



cutting through complexity

KPMG GLOBAL ENERGY INSTITUTE

Unlocking the supply chain for LNG project success

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LNG report series

Contents

Overview	02
Introduction	03
New LNG supply chain challenges	07
Why is the supply chain so important to LNG?	09
10 ways to improve the LNG supply chain	11
Managing supply chain as part of Enterprise Risk	25
Supply chain innovations	27
Conclusion	28
Key actions to help improve supply chain performance	30
KPMG Global LNG Advisory Competitive Advantage	31
Further LNG Insights	32
KPMG Global Energy Centers	33

Overview

This report is one of a series providing an overview of the developments and challenges that the liquefied natural gas (LNG) industry is facing during its unprecedented wave of expansion. Lower oil and gas prices, along with upcoming projects facing tough conditions, make timely and cost effective project delivery and operations more important than ever.

Optimizing the supply chain, both during construction and operations, is key to reducing costs and speeding time to market for new LNG export projects. KPMG identifies 10 ways to improve the LNG project supply chain, outlined in this report.

This is the third in a series of LNG reports that provides deeper insights on improving project economics and certainty through better project management, cost transparency, governance, jurisdiction engagement, stakeholders and opportunity selection.

Hilda Mulock Houwer

Partner and Global Advisory Leader
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With 23 years of consulting and auditing experience in the oil and gas, energy and mining industries, Hilda Mulock Houwer provides advisory services across the entire oil and gas value chain, from strategy development to strategy implementation. Hilda's extensive experience includes operational excellence, process transformation, procurement, change management and financial process redesign.

Introduction

“We’re taking advantage of spare capacity in the supply chain.”

John Watson, CEO Chevron,
January 2015



Global spending on LNG facilities will rise by **88%** in the 5 years to 2019, with **US\$193 billion** spent on liquefaction and shipping.

How do you build an LNG project with a footprint that spans an area larger than the entire UK? Or in an area 2,000 kilometers from the nearest big urban area, itself the most isolated major city in the world? Or invest twice an African country’s GDP in its first LNG plant? How do you effectively support operations on a first class nature reserve island with stringent quarantine rules? Or construct an expansive plant in a mountainous area – with barely enough room to lay down the components?

Combine these challenges with lower oil and gas prices, and it’s clear the economics of new LNG export projects will be under more pressure than ever. “We will...actively pursue cost reductions throughout our supply chain in order to lower overall outlays,” as Chevron CEO, John Watson, noted; 27 percent of Chevron’s upstream capital expenditure in 2015 would be on LNG, notably completing the giant Gorgon and Wheatstone projects in Australia.

The focus of this paper is on the supply chain required to build and operate LNG projects. The supply chain of LNG itself to the end-consumer is a separate topic. Liquefaction plants and their associated upstream assets need a considerable and continuous flow of capital goods, materials and services, ranging from the routine to the highly specialized and critical.

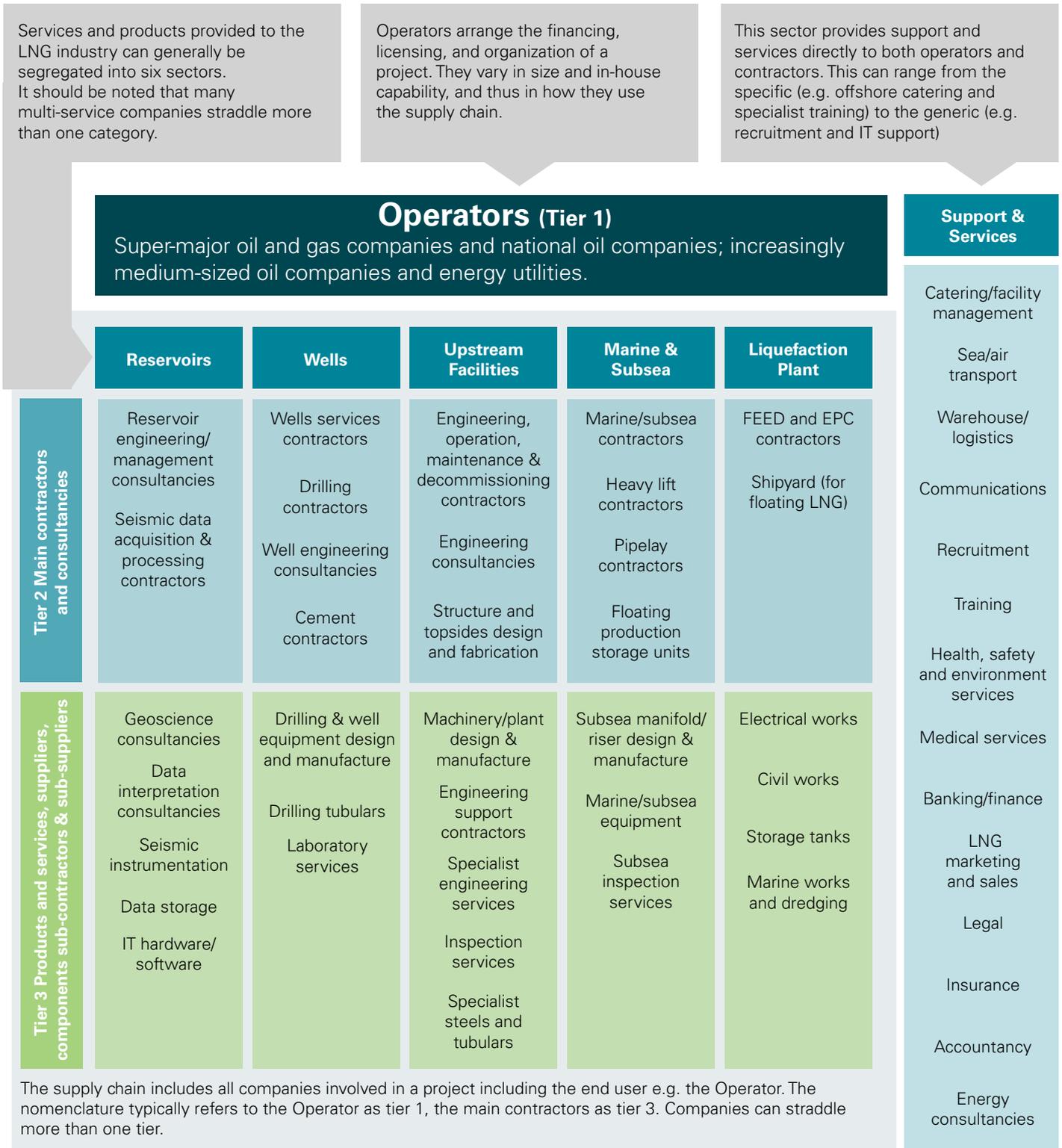
Once in operation, the plant requires a steady stream of hydrocarbons, delivered by pipeline possibly from fields a significant distance away; power, possibly sourced from off-site; a wide range of consumables and spare parts; and operations and maintenance staff. In remote locations or offshore, staff will usually rotate to the project location. In a few places, such as the United States (US) Gulf Coast, many may live nearby.

Managing supply chain means ensuring LNG projects get the materials and the people they need to be built and to operate efficiently, on time, in the right order and condition, safely and yet at the lowest possible price. Such management is essential to reduce costs to realistic levels, to achieve acceptable financial returns. In turn, showing that such major savings can be achieved will be essential for giving all stakeholders the confidence to press ahead with the next wave of major LNG plants.

