

DECISIONS BETWEEN RISK AND UNCERTAINTY – EXPERIENCES FROM MAJOR LNG PROJECTS

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1. OVERVIEW

For the oil and gas industry 2008 will go down as a year of turbulence: spot oil prices (WTI) moved between \$145/bbl (all time one day peak in July) and \$30/bbl (late December), Henry Hub moved between \$10.82/mscf (June average) and \$5.87/mscf (December average) - the widest monthly range in history in a single year and with a one day peak of \$13.68/mscf on July 2, 2008. Meanwhile the \$ exchange rate fluctuated between \$2.03/£ sterling and \$1.44/£ sterling and \$1.59/€uro and \$1.24/€uro whilst \$ interest rates fell from 4.25% to 0%.

Oil & gas industry activity was further impacted by unrelenting upwards pressure on EPC contracting costs rising some 13% in 2008 - possibly driven by full order-books and consolidation within that sector, the challenge of securing debt financing for major capital projects, and global economic uncertainties making for difficulties in planning long term investments and predicting returns. Consequently the outlook for overall activity in the industry in the near term (at least 2009 and 2010) is depressed with most operators delaying investment decisions until they have a clearer outlook.

In the LNG industry 2009 represents 10 years since the “second phase” of Atlantic Basin (AB) LNG activity took hold with the start-ups in 1999 of both Atlantic LNG (Trinidad) and NLNG (Nigeria) joining the two already established AB producers (Algeria, 1964 and Libya, 1971). Since 1999 there have been further AB greenfield project start-ups in Egypt (2004 & 2005), Equatorial Guinea (2007) and Norway (2007). AB brownfield (expansion) projects have taken place in Algeria, Nigeria and Trinidad whilst new projects are under consideration for Angola, Nigeria, Russia, Brazil and Venezuela - but finalization and approval has moved slowly for reasons that we will be discussing.

On the face of it gas demand - particularly for power generation - in both the developed economies and in lesser developed countries (LDC's) will continue to increase based on population growth and aspirations of higher standards of living worldwide and because of gas's green credentials. LNG is an expedient in the process of bridging the supply-demand chain yet LNG projects are very expensive and the long-term nature of the commitments means that investment decisions are not taken without rigorous evaluation. Some of the critical issues to be considered in evaluating an LNG proposition are gas supply risk, LNG market uncertainty, price risk, construction risk, environmental/social risks, financing risks, transportation risks, shareholder alignment (depending on their positions in the overall value chain) and other stakeholders' agendas.

Clearly, there is nothing particularly special about this list of critical issues apart, that is, from the scale and the uniqueness of LNG projects: *scale* because of the huge capital amounts involved along the value chain which can in total nowadays be of the order of \$25+ billion, and *uniqueness* because project promoters do not have a lot of freedom with regards to where to site an LNG liquefaction project (must be near to gas supplies and to the coast) and because of the number of linkages that LNG projects have which must be simultaneously managed. Each plant is a one-off.

As mentioned, LNG liquefaction plants - which are our main concern here - are a component in the value chain that extracts raw gas from its reservoir in one location and delivers it, in accordance with market specifications, to wholesale or industrial customers in another global location. The point of LNG is that it is the most economic way of transporting gas over long distances where conventional gas transmission pipelines are either not economic or are not feasible. Generally speaking, the limit for pipeline transportation of natural gas vs. LNG is somewhere between 1,500 and 3,000 miles depending on the specific capital and operating costs of the competing concepts.

To put LNG into context, in 2007 consumption of primary energy worldwide was 11.1 billion tones of oil equivalent (BTOE) with 3.9 BTOE for Oil (36%), 3.2 BTOE Coal (29%), 2.6 BTOE Gas (24%) and Hydro 6%, Nuclear 5%. Of the Gas volume consumed about 8% was from LNG trade, equivalent to about 2% of primary energy worldwide. Compared to the scale of Oil and Coal, LNG has some way to go, yet it still represents about \$57 billion in annual trade.

With respect to the order of capital costs involved in LNG we can look at the current LNG liquefaction projects that are underway and note that some 50 MTPA of capacity is being added globally. If we assume a capital cost of \$900 per MTPA we see that approx. \$45 billion of investment is in progress (excluding owner's costs and shipping).

This paper looks over this landscape, drawing on experiences from major LNG projects in which the authors have first-hand knowledge, to consider the implications for decision makers

Since we are concerned with Risk and Uncertainty some definitions are necessary which have been placed in the Appendix.

2. THE GLOBAL OIL AND GAS INDUSTRY

The starting point for our analysis is the global oil and gas industry, usually described as the “Upstream” or “E&P” (Exploration and Production) sector: we are going to look at the systemic risks and uncertainties.

1) Long time horizons / schedule risk: Project conception, definition, detailed design, engineering, procurement and construction can typically be from 5 to 10+ years, operations typically from 8 to 30+ years. The fundamental value proposition in the oil and gas industry stems from making a major capital investment in a unique project, during which time capital is accumulating and at risk, until the day that production starts and a stream of revenue flows to enable recovery of capital and a return on the investment.

Obviously the longer the period taken to get to start-up the resultant delay in achieving positive cash flow will be detrimental to the project economics. The key to economic success with respect to schedule is to achieve the shortest period of Capital investment (CAPEX), where serious money is placed at risk, by defining and managing a realistic schedule and then sticking to it. Furthermore it is a golden rule of project value management to put in adequate effort (which is at relatively low cost) during the definition stage of a project (FEED - Front End Engineering and Design) before taking the Final Investment Decision (FID) and irrevocably committing to construction.

