White Paper

The Natural Wealth of Nations: Transformation of Oil- and Gas-Producing Economies

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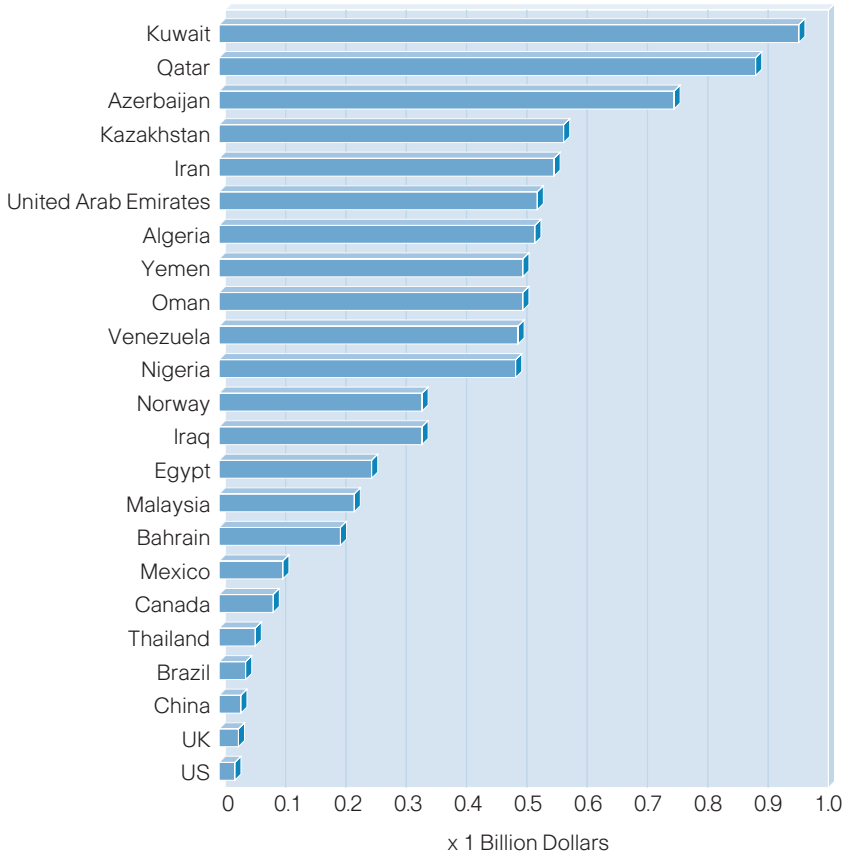
Introduction

As world demand for oil and gas increases, energy prices are rising. Globally, oil and gas will remain the energy source of choice for power generation and transportation to 2030 and beyond, according to the International Energy Agency. As demand continues to rise, oil- and gas-producing nations increasingly recognize the need to maximize the wealth and longevity of their critical energy assets through effective management. To achieve this, these economies need to build infrastructures that will create a sustainable base for efficient exploitation of their resources and, at the same time, allow for development of diversified economies that will ensure long-term prosperity.

Oil- and gas-producing countries have an opportunity to invest wealth derived from their natural resources in building sustainable, efficient, diversified economies, enabling them to make the most of their oil and gas assets far into the future (see Figure 1).

Figure 1. Natural Resource Wealth—Estimated Oil and Gas Revenue/Gross Domestic Product



Source: EIA Country Data; Cisco IBSG, 2007

Developing the Capability

In planning for social/political investments such as economic and infrastructure development, expansion of information and communication technologies (ICT) and the associated infrastructure (such as pervasive broadband capability) should be key priorities. The oil and gas industry is knowledge-intensive, and key resources for value creation, such as geoscientists and engineers, need to collaborate and communicate effectively to manage the reserves.

An effective ICT infrastructure provides a platform to build the skills required to manage oil and gas resources, together with the extensive fixed assets (plant and equipment) necessary to maintain the wealth-creation engine. ICT infrastructure also supports innovation, efficiency, and productivity. This creates an environment capable of nurturing economic diversification, because the ICT infrastructure required to support the industry can be the same infrastructure that provides the backbone for the diversifying economy.

