced producers recognize that market conditions can—and do—change. The investment horizon is long and must withstand variability in underlying drivers. Optionality and asset flexibility, superior performance in both operations and construction, and sustainable competitive advantage ultimately provide value to both customers and investors while creating long-term success.

Ideal investment conditions are rare in the chemical industry. However, strategic planning lends companies the flexibility and nimbleness they need to make short-term operating plan adjustments that accommodate this volatility. Companies that take action quickly will be able to take the greatest advantage of current market conditions. And wise decisions made in 2015 will result in both productive and profitable facilities coming online three to five years from now.

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For more information visit on.ihs.com/Q23ChemicalCapex

View the video “Opportunity and risk ahead for the global chemical industry”
Mapping the geopolitics of lower oil prices

*IHS Quarterly* sat down with IHS Senior Vice President Carlos Pascual, former US ambassador to Ukraine and Mexico and founder of the State Department’s Bureau of Energy Resources, to discuss the global political and economic implications of the decline in oil prices. IHS Energy is projecting the price per barrel of Dated Brent Crude will have bottomed out in mid-2015 before starting a modest climb back to the low-$70s by the end of 2016. While these shifts bring with them new opportunities, they also bring new risks.
Q. Net energy exporters Iran, Russia, and Venezuela are seen as the economies that are perhaps the most challenged by lower oil prices. What are the geopolitical and internal risks these nations face?

Carlos Pascual: Russia, Iran, and Venezuela are three exporters that have been profoundly hit by the collapse in oil prices. For Russia and Iran, the collapse has been combined with international sanctions that preclude both countries from access to capital markets and a way to finance themselves out of their current financial crisis.

For Russia, the critical issue has been its extreme dependence on oil for export revenue. Oil constitutes 70% of export revenues, and together oil and gas make up 52% of the budget. The combination of sanctions that has deprived Russia of access to new technology and to capital markets, as well as the collapse in oil prices, has put Russia in a dire financial position. The exchange rate lost 50% of its value. People have lost 50% of their real income. Businesses have found it extremely difficult to operate because they cannot afford to bring equipment and foreign inputs into the country—and then translate those into local currency ruble costs and still have competitive products.

The issue for Russia, of course, focuses on its intervention in Eastern Ukraine, where it annexed Crimea to the Russian Federation and then supported an insurgency that has destabilized Eastern Ukraine. The critical challenge for Russia to see sanctions lifted is whether it would be willing to support decisions that would allow for stability in Ukraine and establish the grounds to allow Russia to regain access to international capital markets.

Iran has a comparable situation—it has a tremendous natural resource base, but cannot use it to gain export revenues or leverage access to international capital markets. International sanctions have been levied because of Iran’s potential development of a nuclear weapons program. But the 14 July agreement between Iran and the five permanent members of the UN Security Council plus Germany (P5+1) could potentially allow Iran to gain access again to international markets.

For Iran, there is a self-interest in a settlement that would once again allow it to rejoin the international community and develop its natural resources. For the international community, there is the supreme
incentive to deter and prevent an Iranian nuclear weapons program that could present a threat globally and regionally. The US Congress and Iranian parliament have two months to review the agreement. If the agreement is upheld, it will move into a preparatory stage that would see the reduction of uranium, the removal of centrifuges, the redesign of the Arak heavy water reactor (so that it cannot produce plutonium), and relief on sanctions implemented most likely in early 2016.

A critical issue for the P5+1 has been creating the rights to inspection and transparency needed to ensure that Iran would abide by an agreement. For Iran, there is pressure internally to seek concessions before taking actions to curtail its nuclear program. In the end, it will take leadership and foresight on the part of Presidents Obama and Rouhani to steer through the political constraints and secure an international solution for a nuclear agreement with Iran.

Venezuela presents a different case. There are no international financial sanctions that have been imposed on Venezuela, but its own political and economic mismanagement has left it in this crisis.

Within the country there has been a collapse of the currency, skyrocketing inflation, and a scarcity of products. One of the critical byproducts has been decreased access to electricity: brownouts and blackouts have been occurring throughout the country because of Venezuela’s inability to service its hydroelectric plants, and now Venezuela is burning oil to generate power. All these factors have led to an increase in demonstrations, even in those neighborhoods that have traditionally been in favor of President Nicolas Maduro.

‘In the end, it will take leadership and foresight on the part of Presidents Obama and Rouhani to steer through the political constraints and secure an international solution for a nuclear agreement with Iran.’
A key issue for Venezuela will be whether it can regain the political and economic confidence of the Venezuelan people. Without that, further political instability and economic deterioration are likely. One of the impacts will presumably be the collapse of Petrocaribe, which would affect the Caribbean states: Cuba, Dominican Republic, Haiti, Jamaica, and others. This would raise the threat of increased migration to the United States as Venezuelan subsidies decline.

For the Caribbean states, low oil prices could offer the chance to transition out of dependence on Venezuela. They have the opportunity to reduce their dependence on liquid fossil fuels to generate electricity—and move to more stable and sustainable solutions.

Q. Elaborate on the tension between NATO and Russia, and the implications for Ukraine and other Eastern European nations? What might occur in 2015-16?

Carlos Pascual: The tension stems from Russia’s violation of Ukraine’s national sovereignty and territorial integrity. As indicated earlier, Russia annexed Crimea and has supported a separatist insurgency that has involved Russian troops. Any solution to the crisis has to involve the withdrawal of Russian troops and the re-establishment of a ceasefire. In February 2015, German Chancellor Angela Merkel and French President Francois Hollande brokered a ceasefire with the participation of Russian President Vladimir Putin and Ukraine President Petro Poroshenko. That agreement broke down within days as a result of intense fighting around the town of Debaltseve, which led to battles to take over the city. Since then the intensity of the fighting has diminished, but the ceasefire violations continue.

Given these failures, it will take immense effort on the part all of the parties, the four leaders, and
pressure from abroad to achieve a ceasefire agreement that will hold.

The core elements needed for a ceasefire are well-known. Russia needs to withdraw troops and stop supplying the insurgents. Ukraine would have to follow through on earlier measures to decentralize political powers to local authorities, consistent with the Ukrainian constitution. All sides would have to accept a massive number of observers on the ground to ensure compliance.

Among NATO allies, there have been concerns that Russia could attempt similar incursions within the Baltic states, which are part of NATO. Such an incursion would trigger Article 5 of the Treaty of Washington that underpins NATO, and would require all NATO members to defend a state that faces an external threat. It would be unwise to test NATO’s commitment. The members of NATO have consistently said that they will uphold the treaty and defend its members.

The critical step that all parties can take is to recognize that the best thing for Russia, Ukraine, the European Union, and the United States is to have a ceasefire arrangement that holds; and to have a political arrangement that allows for normalized life in the Eastern and Southern parts of Ukraine. Such steps would allow Ukraine to achieve economic prosperity, and it would help Russia regain access to international capital markets that are critical to Russian economic growth.

Q. You’ve called for Europe, and in particular Ukraine, to diversify energy sources to reduce its reliance on Russia. And on 19 March you testified before the US Senate Committee on Energy and Natural Resources on the economic benefits to be gained by lifting the ban on US exports of crude oil. How do you see these issues unfolding?

Carlos Pascual: The diversification of fuel sources and types is a fundamental part of building energy resiliency. Europe has already taken many important steps to lay the foundation for a more diversified system.

The European Commission has put in place, through its third energy package, a series of regulations and policies that prevent any one company—in this case, Gazprom—from owning gas resources supplied to Europe, from owning transit pipelines, and from owning the distribution system.

It has also lifted “destination clauses” in gas contracts, which means that once a buyer purchases the gas, it is free to trade it with any other party. These policy measures have created a foundation for competition.

Europe has also put in place significant infrastructure investments, including massive investments in regasification infrastructure for LNG (liquefied natural gas), as well as interconnecting pipelines that allow for gas to be moved from west to east, north to south, and south to north. That network, however, is not complete; there are some states, such as Bulgaria and the Baltics, that still largely depend on one source—Russia—for gas.

The critical next step for Europe is to complete the internal infrastructure that allows a European gas market to include all of its members and to benefit from the greater resiliency that it has already started to build.
In addition, there are important steps that Europe can take to complete the southern corridor for gas that begins in Azerbaijan, passes through Turkey, and cuts through Greece, Albania, and Italy. The changes in political leadership in Greece have delayed completion of this network, and issues still need to be resolved on landing rights in Italy.