Risks from schedule overrun can be quantified by use of techniques to apply a range of values to each major task, defining earliest start, latest start, earliest finish, latest finish, identifying all dependent activities and the critical path running through the whole project. Independent benchmarking of schedule durations can help to validate the whole effort towards production of a risked, or probabilistic schedule. This level of definition can now be fed into the overall project economic analysis to evaluate the financial impact of these possible outcomes on the investment at risk.

Whilst the importance of project definition and realistic estimates of timelines is critical, and under the control of the project management team, there are external issues that can cause a planned schedule to come off the track: typical ones that have been experienced in the industry include non-performance of contractors, usually from delays in mobilization of resources, delays in deliveries of materials and equipment to site and poor project management by the contractor (or owner), including sub-contractors, inadequate coordination by the owner of different contracts and delays if free-issue materials do not come on time and very common the discovery during construction that some change is required to be incorporated which upsets the agreed schedule and inevitably causes some overrun. Whilst each project with its challenges is unique, the global oil and gas industry can experience systemic problems in the construction stage if, for example, consolidation of EPC contracting firms or major materials suppliers (e.g. steel mills) occurs - which we have seen - resulting in work overload or inefficiencies from unrealized synergies that can cause delays to agreed schedules.

In fact, the upstream industry tends to have a systemic “feast or famine” problem that means the global oil and gas companies see the outlook for project opportunities in a very similar manner - often tied to oil price realizations and projections - which means that major construction projects are not evenly spread over time and across oil companies but are bunched into periods when activity is intense or when a slackening off in pace occurs. Inelasticity in the EPC sector makes for unpredictable performance of contracting firms who therefore might have the tendency to over commit when demand for their services is high, such that they fall short on delivery performance, and to hold on to work that is under current contract if the outlook for new work is thin.

2) Large CAPEX: The global oil and gas industry deals in multimillions of \$ of investment per project (e.g. \$250 million - \$10+ billion) and the very fact that such capital is at risk until it has been recovered from production and sale of hydrocarbons, before showing a return to the investor, is a key characteristic of the industry. Compounding the scale of the CAPEX commitments is the fact that when the Final Investment Decision (FID) is taken to commit to production facilities construction or drilling for oil and gas wells, there is no guarantee that the carefully estimated cost will be the final one, and history shows that cost increases are likely to occur for a variety of reasons. It should be apparent that the sort of issues already discussed related to schedule overrun have a cost impact - delay to execution leads to increased cost, new work or re-work leads to increased cost and the quality of the original estimate might have been biased towards an optimistic view rather than a pessimistic view of likely total CAPEX.

So, large CAPEX is typical of the industry, however, the risk is that estimates on which FID decisions are made turn out to be unrealistic - on the low end - such that realized cost exceeds the estimate and project economic outcomes are directly adversely affected. CAPEX overruns represent one of the worst impacts to project economic performance, hence maximum efforts should be taken to develop cost estimates from a variety of sources and using different techniques and then experience factors applied to produce a range of probable CAPEX forecasts. Given the large CAPEX typical of the oil and gas industry it is not adequate to merely apply a blanket, say 15%, contingency factor to a

CAPEX estimate to allow for cost increases: the estimates must be done rigorously so that informed investment decisions can be taken and the range of economic outcomes quantified and accepted. It has been known for major capital projects to cost over twice their original estimate - so simple cost estimating techniques are clearly inadequate.

Similarly to schedule issues, cost risk can be both unique to the individual project or systemic in the industry, for example, the cost of raw materials like steel, cement, copper cable are subject to market supply and demand factors after a cost estimate is finalized, and labor costs can increase particularly if craft unions are involved or local impositions are placed on employment regulations that were not anticipated.

3) Joint Venture (JV) or other partnership arrangements: Given the scale of oil and gas operations generally, and the risks involved, it is common practice for a consortium of companies to jointly undertake the venture concerned – usually meaning the exploration and production activities - under a designated Operator who will most likely be the company holding the original concession, license or similar rights. Non-operating partners might be those previously agreed, e.g. under a form of Memorandum of Understanding (MOU) for the activity concerned, or those invited to join later or the National Oil Company (NOC) that has rights to participate under some stipulated arrangement. Note that the Operator does not necessarily have to hold the majority share in whatever partnership - merely that they are competent to operate and that they subscribe to the Operating Agreement that has been drawn up. This means that the Operator is subject to the controlling committee that is set up to represent all interests and which normally has to approve work programs, budgets and contracting activity applicable to the whole venture.

Alternatively a fully incorporated legal vehicle can be set up with participants holding conventional shareholding interests in proportion to equity. The company thus established has to be staffed, often with a mix of secondees from the shareholders, with its own recruited employees, with professional contractor or consultant staff and with agency personnel.

As a result of these partnership conventions it is necessary that alignment of purpose exists amongst the participants in the venture and that the activity fits within the individual participants' business strategy: this is particularly important with respect to funding the joint activity since a dissenting participant can disrupt the activity proposed by the Operator who is charged with expeditiously pursuing the opportunity and complying with the terms of the concession / license.

With such partnerships there is the need for an executive or corporate champion within each participants' entity who actively supports and promotes the venture and who aligns with fellow champions. Without this level of support it is possible that an individual participant might press for a certain agenda or seek to impose new or additional demands on Operator which might cause distraction to an agreed strategy or business plan. This issue applies both when International Oil Companies (IOC's) are working together and when a National Oil Company (NOC) is involved since there can be shifts in National political agendas or changes in funding priorities that can impact an agreed joint plan of action after the fact.