Despite lower oil and LNG prices over the past 6 months, forecast LNG spending remains strong. Industry consultants Douglas-Westwood have predicted that global spending on LNG facilities will rise by 88 percent in the 5 years to 2019, with US\$193 billion spent on liquefaction and shipping. The focus of spending is shifting from Australasia to North America (US and Canada) and East Africa.¹

¹ Douglas Westwood (December 2014) ‘World LNG Market Forecast 2015-2019’

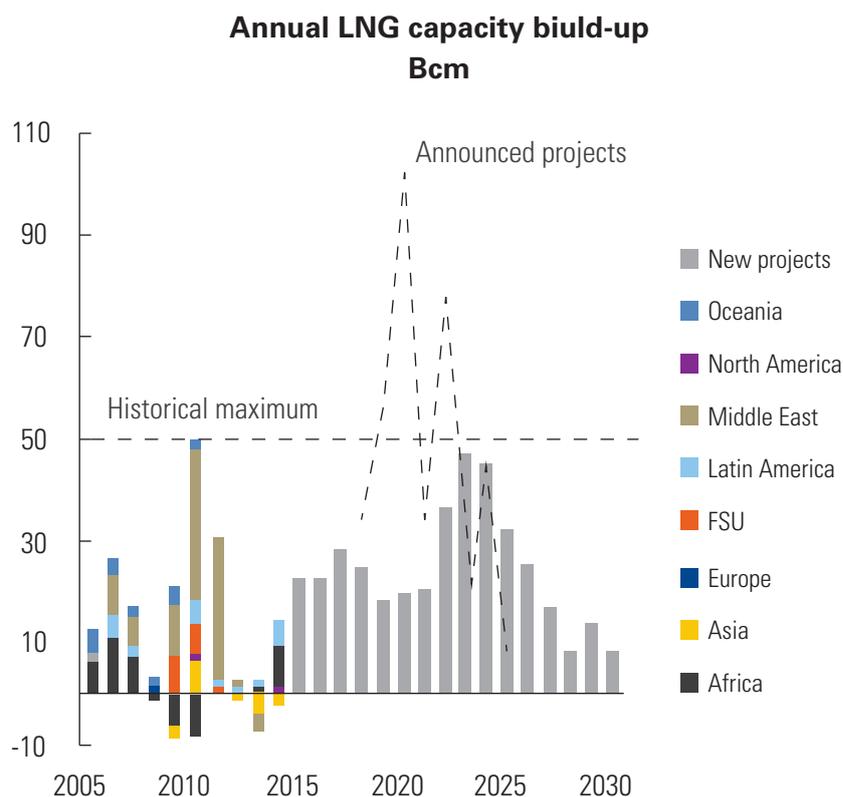
Figure 1: LNG supply chain categories and activities



Source: Oil & Gas, UK

“Companies cannot control global LNG prices – but they can have some control over their supply chain costs.”

Figure 2: Proposed new LNG plants represent an unprecedented wave of supply – and hence strain on the supply chain²



Source: Oil & Gas, UK

Concentrations of new projects – in Western Canada or East Africa, for example – could encounter supply chain bottlenecks (as experienced in Australia over the last 5 years) – even if the global background is slack. Most importantly, LNG proponents cannot simply wait passively for the industry cycle to do their work for

them. Companies cannot control global LNG prices – but they can have some control over their supply chain costs.

The companies that can recast the supply chain now will be best placed both to deliver their existing projects successfully, and to launch new ones ahead of the competition.

² Source: Statoil, 'LNG – Clean Energy from the Arctic to Asia', 30th September 2014



New LNG supply chain challenges



Jonathan Smith

Partner, Energy and Natural Resources
Oil and Gas Sector
Leader
KPMG Australia

Jonathan Smith brings over 25 years of experience in systems and process improvement. He specializes in assisting finance leaders in capital intensive industries on performance improvement of finance operations through CFO advisory, financial transformation and cost optimization/transparency. Jonathan has published on the role of the CFO in the development of corporate strategy, cost optimization and developing a cost culture in LNG/CSG projects.

The recent boom in LNG construction could see global output almost doubling its 2012 level of 250 million tonnes per year (Mtpa) by 2030. Roughly 60 Mtpa of this are currently being added by Australia.

Developers and their shareholders, however, have become increasingly frustrated with underestimated budgets and subsequent blow-outs and slow time to market. Rising labor costs, workforce activism, community opposition, local content requirements, complex environmental approvals, infrastructure challenges related to the difficulty of construction in remote locations, and unfavorable exchange rate movements have all contributed to cost over-runs.

Construction costs, usually the largest single component, run at 30 percent of total project costs; however projects in Australia have seen this rising to 50 to 60 percent. From 2000 to 2013, average capital costs of liquefaction plants rose from US\$300 per tonne per year to US\$1,200.³ For the full project, including upstream gas production, this figure can reach US\$3,500 per tonne per year in some Australian projects. The complexity and size of these projects strain the capacity of even the most experienced companies.

For instance, the major LNG projects off Australia's north-west coast are 2,000 kilometers from Perth, already

the most isolated major city in the world. With its upstream onshore gas supply, Queensland Curtis LNG spreads over an area larger than the entire mainland UK. Mozambique, with a GDP of US\$15 billion, will potentially attract investments of US\$30 billion to build 20 Mtpa of LNG capacity – and that is just the first phase.

As a key locus of LNG supply and demand, Asia Pacific (ASPAC) is a geographically huge and diverse region. Moreover, the supply chain to LNG plants comprises many components. Nonetheless, ASPAC's energy and natural resources (ENR) supply chain is generally considered underdeveloped and high cost.⁴

Some recent LNG and oil projects, in non-traditional locations, have had severe problems during start-up, requiring lengthy maintenance and rework. As Jonathan Smith, Partner, Energy & Natural Resources and Oil and Gas Sector Leader, KPMG Australia notes, "The supply chain issues have been a result of underestimating the complexity and scale of these mega projects. We are still yet to see how these supply chains will perform once these projects go beyond first gas. One thing for certain is there is still a great deal of work to be done to optimize them as little data exists at this stage."

By

2030

Global LNG construction could see global output almost doubling its 2012 level of **250 million tonnes** per year (Mtpa) by 2030. Roughly 60 Mtpa of this are currently being added by Australia.



³ B. Songhurst (February 2014) 'LNG Plant Cost Escalation' Oxford Institute for Energy Studies

⁴ 'Future of procurement in Asia Pacific: Keeping pace with change in the Energy and Natural Resources Sector', KPMG Global Energy Institute, 2015

Why is the supply chain so important to LNG?

Good supply chain management is, of course, important to any energy industry project. Why is it particularly vital to LNG? There are three main reasons.

- 1) Large and complicated:** LNG projects are particularly massive undertakings with thousands of construction workers on site during project implementation.⁵ Other than mining and dams, few other such large construction projects are undertaken outside industrialized areas.
- 2) Challenging locations:** The new wave of LNG projects are mostly in challenging locations – remote from traditional industry supply bases, often remote in absolute terms from any population centers, and sometimes in tough terrain that may also be environmentally or politically sensitive.
- 3) Cumulative impacts:** Multiple projects are being constructed in contiguous locations, putting stress on local workforces and suppliers, and leading to sharply rising costs.

The supply of hydrocarbons for processing and liquefaction is at the heart of any LNG project, and can be considered a critical part of the operational phase (though not construction phase). LNG projects may be vertically-integrated: in this case, a single venture encompasses the upstream supply (gas fields), a pipeline, the liquefaction plant and the marine terminal. The supply chain has to provide equipment, consumables and personnel to each segment of the project, in quantity and schedule, which may be in far-flung locations. In this case, the supply of gas to the liquefaction plant itself is within the control of the joint venture. This is the most common model worldwide, as in most projects in Western Australia, Russia, Norway and elsewhere. In some cases, as in Nigeria, Qatar and Angola, the upstream gas suppliers are a different, but closely-related joint venture.

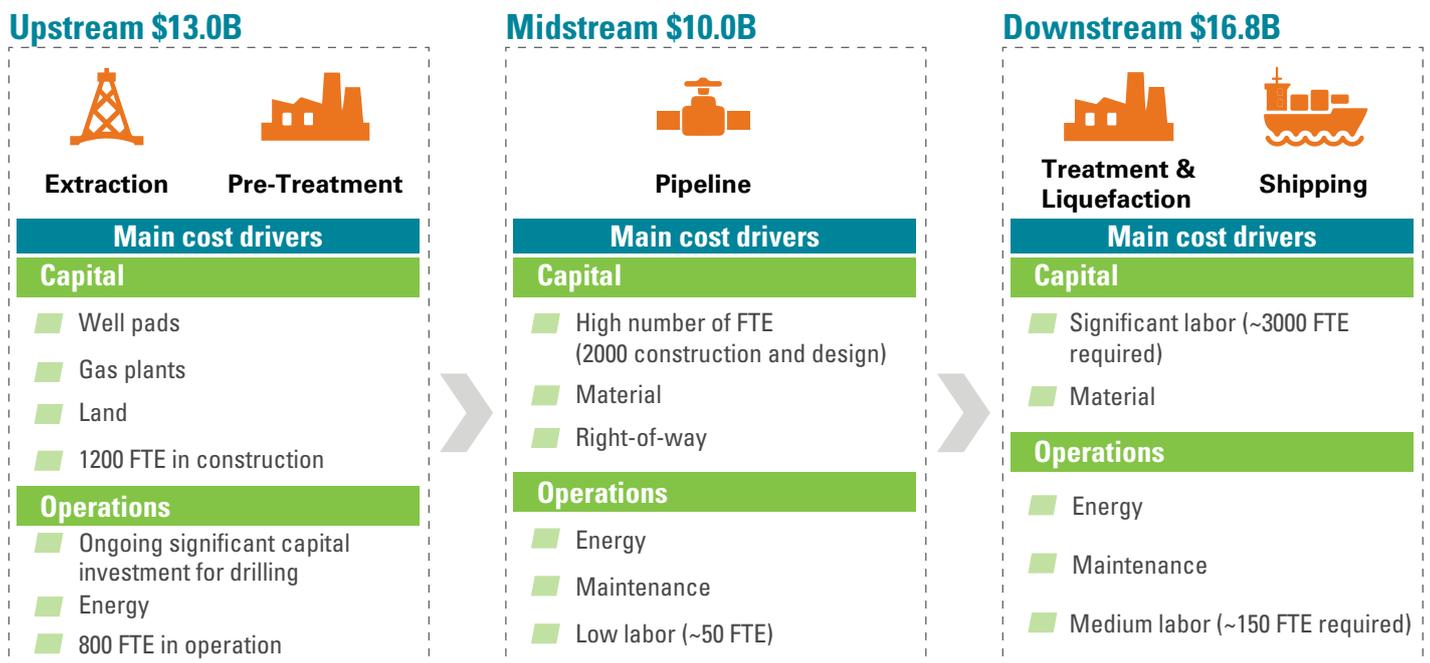
Or liquefaction plants may acquire gas directly from the grid, the proposed model for US Gulf Coast projects such as Cheniere’s Corpus Christi facility or