Additionally, effective ICT infrastructure creates an environment that encourages inward investment because international companies investing in these countries expect to be able to use modern communications and IT capabilities in business (and at home and play)—not only for their people resident in the country, but for day-to-day operations and communications with the rest of the organization.

Yet ICT infrastructure alone is not sufficient to transform an emerging economy that derives its wealth from oil and gas. The longer-term goal is to create an oil and gas ecosystem, or cluster, with the momentum to sustain its own growth and foster the development of adjacent industries. To achieve this, a country must invest in people and education to develop and expand its intellectual and creative capacity. Developing the skills and technology in-country also helps attract expertise from abroad. Clustering helps support the profitable and sustainable development of oil and gas resources and the management of adjacent industries and infrastructure.

Once a cluster has been established, it tends to gain momentum in a self-reinforcing cycle. As one company's success attracts suppliers and skilled people, other companies begin to locate nearby to take advantage of these growing resources and capabilities. Knowledge spills over from one company to others as people change jobs and formal and ad-hoc partnerships are formed. Metcalfe's law, which states that the benefit of the network grows exponentially, is a powerful driver here. (In other words, the more connections that are made, the greater the benefit to all.) More linkages between firms and institutions like colleges and universities form spontaneously and spawn additional growth.

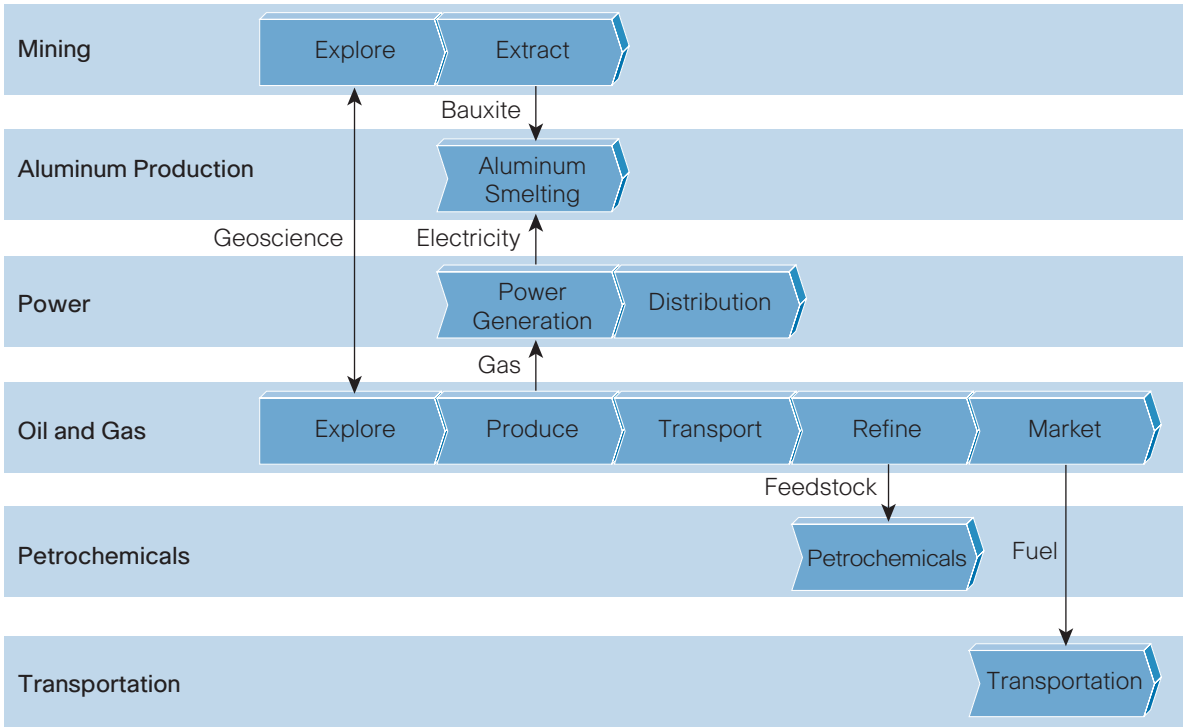
Once the economic cluster or ecosystem is established, it opens the opportunity eventually to export knowledge and expertise across industries and geographies. For example, in oil and gas ecosystems such as Aberdeen, Scotland and Stavanger, Norway, there is "cluster expertise" in designing facilities for the harsh environmental conditions prevalent in the North Sea. This specialized knowledge has potential uses in other areas such as the Gulf of Mexico or West Africa.