Europe also continues to pursue a major antitrust case against Gazprom for alleged noncompetitive practices. The conclusion of this case will have vast implications for a competitive gas market in Europe, and the ability of individual countries in Europe to secure multiple suppliers of gas. Europe can—and should—continue to purchase Russian gas, but these measures will ensure that purchases are made on a competitive basis, not simply because there are few other choices. That will help defuse the extent to which gas supplies can be used to exert geopolitical influence over European customers.

Q. Mexico recently lifted the ban on foreign direct investment in the country’s energy sector. Do you see lower oil prices impacting Mexico’s energy sector? Perhaps an increased reliance on oil for power generation?

Carlos Pascual: It is important to recognize the historic nature of the steps that Mexico has taken to open up its hydrocarbon sector to foreign investment for the first time since 1938. In 2013, it passed a constitutional amendment that opened the path to foreign investment in the energy sector—oil and gas, as well as midstream and downstream markets, and electricity. In 2014, Mexico passed secondary legislation needed to create the legal framework for foreign investment to move forward. Now Mexico is conducting a bid round to tender shallow water, onshore, unconventional, and eventually deepwater fields within Mexico for private investment.

The first bid round began in December 2014 and will be conducted in five phases. Bids under Phase 1 were submitted on 15 July 2015. Data rooms have been opened, 39 companies have bought data packages, and 34 have prequalified. Given low oil prices, few companies bid in Phase 1. This first phase will be a learning process for Mexico, to test the market and understand the competitiveness of Mexico’s resources in a tight global environment. Inevitably, Mexico will draw from this experience in assessing how it sets future fiscal terms.

This is the first time that Mexico has solicited private investment in the hydrocarbons sector since it was nationalized in the 1930s. The collapse of oil prices internationally, of course, affects this process. Mexico will have to demonstrate that the resources it has to offer are going to be competitive internationally. Part of the answer to that question is available in the seismic and subsoil data. Mexico also can help its own case by working
with bidders to help them understand the quality of the resources available, and how they may be analogous to comparable resources that may be available in different parts of the Gulf of Mexico and shallow waters.

The opportunities that potentially exist for Mexico are huge, but we have to understand that the process may take longer than initially anticipated. It is an enormous and technically complex process that Mexico has embarked on, seeking to attract private investment in more than 160 fields over the five different types of resource areas that are on land and offshore. Even if the process is delayed and extended, there are still huge opportunities for international investors, and it will be critical for Mexico to maintain a dialogue with the investment community in order to understand their interest and concerns, and to be realistic about the fiscal environment that is affecting all investors in the hydrocarbon sector today.

Q: Lower oil prices mean a potential for an increase in the consumption of oil, primarily for transportation, but also for power generation to a lesser extent in countries such as India, Mexico, and Japan. Global GDP growth is expected to increase in the next few years, driven in part by lower oil prices. Also, cheap coal may delay investment in alternative energy and smart grid technologies. What implications do you see these factors having on the pace of CO2 emissions and climate change? Specifically, what implications may this have on national policy and on the UNFCCC COP 21/CMP 11 conferences in Paris in December?

Carlos Pascual: The crash of international oil prices has boosted economic growth in many countries. There has been concern among some that increased growth would lead to increased oil consumption, which would, in turn, have a negative impact on global emissions. It is important to understand the linkages between economic growth and energy consumption, but we should not forget that economic growth is a fundamental aspiration of people globally. When countries grow, they have more resources to help them make and finance tough decisions. Countries are always able to make better decisions on policies when their resource base is strong, rather when they are in a difficult economic situation.

With that kind of positive resource base, one of the questions that many countries will face is how to create greater competition among fuels to be able to achieve a lower carbon economy, to encourage investment in energy efficiency, and to lower carbon power generation and industrial fuel uses. The biggest challenges are going to be faced in Asia.

Asia is currently on a path of increased coal consumption that, unabated or without carbon capture and storage, will lead to much higher emissions. In Southeast Asia, coal as a percentage of fuel use is projected to increase to 50% by 2030 from 30% last year. Coal consumption continues to increase in India. China is taking measures to curb the use of coal as a share of total consumption, but absolute consumption continues to grow.

To reduce emissions in Asia and globally, it will be necessary to find lower carbon solutions that can compete with coal in power generation and industrial use. Outside of China, the private sector in Asia tends to drive investments in power generation and fuel choices based on projects that offer the highest rate of return. Because of the intermittency of renewables, coal investments still often offer the highest returns on investment in Asia. For gas, nuclear, and renewables to compete with coal, countries can take policy measures that put a price on the environmental impacts of coal, reduce financing costs for lower carbon fuels, invest in technologies with greater capacity factors that cut intermittency, and address other policy constraints such as land access for geothermal that affect the competitiveness of low-carbon investments.

The critical new opportunity that is offered by the UN Framework Convention on Climate Change in 2015 is the prospect to focus climate action plans around individual country realities. Rather than focus negotiations on an ideal scientific path to emissions reduction, countries will propose measures in order to create momentum on emissions reductions. Under this new framework—laid out in the UNFCCC’s Lima negotiations in Peru in 2014 and which would ideally be completed in Paris in December 2015—individual countries would submit to the UNFCCC their projections for emissions targets based on what they can do. Eventually, these plans must be reconciled with scientific imperatives for emissions reductions, but for now they will drive action while it is still difficult to forge consensus on how countries must share a carbon budget under an ideal outcome.

A key issue is whether those plans are supported by commercially viable strategies that will lead to lower carbon investments. This is where international
cooperation will be critical—among policy experts and representatives from the financial world who will assess project viability; with energy developers and development organizations; and among technical experts globally seeking to drive down costs and improve technology performance—to find country-specific solutions and develop alternative financing models that will result in commercially viable investments for lower carbon outcomes.

‘I am optimistic about COP 21 because it offers a path for developing solutions that will move us to a lower-carbon economy globally, and this approach will encompass all countries.’

Here is a practical example: what kind of policy changes and financing arrangements would be necessary to encourage investment in geothermal investment, as opposed to coal? Issues such as these will have to be resolved on a case-by-case basis.

The new UNFCCC framework that will be created in Paris will stimulate a new degree of activism in climate work because it demands pragmatic solutions.

That will create business opportunities to look for country-specific solutions to deliver power and energy supplies with a lower carbon profile and at a competitive price. On its own, this approach will not solve the challenge of climate change, but it can create new momentum based on the kind of commercial sustainability that is needed for a sustainable environment.

Q. Are you optimistic about COP 21?

Carlos Pascual: A huge amount of work needs to be done. A challenge countries may face is that we end up with solutions that result in lower emissions over time but with no mechanism to ensure that those lower emissions will actually achieve the reductions necessary to avoid the more cataclysmic implications of climate change. I am optimistic about COP 21 because it offers a path for developing solutions that will move us to a lower-carbon economy globally, and this approach will encompass all countries. Developed and developing countries must participate in order to succeed. Whether we are going to get to the point of actually achieving the kind of cuts necessary to avoid the worst impacts of climate change will depend on leadership. The steps already taken by the United States and China set a good precedent. There is little doubt in my mind that the debates over which countries reduce emissions, how much they reduce, and the pace of reductions will be one of the biggest geopolitical challenges in the energy sector over the next decade.

Carlos Pascual is senior vice president, IHS Energy. He was US ambassador to Ukraine from October 2000 until August 2003, and US ambassador to Mexico from August 2009 until May 2011. In May 2011, Ambassador Pascual was appointed the State Department’s Special Envoy and Coordinator for International Energy Affairs. In September 2014 he joined Columbia University on a research and teaching fellowship on energy geopolitics. He joined IHS in January 2015.

For more information, visit on.ihs.com/Q23Geopolitics
Lessons from the fading commodity supercycle

Prices of raw materials—crude oil included—have plummeted, signaling the end of a 15-year commodity boom. The implications for countries and businesses are far reaching.

By Farid Abolfathi, John Anton, and John Mothersole
The past 12 months have seen a precipitous drop in many primary commodity prices. Crude oil prices have collapsed, with the price of Brent crude falling from well over $100 per barrel last year to less than $60 earlier this year. Likewise, iron ore prices declined from around $95 per metric ton to below $50, and rubber prices tumbled from nearly $2.00 per pound to less than $1.60. Collectively, commodity prices, as measured by the IHS Material Price Index (MPI), have fallen more than 36% since July 2014.