Freeport LNG. In this case, the relevant supply chain includes construction (or conversion from import to export) and operation of the liquefaction plant, and reliable supply of gas feedstock in the right quantity and specification. However, as the case of the ELNG and SEGAS LNG plants in Egypt shows, this model can be vulnerable to upstream supply problems.

In the case of floating LNG (FLNG) plants, such as Shell’s Prelude in Australia or Petronas’ PFLNG1 & 2, no pipeline is required as the production facilities are moored directly over the field itself, as noted in KPMG’s report ‘Floating LNG: Revolution and evolution for the global industry?’.

The current trend for modularization may see major components constructed in other sites – often, other continents – and brought to the plant location for assembly. FLNG takes this to an extreme, with the entire vessel and its liquefaction process constructed in a shipyard and sailed out to the field.

Figure 4 Supply chain elements in a vertically-integrated LNG project



⁵ Major new refineries, petrochemical plants or gas-to-liquids plants are similarly large, but usually in established industrial sites.

Interview with Patricia Roberts, Director, LNG-Worldwide Ltd.

What are the main current issues in LNG supply chains?

A: At the moment, we've got an unprecedented number of new global LNG projects, 135 million tonnes, under construction. The problems are the sheer number of projects in one country, limited resources, and cost escalation, in both material costs and also the cost of labor. Australia has suffered the most from cost escalation. At the moment, it is difficult to see anything that will break these chronic problems.

Cutting costs is one thing that everyone aspires to do, because they can control costs more than they can control downstream prices. We can't rely on market prices continually inflating to cover the supply costs, so some major correction must happen.

Do you think a slowdown in new projects will feed through into reductions in supply chain costs?

A: The EPC contractors have a fairly full order book over the next few years, with what is under construction at the moment, and front-end engineering design (FEED). It's difficult to see what would break that cycle.

What innovations are you seeing in supply chains to control those costs?

A: A lot of the easy projects have been done. We do talk about more remote locations, more environmental and stringent terms and conditions for developing these projects. Historically, many LNG ships were built in the Korean, Japanese yards; there's a growing trend now for Chinese yards, so its unfamiliar fabrication locations as well as plant sites.

The large IOCs are trying to simplify design. In the last 10 years, we've seen innovations, such as scaling up, like the Qatari projects, around 8 million tonnes. We've seen initiatives to try to go to small scale. Developers have looked at a variety of types of engineering, including modular engineering, to break this vicious cost cycle. We still haven't seen what the cost base will be for floating liquefaction. It's going to be a few years before we understand which will be the right pattern.

The US LNG projects are different, coming from unconventional gas sources from the most liquid market in the world, but will costs be controlled? We're seeing 10 trains of US LNG under simultaneous construction.

If costs escalate, just who is carrying that risk? Over the last 5+ years, the risk has tended to be put back more on to the sponsors, rather than the EPC contractor. Particularly for remote locations, the trend is either for lump-sum turnkey contracts, or some kind of risk sharing between the contractor and sponsors.

The traditional joint venture model, where the NOCs and the IOCs and perhaps a few other entities share risk, is certainly a good model, but it's not the only one. The full integrated supply chain means that the project sponsors have equity involvement from the upstream through the liquefaction, and perhaps into shipping, and into the downstream markets. The US tolling model is a totally different approach again to risk and reward. By 2020, we'll see a mixture of different enterprise models. The risks in LNG haven't changed, but the way in which we unpack those risks, and the way in which we can repack them and relocate them among sponsors, is changing.

How are supply chain skills and knowledge retained?

A: The first generation of LNG project developers, and probably even the second generation, are coming up to retirement. Just simple training of the next generation by the last is absolutely necessary. But the ramp-up in skills that's needed, and the extent and the range of locations, mean that the training service industry has got to be built up.

People go to distance learning. I'm not convinced how effective that is, compared to face-to-face and group training. There is a growing community for which English is a second or third language, and yet that is the business language.

How are local content requirements affecting the supply chain?

A: All the lessons learned about local content from projects like Nigeria, Angola, Equatorial Guinea, are being redeployed in the Mozambique projects. For the floating liquefaction projects, a lot of the local issues are outsourced, because the main construction is in the shipyards. Lots of governments want to develop their resources, but in a way that's long-term beneficial to the country, and local content is very important. It's not just about the actual project itself, but about the ancillary service industries.



Patricia M. Roberts, PhD

Director of LNG-Worldwide Ltd.

Dr. Patricia Roberts brings over 30 years of international experience in the oil and gas industry, having worked with large global and national energy companies, including utilities, state energy agencies, independent developers, equity investors, banks and law firms. Her broad expertise includes strategic business planning, commercial strategy, contract negotiation, economic and market analysis, regulatory assessments, project development, operating and optimizing an LNG portfolio as well as expert analysis and testimony for international energy litigation and arbitration matters.

An independent consultant and conference organizer since 2005, Dr. Roberts' advisory experience includes large scale LNG infrastructure projects and commercial arrangements for businesses under development and start-up operations. Prior roles include the Shell Group of Companies, with involvement in the start-up of Shell's global LNG business, an LNG aggregator and major portfolio player.

10 ways to improve the LNG supply chain



Human Resources

- 1** Put human resources first—and treat supply chain excellence as a core skill



Organizational Models

- 2** Adapt learning from other industries
- 3** Collaborate with other operators
- 4** Rethink contractual relations with suppliers
- 5** Prepare for environmental, ethical, and local content supply chain requirements



Construction

- 6** Unlock the potential of modularization
- 7** Consider floating LNG
- 8** Understand the local environment



Operations

- 9** Manage the transition to operations
- 10** Adapt maintenance philosophy to the situation

1 Put human resources first

As some of the biggest industrial projects in the world, LNG plants require several thousand workers during construction, then hundreds on-site during the operations phase. In some locations, such as the US Gulf Coast or Brazil, these skills may be relatively readily available. "In Brazil, we have a good level of maturity for E&P projects, in terms of engineering, level of capability of people, workers, so it is not a big issue for us to put an LNG plant in a remote location," as André Donha, Partner-Diretor, Management Consulting, KPMG in Brazil discusses. Brazil, an LNG importer, is also considering floating LNG liquefaction plants as a solution for gas produced in its offshore "pre-salt" fields.

Some major LNG projects however, have suffered from hiring inexperienced people, who were not properly prepared

for the scope required. As Mark Woods, Director and Global Lead Supply Chain, KPMG Australia observes: "Most supply chain teams can manage logistics capably, but not optimize it".

Given the intense competition for human resources, many projects have been content to hire supply chain professionals from other companies, or as contractors with short-term commitments or not deeply engaged in the project. At times of cost cuts, these people are then the first to be released. This type of resourcing leads to high turnover, lack of continuity and a loss of corporate memory, compounding the effects of an older professional demographic. Short-term contracts avoid long-term expenditure commitments, but lead to excessive salary growth, sub-qualified talent and short job tenures for the best personnel.



Mark Woods
Director and Global
Lead, Supply Chain
Energy & Natural
Resources
KPMG Australia

Mark Woods has over 25 years of experience in transformation projects with major global clients. He specializes in process re-engineering, system implementation, business transformation (including operating model design and change management), outsourcing and off-shoring. Mark was Project Manager for the transformation of the end-to-end supply chain and logistics operating model to meet the requirements of LNG plant construction for one of the world's largest natural gas projects and the largest single resource development in Australia's history.