Several critical factors are required to foster the emergence of clusters. Foremost is access to a strong, diverse, and tech-savvy talent pool. Access to these human assets becomes critical in a company's decision to locate within a cluster. Eventually, clusters around the world find themselves "competing on creativity," as has happened with the high-technology clusters. Silicon Valley, the first high-technology cluster, soon found itself competing both for customers and for skilled employees with other (admittedly smaller) clusters such as Boston's Route 128 and clusters in Japan and Taiwan. Within the oil and gas industry, ecosystem clusters in Houston, Aberdeen, and Stavanger serve as useful examples.

Also required for cluster development is the presence of established "tenant" companies with global reach, such as the international oil companies (IOCs), service and supply companies, or aspiring national oil companies (NOCs). These companies will be influential in attracting knowledgeable people, risk-tolerant venture capital, and institutional investors. The concentration of oil, gas, and energy companies in Houston and, more recently, in Calgary, Canada, are a testament to this requirement.

For a cluster to develop, there also must be a sustained partnership among industry, the government, and private investors. The government must develop policies, including strategies and incentives that encourage an environment where the oil and gas industries, and appropriate industries with linked value chains (such as refining, chemicals, and power generation), can thrive (see Figure 2).

Figure 2. Value Chains Linked with Oil and Gas



Source: Cisco IBSG, 2007

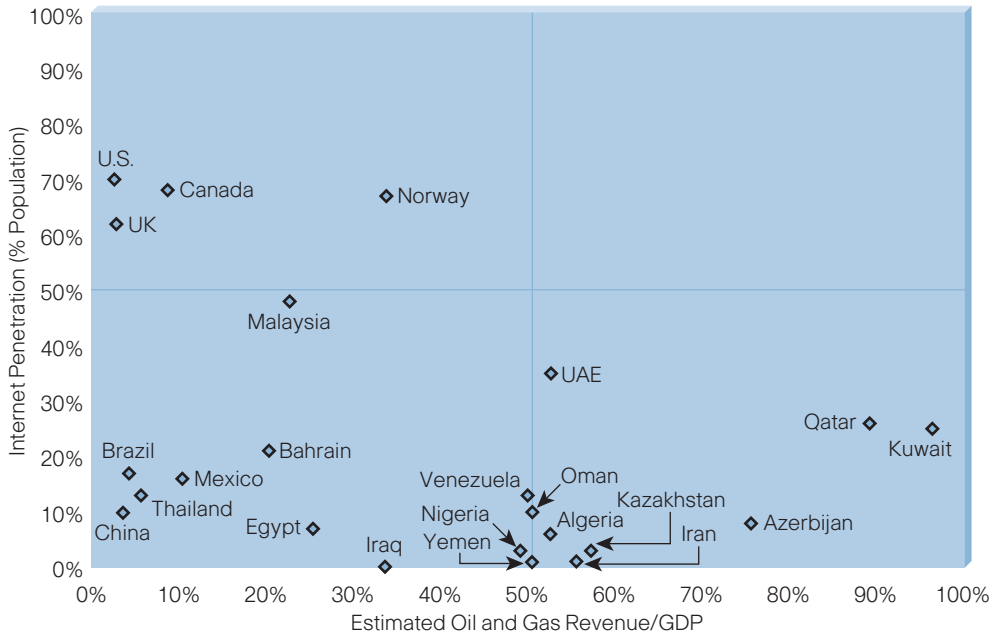
The key to facilitating development and successful growth of a cluster is understanding the relationships among accessing the right skills, attracting investment, creating the right culture, and using technology to mediate among these intersecting value chains. Increasingly, ICT creates synergies among these key elements to create a thriving cluster economy.

The government can use revenues derived from oil and gas resources to fund development of the technology infrastructure, encourage research and development, facilitate linkages among intersecting value chains, and drive other initiatives such as tax incentives to support relocation of business activity. Between industry and government, there must also be a joint effort to create a culture that fosters the innovation and collaboration that fuels cluster growth.