Last year’s commodity crash was not totally unexpected, but the speed of the decline for many commodities took most traders by surprise. Indeed, the IHS MPI, a weighted average of weekly input spot prices for the manufacturing sector, went into a near-free fall during the second half of 2014. The index had in fact been on a downward path for the past four years, after having hit its cyclical peak in late April 2011. Since then, despite periodic short-term rebounds, it has generally been trending down and currently stands more than 53% below its 2011 high.

As the price decline has unfolded, an increasing number of market analysts have been heralding the end of the powerful commodity boom that had persisted for most of the past 15 years (see figure, p58 top). Some of the more bearish analysts go even further, suggesting that the commodity crash is a leading indicator of a powerful global deflationary wave that is constraining the world economy. Moreover, there is a growing consensus among commodity bears that the
The boom-bust commodity cycle was a natural consequence of the past several decades of rapid liquidity growth and excessive debt accumulation.

The evidence supporting the commodity bears is now very strong. Among the 53 commodities for which the International Monetary Fund (IMF) publishes monthly price data, the vast majority show prices that are currently 40-60% below their 1980-2015 peaks, and nearly all the others have fallen 15-37% from their high points (see figure, p59).

There are still some commodity bulls who contend that the ongoing downturn is only a pause. Indeed, they view current prices as an opportunity for accumulating assets at bargain levels.

These stalwarts expect prices to rebound soon and to reach new all-time highs over the coming years. The bullish case has become increasingly difficult to maintain as commodity prices have continued to sink.

Commodity supercycles since 1900

When aggregated into a single broadly representative index, commodity price movements show far less short-term volatility, and the supercycles stand out much more clearly.

Over the past 112 years, two small supercycles were recorded during the first two decades of the 20th century, followed by three giants: one in the 1920s, another over the 1970s, and the third during the last decade (see figure). The first of the two smaller supercycles, which spanned 1892-1905, was associated with Germany’s rapid rise as an industrial and geopolitical power. The second, which covered the years from 1916 to 1919, was related to supply disruptions during World War I and the rise of the United States as an emerging economic power. A key reason for the small amplitude of these two early supercycles was that the
What causes commodity price volatility?
The central reason for the high volatility of commodities is that both their demand and supply can experience large changes in relatively short periods.

Supply can be very “lumpy,” especially in the case of mega-mining projects, particularly in some of the gigantic mines today in Australia, Canada, Brazil, Russia, Mongolia, and West Africa. Similarly, discoveries of new oil reserves frequently come in the form of huge new plays. As a result, increases in production capacity can come in large chunks, making it difficult at times to match demand with supply. The problem of managing production growth is often accentuated by the long lead times of energy and mining projects, which stem from their increasingly challenging regulatory environment. Consequently, it is not that unusual for oil and mineral supplies to go through periods of oversupply, with prices crashing, followed by periods of shortage, when prices start to rise and sometimes boom for an extended period.

Severe weather conditions and other natural disasters can also upset the supply side. Some of Australia’s iron ore and coal mines, for example, have occasionally had to halt their operations for extended periods as a result of flooding caused by severe tropical storms. Geological disasters can also disrupt supplies. Earthquakes are an obvious case, but even giant sinkholes can be extremely disruptive for mines located in regions susceptible to such an event—such as some of Russia’s giant potash producers in Siberia.

Political risk can further disrupt commodity supply and spark price volatility. This has historically been a major problem in the case of mineral supplies from developing countries. Because of their weak institutions, developing countries are vulnerable to political instability and violent central banks of those eras could not accommodate the boom periods with aggressive reflationary policies since currencies were tied to gold prices, which did not allow any flexibility in monetary policy.

The first truly giant supercycle in the 20th century was from 1926 to 1929, the four years immediately preceding the Great Depression. During that period, permissive lending by banks and an insatiable appetite for speculative investment by businesses and households led to excessive leveraging of the private sector, especially in the United States. After the boom turned to bust in late 1929, commodity prices dropped sharply for a few years and then trended down at a more gradual pace for most of the next 15 years through the end of World War II.

The 1970s commodity supercycle was also preceded by a period of rapid economic growth starting in the 1960s—a period fueled by expansionary fiscal policy, monetary accommodation, and speculative investment. The euphoric investment climate eventually spilled over to commodities, with energy and raw material prices surging during the 1970s and early 1980s.

Commodity supplies were also roiled during those years by the nationalization of most extractive industries in developing countries. Such actions discouraged foreign investment in the developing countries’ commodity sectors and further increased global supply disruptions and price volatility. The flight of foreign investment from developing countries was a key reason for many countries’ poor economic performance during the 1990s, and was a major factor behind the tightening of commodity markets and shortages that lay the groundwork for the dramatic price increases in the 2000s.

Farid Abolfathi
conflicts, which can damage production facilities and transport infrastructures.

The concentrated supply structure of some commodities can lead to market instability. The best example of such concentration is the high share of traded petroleum originating in a handful of countries in the Persian Gulf. Over the last several decades, almost any political or policy change in these countries has made commodity markets nervous and often had a major impact on oil prices.

Demand swings can also destabilize prices. Decisions to increase or decrease the desired levels of inventory during the course of a business cycle can greatly amplify changes in apparent consumption and cause short-term price volatility. Since some commodities are traded in open exchanges, this can add to their volatility as well. To be sure, investors generally benefit from the resulting increased transparency and liquidity.

Such benefits come at a cost, however, since financially traded commodities attract speculators and are vulnerable to swings in investor sentiment that sometimes are divorced from the markets’ physical fundamentals.

It is important to note that accentuated commodity boom supercycles that deviate greatly from their physical fundamentals are not possible without a permissive monetary environment. Indeed, supercycles have their origins in reflationary monetary conditions and are fueled by negative real interest rates or excess liquidity growth.

Commodity supply-and-demand dynamics make it difficult for markets to achieve a stable equilibrium. Even when a commodity market does reach balance, it is unlikely to last long. Commodity markets require constant—and on occasion, major—adjustments that can sometimes only occur through huge price movements (see figures).

Parallels among supercycles
The history of past supercycles shows that they have similar dynamics, even though each has unique characteristics (see sidebar, pp58-59). Factors that influence supercycles include economic and political shocks, government policies, diffusion of new technologies, and investor psychology. These sometimes work in concert to accentuate a cycle by increasing its amplitude and/or stretching out its duration. Ultimately, however, all economic booms that lead to commodity supercycles are powered by rapid liquidity growth and/or negative real interest rates.

The dynamics of the latest supercycle—which IHS believes came to an end in 2014—are essentially the same as the four that occurred in the 20th century. High liquidity growth and/or negative real interest rates were the key causal factors during most of the past 20 years. The liquidity boom that characterized the late 1990s was fueled mainly by
European banks and US venture capitalists, and subsequently by the response of major central banks to the economic downturns that followed the high-tech bust of 2001 and the Great Recession of 2008.

The easy money on tap during those years helped inflate various asset bubbles, and drove energy and raw material prices to unsustainable levels. Certainly, the severe credit squeeze that was triggered by the Great Recession caused a violent crash in commodity prices. But the monetary authorities’ aggressive reflatory measures—including negative real interest rates and quantitative easing—halted the adjustment process and stimulated another boom in many commodities that ended only a few years later, roughly in 2011.

The fact that reflatory monetary measures were left in place for such a long time aggravated the problem, since they fueled a powerful debt-financed consumption and investment boom that eventually became unsustainable. The reflatory measures did succeed in igniting global recoveries in 2003 and 2009, but they also created new asset bubbles. In particular, they set the stage for the increasing “financialization” of commodity markets. Indeed, the growing participation of financial market investors in commodity trading likely contributed to the excessive rise in prices during the boom, worsening the subsequent bust (see figure).

**Where to next for commodity prices?**

IHS contends that most prices have fallen sufficiently for the market to at least find short-term price stability near their current levels. Indeed, when measured in most major currencies, commodity prices have probably already hit bottom.

There are two reasons why further declines will likely be limited. First, for many commodities, prices are approaching production costs, placing at least a temporary floor under prices. Second, while the global economy’s expansion has been lackluster over the past several years, we do see a slow improvement in growth ahead, which should provide some degree of demand support.