André Donha
Partner-Diretor,
Management
Consulting
ENR Sales and
Operations KPMG
Consultoria Ltda.
KPMG in Brazil

André Donha brings over 15 years of global experience in energy and natural resources in business development and management consulting projects, including process design and optimization, strategy development, environment, health and safety and capital projects management. A Chemical Engineer with a post-graduate degree in Health and Safety Engineering, André also achieved a Master's degree in Refinery, Gas and Marketing.

To combat this, Andy Calitz, CEO of LNG Canada, advocates that proponents should “ensure that projects resource highly respected project managers/ directors and CEOs, who will provide opportunities for success and build confidence in the project, and in turn, attract the best staff; provide incentives or penalties within contracts to retain key personnel/ leadership.”

Long-term framework agreements help supply chain contractors commit to personnel retention and development, and to plan their human resources needs over several years.

The extended time-frame of LNG projects, often 6 to 10 years before operations begin, makes retaining skills more important, but also allows a more considered perspective on investing in human development. Large companies executing several LNG projects can plan personnel needs strategically, developing supply chain professionals able to translate knowledge from one setting to another, and are open to redeploying globally.

Supply chain expertise needs to be understood as a core competence in itself. Skill in tactical logistics does not necessarily translate into mastery of strategic supply chain management, without suitable training and experience. Supply chain is a cross-functional discipline, which includes skills in logistics, contract management, negotiation and value reporting, and ability to interface with other disciplines such as finance, tax, HSE and IT. Companies should produce appropriate competency matrices, and plan how their people will acquire credentials and qualifications. The KPMG Global Energy Institute’s report advocates that “procurement in Asia Pacific’s energy and natural resources sector should take on a cross-functional approach, involving teams of engineers, finance and procurement/supply chain...

to address the need to professionalize the procurement function.”⁶ At a corporate level, most of the 25 best-performing companies in supply chain use centers of excellence to improve costs, efficiency and performance.⁷

Especially in remote locations, investment in training centers, in partnership with global institutions, and perhaps jointly with local academia, can be important. One major LNG project in the Middle East has located a training center in collaboration with an internationally-recognized research body, at the plant site, to allow on-the-job training and reduce security concerns. Chima Isilebo of Nigeria LNG Ltd. observes, “NLNG being the first and only LNG plant in Nigeria, there are no precedents. We have to “grow our own timber.” We are not located in a center where you can have access to experienced personnel readily.” The same will apply to the new plants in Mozambique and Tanzania – even more so, given that these countries do not have large existing oil and gas industries.

New working practices and technologies

The aging workforce demands more attention to retaining more experienced supply chain professionals, and offering more flexible options or different working environments to retirees. While there are challenges for fresh graduates in achieving professional competence quickly⁸: as Paul Sullivan, Senior VP of Global LNG and FLNG at Worley Parsons, has observed, “We’re bringing along younger people who see the opportunity, but they’re not going to be fit to take on these projects in 10 years’ time. It’s going to take them 20 years to get to that stage, so you’re going to have a bit of a shortage in the meantime.” However, new working practices and technology can be deployed to accelerate learning and allow greater productivity from afar. For instance, virtual collaboration techniques

⁶ ‘Future of procurement in Asia Pacific: Keeping pace with change in the Energy and Natural Resources Sector’, KPMG Global Energy Institute, 2015

⁷ K. Chadwick (21st April 2014) ‘Centers of Excellence Are Critical Enablers of Success in Supply Chains’ Gartner

⁸ P. Askew (19th July 2012) ‘The Challenges in the Oil and Gas Industry through the HR Lens’ Schlumberger

and simulations can help with remote locations and dispersed fabrication sites. Additional distance learning is being used, but it needs to be monitored carefully to understand how effective it is.⁹

Collaboration with government

Project proponents also need to engage with governments on workplace reform, to avoid excessive wage appreciation, restrictions on expatriates and labor inflexibility, perhaps in return for better human capacity development, working conditions, and long-term investment in

the indigenous workforce. Governments should avoid unworkable requirements on credentials, local content and the deployment of temporary workers, in return for a reasonable depth of training and development for local citizens. Existing national skills, for example in cargo handling or contract management, may translate into supply chain positions. For example, developing countries may have supply chain and logistics expertise from mining, ports and maritime business, aviation, trucking businesses and retail.

2 Adapt learning from other industries

The oil and gas industry has a long and proven history of operating in remote locations. Nevertheless, other industries may offer valuable learning. The mining industry has vast experience in operating large capital projects in remote locations in Australia, Canada and Africa. This may bring knowledge of local weather conditions, appropriate shift patterns, how to set up camps and make them attractive in a harsh environment, as well as how to keep staff happy and motivated.

Just-in-time delivery may be appropriate in some locations and for some – but unsuitable for others. Deciding when and where to use this approach can draw on experience from manufacturing or retail ventures. For instance, one major LNG developer brought in logistical expertise from global retail supply chain leaders as employees. Transport industries – aviation, rail, shipping and road haulage – can offer learnings in scheduling and managing disruptions. To some extent, technologies have been adapted from the automotive, defense and aerospace industries, but the differences have to be acknowledged. Radio frequency identification (RFID) is being slowly introduced, but could be used more widely.¹⁰

In future, drones and autonomous vehicles may enter the delivery business.

For example, DHL already uses drones to make deliveries to remote German islands in the North Sea — with obvious applicability to the offshore LNG business. Mining companies in Australia use drones for monitoring and surveying. Autonomous vehicles can reduce the need for labor in remote and possibly hostile environments — which cuts down on other parts of the supply chain too, such as catering.

Logistics coordination still relies too much on white-boards, Excel, emails and phone calls, labor-intensive, slow and prone to human error. Sophisticated IT tools, similar to those employed by delivery firm UPS, can help with optimizing logistics, particularly when serving either multiple suppliers or multiple project sites. But they need faithfully to represent the reality of loading and dispatching the supplies an LNG plant needs, not just based on simple criteria such as dimensions or weight. For instance, will they safely fit in the delivery vessel, can they be moved by smaller transport once unloaded near the project site, and can they be unloaded and stored in the right order? Automated data transfer on logistics operations and inventories is essential, as manual data entry is too slow, error-prone and insufficiently detailed.



⁹ P. Sullivan (2015) 'A Balancing Act: The outlook for the oil and gas industry in 2015' DNV GL

¹⁰ KPMG (July 2010) 'Supply Chain Opportunities in the Oil & Gas Sector'

3 Collaborate with other operators

A feature of today's new wave of LNG is the emergence of clusters with numerous projects in close proximity. This was a feature of Qatar's rapid expansion, and is being repeated on the US Gulf Coast, in Canada's British Columbia, Mozambique, Tanzania and Australia's Queensland and Western Australia. These clusters often feature other natural resource developments including oil, mining, petrochemicals and unconventional gas production.

Such concentration creates problems for local infrastructure and scarce labor. But it is also an opportunity for operators to work together to optimize supply chains, for example, common logistics bases, lay-down areas, synchronized supply vessels

and common pools of maintenance spares. In mature locations such as Aberdeen, Stavanger or New Orleans, such clusters have already emerged naturally or by deliberate industry initiatives.

However, operators have often been unwilling to try to realize such synergies, possibly due to fears of added complexity, perceptions of reduced control or having to rely on competitors or contractual problems of cost allocation. Mark Woods, points out that, "Projects in Western Australia, within 200 kilometers of each other, are shipping everything from Perth with their own supply chains."

Energy and Natural Resources Supply Chain

Client challenge

- An Australian E&P company needed to transform its procure to pay (P2P) process to meet the needs of a US\$12 billion LNG joint venture.

KPMG response

- We managed the P2P process improvement project, which identified all the risks and root cause issues within the previous processes, including areas of non-compliance and potential revenue leakage.
- We developed a prioritised action plan to implement the improvement initiatives for both the quick wins and the longer term improvement opportunities, including business transformation and IT system (SAP) re-implementation project assistance.

Benefits to client

- The client received
 - A set of 15 key improvement initiatives that would improve the throughput of the P2P team, while reducing the opportunities to overpay for services received.
 - A set of high performance process maps for the P2P area of the corporate team.