ICT is the single most critical facilitator in cluster growth because today's technology has developed to the point where it can facilitate ubiquitous sharing of data and expertise, independent of location, through technologies such as mobile communications—supported by wireless, broadband infrastructure, and so forth. Technology, together with a vibrant telecommunications capability, can provide a platform for the collaboration and communication that are the basis for cluster formation and growth.

In today's oil and gas economies, a portion of the wealth generated from oil and gas assets has been spent on roads, education, and other social benefits. Using Internet penetration as a proxy, it can be surmised that typically little of this has been spent on building ICT (broadband) infrastructure (see Figure 3.)

Figure 3. Internet Penetration Versus Estimated Oil and Gas Revenue/GDP



Source: Cisco IBSG, 2007

Building a society that can create and sustain economic diversity requires an ICT infrastructure to facilitate communications and data sharing. For instance, the Kingdom of Saudi Arabia has recognized this, and is investing aggressively in building "Economic Cities," communities that are planned and built from the ground up with integrated industry, transportation, communications, social networking, and public sector activities—all connected via an intelligent network.

Going forward, other oil- and gas-producing nations should similarly consider investing their wealth in upgrading infrastructure to create a platform for long-term growth. This long-term growth is made possible only by sharing knowledge among different firms and organizations—facilitated by the ubiquitous, collaborative nature of the ICT infrastructure. So there is a virtuous cycle created by the investment of oil- and gas-derived wealth in ICT, the ability of the technology to faciliate collaboration and innovation, and the resulting, more effective exploitation of oil and gas resources.

Policy Implications

Government plays a leading role in the development of an ecosystem that will sustain the oil and gas cluster and support creation of diverse economies. National policies that encourage investment in the ICT infrastructure and development of an innovation culture will have an impact at every level. The governments of oil and gas economies can accelerate development by providing infrastructure and knowledge assets. Even more important, government can play a key role in coordination and consensus-building between companies and organizations that in the past may not have acted in concert. For example, in Norway, a government-sponsored initiative called OG21—Oil and Gas for the 21st Century—has created a thriving and innovative dialogue by bringing all parties to the table: "The partnering between the Government, the oil companies (Norwegian as well as international), the supply industry, the research institutions, and academia has made Norway a good environment for technological developments. The companies have worked together to develop, test, and implement new technological solutions in various projects on the NCS. The result has been significant value creation for the Norwegian society."[1] (For more on Norway's oil and gas initiative, see the sidebar "Best Practice: Norway's OG21.")

Both public and private industry policy must recognize the importance of creating linkages among the different elements of the ecosystem. Merely putting an ICT infrastructure in place will not create connections among the different pieces of the puzzle—particularly the connection between the research community and the clusters, which is key. This is where culture, social factors, and the building of institutions based on innovation and cross-fertilization of ideas and information come powerfully into play. The human factors make it all work, where there is a willingness to create linkages and share data and a culture where creativity and innovation are part of the value structure. Interconnected voice, data, video, and mobile connectivity make it possible for people to do what they need to do, anywhere and anytime.

1. *OG21-Oil and Gas in the 21st Century: Norway's Technology Strategy for Value Creation on the NCS and Enhanced Competitiveness in the Oil and Gas Industry*, November 2005.

Governments also need to encourage commitment through foreign direct investment. To achieve this, governments must exert "pull" on investor companies to attract their investment, knowledge, and skills. Initially, companies are attracted by the fundamental business opportunity represented by the presence of oil and gas reserves; to make a long-term commitment, these firms must see that there is a serious, ongoing effort to build infrastructure to sustain cluster growth. The investing companies need to see a good, long-term business opportunity, an opportunity to gain competitive advantage, and the ability and willingness of the government to protect their investments. Crucially, there should be evidence that the establishing culture respects intellectual property rights. A country whose government tolerates piracy of intellectual property will not be able to attract long-term foreign investors and committed business partners. Knowledge is not a free "good"; it is always obtained at a price. Those who have invested in the development and acquisition of knowledge want a return on their investment.