What do these mean for commodity prices? IHS expects any recovery in prices to be fairly muted over the coming quarters, particularly since IHS believes that China’s economy is set to edge down further in 2016. As a result, excess production capacity in many sectors should constrain price increases in most commodity markets for at least another year. For some commodities, such as iron ore and aluminum, abundant capacity will likely ensure downward pressure on prices for some years.

The history of past supercycles suggests that a disorderly price correction, such as the one we have witnessed during the past 12 months, is usually followed by a long period of relatively weak pricing power and underinvestment in commodity markets. After a powerful boom usually comes a long, painful bust that discourages investment, but eventually sets up the markets for the next commodity boom and sometimes a supercycle. So the odds are that commodity prices will remain relatively flat, rather than recover strongly, for at least several years. Indeed, IHS believes commodity prices will not regain their early 2014 levels for the rest of this decade. After an initial short-term cyclical rebound, real prices might slowly drift higher, but they are still likely to remain far below their 2014 levels even by 2025.

**Winners and Losers**

The impact of the decline in commodity prices has been highly uneven across countries. Broadly speaking, all net importers of energy, food, and other raw materials have benefited at least modestly from the improvements in their terms of trade. But for many net exporters, the economic situation has deteriorated severely. At the global level, however, the net effect on world
While we can blame easy monetary conditions for facilitating the last decade’s commodity supercycle, its key driver was the rapid economic expansion of emerging markets during the past two decades. In particular, it was China’s dizzying pace of growth that underpinned the rapid rise of energy and raw material prices. Moreover, China’s insatiable appetite for energy, raw materials, and other goods enabled other developing countries to sustain robust growth. In short, China’s soaring demand for everything from iron ore to oil and gold was the dominant driver of the supercycle (see figure).

China’s ascension to the World Trade Organization (WTO) in December 2001 was a watershed event, without which the supercycle might not have been possible. At a minimum, the cycle’s amplitude and duration would probably have been far smaller. WTO membership not only boosted tremendously China’s exports to the rest of the world, but also attracted huge volumes of foreign direct investment (FDI) into the country’s manufacturing sectors. These, in turn, led to vast amounts of domestic capital being invested in precisely those industries that are intense users of energy and raw materials.

The domestic investment binge, which was easily financed by the Chinese people’s excessive savings, generated an insatiable appetite for energy and raw materials during the last decade. Indeed, not only did levels of physical consumption of commodities rise, but the rate of their growth accelerated as well. It was this acceleration that started to strain commodity markets and pushed prices progressively higher—far above previous nominal cyclical peaks. Commodity prices roughly doubled between 2002 and 2004. They doubled again between 2004 and early 2008, before crashing during the Great Recession’s global credit crunch.

China’s 2008 crash proved remarkably brief, though. The Chinese authorities’ implementation of an aggressive economic stimulus package in response to the Great Recession in late 2008 soon triggered a frenzied capital spending boom that, in turn, drove demand for many raw materials sky-high, pushing prices to unsustainable levels once again. For instance, the price of iron ore at China’s Tianjin port climbed to about $200 per ton by February 2011, nearly seven times higher than its average during the preceding decade.

Even though the vastly elevated price levels were not supported by market fundamentals, for many commodities the boom was sustained by what analysts sometimes refer to as “mania,” or psychological factors. But eventually the day of reckoning did arrive. As China’s economic growth decelerated over the last several years, broad-based commodity price indices ran out of steam. The IHS MPI, along with other commodity price indices, started to sag in 2011—slowly at first, but steadily.

The gradual downward trend continued for about two-and-a-half years, before culminating in last year’s crash. Even though prices seem to have stabilized somewhat in recent months, they would likely decline further if China’s economy continues to decelerate.

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growth appears to have been minimal, with the positive impact on net commodity importers being offset by the negative impact on net exporters.

At the micro level, the lower prices have certainly had a positive impact on the finances of most households and businesses around the globe. From a macro level, however, there have been many losers as well as winners. The economies that have benefited most from the lower prices are those that are primarily manufacturing or service oriented. Since these economies do not receive much income from primary commodity production and exports, they are unlikely to see a major negative shock from the crash in commodity prices. The benefits to these economies from lower prices are likely to be rather modest, however, since the aggregate value of their commodity imports is relatively small compared with the overall size of their economies.

Among developed countries, those that have seen a significant boost to their economic growth in recent quarters are mostly in Western Europe, but this has been mainly due to improving fiscal and monetary conditions rather than lower commodity prices. In fact, IHS estimates that lower commodity prices have added less than 0.3% to the regions’ GDP growth since June 2014.

When it comes to the impact of lower prices on emerging markets, the countries that have seen notable acceleration in their economic growth in the wake of last year’s commodity price crash are primarily located either in Central Europe or the Caribbean. Here as well, the contribution of lower commodity prices to economic growth has been rather modest—roughly 0.2-0.3%.

As noted above, clearly the end of the supercycle has hurt the economies of all net commodity exporters, which are overwhelmingly emerging markets or developing economies.

There are only three major net commodity exporters that are advanced economies—Australia, Canada, and Norway. These three countries had benefited immensely from the booming commodity prices during the last decade and a half, but they are now facing a very challenging period of austerity that will likely last several years. These developed economies are likely to come through the period of adversity in relatively good shape, however, since they generally have effective decision-making organs, strong financial institutions, stable political systems, and wealthy populations.

The biggest losers at the end of the supercycle are the developing countries that earn most of their foreign exchange inflows from exports of energy and/or minerals—in other words, most countries in the Middle East, Africa, and South America, as well as some in Asia. The economic situation of these countries has already deteriorated rapidly since 2014, and their prospects are expected to remain negative as long as commodity prices remain depressed.

The adverse impact of the lower prices on net commodity-exporting economies will vary, depending on the degree of reliance on commodity exports, the extent of its diversification, and the strength of its macroeconomic fundamentals. The ones that are coping best with the commodity crash are those with dynamic manufacturing sectors, such as Indonesia, Malaysia, the Philippines, Vietnam, and Mexico, since they are benefiting from lower input prices for their manufacturing sectors. Affluent petroleum exporters, like Saudi Arabia, Kuwait, and Qatar, should be able to manage the situation with only a limited amount of austerity, since they can tap their ample foreign exchange reserves and vast accumulated overseas assets.

The end of the supercycle has hurt the economies of all net commodity exporters, which are overwhelmingly emerging markets or developing economies.
Lifting the fog on shipping costs

The increasing use of Big Data analytics in shipping signals a sea change in the way the industry and its customers plan for the future.

By Richard Clayton and Andrew Scorer
Shipping has always been a game of chance, with profits too often riding at the mercy of geopolitical forces, powerful boom-and-bust cycles, and the best guesses and gut instincts of the established families and entrepreneurs who created and drove the maritime industry, generation after generation.

In such a complex, zero-sum environment, one key to success has been moderating risk through accurate forecasting. But the variables have proven so numerous and complex—everything from stiffening credit restrictions in China to small bands of sea pirates terrorizing shipping routes—that the forecasts produced from them are extremely brittle.

This was never more evident than when world powers considered lifting an oil export embargo on Iran, a reward for agreeing to nuclear treaty terms. Shippers and their customers suddenly had a new set of complex factors to forecast, and the variables to plug into the equations were daunting.

Sure, shippers were likely making the calculation that increased oil supply on world markets would lower oil prices, and that tanker demand, especially to China, would rise, leading to an increase in shipping rates.
This would also affect the businesses of shipping customers, who ultimately underwrite the industry. But the variables that would determine the magnitude of the Iranian situation were complex. When would Iran be able to export oil? July? October? The later in the year it occurred, the less impact on 2015 freight rates it would have. Would Iranian oil be exported to many countries, with each casting its own influence on shipping; or would exports be confined just to the major Asian economies? How much oil does Iran actually have in floating storage as well as on-shore storage? Yet this would not have an impact on freight rates initially, as they are already out of the market. The impact on freight rates would be when non-Iranian ships can export crude.

The real problem for the industry is that much maritime forecasting is stuck in technologies or processes from the past—some even relying on back-of-the-envelope calculations or, more likely, some combination of instinct and technology to give shippers and their clients a better view into future demand.