When we look at the risks faced by these arrangements to the success of the joint venture intent we can envisage cases where the designated Operator might press for his own company's agenda - which could include a political agenda or could include for preferential use of company affiliates for services to the JV - which might or might not be fully competitive. It has to be recognized that the Operator or incorporated legal enterprise is in a strong position to press forward with its own preferences since it has all the knowledge available to it first hand, yet this is offset by the control exercised by the management committee of participants or the shareholders, as the case might be. On the other side of the coin the risk exists that one or more participants might seek to interfere with plans and budgets put forward by the Operator, e.g. by withholding their approval, in order to try to force a shift to a different agenda. This can be because of genuine concern that the Operator is deviating from a desired course of activity or because participants have a conflict externally which they are trying to resolve.

This latter case gives rise to a systemic risk with these joint ventures: participants, whether they be the Operator, the other non-operating parties, and whether they be IOC's or NOC's; they will inevitably have business interests outside of the present venture which might impinge positively or negatively on it. This situation is usually called "conflict of interest" but can be more subtle, or more direct. As an example, if an IOC takes over another company which holds a JV interest in an area competing with the parent company's activity; so it might seek to slow down the JV activity it has acquired since it competes with its existing position and, again, there might be internal competition for funds. A company might decide that a certain region has an increased risk profile and therefore wish to reduce its exposure for a period to see how things evolve. And, in another example, a company might be individually committed or incentivized to perform activities under a license or permit in country and therefore press a JV Operator to speed up activity which can be recognized as contributing to fulfilling company's commitments.

Possibly a more common case arises when one or more participants expect that oil prices are likely to fall, for example, and wish to delay activity until a higher price is to be expected. If other participants do not share this view then friction can occur.

Hence the reality of differing strategies, tactics and external business interests of individual JV participants represents a risk to the success of any JV arrangement and can be considered a systemic risk since the characteristic is that such risks cannot be readily managed by the Operator or by other participants or shareholders.

4) Management team capability and affiliation: We have noted that a JV or other vehicle might be staffed with a mix of secondees from the shareholders, with its own recruited employees, with professional contractor or consultant staff and with agency personnel. The senior management of the Operator or legal enterprise will often come from the original concession holder or the entity with the majority interest in the venture - but not necessarily. Disregarding the issues of relative competence of one individual over another, there still will exist the “principal / agent” problem where allegiances are torn between what one knows as one’s parent company position and what is best for the venture one is temporarily assigned to. Common practice is that individuals who are seconded to a joint effort are expected to perform, and should be rewarded, with that venture’s best interests foremost and leave it to others - for example, the parent company’s “asset team” - to formally engage with respect to the interest held by the parent company in the venture.

Another risk is that the JV may not be adequately resourced in timely manner at the outset or as needed to meet project milestones, it may have varying levels of competency, may contain experienced functional managers but who may not necessarily have multi-functional team experience or be capable of General Management or may not have experience as senior management team members. And, whilst team members’ backgrounds - if sourced from Shareholder companies - will have differing cultures, biases and systems knowledge that are not all compatible, at least the diversity is a benefit if it is not a distraction or source of debate inside the joint venture. Also there is a challenge of having staff in different locations: often project and / or management team members are located in different locations leading to poor communications and inefficiencies. This aspect is one risk that is widely acknowledged as to be avoided if at all possible and is largely controllable.

5) Receptiveness and culture of host governments: It is not to be assumed that there will be a mutuality of expectations and values between investors and host governments; how host governments intend to evaluate success can be quite different from the “Wall Street” approach. Also, investors should be aware of competing projects vying for government support, the potential for inadequately defined and shifting fiscal and regulatory terms plus the potential for accepted fiscal or regulatory terms when FID decision is made to change over time. It is questionable too if there will be any meaningful / enforceable rights beyond a comfort letter that might be issued by a host government. Also relevant is an understanding of the fiscal environment with respect to currency exposure, repatriation of funds, dividend restrictions, acceptable funding options, conventional terms of trade, etc. Further, one needs to consider the potential for application of production limitations or other quotas - e.g. if OPEC member and applicability of price controls / deemed prices for crude oil or gas sales to third party or to affiliates. Overall the scale of oil and gas operations, the fact that the resources are under ownership of a sovereign state and the value of the commodity on the global market is such that sharing of economic rent is a critical issue for both the host government and for the IOC. The government usually has the upper hand and might view an IOC as simply a contractor - and one of many that can be engaged to exploit and commercialize its hydrocarbon resources.

Risks can be summarized as relating to the classic “landlord / tenant” relationship, where interests are largely mutually opposed with the control and share of the economic rent at center of all issues. And whilst fiscal terms, regulatory issues, model agreements, etc. will be investigated at the outset of any commitment by investors, there is always a possibility for change to occur at a later date, hence giving exposure to political risk. This, is applicable to all concession / license holders in the country and therefore represents a systemic risk.

6) Contracting & procurement activities: The risk here is that conventional, tried and tested, international practice in contracting and procurement might not work out when the market is approached - for whatever reason. The consequence is the need for a rethink (with loss of time) on strategy to achieve the desired result. Again alignment with host government or NOC as to acceptable contracting and procurement practices should be validated early on to avoid recycling. A fundamental issue in developing the contracting policy for a major project is allocation of risk. Whilst it might seem obvious to place most risks onto a contractor this would entail higher costs and contingencies being factored in and does not recognize which party is best able to manage each risk. The potential for conflict is high with this approach and the knock-on effects to schedule can be imagined.