Governments can create an environment that nurtures cluster development, as has happened in Aberdeen through the activities of government-supported bodies such as Scottish Enterprise. With North Sea oil in decline, both the Scots and Norwegians want to protect and expand their existing ecosystems. Scottish Enterprise is expanding its geographic (export) and building capabilities in adjacent industries. Norway is working through its ambitious plans for OG21, which was established to assure that Norway's hydrocarbon reserves will last profitably for the next 100 years, even as these reserves are increasingly found in some of the most forbidding environments on earth.

A significant part of the OG21 initiative involved the development of a permanent, national technology strategy and the public funding of petroleum research. ICT is critical in both instances. A recent study by the Norwegian Oil Industry Association (OLF) details the deployment of "integrated operations" to increase the value of reserves on the Norwegian Shelf. Integrated operations is defined as "The use of information technology to change work processes to reach better decisions, remote-control equipment and processes, and to move functions and personnel onshore." OLF reports that the Norwegian oil industry is deploying integrated operations to:

- Increase production by using remote monitoring devices, dynamic simulation of processes and production, and analytical tools to extract information from operating data, while providing continuous onshore support from specialists.
- Increase reserves by collecting consistent production and reservoir data, creating accurate reservoir models, and by using real-time reservoir monitoring and management.
- Reduce operating and maintenance costs through systematic maintenance programs; transferral of administrative, surveillance, management, and reviewing activities onshore; and improved efficiency for monitoring and maintenance functions.

- Reduce drilling costs with fewer sidetracks and more accurate drilling, real-time optimization of path and drilling processes, and by keeping specialists and service personnel onshore as much as possible, allowing them to provide remote support.[2]

Managing the Energy Ecosystem

As globalization continues, so has the importance of interlinked industrial clusters and networks. Strengthening cluster growth requires an understanding of the oil and gas ecosystem: the interdependence of IOCs, NOCs, service and supply companies that support IOCs and NOCs, governments, educational and research institutions, the available labor pool, and the cultural climate.

For access to reserves and in-country expertise, IOCs rely on NOCs and governmental owners of mineral wealth. In return, IOCs pay fees, taxes and royalties, and provide access to global resources, including specialized knowledge. Service and supply companies support both IOCs and NOCs with goods and services that these companies would otherwise go to the expense of developing themselves, and thus are an indispensable link in the value chain.

This ecosystem is supported by educational and research institutions providing a skilled labor force and research and development. Again, these institutions can exist only in a culture that values education and understands education's role in maximizing a country's wealth.

Maximizing Oil and Gas Wealth

Carefully managing the source of the wealth to build a growing cluster is essential; it is the engine that drives growth, stability, and economic diversity. Increasingly, this is where ICT is becoming prominent. The ability to exploit and manage these resources is realized when the oilfield itself becomes truly digitized, and oil and gas companies virtualize and deploy an intelligent network to instigate a true sense-and-respond capability. This has demonstrable business value; the OLF study mentioned above concludes that integrated operations in the Norwegian oil industry represent a potential value of US$41.3 billion, at a cost of US$4.1 billion, over the next 15 years. On this evidence, it is evident that integrating operations through the connected oilfield and virtualizing the oil company will be prerequisites for extracting this potential value.

The Promise of the Connected Oilfield

As demand increases, the oil and gas industry needs to address exploitation of reserves that are more difficult or more costly to access, such as the Canadian oil sands or most deepwater developments. This invariably will have an economic impact that is most effectively addressed by digitizing the oilfield itself. Better usage of these assets is achieved by digitizing plant, equipment, and workflows so that data can be more efficiently captured and analyzed. This allows for better-informed and more timely decison making, as well as improved execution. It also gives organizations enhanced ability to respond to unplanned or emergency events, resulting in greater

2. *Potential Value of Integrated Operations on the Norwegian Shelf*, Norwegian Oil Industry Association (OLF), April 2006.

production and recovery rates. Ultimately, this resonates at the bottom line in improved cash flow and overall value.

For example, down-hole sensors can be used to access live data in remote locations. This data can be transmitted in real time to reservoir and production engineers, who can model performance and develop different scenarios for production management. Or, depending on the data, immediate action may be needed, such as adjusting choke valves to moderate or shift production from one well to another.