4 Re-think contractual relationships with suppliers

Contractual supply chain approaches have too often not been fit-for-purpose. This has often stemmed from the failure to manage engineering, procurement, construction management (EPCM) and engineering, procurement, construction (EPC) contractors appropriately. Contracts have set the wrong metrics or misaligned the parties, without incentives or penalties. This has led to material being delivered in the wrong order, sent out according to simplistic volume or weight criteria or shipped backwards and forwards in supply-constrained situations to expensive, far-off sites.

To avoid such problems, a mix of contractual approaches can be used, each being weighed carefully. Even simple key performance indicators in service-level agreements, such as efficiency and effectiveness of shipping material would align the business needs of the client and supplier better than simply measuring time and materials. Critical items may be procured and managed by the client; contract management contractors may be engaged to deal with suppliers; or the turnkey lump-sum may be used for non-critical supplies.

For the most effective supply chain, relationships with suppliers have to move beyond simple transactional approaches based on least cost. Lowest cost may be appropriate for simple supplies where schedule and quality are not

critical. But for time-critical components, suppliers need to be assessed on their ability to deliver on time, requiring good intelligence. As Mark Woods notes, "Companies need to be able to see deep into their supply chains. What do they do if a third-tier supplier suffers an interruption?"

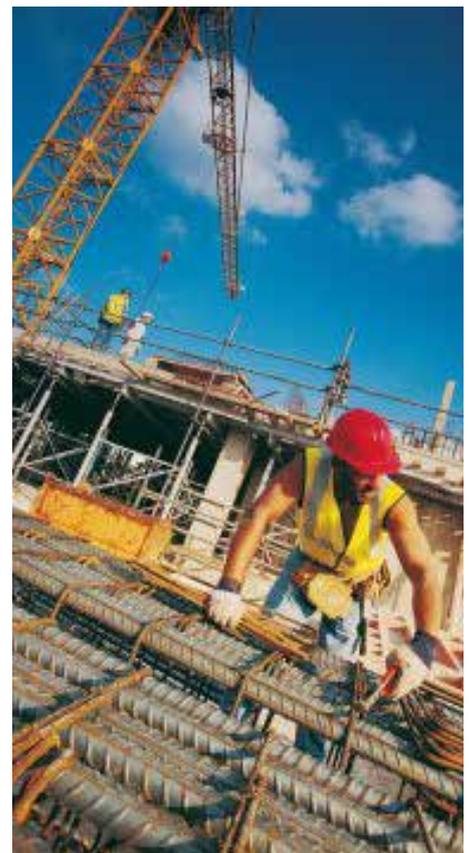
Joint venture governance concerns can arise for large and complex supply chain consortia featuring companies that may not be familiar with the project's locality, and which may come from a disparate set of cultures and jurisdictions. The challenge for today's LNG project is not only with remote locations, but also with non-traditional suppliers, such as newer Asian shipyards – they may be highly competitive, but need to gain mutual familiarity with major LNG proponents.

Service providers and supply chain companies themselves may not be ready for such deeper involvement, despite the alignment it offers. As Managing Director, Head of Energy & Infrastructure, KPMG in Japan and Head of Energy & Natural Resources, KPMG in Asia Pacific, Mina Sekiguchi, points out that, "Bargaining power is not very much equalized. How can we align the different stakeholders which have different time horizons? Engineering companies are having difficulty in integrating because they are proud of their own technology, and concerned about leaking it."



Mina Sekiguchi
Managing Director,
Head of Energy
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KPMG in Japan and
Head of Energy &
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As Head of KPMG in Japan's Energy & Infrastructure sector and the Head of KPMG in Asia Pacific's Energy & Natural Resources sector, Mina Sekiguchi, focuses on advising power and utilities, oil and gas, Japanese major trading companies and large power machinery manufacturers. Mina also has 7 years of corporate finance advisory experience and she provided M&A advisory services to major Japanese clients, including multiple cross-border M&A transactions.





Hak Bin Pek
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Pek Hak Bin is the Head of the KPMG Oil & Gas practice for Asia Pacific. A finance-trained oil and gas executive, Hak Bin has worked in various disciplines in the energy industry, in a career spanning more than 20 years. Former roles include Country President and Chairman for BP's Singapore operations, 15 years in BP and 3 years in Halliburton Energy Services. Hak Bin is a well-known energy specialist in Asia, having spent 5 years in China pioneering BP's investments into China, heading up BP Thailand for 3 years and BP Singapore for 6 years.

Hak Bin Pek, Partner and Head of Oil & Gas, Asia Pacific, KPMG in Singapore, suggests that "The capabilities required to support the LNG infrastructure and commercial developments in Asia are growing rapidly in recent years. Geographically located at a strategic choke point in Asia, Singapore has a number of strong attributes to support its ambition to become the regional gas trading hub. In addition, it is also a central hub for LNG shipbuilding capabilities and engineering firms. So I see these developments as extremely helpful to any

company developing LNG supply chain infrastructure."

Good practices include regular reviews and sharing of lessons learned, with a focus on improving the performance of the client, as well as the supplier. Incentives are, of course, already widely used. Contractual models can be considered that share gains between supplier and client. Early engagement with contractors is emerging as a key feature, to identify challenges in delivery and constructability. Supplier companies

Oil & gas super-major: Project logistics optimization

Client challenge

- A large Australian project under construction needed a "cold eyes" review of the complex supply chain, to review the operational and planning components.

KPMG response

- KPMG identified multiple supply chain issues including insufficient integration of the supply chain organization, poorly defined processes, lack of suitable demand planning, inefficient vessel loading and unreliable supply of contractor freight.

Benefits to client

- The client received a comprehensive effectiveness analysis and recommendations for improvement.



can be encouraged to set up consortia with specific tasks to solve, then rewarded with incentive payments or extra access to information when they succeed. Bringing contractors “into the tent”, however, can create tensions when companies would typically have contracts competitively bid – indeed, this may be a government requirement in some countries.

Companies can think of “innovative content strategies”¹¹, as described by

Regina Mayor, Principal, Head of Oil & Gas Americas, KPMG in the US. As she advocates, “Find non-traditional suppliers to consolidate demand (e.g. logistics suppliers to manage water hauling) and look for vertical integration opportunities to manage/control more of the critical components yourself.” Instead of vertical integration, project developers may also consider alternative suppliers or even the use of alternative components entirely to avoid bottlenecks.



Regina Mayor
Principal,
Head of Oil & Gas,
Americas
KPMG in the US

With over 22 years of experience in advisory services across the oil and gas value chain, Regina Mayor has significant depth and expertise in business transformation, process redesign, organizational design and change management, delivering large scale business and technology changes to major global oil companies. Harvard-educated, Regina is a sought after speaker at global industry forums, such as the National Petroleum Refiners Association, the Argus Americas Crude Conference and the World Energy Conference.



¹¹ Regina Mayor and Michael Lueck, KPMG in the US, (5th January 2015) ‘The Five Imperatives to Managing a Resilient Upstream Supply Chain’, Oil & Gas Monitor

“Providing local economic opportunities helps win support from communities, governments and indigenous people. At the same time – at the cost of some up-front investment – it can deliver more robust, timely and cost-effective supply chains.”

5 Prepare for environmental, ethical and local content supply chain requirements

As LNG plants are not large employers post-construction, attention from governments and communities has turned to achieving the maximum sustainable economic benefits.

Developing the local supply chain is as much a concern in Australia and Western Canada as it is in Yemen or East Africa.

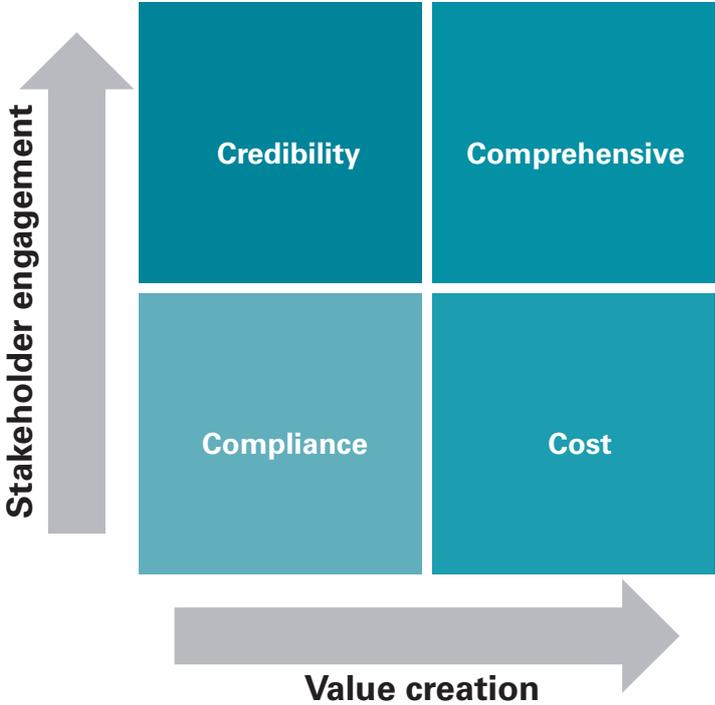
LNG proponents can turn this expectation to their advantage. Providing local economic opportunities helps win support from communities, governments and indigenous people. At the same time – at the cost of some up-front investment – it can deliver more robust, timely and cost-effective supply chains. Project developers can help small local businesses understand their supply chain procedures and build up the necessary skills to meet them. This can include partnering with educational institutions and business associations, such as chambers of commerce. Start-ups may be less sophisticated to begin with, and need some help to reach safety and quality standards, but offer lower costs, local knowledge and community buy-in.