Examples of risks in this area can be (i) limited number of bid responses because, e.g. consolidation amongst bidders or mutual agreements amongst them not to compete with one another or refusal to bid because of concerns over country / political risk or refusing to bid since another more interesting project is being bid for, (ii) bidders not willing to accept terms requested by customer - and are able to do so because of supply/demand considerations; contractors / suppliers can call the tune, (iii) challenge of client being able to provide accurate and high quality of information e.g. with respect to site soil conditions, which might not be adequate for a lump-sum contractor to provide required guarantees or be adequate to avoid variation orders later in the day.

The industry is faced with the systemic risks from contracting and procurement activities since there are limited numbers of international contractors looking for work right now.

7) Identification of all stakeholders: This aspect goes beyond the regular cluster of joint venture participants, equity shareholders, lenders, customers, suppliers, contractors, government authorities (national, regional and local) and stakeholders who do not have a direct stake in the venture's outcome but are nevertheless influenced by the activity and are able to influence, for better or for worse, the activity.

Other stakeholders include e.g. press and media – local, national and international; NGO's active in the region or in the oil and gas sector generally, clearly including those with social and environmental remits; those communities at or close to the site of the oil and gas activities who might be directly impacted (e.g. by land expropriation, disturbance, noise, hindrance to normal work, livelihood, social routines) or indirectly (e.g. by having to endure various inconveniences).

With respect to local communities an appropriate relationship can be an agreement to social programs of sustainable nature that in principle provide for an economic spin-off to legitimate and affected communities.

The main risks in this area are failing to recognize both bona fide and other stakeholders who can influence the venture's activities in some way if their relationships are not adequately understood and addressed. Whilst this is usually relevant for the potential that exists by some parties to cause disruption, one needs to be aware of broader implications to the public, industry and stock market reputation of equity shareholders and to the incorporated joint venture (if one exists) such as non-adherence to Equator Principles - to the extent they are applicable.

Whilst the risks outlined relate to the nature of the project in its location the risks to reputation can be wider and can affect the whole industry if, for example, one company is accused - fairly or unfairly - of pollution then a systemic event can occur by extension that all oil companies pollute and therefore an adverse public and stock market reaction can be predicted and regulations most likely tightened.

8) Effort needed to establish enterprise investment vehicle: There are challenges if an incorporated legal entity (versus an unincorporated JV arrangement) is to be used as the vehicle for developing a project or other opportunity: there is the time and effort needed to set up, agree and implement the necessary articles of association, corporate structures, systems, organizational structure, delegation of authorities and to conform to all legal, tax, fiscal and regulatory standards applicable. A governance document containing the rules for Board Meetings and for Shareholder involvement needs to be drawn up as well as nomination of directors, senior managers and establishing various Board Committees.

The main risks to be considered relate to (i) achieving full agreement amongst shareholders as to the requirements and specifics of all components of the incorporated venture in a timely manner, and (ii) developing a workable solution that is efficient and does not end up lacking clarity such that distraction and delay occurs with trying to solve process type issues. Potentially, any new corporate entity, particularly if it is nothing more than a special purpose vehicle (SPV), can be difficult to manage if there are differing intentions and motivations amongst shareholders and management of the enterprise; e.g. disagreement about exactly who has authority to do what can be a source of friction between the management team and the shareholders.

In extreme cases one can imagine that the working relationships of the participating shareholders in the particular venture could be at such a level of confrontation that it spills over to other relationships that they have in other areas and takes on a negative connotation for current and future mutual arrangements. This is not quite a systemic risk - of the whole industry sector - but can be a risk that migrates beyond the boundaries of the particular activity and location.

9) HSE issues: The oil and gas industry has the tendency to be cited by the media as one of "high risk" and as such any events like inadvertent discharges of hydrocarbons, fires, explosions or fatalities are usually give high and adverse publicity which serves to demonstrate the view of inadequate attention to Health, Safety and Environmental (HSE) matters by management. Whatever the statistics for the industry might actually show with respect to HSE incidents the topic needs to be adequately addressed by a dedicated team reporting to the MD or equivalent.

Separately, there is the need for professionally produced Environmental, Safety and Health Impact Assessments (ESHIA's) to be developed for the project and for the associated management plans that will achieve the objectives.

Managing HSE, along with other high profile issues, has an impact on public perception of the industry: a fatality or oil spill is bad news and can easily result in a company's reputation being damaged. This means that remedial actions will be needed, costs incurred (possibly fines) and procedures will need to be tightened. Publicly traded companies might see their stock value decline as a result.

Risks from HSE incidents, and from poorly responding to incidents, can have adverse reputational impact on the enterprise and its shareholders with the potential that a single event can be taken by outsiders to prove the case that the industry is unsafe, dirty and irresponsible. A systemic risk could occur if regulators perceive that HSE rules need to be tightened throughout the industry in response to a major incident or series of events .