As a consequence of connecting the oilfield, personnel at remote locations, such as the well site, will have real-time access not only to the company's data, but also to experts anywhere in the world who possess specialized knowledge and skills. Ultimately, managers will know exactly what is happening in remote locations, driving business decisions that impact the exploration and development cycle.

Virtualizing the Oil Company

Responding to the aging workforce and the need to replicate key skills and capabilities in remote locations across the world, IOCs and service and supply companies will increasingly need to virtualize their capabilities and interact more effectively with all of the ecosystem players and stakeholders. Linking this virtual organization with the information workplace will be critical, as will the required organizational transformations.

The virtual oil company minimizes or eliminates the obstacles created by location, distance, and time, becoming an "anywhere, anytime" operation. Workers confronted with a problem in a remote African location can contact an expert in Houston and share charts, graphs, and/or video to help explain the situation. Sensors down-hole in the Arctic can transmit real-time information to headquarters in Stavanger, Norway, allowing managers to collect and analyze data needed to make critical decisions about production.

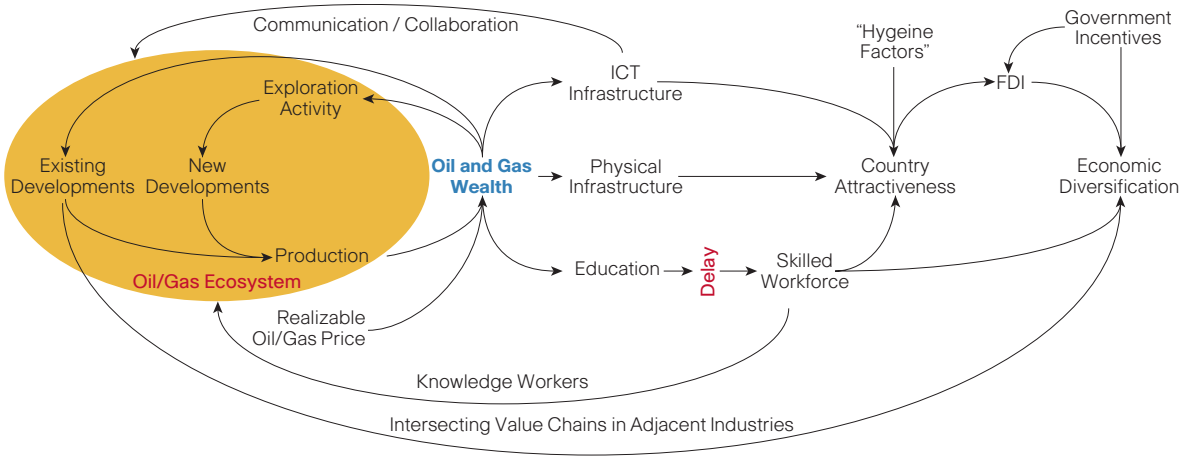
The virtual oil company also fosters collaboration among various players in the value chain, including government and research institutions, which benefit from the creativity and innovation that collaboration can engender. Rapid sharing of information allows the virtual oil company to make faster, better-informed business decisions.

The enabler of the virtual oil company is the information and communications network. The network ties together all the disparate elements of the company, no matter how remote, providing real-time access to people, data, and processes around the world.

Uses of Funds Derived from Oil and Gas

Oil- and gas-based economies have an opportunity to use the wealth derived from mineral assets to create societies capable of sustaining growth and diversity, with infrastructure and education taking priority, as illustrated in Figure 4. Infrastructure will provide the platform for linkages across the oil and gas community, fostering creativity and innovation. Education will help to create an environment where innovation can take place, and will also provide the labor pool so desperately needed by an industry whose specialized knowledge and talent are currently dwindling instead of growing.

Figure 4. Source and Use of Oil- and Gas-Derived Funds



Source: Cisco IBSG, 2007

By creating an ICT infrastructure, educational and research institutions become connected to community and industry. Connected cities become part of the network, providing access to data and enabling collaboration and cooperation among communities, companies, institutions, and government.

When the workforce becomes connected, even while mobile or in remote locations, and manufacturing and production are tightly tied to business analysis and decision making, the benefits become tangible and quantifiable.