Yes, technology is increasingly making shippers smarter, with such things as on-board sensors monitoring engine performance, fuel usage, and tracking cargo container by container. But technology has frustratingly not been as influential in the home office, where forecasts that drive a company’s prosperity are made.

Enter the arrival of Big Data analytics, which promises to improve the fortunes of the industry and its customers just as it has revolutionized every other industry it has touched. IHS believes that the equation of Big Data, plus analysis, plus hypothesis, equals a significant competitive edge that few in the industry are yet taking advantage of.

Companies able to analyze data and gain critical insight can enhance, as never before, their balance sheet, take control of their business, and improve the likelihood of survival in a fragmented and volatile industry. Better forecasting might also mean more investment in the industry, as investors and bankers gain more transparency into companies and how they operate.

The picture today
First, let’s take a snapshot of the industry today, using some of the new data tools available to us. IHS research reveals two distinct sides to the shipping market in mid-2015, driven largely by events in the energy sector and, in particular, the crude oil business.

On one side, some players are taking advantage of geopolitical developments to improve their bottom lines. Larger tankers have seen earnings rise rapidly since the fourth quarter of 2014. Underwriting their success has been a low oil price that has increased demand, with China and OECD countries taking advantage of the situation to top up their strategic reserves, together with the stockpiling of crude oil on shore. Tanker revenue has also been helped by a slowdown on the supply side: newbuilding orders have been slow since 2012.

However, the picture for these tankers could change soon. Concerns are growing that improved freight rates have encouraged shipowners to return to the shipyards. As a result, there is speculation that increased levels of vessel deliveries in 2016 may force the tanker market down into another cycle. At the same time, uncertainty exists around OPEC’s future decisions regarding oil production levels.

Other fleets are not faring as well. China, which drives so much commerce, also takes it away. The unrestrained growth that underwrote an increase in shipping capacity over the past two decades may be running out of steam with increased restrictions on credit lending. This is of significant concern for the maritime community, since China’s growth had been the prime guarantor of investment in shipping. Imports of steelmaking raw materials (iron ore and metallurgical coal) and energy resources (thermal coal, crude oil, and liquefied gas), together with exports of electronic and consumer goods, have driven demand for dry bulk vessels, tankers, and gas carriers, as well as for container shipping. This is also a headache for Asia-Pacific raw material exporters, which have built up their own extractive economies on Chinese demand.

Profitability depends not only on how many ships are available, but also on how much cargo is demanded by the industries and countries being served. These are complicated end markets, inextricably linked to one another and to the wider global economy. With 3.5% growth forecast for 2015, global trade growth as tracked by IHS has been slowly improving.

While this is a good sign, more interesting for shipping is where this trade is happening and where
it is expected to go in the future. For accurate forecasts, a deep understanding of market drivers is needed.

**Too much supply**
The link between supply of, and demand for, cargo capacity lies at the heart of the fundamental challenge the shipping industry has confronted in recent years: increasing uncertainty at a time of greater volatility. Few economists predicted the global financial crisis, and no one appears to have anticipated last year’s plunge in the price of crude oil. The shortfall in demand left by China’s slowdown has not been filled by increased demand in the United States or the European Union, and the result has been surplus shipping capacity across the world.

One consequence: this surplus has depressed freight rates for dry bulk and container shipping, and there is little sign of improvement. According to IHS Maritime & Trade, the current order book for dry bulk ships stands at 18% of the existing fleet. Ships are, therefore, accepting contracts at less than operating cost just to remain employed. That makes sense in the short term but digs deep into financial reserves over the medium and long term. When will this end?

In contrast, tanker shipping has seen freight rate growth for the past six months, as the low price of crude oil has encouraged emerging economies to burn oil rather than use coal, gas, or renewable energy. Companies operating the largest tankers (VLCCs – Very Large Crude Carriers) have posted stellar earnings for the first half of 2015, and excellent revenue is anticipated throughout the year or until oil prices rise again. VLCCs on the Middle East Gulf–Far East route were earning $60,000 per day in April 2015 versus $10,000 in April 2014 and breakeven rates in April 2013.

Understanding these market developments will inform the decisions by charterers as to whether they should persevere with high spot rates, or if they should look to secure a period charter covering the medium term. The current disconnect between the expectations of owners and charterers for three- to five-year spot rates and stable newbuilding prices suggests that freight rates are not expected to maintain their current high level.

**Tanker freight rates have increased over the past six months as low crude oil prices have encouraged emerging economies to burn oil rather than use coal, gas, or renewable energy.**

From an owner’s perspective, lucrative earnings could be made from chartering a ship at the right rate at the right time. Conversely, the aim for the charterer is to achieve a rate that is less than that of their competitors at the time of fixing, which is not necessarily the actual freight rate figure.

So, that’s great news if you own a fleet of tankers. But it’s not so rosy if you own a fleet of bulk carriers, which is why several shipowners have switched their newbuilding orders from bulkers to tankers. Whether this is the right decision depends on what the market will be like in two or three years’ time.
Today’s healthy or unhealthy shipping market is rarely a good indicator of profitability in five years.

**A challenging environment for decision-making**

That’s a quick look at the current state—and it’s a messy environment, as always. And unforgiving. For one, there is less time to make quality decisions. Market volatility has traditionally been masked by the familiar rise and fall of business cycles, but times are changing as forward freight agreements (FFAs) and trading models reduce the window within which informed, strategic decisions have to be taken. Moreover, decision-making is made more onerous by the addition of governance and regulation gripping the industry, along with the complexities and requirements imposed by banks and private equity as they become more involved in shipping management.

The environment is transforming in another, fundamental way. Maritime leadership is changing. The new realities of global interconnectedness, advancing technology, and speeded-up business conditions have
spurred a shift away from the romantic notion of shipowners fulfilling dreams toward more hard-nosed business entrepreneurs. This new breed possesses a deep understanding of the heightened importance of return on investment, residual value risk, and cost of debt and capital.

The necessity to understand a company’s net asset value and the health of its balance sheet has made vessel owners and investors more sophisticated. Moreover, business is seeking to share responsibility with investors concerning regulations that have eaten away at profitability.

Despite these changes, the industry appears not to have learned from its mistakes, as history repeats itself with overcapacity and overexposure to risk, presenting a new group of questions. How should shipowners mitigate prices and rates? On the shipping side, is it better to lock in the good returns for a three-year timecharter or take the risk on the spot market?

Euronav CEO Patrick “Paddy” Rodgers may speak for many shipping services providers on that matter.

“I don’t want to give a discount to the spot market to fix a timecharter and not get the income protection in the later years, so the period we’re looking at is three to five years,” Rodgers said recently. The more time shippers get it wrong on the spot side, he believes, “the more appetite they will have to get it right on the timecharter side.”

The answers to these questions lie in understanding where in the cycle the business finds itself, helping to manage risk and maximize financial leverage. And in this environment, uncovering those answers requires data. Lots of data.

**Reactive to proactive**

Big Data and advanced analytics are especially valuable because they provide an ability to move beyond what is known and what is predicted, enabling, for example, business strategists to understand how a target market can be penetrated with flexibility to minimize risk of illiquidity and liability.

Here’s one example of how data reported by remote sensors—a basic ingredient feeding the data revolution—can advance maritime forecasting capabilities.

From a shipping point of view, shore support has a major influence on a ship’s behavior. Automated Identification System (AIS) is a good Big Data point to start with: it tells us where ships are operating, and where they are loading and discharging. Connecting this to ports and bill of lading data gives insight into what commodities ships are carrying and how trade routes are developing. Decision-makers can also use AIS data to optimize trading routes, taking into account weather, piracy, and ice as well as fuel consumption, linked to slow steaming. Other key issues on which Big Data analysis can help companies sharpen forecasting models include:

- Ability to watch all aspects of business
- Maximizing earnings potential and cost management
- Fleet utilization
- Maintenance schedules
- Trade pattern changes

Clearly, technology is providing the industry with views of its world never available before, with the promise of providing better visibility into the future—whether that is weeks, months, or even a few years ahead.

For example, by applying pattern-recognition technology to examine fleetwide behavior, new data sets can be created. These tell us in much sharper detail than previously available which carriers spend more or less time than their competitors in certain ports; it means we can monitor delay up until real time at a port and nearby alternative ports.