In Asia Pacific, the capability of the supply chain and logistics industry varies from country to country. In numerous countries across ASPAC, international companies have to comply with local regulations that stipulate the use of local content for ancillary services. Although there are good examples of major oil and gas companies working with local suppliers to

develop capabilities to a level where they are an integral part of business operations, local content compliance remains an obstacle many companies have to overcome. Gaurav Moda, Partner, Head of Oil & Gas, KPMG in India, notes that, “Local governments have been observed to be more accommodating initially on core equipment that has to come from the original equipment manufacturer, but do push for high local labor content.”

Growing public scrutiny of large companies includes environmental and ethical issues – including attention to sustainable sourcing, human rights and labor conditions. The growing complexity of international and US-led sanctions presents another complex area for supply chain compliance.

Such factors demand more rigorous auditing and certification of sub-contractors. Specific environment requirements have to be planned for in advance. For instance, LNG Canada is using a mix of efficient natural gas turbines and hydroelectricity to reduce its carbon footprint to half that of an average LNG plant. The siting of the Gorgon LNG plant on Barrow Island, a Class 1a Nature Reserve, resulted in unique and very challenging supply chain requirements, including quarantine to avoid introducing alien species. Just meeting requirements is not enough – it is necessary to be able to demonstrate this to regulators and to interested stakeholders.



Gaurav Moda
 Partner,
 Head of Oil & Gas
 KPMG in India

With over a decade of strategy and consulting experience, Gaurav Moda possesses deep expertise in oil and gas across the entire value chain (upstream, gas/LNG, refining, petrochemicals, retail, trading, lubes, EPC, power, infrastructure, etc.). He has led multiple global strategy and large scale global business transformation projects with several IOCs, NOCs, as well as independents. Gaurav delivered client impact in areas of strategy, transformation, sales growth, operations improvement, human talent, procurement and supply chain.

Supply chain approaches can focus on value creation, stakeholder engagement or both. This leads to identifying four possible models: Compliance, Cost, Credibility and Comprehensive.

Compliance aims for simply meeting applicable laws and regulations, a lowest-cost, low-engagement approach. **Cost** is primarily internally-focused, generates value from the supply chain by seeking to balance a lowest-cost with a value-added approach. **Credibility** engages external stakeholders, to obtain a “license to operate,” but may not involve fundamental changes in the way the business is conducted. Finally, combining value creation with stakeholder engagement leads to the **Comprehensive** approach. This holistic method involves partnerships with suppliers, the development of local content providers, investment in human resources, and the deployment of technologies that may have a higher up-front cost, but repay that in environmental or social benefits, and the robustness and reliability of the supply chain.

As an example of value-added approaches that also reduce environmental impact and add social value, transport costs in the supply chain can be reduced by:

- Using more efficient logistics such as “slow-steaming,” where project timelines permitting, vessels sail more slowly to lower their fuel consumption.
- Deploying fuel-efficient or cleaner vehicles, such as LNG-powered trains, trucks and ships, running from the plant’s own products during operations.
- Effectively employing multi-modal transport – and the development of links where these are not available. In Asia Pacific and East Africa, for instance, maritime transport is well-developed, aviation also to a considerable extent, but road and rail connectivity is often poor. Missing links can be created by partnerships with governments, and with other logistics users such as mines.



Mary Hemmingsen
Partner, National Sector Leader, LNG and Power and Utilities
KPMG in Canada

Mary brings over 20 years of experience as a North American energy business leader in asset management and related business and project development. This includes leadership in the development and delivery of policy, strategy and initiatives for energy, power, utilities and related infrastructure businesses in a range of capacities in both the public and private sector and for major utilities and global energy and asset managers.

“Modularization is a response to supply chain challenges – but introducing new innovations and configurations that create new issues and challenges, new reliance on the supply chain, and changes in how the project is assembled.”

Mary Hemmingsen

6 Unlock the potential of modularization

Modularization is fabricating units off-site, then shipping them to the site for hook-up and commissioning. This contrasts with building everything in situ. Modularization can reduce the total number of person-hours’ work required in remote locations, if thoroughly planned and sufficient allowances are made for “end-to-end” testing after hook up and prior to start up. “The modularization partners are in countries with depth of fabrication and engineering capabilities,” notes Mary Hemmingsen, Partner and National Sector Leader, LNG and Power and Utilities, KPMG in Canada.

Andy Calitz, CEO of LNG Canada, explains that, “With a modularization approach, the capacity and assessment of module fabrication is key to enable an optimization of yards for varying sizes and complexity of process modules and piperacks. The supply chain requirements for modularization requires an earlier completion of the engineering and procurement requirements, affecting

schedule and timing of bidding proposals to the market.” IT tools, such as those described in point 2 above, can help here.

Mary Hemmingsen notes that “Common standards are required. Fabrication is often in LNG buyer countries such as Japan, South Korea and China, which suggests the possibility of collaborative arrangements, flexible financing arrangements through government-driven export credit agencies (ECAs) and partnerships or potentially, alliance arrangements.”

However, modularization does involve other supply chain risks. As Hilda Mulock Houwer notes, “the risk of operating and the supply chain can increase as the human resources involved in building are not the same as operators.”

An effective modularization concept however, not only enables “fast” project installation and startup, but also considers a reasonable maintainability over its target life.

7 Consider floating LNG (FLNG)

KPMG’s recent report ‘Floating LNG: Revolution and evolution for the global industry?’ describes the reasons why companies consider floating LNG solutions. FLNG can be used both for offshore fields, or moored near-shore for onshore fields which are remote or constrained for space. It can simplify the supply chain at the project site – the vessel arrives ready with gas processing and liquefaction, utilities, living quarters, etc. It just needs to be hooked up to gas supply, whether from the offshore field or onshore pipeline. Floating solutions represent the extreme case of modularization discussed in point 1, above.

However, FLNG does put more emphasis on the off-site supply chain, with work at the shipyard and other fabrication sites needing to be coordinated.

Once in operation, the FLNG vessel will face a more complex supply chain than an onshore project, with delivery of personnel, consumables and spare parts affected by ship and helicopter sequencing, weather conditions, and new techniques to ensure safe offloading of LNG at sea.



8 Understand the local environment

Some locations, such as the US Gulf Coast, have ample room for construction. In others, though, such as the mountainous British Columbia coast or the heavily developed East Mediterranean shoreline, there is limited room for lay-down. Environmentally-sensitive locations have restrictions on what material can be brought in, and where it can be quarantined and stored. This presents a challenge to highly modularized approaches. “There’s not a lot of extra land for staging...you have to think about where components will be stored until needed,” as Mary Hemmingsen observes.

LNG locations are usually coastal, meaning that many loads arrive by ship, and given extra cargo space, items may

be delivered some time before they are required. Such temporary surplus needs appropriate space for lay-down, where it can be stored safely, tracked, preserved and made easily accessible when required. Tough climates – whether the tropical humidity of Nigeria, the cold of a Canadian or Alaskan winter – or the extreme heat of summer in Qatar or north west Australia – can damage equipment which is not stored properly.

Weather also poses challenges to supply chain schedules, both during construction and operation. LNG locations range from North West Australia’s cyclone-prone coast and the US Gulf Coast’s hurricanes, to Statoil’s Arctic Snøhvit plant and the pack ice at Sakhalin and Yamal.

Interview with Chima Isilebo, General Manager, Production, Nigeria LNG (NLNG) Ltd.

What are some of the main current issues with LNG supply chains?

A: The global LNG business environment is dynamic and the supply chain issues can also vary from location to location. Some of the issues include skills shortage, local content requirements, availability of feed gas, etc. Logistical (not simply geographical) remoteness can also be an issue for some as plant location is usually driven by a balance between the availability of a deep port and the location of the feed gas. The length and complexity of the logistic chain influences lead times and how easy it is to get not only materials to site but also key vendor support. That backdrop influences how we do business, in terms of how forward-looking we are, how we get materials, how we get vendor operations maintenance on site.