Conclusion

World demand for oil and gas is growing rapidly, primarily due to increased consumption on the part of emerging industrial economies such as China and India. This has resulted in higher prices for oil and gas throughout most of the world. The majority of the world's oil and gas reserves are located in emerging economies that now have the opportunity to invest further in the development of technologies and infrastructures that would enable them to exploit their mineral wealth efficiently, while providing a platform for economic diversification.

Creation and management of industry ecosystems or clusters is critical to the success of these efforts. Development of these clusters requires collaboration among industry, government, and research and educational institutions, and the establishment of a culture of innovation and creativity. This, in turn, requires communication among industry sectors and their associated ecosystems, fostering the sharing of knowledge and ideas, and encouraging innovation.

To achieve this, it is neccessary to invest in a robust, scalable ICT infrastructure to create and maintain communication and collaboration among all sectors of the oil and gas ecosystem. By supporting the connected oilfield and the virtualization of oil and gas companies, ICT infrastructure will also enable the oil and gas industry to exploit reserves most effectively and gain access to increasingly scarce, specialized knowledge that may not reside in-country. Technology is now capable of creating anywhere, anytime connections among individuals and organizations that have never before been possible. This collaboration allows rapid consensus and decision making, both on strategic issues and real-time, critical situations. ICT infrastructure allows linkages between different elements of the value chain and makes the entire cluster system possible.

Countries with sustainable oil and gas wealth have the opportunity to use this bounty to diversify and sustain their economies. ICT—and specifically the intelligent network—is the key enabler of economic growth and diversity. These technologies, combined with a skilled workforce, will sustain the oil and gas wealth-creation engine, and at the same time provide the environment for collaboration and innovation that is critical to economic success.

Best Practice: Norway's OG21

Norway is the world's third-largest exporter of oil and gas, and the petroleum sector is the country's leading industry. Recognizing that reserves were increasingly difficult and expensive to develop while world demand was growing quickly, a partnership was formed in 2001 among the government, the oil and gas industry, service and supply companies, research institutions, and academia. The objective was to assure that Norway would create maximum value for society from the exploitation of hydrocarbon resources on the Continental Shelf: "The industry provides more than 75,000 direct jobs. The industry's activities have a large indirect impact on employment in many parts of the country, and makes significant contributions to the development of the Norwegian welfare government."[3] With the assistance of research and development grants from the government, Norwegian companies are working together with researchers and educators to create a plan to sustain oil and gas growth into the future.

A critical element of the plan involves using technology to help convert non-conventional resources into reserves, and exploiting reserves in difficult and/or dangerous

3. *OG21-Oil and Gas in the 21st Century: Norway's Technology Strategy for Value Creation on the NCS and Enhanced Competitiveness in the Oil and Gas Industry*, November 2005.

locations such as ultra-deepwater, arctic/sub-ice, and environmentally sensitive areas. To exploit these reserves, Norway is investing heavily in a complex technology infrastructure. The OLF study reports that the Norwegian oil and gas industry will invest the equivalent of US$4.1 billion in developing "integrated operations" over the next 15 years, with a potential value of US$41.3 billion.[4]

Technology has enabled Norway's oil and gas industry to integrate operations, increase collaboration, and improve decision making due to the ability to acquire and analyze large amounts of data from the field—even when the "field" is deep under ice or located at depth on the Norwegian Continental Shelf. Companies are now able to practice real-time reservoir and production management. Increased integration and collaboration have also led to new and more productive relationships within the Norwegian cluster of companies and institutions. As the OG21 charter says, "The establishment of a national strategy for research and development (OG21) in 2001 has been a success. The initiative has ensured that R&D efforts are focused on the most relevant areas to secure future value creation from the petroleum sector. The oil industry has responded positively to the Ministry of Petroleum and Energy's invitation to work together under a common, permanent national technology strategy. The aim has been to align all stakeholders behind the OG21 strategy and turn it into reality. The collaboration has resulted in a more coordinated approach to R&D."[5]

4. Ibid.
5. Ibid.

Notes:

More Information

The Cisco Internet Business Solutions Group (IBSG), the global strategic consulting arm of Cisco, helps Global Fortune 500 companies and public organizations transform the way they do business—first by designing innovative business processes, and then by integrating advanced technologies into visionary roadmaps that improve customer experience and revenue growth.

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