More to the point, proper use of this technology is dramatically improving forecast accuracy. IHS has used these techniques to improve its matching of AIS records to ship records, bringing the number of verified bulk carriers from 69% to over 90%. This means more port calls are being captured, which improves understanding of trading activity.

**Risk vs reward**

The shipping industry and its customers should be offered a better grasp of the underlying elements of the market so that investment decisions can be built on top of the very best data available and the clearest insight that data reveals. What counts, after all, is not the existence of Big Data but what can be done with it.
Let’s look at an example. By using data to build crude freight-rate forecasts, customers can develop actionable insights into two of the most critical questions in shipping: whether to charter ships, and whether to merge companies.

Rates have been comparatively strong in recent years, impacted by the low oil price as well as the increase in metric ton miles. Last year’s annual average cost for the VLCC Middle-East-Gulf-to-Japan route was in the region of $30,000 per day; this year IHS forecasts that this could be nearer $57,000 per day. Having the capability to utilize a forecasting tool to inform trade route selection for the years ahead should enable companies to compare how they have performed against the actual earnings for those routes, and whether they could have increased earnings by using different routes.

Another major issue faces the industry: market consolidation. Shipping businesses are seeking advice on whether to follow the latest public company merger (Navig8 with General Maritime) or the lead of privately listed companies. Consolidation often appears reasonable at a superficial level, but would potential earnings be increased from the owner perspective, or return on investment enhanced from a private equity point of view? At this time there is no definitive answer. However, understanding how a fleet operates within the crude market (today and over the next five years), and whether additional regulations will impact potential earnings, will guide strategic decisions for reacting to unforeseen scenarios faster and more accurately than competitors.

Without the ability to anticipate market developments, businesses are doomed to react to events instead of being proactive. It’s like a ship’s captain waiting for the storm to hit rather than navigating around it.

Understanding data from technology

When looking at data, we need to treat history with respect, as a guide. Finding reasons and explanations provides the indicators and insights, and it is the indicators we can take into our assessment of the future. This knowledge is hard to find unless you have the expertise and time within internal teams or external advisors to distinguish between the predictable and unpredictable; filtering out the background noise frees you to focus and refine the useful data.

The speed of information flow and the amount of external data available is probably far too much for most companies to take in, process, and utilize intelligently on their own. Yet without the ability to anticipate market developments, businesses are doomed to react to events instead of being proactive— it’s like the difference between a ship’s captain waiting for the storm to hit rather than navigating around it.

Who are partners in this work of finding, filtering, analyzing, and predicting?

Shipbrokers are a significant part of this information equation—but only up to a point. They are the workhorse of the current market, passing information among various parties to aid their decisions. They use proprietary models to understand what they see and what it will mean going forward, with varying degrees of accuracy. But the outcome is just one view or analysis of the situation, and could be dangerous to follow if taken in isolation. That being said, if enough of these
individual opinions build into a consensus, additional weight can be fed into a company’s model.

A second opinion based on independent analysis and insight can come from outside consulting advisers, a viewpoint especially important given the extra governance demands being placed on companies. However, these end markets are complex, often opaque. One question to ask: Does the adviser provide rigorous and advanced analysis that draws on multidisciplinary data and expertise to reflect our interconnected world? In short, the more telescopes and microscopes you have trained on the problem, the more likely the data is going to be verifiable, suited to your specific company and market, and with insights gathered from many points of view.

**Sea change ahead**

The arrival and acceleration of Big Data in shipping is starting to signal a sea change in how the industry and its customers plan for the future.

As forecasts become more accurate, shippers can run more productively (choosing ideal routes), operate more efficiently (using best-price fuel), and become more competitive (understanding what competitors are up to). For shipping customers, the information revolution helps them move product or raw materials from Point A to Point B in the quickest time possible, at the most cost-effective prices. And for maritime investors, Big Data reduces risk exposure and extends visibility into business operations, encouraging further investment.

And for the industry in general, data-driven insights into cycles and where the industry sits in them allow players to pursue their strategies with more confidence—whether it’s building or reducing capacity, turning to the spot market, or delaying or rerouting a shipment.

Big Data won’t end the industry’s cyclical nature or remove all the uncertainty that comes with geopolitical forces, such as oil embargoes. But it will allow players to look with more confidence into future events and act proactively to turn challenges into opportunities.

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On 30 April 2015, electric vehicle manufacturer Tesla announced that it would begin selling stationary lithium-ion battery systems intended for use in the electric power system. What does Tesla’s announcement tell us about where the grid energy storage industry is going and about the global outlook for battery storage?

By Andy Lubershane and Sam Wilkinson
ew electricity users realize, as they switch on the lights or the television, what a complex balancing act it takes to keep the electric power grid running. Supply and demand for electricity must be very closely matched in real time or the lights will go out. Recent developments in the power sector—most notably the steep decline in the cost of renewable electricity sources whose output is intermittent—will soon be exacerbating this long-standing operational challenge.

For decades, grid operators have had to manage their balancing act with limited tools, as storage technology was expensive and the system operator had little influence over real-time customer demand. Operators have historically had just one option for satisfying the technical mandate that supply must meet demand, as well as the legal mandate to keep the lights on: building more reserve power plants. Reserve capacity is needed on a short-term basis for what grid operators call “frequency regulation”—essentially the balancing of fluctuations of supply and demand. It is also needed on a longer-term basis to ensure that the grid has a sufficient margin of capacity for supply to satisfy peak demand each year.

The possibility of holding “inventory” that can be drawn down and replenished as needed to meet customer demand and other market requirements is what makes energy storage such an attractive prospect for providers. At present, however, the grid can be managed relatively cost-effectively as it always has been—without a sharp increase in storage capacity—even as intermittent renewable energy sources begin to penetrate the market. Broadly speaking, there are few power systems using renewables where current levels of wind and solar generation cannot be managed with existing grid resources. Even though the dramatic fall in the price of solar energy over the past decade has enabled electricity customers in some places to begin producing power at homes and businesses more cheaply than they can buy it from the grid, they still rely on the grid for backup when the sun is not shining.

With few exceptions the electric power system does not need storage. However, it would certainly benefit from a cost-effective storage solution across the grid (see figure, p74). Storage is also set to become more valuable in the decade to come owing to two key trends: an increasing reliance on renewables in established markets; and the increasing electrification of less developed countries and areas with weaker or non-existent centralized grid infrastructure. A crucial factor in how these trends play out will be, of course, the evolution of storage technology, particularly of batteries.

What batteries can offer

Until recently, the only significant sources of electricity storage on the grid have been large hydroelectric plants with pumps designed to reverse the flow of water, effectively storing electrical energy by converting it into potential energy. Currently thermal plants—and in a few cases, pumped hydro storage plants—are the global go-to option for incremental peaking-capacity needs.
However, the best sites have mostly been tapped in established power markets; in the United States, for example, no new “pumped hydro storage” has been installed in over a decade, while in Europe new developments have a long lead time, require huge investment, and face strong environmental and social opposition.

Meanwhile, a combination of policy support and niche economic opportunities has ushered in a wave of technology development focused on alternative storage systems, including electrochemical batteries. Some of the interest in batteries is driven by the fact that even though, as we have noted, existing grid resources are adequate for managing most wind and solar generation at current levels of penetration, grid constraints are already emerging as penetration increases. In several European markets, for example, grid operators have needed to curtail 2-3% of annual wind generation—meaning that they have put the brakes on wind turbines when the wind is blowing—because of the challenge of integrating all the power they generate into the grid; this percentage, moreover, is expected to increase with additional wind capacity.

Batteries as a means of energy storage, then, have a potential role in enabling power systems to continue pushing the boundaries of renewable energy generation and accelerating the electrification of poor, remote areas of the world. Other applications include serving whatever onsite customer storage needs eventually emerge in the marketplace, as well as managing the short- and long-term grid flexibility needs that exist even without wind and solar.

From a technical standpoint, most batteries are an extremely good fit for this last application—indeed, batteries have already become an economically viable option for it in some regions. In the PJM Interconnection in the United States, for example, where a sizable industrial load creates a high demand for frequency regulation, batteries are likely to be providing at least 150 megawatts (MW) for this purpose by the end of this year. In South Korea, the state-owned utility is funding an initiative to provide 500 MW of storage for frequency regulation by 2017.