3. MORE CHALLENGING COUNTRIES / LESSER DEVELOPED COUNTRIES (LDC'S)

1) National (state) oil companies (NOC's) as imposed partners: We have already noted that JV's or other configurations are common practice in the industry and that there are risks that an individual participant might press for a certain agenda or seek to impose new or additional demands on the Operator and that this applies both when IOC's are working together and when an NOC is involved since there can be shifts in National political agendas or changes in funding priorities that can impact an agreed joint plan of action. LDC's are more likely to have NOC's in place who function in a variety of ways giving rise to some specific risks: (i) an NOC may largely be an administrative arm of government and function as a ministry whose job is to allocate funds to its constituency and who has no receipt of revenue from the oil and gas production activities it oversees as such, hence it can behave simply in a bureaucratic manner devoid of any serious engagement in the business of oil and gas exploration and production or downstream production and marketing of products, (ii) often approval processes even for travel and attendance at meetings out of the headquarters location can be long-winded with long lead times for approvals being required and then often only the very top official having authority to approve any sort of commitments, (iii) a more independent NOC might behave as a frustrated IOC and constantly be in confrontation with its masters in government as to oil and gas policy, strategy and prioritization for funding and effort, (iv) a dictatorial NOC might see its role as one of extracting as much of the economic benefit from the concession or license holders as possible, finally (v) an NOC might be little more than a controlling, regulating body that oversees the industry and is constantly asking for data and challenging assumptions, plans and execution programs.

Risks inherent in the above situations are apparent: risks of delay from obstruction and red tape, misalignment of purpose, pressure on margins and shifting interpretations of rules or approvals.

2) Sharing of economic rent between the enterprise and the sovereign state: There are fundamentally opposing stances of the enterprise partners / holders of a hydrocarbon concession or license who have permission to search for, extract, process and sell oil and gas and the sovereign state which owns the resource. The value propositions of each party focus on a fair and agreed share of the economic rent that is obtained when hydrocarbon in the ground is raised to surface, treated to sales quality and its market price realized. Because the value increase is so much - from oil in the ground to oil loaded on the ship, the sharing of proceeds is a major issue. A sovereign government will invite an IOC to bid for hydrocarbon concessions on the basis that it itself does not have the technical expertise, the financial resources or the appetite to conduct the prospecting and extraction activities itself, whereas the IOC has the choice of applying for and signing up to an agreement to do just this - but is aware that many other countries are in a similar position such that there is a market for the services of an IOC as a contractor to extract sovereign hydrocarbons.

Risks are not necessarily that economic terms are too onerous in hydrocarbon owning LDC's - since these will be published ahead of IOC expression of interest and will evolve during negotiations anyway - but that terms will change later once the IOC is "on the hook". The classic risks are that the fiscal regime or some fundamental license terms are subject to change with no appeal: e.g. if royalty rates, corporate tax rates, new / special taxes on hydrocarbons are enacted, if rules regarding relinquishment of fallow acreage or enforced sharing of producing facilities or infrastructure are legislated, etc. then the risk to the IOC of diminished returns is likely. An LDC will usually have expanding needs for funds for social and investment programs and will often see IOC's as capable of being squeezed a bit more.

Interestingly at the other end of the spectrum in mature areas where hydrocarbon exploitation has been underway for 40 years or so and field sizes are smaller and exploration and production more costly, a developed economy might well see the need to offer incentives to oil companies to continue searching and producing for hydrocarbons since the industry itself, now mature, offers continuity of employment on a significant scale and can possibly contribute to a national trading status of oil/gas exporter versus one of importer.

When operating in LDC's the main risk is that the value of the IOC is not fully appreciated and that once granted a hydrocarbon license and having something to lose, the IOC can be leaned on to give more contribution to state coffers in one form or another.

3) Contracting processes not always efficient: Transparency in contracting and procurement is a watchword with international oil and gas companies - basically to act fairly, keep within the law and to get the best prices for work that it contacts out for. The mutual relationship between IOC's and major international contracting firms such as drilling services, EPC contracting, supply of linepipe, rotating equipment, ships, boats, helicopters, etc. is best maintained by fostering good and professional relationships.

However, the issues hence risks associated with working in LDC's can be that (i) non-competitive tendering processes are preferred - often associated with limited bid lists - which might deliberately favor local suppliers and which might not bring in competitive pricing or deliver on quality / specification requirements, and (ii) tough negotiating stances can be more prevalent such that rock bottom prices are forced upon suppliers and / or fixed price lump sum contracts which have little chance of being delivered as per the contract giving rise to disputes, delays and cost overruns in the end.

A systemic risk can arise if such attitudes force international contractors to decline to bid in the LDC resulting in all operators there suffering.

4) Local manpower skills, availability: With respect to project and contract management, construction activities, plant operations, general business management and rank and file staff activities, LDC's probably have a limited pool of skills to call upon. Indeed, there might be an established workforce of oil and gas professionals and managers engaged in the industry but not actually an employment market as such. The consequence is that (i) poaching of staff might occur and (ii) individuals taken on with qualifications and experience might not measure up to expectations comparatively within the international oil and gas industry. The context in LDC's is such that blanket employment of expatriates might not be welcomed and that international expatriates often have global choices for employment and command high salaries and compensation if employed in LDC's.

The risks that the above imply are that extensive recruitment and intensive training can be needed in order to staff up for all phases of the activity conducted in such an environment. The time and cost issues are one thing that needs good planning as well as how the process will be conducted and who and where it will be done. Again, there are risks that fallout will occur or trained individuals will still lack hard experience and possibly make mistakes if not adequately supervised.

Across the industry sector within an LDC this handicap represents a system risk.