How do you obtain the right human resources?

A: NLNG being the only LNG plant in Nigeria, and not located in a major industrial hub, we have to “grow our own timber.” We put in place an extensive and robust competency development programme, supplemented by experienced secondees from the joint venture partners.

What challenges do you face in local content requirements?

A: Increasingly, most national governments, particularly in the developing world, want to see that projects like LNG advance their own industrialization. The challenge for LNG is where there is a mismatch between the particular local content law and what the local market actually can support.

In NLNG, right from day one, local content was hardwired into our philosophy. So what we have done is to identify companies that have the potential to meet some of the requirements. Good

examples include the manufacturing of electrical cables and piping. We worked with them e.g. in capacity building, financing etc., helping them to upgrade quality control standards. We put in a lot of effort to make sure that the materials were of the right quality.

What about the challenge of obtaining feedstock?

A: We buy gas from upstream operators. So we can be deemed to be in competition for volumes of gas with other users such as power plants, fertilizers or chemical companies. All our gas suppliers are joint ventures made up of our shareholders, so there is strong alignment.

One of the key planks that drove the setting up of NLNG was to commercially utilize gas that was being flared, considerably improving the environmental performance.

What is different in the LNG supply chain versus other projects?

A: We sell 90 percent of our gas on long-term contracts, and are committed to delivering a cargo on a specific future date, so reliability and reputation are key. So any impact, any hiccup in the supply chain hits us much harder than a typical E&P company. That influences where we rank reliability of supply within our risk matrix.

What approaches are used to manage your supply chain?

A: We have enhanced relationship management with all our key original equipment manufacturers and parts suppliers. Logistical remoteness is striking a balance with how much stock I can hold to insulate me from surprises. It is about constantly analyzing my plant, the health of my equipment, and proactively identifying key and critical spares.



Chima E. Isilebo

General Manager, Production
Nigeria LNG Ltd.

Chima Isilebo is responsible for managing the 6-train 22 Mtpa LNG plant complex located in Bonny, Rivers, State of Nigeria, as well as the Gas Supply Network/Pipelines, where he manages planning, operations/asset management, maintenance, technology, engineering and project development. He has more than 30 years of diverse experience in the oil and gas industry, in both upstream and midstream, including engineering/project management, HSSE management, business planning/economics, LNG commercial/business development and operations/asset management/venture governance.

Chima joined Shell Nigeria in 1981, with multiple international assignments. As Vice President of Shell Gas & Power for the South-East Asia region, he was responsible for new business development and governance of existing LNG/GtL joint ventures. Chima has served as a Director on the Boards of a number of Shell JV companies, including Brunei Shell Petroleum (BSP), Brunei LNG (BLNG), Brunei Shell Tankers (BST), Brunei Gas Carriers (BGC) and the Shell Gas-to-Liquid Plant (SMDS) in Malaysia.

9 Foresee the handover to operations

The operations and maintenance team should not be an after-thought. Too often, the construction organization is incentivized to complete the work without sufficient attention to operability and hand-over. According to Jonathan Smith, “Companies do not plan the handover of elementary documents properly. So the operations team is often provided with a heap of paper and computer files from which they can’t find vital information, or gradually realize that equipment does not perform to its original design specifications. It sometimes happens that the supply chain team for the construction phase is disbanded and a new operations team has to devise their own solutions to the same problems.”

Resourcing the operations function early on allows them to give input into the design philosophy. As the project is handed over, this team can sign off on key issues: for example that project documentation is clear and fit-for-purpose, that vital contracts for services and spares are in place, that warehousing, inventory and maintenance management is properly

functional, and that surplus materials are dealt with appropriately.

Training and simulation that replicates the real plant, and a 3 to 6 month handover period, can smooth the transition. But in a counter-example, Mark Woods observes that one major Western Australia project “scrapped the construction supply chain and set up a completely new one for operations, thus losing the learnings.”

For the supply of feedstock hydrocarbons – particularly for plants receiving their supply from third parties, as on the US Gulf Coast and some cases in eastern Australia – trading and risk management needs to be integrated with the plant supply chain. Too often, these functions remain siloed.

“If you compare NLNG’s location with say Oman LNG or Brunei LNG, in those locations I can readily get vendor support, compared to where I am in Bonny in Nigeria. That backdrop influences how we do business in NLNG, in terms of how forward-looking we are, how we get materials, how we get vendor original equipment manufacturer (OEM) representatives on site.”

Chima Isilebo

10 Adapt maintenance policy to location

Chima Isilebo describes some of the challenges his organization faces. NLNG is a well-established plant with a solid operational record, and it is not remote from population centers. But it is remote from supply of complex components. The plant’s maintenance philosophy, therefore, involves holding significant inventory. Annual turnarounds are taken as an opportunity to replace components proactively.

For another LNG plant in a remote and insecure location, the operator had to contend with frequent attacks on off-site infrastructure. They dealt with this by holding a much larger inventory of spare parts on site, and creating a rapid-reaction team that could quickly move out under guard to replace damaged units. Frequent closure of the regional airport due to security concerns meant that alternative air routes had to be established for rotating operational personnel to and from the plant.

Managing supply chain as part of Enterprise Risk

Supply chain risk is often managed well within a project – using good practices such as proactive project framing, and identification of key risks and mitigations.

What may be done less well is putting supply chain risk in a holistic framework for the enterprise – often a supermajor oil company, executing several world-scale LNG and other projects simultaneously in different locations. Too often, as Hilda Mulock Houwer notes, “supply chain is not seen from an enterprise level and treated as a silo in the organization.” LNG proponents, especially large ones with multiple projects, need to ensure that common risks are highlighted, intelligence on key supply chain bottlenecks shared, and opportunities for common logistics

and personnel redeployment seized. Proactive identification of looming supply chain constraints may show that several projects are going to suffer from similar problems – this can be addressed early, or at least factored into budgets and schedules.

Taxation is one example of a supply chain issue to be handled at both local and global level. Gaurav Moda observes that there may be “taxation problems with part cargo delivery to multiple destinations or jurisdictions.” Issues related to value-added tax or customs duties on centrally-procured material, or that sourced via collaboration with other operators, may need to be optimized at a corporate level.



Interview with Andy Calitz, CEO of LNG Canada (a Shell-PetroChina-Kogas-Mitsubishi joint venture)

What are you doing differently in LNG supply chains versus other E&P projects?

A: The proposed new LNG projects are of a size not yet seen in British Columbia and resources are generally limited. To address this, LNG Canada will seek to reduce the total number of manhours on site through fabrication of module units that are shipped to site for hook-up and commissioning activities. This approach is very different from typical E&P projects for offshore, due to the large increase in the number of modules and greater variation of module sizes. Greater effort is required to sequence the modules for transportation, delivery and installations at site, which affects the sequence of design completion and procurement activities so the fabrication yard space can be managed effectively.

How are you addressing human resource needs?

A: Attracting and retaining experienced craft labour, foremen and supervisors is a key challenge, particularly for remote or hardship locations. At LNG Canada, we seek to become the "Project of choice" by providing highly rated accommodation, ease of ability to travel to and from site, and a safe work environment to increase the attractiveness of the project to potential workers.

How should traditional supply chain processes be adapted to remote locations and just-in-time requirements?

A: Traditional supply chain processes can be improved in terms of accuracy of the material tracking process, which can be achieved through workforce planning. This is very different from a "just in time" process that does not support a remote worksite and workforce planning, given the call for material is generally one to two weeks prior to execution of the work.

With respect to material management, we at LNG Canada are working closely with our supply chain counterparts in mining and other industries to ensure lessons learned are applied. LNG sites generally have good sea access allowing larger shipments

of material to site, which tends to result in additional materials in each shipment. Having materials arriving on site earlier, compared to phased road and rail freighting, leads to the requirement to establish good laydown areas, warehousing, preservation and general material management earlier in the project.

What are key supply chain issues relating to the environment and local content requirements?

A: An LNG project may develop at a faster pace than expected by local suppliers, who are either not mature in their business planning or unable to find resources to respond to bidding requests or the actual work requirements. At LNG Canada, we have been proactive through community engagements to explain contracting, procurement opportunities, and work requirements for our project.

LNG Canada has set out to be the project of choice for British Columbia. Every decision we make during the planning and design process will keep safety, economics, the environment and community interests top-of-mind. For example, LNG Canada has designed the facility to be one of the world's best performing LNG facilities in terms of greenhouse gas emissions. Through a combination of energy-efficient natural gas turbines and renewable hydro electricity, the LNG Canada project would emit less than half the greenhouse gas emissions of the average LNG facility.