Beyond these current niche applications, batteries are most valuable as an alternative source of peaking capacity, the standby resource that grid operators need to be prepared for when electricity demand hits its peak. Yet if they are to play a widespread role in established power systems, batteries will have to compete against the current conventional sources of peaking capacity (gas-fired power plants). Furthermore, the evolution of the regulatory framework will determine how batteries for peaking capacity will compete with demand-side management, which is at a relatively early

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While electric power systems currently do not need storage, a cost-effective storage solution, such as batteries, can provide concrete benefits across the electric grid.

Potential locations for batteries on the grid

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Source: IHS
stage of market development in many regions. Such considerations point to the need to understand the economics of battery storage to assess its viability for any of the applications for which it can be used.

The economics of battery storage

Li-ion batteries, like those Tesla is selling, are a family of battery chemistries distinguished by their high efficiency and energy density. These characteristics have made them the battery of choice so far from a performance standpoint, but not necessarily from a cost standpoint. Falling li-ion prices, however—epitomized by Tesla’s recent announcement—are now fueling intense price competition and challenging all other nascent energy storage technologies, including: sodium-sulfur batteries, currently the most widely deployed type on the grid; emerging “flow” batteries using a liquid electrolyte; and earlier-stage alternatives such as metal-air batteries and advanced compressed air storage (see figure, top right).

Three years ago, li-ion batteries intended for use on the grid were some of the most expensive storage units on the market, with a price over $1,000 per kilowatt-hour (kWh). Yet that cost has fallen rapidly due to cross-sector research and development and economies of scale, and li-ion has become the clear winner for consumer electronics and automotive applications (see figure, bottom right). While Tesla has not yet announced any of the specifications for its $250-per-kWh product, nor any information on its margins, that price demonstrates the progress the industry has made in the past few years alone.

But is this price low enough? From a utility cost-of-service perspective, there are some locations where Tesla’s prices would be low enough to compete with combustion turbines—in particular, densely populated, urban areas, which are a common source of demand for new peaking capacity in the United States, and where siting and building new thermal power plants or transmission lines is very challenging and expensive. Outside of those areas, however, Tesla’s prices are not yet low enough to compete.

Similarly, from a consumer perspective, there will likely be a small subset of residential customers willing to pay for a Tesla home-backup unit. However, those who simply want a reliable source of backup power at the lowest cost can still buy a small-scale diesel or natural gas generator for much less.

Despite these challenging economic fundamentals, a variety of government policies and the intricacies of certain electricity customer rate designs in the United States, Europe, and Japan are improving the economics for battery deployment, particularly at larger commercial and industrial customer sites. Both the German and Japanese governments, for example, are providing incentives for acquisition of small, behind-the-meter batteries. In the United States, the California Public Utilities Commission issued a mandate in October 2013 for the state’s three largest investor-owned utilities to add 1.3 gigawatts (GW) to their grids by 2020. The storage mandate highlights the potential scale of storage demand in the power sector relative to other major sources of battery demand (see figure p76).
Despite the obstacles facing battery suppliers such as Tesla, Panasonic, Samsung, and LG Chem in becoming widely competitive, the kinds of government policies and electricity rate designs described above are creating near-term opportunities for deployment. Most of these initial opportunities depend on installing batteries “behind-the-meter” in residential and commercial buildings. Li-ion’s high energy density enables the technology to be deployed at a distributed level—behind-the-meter as well as on the distribution network—where it can provide highly localized capacity benefits.

While some “early-adopter” customers in the United States may be motivated to buy Tesla’s residential products, there is little economic rationale for installing energy storage in US homes. However, there is a possible business case for residential energy storage in regions where the price utilities will pay customers for their excess solar generation is much lower than the “retail” price consumers pay for electricity from the grid.

One of the most extreme examples of this phenomenon is Germany, where the solar feed-in tariff currently pays residential system owners €0.12 per kWh versus a retail electricity rate of approximately €0.29 per kWh—potentially saving the customer €0.17 per kWh of solar electricity consumed rather than exported to the grid. Germany also happens to be the world’s largest solar market in terms of total installed capacity. As a result of these market and policy factors, approximately 100 MW of systems similar to Tesla’s Powerwall will have already been installed with small residential PV systems in Germany by the end of this year.

While the business case for this application is heavily reliant on government incentives and a growing desire from customers to reduce the amount of electricity they purchase from utilities after several years of steep price increases, falling battery prices will accelerate the development of this business model and help it become viable in an increasing number of regions. However, this model could be threatened by changes in grid interconnection rules for solar and storage systems—changes that are needed to protect the revenue that pays for the grid, which customers still rely on.

In the United States, Tesla is tapping into a different segment: commercial and industrial (C&I) buildings in California and New York/New Jersey, where electricity rate designs for the large C&I customers include very high “peak demand charges.” These charges are a function of the largest amount of power that the customer draws from the grid in the course of a billing cycle, providing an incentive for customers to smooth peaks in electricity usage. For example, Tesla has already announced plans to provide 4.8 megawatt-hours (MWh) of batteries to an Amazon data center in California, and has submitted over 70 MW of applications for incentives from California utilities for similar projects.

Several early-stage companies (including Stem and Green Charge Networks) as well as leading US residential and commercial solar developers (SolarCity and SunPower) are targeting this application and have developed “grid-ready” battery systems—which include a battery module, an inverter, control systems, interconnection equipment, and specialized dispatch algorithms—that can leverage a relatively small amount of energy storage to clip the peak for customers for whom this is a significant need, thereby saving the customer a substantial amount of money. These companies also offer “no up-front cost” solutions such as leases and shared savings agreements. Tesla’s close relationship with the US’ largest solar installer, SolarCity, which already has significant C&I customer channels, could help it accelerate its push into this market.
Developers have seized upon this business model not just in California but also in New York, where incentives are also available to make the economics more attractive. IHS expects this model to drive approximately 50 MW of commercial behind-the-meter installations in North America by the end of 2015. Falling prices and increased adoption in behind-the-meter sites are also enabling storage project developers to begin pioneering “distributed peaking plant” business models by aggregating many distributed battery units as a dispatchable peaking resource for grid operators.

Given that storage hardware—essentially batteries and inverters—is useless until integrated with the other components that go into creating an intelligent storage system, the downstream segment of the energy storage value chain is also attracting investment from a wide range of players, which shows a selection of companies currently active in the sector and their positions along the value chain (see figure above). Notable early entrants include established power equipment suppliers such as GE, S&C Electric, ABB, and Eaton, which have leveraged their existing power conversion technologies to develop utility-scale battery systems.

Globally, it is clear that grid battery technology has evolved beyond the demonstration stage to the early-commercialization stage of market maturity. Niche opportunities abound, in frequency regulation and in peak-shaving in very dense, urban locations. It is no surprise that the initial wave of commercial deployments is centered in regions with supportive policy, most notably California, Germany, Japan, and South Korea. If these early opportunities are sufficient to drive continued investment in scale and R&D, storage could emerge as a significant new resource for grid operators around the world. And the adoption of cost-effective storage technology will smooth the way for greater grid penetration of wind and solar energy in decades to come.

By Andy Lubershane, senior analyst, North America renewable power, IHS Energy; and Sam Wilkinson, research manager, solar & energy storage, IHS Technology

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Economic crisis averted

As of mid-July, the global economy appears to have sidestepped disaster, with Greece staying in the eurozone and the fallout from China’s stock market crash remaining modest, as evidenced by limited volatility in financial markets. China’s economy has stabilized and is expected to post 6.5% growth for the year. The US economy is expected to strengthen in the second half to 2.9%, while Europe’s growth is projected to be 1.5% for the year. The long-term deceleration of China’s economy and the drop in demand for raw materials has driven global commodity prices down to their lowest level so far this year. IHS expects motor vehicle output to grow by about 3% a year through the end of the decade as long-term growth slows. All figures are in real US dollars.

WHERE’S THE GROWTH?

Annual percentage growth rates of real GDP, capital investment, and output of motor vehicles, parts, and motocycles, 2015–19, of the 20 largest countries and regions ranked by share of world GDP.