5) Influx management: In an LDC, once construction activity gets underway, and later when an operating plant is commissioned, there is potential for influx of villagers and other opportunists who see the potential for selling items or services or just hoping to be on hand to get employed, earn some money or otherwise take advantage of the situation. Quickly, unauthorized settlements can be established with the resultant mess, chaos, disputes, fire hazards, etc.

The risks are not just one of general inconvenience but of potential adverse impact on the reputation of an IOC for a well-managed and organized operation.

6) Basic infrastructure: The availability, reliability and adequacy of such fundamental services as electricity supply, potable water, sewage treatment, drainage, along with adequate roads, ports (air and sea) plus the existence of police / security services can all be subject to great variability in an LDC environment. Importation problems for equipment, e.g. delays in port clearance and settlement of customs duties can also give rise to additional risks that have to be recognized.

Correspondingly, the risks are that external obstacles to routine business activities - whether of construction or operational nature - can exist which can interfere with the implementation of business plans.

7) Aggressive domestic gas policies: For a variety of reasons, LDC's generally are currently pursuing somewhat aggressive domestic gas policies which give rise to a further dimension of risks and uncertainties for gas producers. Examples of increasingly aggressive domestic gas policies are apparent in e.g. Nigeria, Trinidad, Indonesia, and Egypt. Correspondingly fiscal terms for gas, if they previously existed or not, are being tinkered with since gas exporting countries do not necessarily see gas export as just another business to be taxed like regular corporate entities but one that, as noted previously, sharing of rent and capturing a significant part of net income to the State is of paramount importance - whereas in mature, developed countries, the gas business has no special attribute to warrant it being the focus of government attention and an open competitive environment allows for domestic and export businesses to work side by side without heavy intervention.

LDC's may be pursuing such a course of action right now because: (i) they see the need for gas utilization for expanding demand for power generation, (ii) they are taking action to put flares out (for economic as well as for environmental needs), (iii) industrial expansion opportunities can be driven by gas (e.g. cement, iron/steel, glass sectors), (iv) potentially the application of a previously underutilized resource can be applied to supply energy needs in the broad commercial, industrial and, ultimately, domestic sectors. LDC's might also believe that gas is a cheap resource since it is either wasted (flared) today or is a by-product of crude oil. An assumption that gas should be cheap, however, denies the cost of capital plant for gathering, processing gas and for storing Natural Gas Liquids (NGL's) and for infrastructure development (high pressure trunkline and lower pressure distribution networks) and for returns on investment given a typical long, slow and unpredictable demand build up.

Consequently, risks can arise with respect to pricing of gas to domestic users - the basis of pricing is a very debatable point which might end up being an imposition by government that suits local customers but does not offer a realistic return for investors. Unclear fiscal terms for gas generally, including for NGL's, and the regulatory regimes applicable to domestic gas can all give rise to additional risks and uncertainties. All in all this situation makes it very difficult to assess a project's economic value.

4. NIGERIAN BUSINESS ENVIRONMENT

1) Shifting gas policy: With one of the worst gas flaring records of any oil producing country: 2+ BCFD gas flared, Nigeria has sought on and off to encourage gas utilization schemes with "flare-down" as the driver. Some JV Operators signed MOU's in late 2001 with the Federal Government to conduct studies to look at gas utilization projects, specifically LNG projects, along with proposing how the supply would be realized.

In 2005, under the previous (President Obasanjo) administration, new aspirations for natural gas were mandated to end gas flaring and to capture economic value of gas both from domestic and from export markets. To achieve these ambitions a new gas policy was defined which included downstream gas fiscal reforms, Deepwater gas fiscal reforms and a Downstream Gas Act. A Government target to stop flaring set for the end of 2008 has not been met and has been revised to the end 2010 with penalties for contravention.

The new Federal Government under President Yar'Adua (from 2nd qtr. 2007) produced a 7-Point Agenda for the Nation of which the first Point was Power and Energy: to achieve power sufficiency in the Nation thereby driving the domestic economy. Consequently the Government in early 2008 mandated industry to strategically refocus gas utilization towards domestic use for power generation over export projects: plans would be required to be submitted by operators by October of that year.

A domestic gas supply obligation which mandates all oil and gas operators in the country to set aside a pre-determined amount of gas reserves and production for domestic use has now been introduced. The Minister of Energy (Gas) said that domestic gas supply to power generation is a priority over any LNG project given that the country needs power and that companies must raise the portion of gas allocated to domestic use every year until 2015. The domestic supply obligation empowers the Minister of Energy (Gas) to stipulate the amount of gas required for a period of 5 to 7 years taking into account the domestic economy and the aspiration for rapid industrialization. Operators who do not comply with these obligations will face fines of \$3.50 / mscf.

Earlier this year an updated "Gas Master Plan" (GMP) has been approved as Government policy which calls for an infrastructure blueprint comprising gas gathering and 3 central processing facilities which will extract liquids and produce dry gas to be fed into a gas transmission network. To enable these plans to be achieved franchises will be awarded for the central processing facilities and existing operators will be encouraged to invest in gas to power projects.

2) Government funding for industry via NNPC: Another challenge in Nigeria is that the State owned Nigeria National Petroleum Corporation (NNPC) is a majority partner in all upstream joint ventures and therefore has to contribute up to 60% of the JV funding requirement and whilst this concept is not uncommon in other countries, funding for NNPC comes from the Federal Government and in any year Federal budget priorities may not always be targeted for the oil and gas industry. Consequently the upstream industry has always experienced restricted funding (and late funding) from NNPC which has contributed to the flare-out deadline not being met even though various gas utilization projects have been committed to.