Which different supply chain models are used? How is the transition from major capital projects to operations & maintenance managed?

A: Various models are being used ranging from Client based and managed contracts and procurement of critical and/or high value requirements, through to appointment of Contract Management Contractors to manage the supplier and execution of the works, through the turnkey lumpsum (EPF).

To read the full interview with Andy Calitz, please [click here](https://www.kpmg.com/LNG) or visit [kpmg.com/LNG](https://www.kpmg.com/LNG).



Andy Calitz
CEO, LNG Canada

Andy Calitz, CEO of LNG Canada, a Shell-PetroChina-Kogas-Mitsubishi Joint Venture, started his working career in the electricity business, joining Shell in 1996. He has spent more than 30 years on various energy projects having worked internationally in a variety of roles, including business development, project management and commercial aspects of the Shell business. Andy's LNG experience includes LNG shipping and commercial and director roles on the Sakhalin and Gorgon LNG projects.

With an Electrical Engineer degree from the University of Stellenbosch, Andy has further qualifications in commerce, management and business administration from the Harvard Business School and the Universities of Witwatersrand and Insead.

Supply chain innovations

High commodity prices and the pressure to deliver projects may have led to sub-optimal supply chain practices. Low oil prices in the late 1990s transformed North Sea operating models, and low natural gas prices have continued to drive US shale gas operators to optimize. In a similar way, three factors will push supply chain innovations and improvements:

- 1) Lower LNG and oil prices, straining the profitability of new projects unless they can sharply reduce capital and operating costs.
- 2) The continuing trend for tougher LNG projects – in remote or non-traditional locations, areas of political volatility or fed by unconventional or more technically challenging upstream resources.
- 3) The experience and challenges of operating the latest wave of newly-constructed plants, mostly in Australasia and Africa.

New software solutions can help workforce planning, tracking and tracing materials, managing inventory and reducing waste and loss. This has cost, schedule, safety and environmental benefits, and can reduce the burden on personnel. But the most effective use of software solutions requires them to be properly embedded in project management models, and used by skilled people.

Stakeholder management is also increasingly challenging. Local content desires and requirements are not a new issue, but novel locations and project types require new approaches. For example, for floating LNG, to meet local concerns, companies are likely to have to place some infrastructure onshore – for example, supply bases, heliports and FLNG training centers – and possibly even do the ship-building in-country, requiring upskilling of local yards. Shell, for instance, has stressed for its Prelude floating LNG vessel, that

70 percent of annual operating costs will be spent in Australia, with policies to encourage local and indigenous suppliers. Proponents will have to commit to local employment and education, especially in developing countries such as Mozambique and Tanzania, which are trying to build a skilled workforce. But done well, local content becomes a source of community support for projects, and a long-term cost-saving approach during the operations phase.



Conclusion

The rush to first LNG delivery, the challenges of constructing plants in remote and unfamiliar locations, and workforce skills shortages, have all contributed to sub-optimal supply chains. This move to tougher LNG projects and environments, at a time of lower oil and gas prices, demands a more rigorous and innovative approach to the supply chain. To reach a final investment decision, proposed projects need to demonstrate capital efficiency and the ability to stay on schedule. Developers will seek to lock in key suppliers and reduce supply chain costs, but the projects need to remain viable for contractors too. With volatile commodity and service prices, there is a better chance of success for both project proponents and contractors when they use contractual models that align the interests of all participants. Meanwhile, existing plants need to optimize productivity and operating costs. Supply chains need to be efficient, but they also need to be resilient – able to function well – despite unexpected disruptions and changes.

Developers can continue to deliver viable LNG projects even in a world of lower commodity prices and more challenging situations, if they pay close attention to the key areas: putting human resources first; investigating new supply chain models and technologies; understanding and adapting to the construction environment; and optimizing supply chain from construction through the transition to operations.



Key actions to help improve supply chain performance

Set long-term goals to help ensure a resilient and responsible supply chain.

Put human resources first – and treat supply chain excellence as a core skill.

Find and adapt learning from other industries.

Consider new approaches, including modularization, floating LNG and new IT tools – but understand their strengths and weaknesses.

Develop innovative contracting and alliance models, including synergies with other nearby operators. Reduce supply chain costs via partnerships with other companies, governments and stakeholders, engaging employees in solutions.

Treat supply chain risk at a holistic, enterprise level. Deal with pricing issues, volatility and uncertainty in the marketplace i.e. fluctuating commodity prices, increased environmental regulation, customer demands for transparency about products and services, awareness of the social license to operate, and local content requirements.

Manage the transition to operations, and adapt maintenance philosophy to the situation.

KPMG Global LNG Advisory

Competitive Advantage

For today's oil and gas companies, dealing with complexity has become a competitive challenge. Global competition, novel stakeholders and environmental concerns introduce new layers into business decisions.

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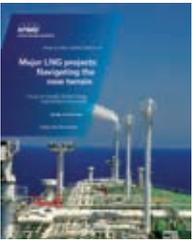
Business issues and risks	KPMG member firm advisory services
<ul style="list-style-type: none"> • Capital projects • Real-time assurance on capital expenditure management 	<p>Managing capital projects, contract processes and providing assurance are the focus of our Major Projects Advisory group.</p>
<ul style="list-style-type: none"> • Risk identification • Enterprise risk management • Outsource or insource? 	<p>Risks through tools and methodologies that address demand planning, supply and inventory management, strategic sourcing and helping to mitigate contract management.</p>
<ul style="list-style-type: none"> • Business operations strategy • Demand side management 	<p>Organizational effectiveness, business readiness for LNG and operational excellence.</p>
<ul style="list-style-type: none"> • Issue recognition and strategy development • Business operations strategy • Capitalizing on different technology investments • Quality reporting 	<p>Designing or improving current business processes, including implementing technology focusing on logistic, supply chain and procurement management, are services that member firms' advisory teams have delivered successfully.</p>
<ul style="list-style-type: none"> • Talent transformation • Business operations strategy • IT projects implementation 	<p>Implementing appropriate size Human Resource strategies with the right enabling technologies is a key focus area to address labor-related risks.</p>
<ul style="list-style-type: none"> • Major project assurance • Enterprise risk management • Corporate governance improvements 	<p>Utilizing KPMG subject matter experts across our global network, advising businesses on implementing governance processes, risk management and ensuring compliance with legislation, including taxation.</p>
<ul style="list-style-type: none"> • Managing major capital expenditure projects and energy investment requirements • Major transaction management • Managing mergers, acquisitions, joint ventures and other third-party relationships 	<p>Project structuring, raising development phase equity, transaction advisory (financial modeling; development of country/project specific contractual frameworks), progressing these to support bankability, including advising in gas sales and purchase, and power purchase agreements. Advisory support can be provided during procurement and financing of capital projects.</p>
<ul style="list-style-type: none"> • Meeting increasing regulatory, government and multiple stakeholder demands • Managing major capital expenditure projects and energy investment requirements • Security of supply • Talent management 	<p>Managing relationships between IOCs and NOCs is critical to helping ensure a balance between political and commercial objectives, such as royalty and taxation, security of supply, employment and infrastructure development. We assist IOCs and NOCs in creating a stable and attractive investment environment by developing policy and governance structures.</p>

Further LNG Insights



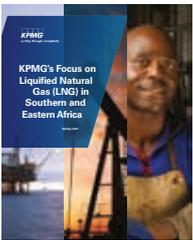
Floating LNG: Revolution *and* evolution for the global industry?

After a lengthy period of R&D starting in the 1970s, floating LNG (FLNG) plants are on the verge of entering service, with five due to begin operations between 2015-19. Sixteen other FLNG projects have been announced as probable and 21 as possible.



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The LNG industry is approaching an unprecedented wave of expansion as new projects in Western Canada, the US Gulf Coast and East Africa pose technical challenges, but more importantly – non-technical challenges.



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KPMG Global Energy Institute 4th Cocktail Reception: "Singapore – as an LNG hub"

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For further publications, videos and other information on LNG, visit: kpmg.com/LNG

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These Centers enable KPMG professionals to transfer knowledge and information globally,

quickly and openly. With regular calls and effective communications tools, member firms share observations and insights, debate new emerging issues and discuss what is on member firms' clients' management agendas. The Centers also produce regular surveys and commentary on issues affecting the sector, business trends, changes in regulations and the commercial, risk and financial challenges of doing business.

KPMG member firms 18 Energy Centers



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