1. USA
   - GDP: 2.8%
   - Capital investment: 4.8%
   - Automotive output: 3.8%

2. China
   - GDP: 6.6%
   - Capital investment: 5.3%
   - Automotive output: 5.5%

3. Other Europe *3
   - GDP: 1.9%
   - Capital investment: 2.3%
   - Automotive output: 4.1%

4. Japan
   - GDP: 1.0%
   - Capital investment: 1.8%
   - Automotive output: -1.9%

5. Germany
   - GDP: 1.9%
   - Capital investment: 3.2%
   - Automotive output: 1.3%

6. Other Asia-Pacific *6
   - GDP: 4.6%
   - Capital investment: 5.3%
   - Automotive output: 5.3%

7. United Kingdom
   - GDP: 2.5%
   - Capital investment: 4.3%
   - Automotive output: 1.5%

8. France
   - GDP: 1.3%
   - Capital investment: 1.7%
   - Automotive output: 2.2%

9. Middle East *9
   - GDP: 3.8%
   - Capital investment: 4.0%
   - Automotive output: 3.8%

10. Brazil
    - GDP: 1.7%
    - Capital investment: 2.7%
    - Automotive output: 1.8%

11. India
    - GDP: 8.1%
    - Capital investment: 8.6%
    - Automotive output: 8.5%

12. Other Latin America *11
    - GDP: 2.9%
    - Capital investment: 3.4%
    - Automotive output: 2.3%

13. Russia
    - GDP: 0.3%
    - Capital investment: -2.5%
    - Automotive output: -2.7%

14. Canada
    - GDP: 2.4%
    - Capital investment: 1.1%
    - Automotive output: -3.3%

15. Nordic region *15
    - GDP: 1.7%
    - Capital investment: 2.0%
    - Automotive output: 3.3%

16. Australia/New Zealand
    - GDP: 2.8%
    - Capital investment: 2.8%
    - Automotive output: -34.7%

17. South Korea
    - GDP: 3.3%
    - Capital investment: 3.2%
    - Automotive output: -0.5%

18. Mexico
    - GDP: 3.6%
    - Capital investment: 3.9%
    - Automotive output: 5.0%

19. Africa *19
    - GDP: 4.3%
    - Capital investment: 4.7%
    - Automotive output: 3.7%

20. Poland
    - GDP: 3.8%
    - Capital investment: 4.8%
    - Automotive output: 7.6%

*3: Austria, Belgium, Bulgaria, Czech Republic, Greece, Hungary, Ireland, Italy, Netherlands, Portugal, Romania, Slovakia, Spain, Switzerland, Turkey, Ukraine

*6: Bangladesh, Hong Kong, Indonesia, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam

*9: Bahrain, Egypt, Iran, Israel, Jordan, Kuwait, Qatar, Saudi Arabia, United Arab Emirates

*12: Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Honduras, Jamaica, Panama, Peru, Uruguay, Venezuela

*15: Denmark, Finland, Iceland, Norway, Sweden

*19: Cameroon, Kenya, Morocco, Nigeria, Senegal, South Africa, Tunisia, Zimbabwe
Economic crisis averted
As of mid-July, the global economy appears to have sidestepped disaster, with Greece staying in the eurozone and the fallout from China’s stock market crash remaining modest, as evidenced by limited volatility in financial markets. China’s economy has stabilized and is expected to post 6.5% growth for the year. The US economy is expected to strength in the second half to 2.9%, while Europe’s growth is projected to be 1.5% for the year. The long-term deceleration of China’s economy and the drop in demand for raw materials has driven global commodity prices down to their lowest level so far this year. IHS expects motor vehicle output to grow by about 3% a year through the end of the decade as long-term growth slows. All figures are in real US dollars.

OUTLOOK

GDP growth on the uptick
Annual percentage growth rate global real GDP, 2014–19

Capex growth will peak in 2017
Annual percentage growth rate global capital investment, 2014–19

Global motor vehicle market settles down for slower growth
Annual percentage growth rate for motor vehicles, parts, and motorcycles, 2009–19

WHERE’S THE GROWTH?

GDP Capital investment

Motor vehicles, parts, and motorcycles

2015 2019

2015 2019

2015 2019

$57.72 $65.30

$7.57 $3.31

$13.67 $16.15

$2.47 $0.39

$3.1 $3.70

Annual percentage growth rates of real GDP, capital investment, and output of motor vehicles, parts, and motorcycles, 2015–19, of the 20 largest countries and regions ranked by share of world GDP.
$60,000/day
Earnings in April of Very Large Crude Carriers plying the Middle East-Far East route, up from $10,000 a year ago

$606.7 million
US DoD FY2016 budget for cyber operations, up from $431.6 million in FY2015

20,000 TEU
Capacity of ships, in 20-foot-equivalent units, able to transit Suez vs. 13,000 TEU for the Panama Canal

40–60%
Range of price decline of 53 indexed commodities from their recent peaks—evidence of a fading commodity supercycle

$10.4 billion
First-year sales of hepatitis C cure Sovaldi, the most successful launch ever of a medicinal drug
$860 billion
Defense spending by NATO in 2015, down $206 billion from 2010

37%
Projected decline in global chemical capex, 2014 to 2019, driven by China’s slowing growth

81%
Margin in 2013 by which Chinese wages exceeded Thai wages

37%
Decline this year in global oil & gas upstream spending, compared to 2014

74%
Top 25 chip companies’ share of 2015 total global semiconductor revenue

350+
Number of vehicle configurations currently in the US automotive market
Managing risk in the post-supercycle era

All eyes are on commodity markets these days following the near-60% drop in oil prices and a 25% decline in non-oil commodity prices since mid-2014. With the commodity supercycle coming to an end, all sectors from energy, chemicals, and industrial manufacturing to technology, transportation, and finance face both opportunities and challenges ahead.

Depending on their positions within their supply chains, all businesses are feeling the pronounced effects of the end of the supercycle steaming its way through the global economy. Certain producers of commodities and raw materials are facing the brunt of the storm as prices tumble, while many semi-finished and finished goods manufacturers are realizing the benefits of lower materials prices as commodity-related price fluctuations work their way down the supply chain.

So, how are organizations adapting to this changing and uncertain environment? Looking upstream, energy operations hit hard by the price drops are turning to operational efficiency, cost optimization, and process improvement actions to cut costs, continue operating, and preserve margin. Firms are accelerating industry standardization to rationalize as well as optimize equipment and processes while reducing risk exposure and cost sub-optimization associated with proprietary standards. They’re also pursuing industry collaboration opportunities that accelerate equitable means for stakeholders to drive efficiencies, innovation, and sustainability. At the same time, companies are preparing for the “Big Crew Change,” where over half of the industry’s senior technical workers will exit the workforce and leave an ill-timed skills gap.

Moving downstream, lower commodity prices present cost-saving opportunities for purchasing managers, such as in the automotive market. Lower oil prices also leave more disposable income in consumers’ pockets, prompting some to return to market for new-vehicle purchases. Thus, an end to the commodity supercycle presents bottom- and top-line opportunities. The real question for automakers is how they can beat the competition and gain market share in an increasingly crowded landscape that IHS forecasts to grow by only 1.8% globally in 2015.

At IHS, we have the privilege of interacting with the majority of strategic planners, operations professionals, geologists, and engineers in the world. They count on IHS to provide the insight and analytics to help them make the toughest decisions imaginable—including those that help them navigate the uncertainties associated with the ending commodity supercycle.

The IHS Product Design business has the great fortune of supporting nearly half the world’s engineering and technical professionals. We help them accelerate innovation, solve problems, and improve time-to-market each day. Engineers need these capabilities more than ever as they confront these dynamic market conditions. And IHS is with them each step of the way toward engineering excellence.
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2015 IHS SPECTRUM Excellence Award Winners

IHS is proud to spotlight these organizations for using information, analytics, and expertise to make better decisions and achieve their business goals.

Airbus publishes 20-year forecast—Flying on Demand—confirms strong growth in commercial aviation markets

Airbus Defence and Space drives new growth strategies by providing stakeholders with global market forecasts

Airbus Defence and Space accelerates launcher research by up to 30% in a more and more competitive landscape

Autobytel’s network captures consumers that represent over 4% of all new-vehicle retail sales in 2014

Baker Hughes accurately forecasts falling oil prices to enable better strategic business decisions

Braskem Idesa builds advantage with bold strategy and largest petrochemical investment in Mexico in 30 years

IEC Electronics defuses supply chain risks and boosts operational efficiency to strengthen competitive edge

Texas Instruments enhances customer service by expanding its competitive cross-reference capability

Toray Industries America implements strategic road map to uncover new markets for aggressive growth by 2020

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