Late funding (e.g. Nigerian 2009 Appropriations Budget was approved on 12 March) and underfunding of NNPC is a constant issue that causes delays to project schedules. As a result in the case of upstream activity IOC Operators are increasingly drawn into carrying NNPC's interest and recovering it by some production volume / revenue mechanism in order to achieve project timelines and to assure predicted economic outcomes.

However in Nigeria history has shown that funding is achieved at the end of the day and very few projects have not been realized despite significant delays.

Another real case where funding is an issue is where an approved project proceeds but costs escalate significantly such that NNPC balks at paying its share of the increase and accusations of mismanagement by Operator have been levied.

3) Political stability / relationships between industry and stakeholders: Nigerian has seen military governments and democratically elected ones, including cases where election results have been challenged. Changes of government have not necessarily meant fundamentally different approaches towards the oil and gas industry and politicians of all factions appear to understand where Nigeria's economic wealth lies and that the oil and gas operations, with the presence of international companies, are best maintained in a relatively stable mode as far as possible. However the implications of changed administrations are that a new administration has to be introduced to the current industry ventures and capital projects such that support can be garnered anew given that some suspicion usually exists as to the relationship of the prior administration and its decisions with respect to capital investment projects. Such re-education and getting support can cause a hiatus to the project's progress. Again, with change of government often comes a change to NNPC management with the resultant delay in getting new individuals up to date and supportive of the status quo of ventures and capital projects.

Political objectives may differ between the Federal Government and State Governments - which are the ones in whose territory the oil and gas operations physically take place and who act as sponsors to the IOC operators. But sales of crude oil accrue to the Federal Government and it is only by derivation from the national budget that individual States enjoy a share of the oil revenues. Given that the onshore oil producing states are located in the Niger Delta, which is one of the poorest, underprivileged areas in the world, sharing of Federal funds with the States and then allocation to regional and local communities is a source of constant battle and accusations of misappropriation of funds, corruption and violence.

As a consequence social unrest, militant action, criminal activity and sabotage are present in the Niger Delta to an extent that today significant volumes of oil production are shut-in because it is unsafe to access the locations and because of threats to company assets and personnel. Armed militants are in control of some oil fields and illegal oil bunkering operations are taking place which the Nigerian law enforcement authorities seem incapable of dealing with since they are often not as adequately armed compared with the militants.

Further risks can be noted that potentially downstream locations, outside the Delta, can be subject to militant spillover and receive threats or direct action if operators are perceived to be unfairly treating local communities from whose land hydrocarbon wealth is being extracted. But in the majority of cases agreements with host communities can be made by way of Memoranda of Understandings (MOU's) which are signed to recognize a mutual dependency but these may be challenged or become a constant source of disagreement or different interpretation or subject to obstacles between different factions or groups such that a mood can prevail "that if they get it, we are entitled to more". It is not unknown in Nigeria for a community who has benefitted from an industry investment in a school, hospital or public building, etc. to find that it is destroyed by a neighboring community who feel neglected or have need to retaliate for some other reason.

Hence there are overall safety and security concerns for personnel and assets: Nigerian standards in these areas may not be adequate and attitudes may differ from those customarily expected, including events of criminal acts and sabotage. It is possible that, for example, EPC and other contractors will build-in risk premiums to their bids for Nigeria work in the expectation of loss, interruption or the necessity for rework because of these concerns.

4) Nigerian content / Nigerianization / expatriate quotas: Regulations in Nigeria impose obligations with respect to use of local contractors for supply of goods and services, direct employment of Nigerians and the number, type, qualifications and duration for expatriate workers.

Compliance with the Nigerian Content regulations can be achieved on paper but quality and timeliness of delivery of goods / services and adherence to required standards of HSE or construction by local contractors might not be realized and disputes can easily arise. Very careful screening of bidders is necessary at the pre-qualification stage to ensure that a bid is technically valid and then the price is realistic so that it can be awarded with confidence and that delivery will be realized.

With regards to Nigerianization, the time and cost needed to recruit and train local personnel for managerial, staff and plant operating positions needs to be factored in; there is no ready market to recruit from for many functions that are needed in the industry. Leaving this obligation to international contractors might not work since they do not necessarily have the Nigerian experience to address the issues and are more likely to want to bring in expatriates from other countries as temporary skilled labor during plant construction, for example. For greenfield sites under construction or for ongoing operations the employment of Nigerians will raise the issue of company provided housing, medical facilities, family or single status for employees, schooling provision and so on, particularly for the remote areas. All these need to be considered and agreed since expectations will be at the high end for those locals fortunate to benefit in some way from the activity. Again, employee representation (both for blue and white collar workers) is active in Nigeria - so this needs to be recognized in connection with employment of Nigerians.

Finally, there are Nigerian quota obligations for expatriate staff taken on by the project or venture - this being the other side of the coin to Nigerianization which can imply that an expatriate position might be approved provided an understudy of a Nigerian is employed simultaneously. This is an issue that adds cost and requires managing on an appropriate scale to comply with the regulations.

5) Health issues: HIV/AIDS is prevalent in Nigeria as is Falciparum Malaria. Consequently training in awareness and use of prophylaxis should be mandatory for employees as well as quick access to clinical facilities for testing and diagnosis of cases. The risk for employers is that foreign individuals and contractors might not be willing to locate to Nigeria for work or might not accept the imposition of daily / weekly medication to avoid malaria. Generally standards of hygiene do not match up to international standards and hazards from pollution (air, water) are abundant with inadequate clinical facilities particularly in remote areas such as construction sites.

6) Climatic conditions: The tropical climate giving rise to wet and dry seasons plus the potential for severe weather without adequate warning add another dimension to operations in Nigeria. Frequently construction activity and movements of goods and personnel (by land, water, air) are hampered by sudden extreme weather and the wet / dry seasons as such need to be factored in with schedules so as to operate as efficiently as possible.

5. LNG LIQUEFACTION PROJECTS IN NIGERIA

At the end of 2008 Nigeria was the 5th largest global LNG producer supplying 10% of the world's supplies - from Nigeria LNG (Bonny Island).

Interestingly Nigeria as a hydrocarbon province is gas-prone despite some 40 years of oil exploitation and associated gas flaring. Government estimates are that some 180TCF of gas reserves are available for economic development,

however, as already mentioned the current emphasis is for internal use of gas for power generation versus export earnings from LNG.

(i) NLNG (jointly owned by NNPC (49%), Shell (25.6%), Total (15%) and Eni (10.4%))

Nigeria LNG Limited (NLNG) located on Bonny Island, Rivers State has been the pacesetter not only in establishing Nigeria as a significant LNG exporting country but as a significant force in a global LNG context.

Discussions regarding an LNG plant on bonny island started in 1978 but stalled in 1981, however, these were revived in 1984 leading to the incorporation of Nigeria LNG Limited by 1989. Duly, the Final Investment Decision (FID) for the base project of 2 trains (each train of 3.3 million tones per annum - MTPA) was taken in 1995 leading to first LNG production in 1999 and in the same year the decision for a third train (3 MTPA) was made which came onto production in 2002. This year also saw the FID for trains 4 and 5 (4.1 MTPA each) with start-ups in 2005 and 2006 respectively. Meanwhile, 2004 saw the decision to commit to train 6 (4.1 MTPA) which came onto production in 2007. Total capacity of the 6 trains is approx. 22 MTPA of LNG.

NLNG is clearly a success story for Nigeria.

NLNG have further announced that plans for building Train 7 (8.4 MTPA), that will lift the total production capacity to over 30 MTPA LNG by 2011/12, are at an advanced stage. However, timing of approval is subject to some uncertainties. Whilst development work started in 2005 it is now recognized that potential shortfall in gas supplies could be a problem; at a presentation to the Nigerian Minister of State (Gas) in April 2008 the gas supply arrangements and the funding of the gas supplies were cited as obstacles to project approval and more recent concerns are believed to relate to (i) security in the Niger Delta (gas supply pipeline vandalism and other militant actions forced NLNG to declare force majeure from November 2008 till March 2009), (ii) Government revisit of National gas strategy with strong focus on domestic gas / power generation, and (iii) uncertainty over NNPC restructuring and its fall-out.

(ii) Brass LNG: (jointly owned by NNPC (49%), Eni (17%), ConocoPhillips (17%) and Total (17%))

This project is to be located on Brass Island in Bayelsa State near to the existing Nigeria Agip Oil Company's (Operator of JV oil production venture with NNPC) oil terminal.

Conceptualization of the LNG project took place through end 2002 and a team was established during 2003 for the FEED and EPC Phases. Chevron joined later in 2003 and remained a shareholder until mid-2006 when they pulled out in favor of the OKLNG Project whilst the French oil company Total backed-in to take over Chevron's interest and the gas supply opportunity.

Project sanction was expected in early 2006 for the first two trains (5 MTPA each) with start-up originally planned for 2009, however, this fairly soon shifted to 2011 as commercial and engineering delays were encountered and in mid-2008 it was estimated by industry commentators that a start-up date of 2014 was more realistic. In March 2009 the project was still awaiting sanction citing delays in getting full commitments for its gas supplies. Other sources quoted that the delay was also due to uncertainties with regards to the Federal government's finalization of the Gas Master Plan and how the strategic split of gas to supply the domestic market, with a priority on gas to power generation, versus gas for export projects would be determined. Recent information indicates that FID is to be targeted by end 2010.

The Brass business model includes for DES (Delivered Ex-Ship) sales of LNG - essentially a CIF arrangement with provisions for destination flexibility.

Meanwhile, a recent step forwards was achieved in April 2009 with approval being granted for the project to have its own direct port status.

(iii) OKLNG: (jointly owned by NNPC (46.75%), Shell (19.5%), Chevron (19.5%) and BG (14.25%))

Following preliminary work in 2005 a formal agreement amongst the partnership in early 2006 established a project team to define a two train LNG project, expandable to 4 trains (each train of 5.5 MTPA) by end of 2006 such that project sanction could be taken in mid 2007 and first LNG on the market in early 2011. In early 2007, with the establishment (late 2006) of the corporate entity, OKLNG Free Zone Enterprise, and the signing of a shareholder agreement, project sanction was reevaluated in light of technical issues and new effort was undertaken to apply value improvement practices that would target cost reductions and improve economics.

Current industry reports are that delays due to political uncertainty, funding issues, capital cost challenges, security concerns in the Niger Delta and the need to secure a reliable supply of feedgas have pushed the 1st LNG date back to mid-2015 at the earliest and that further delays are highly probable.

Sale is FOB to shareholders in proportion to level of equity

(iv) Others: Conceptualization of other LNG projects has been reported: Progress LNG (offshore floating project) and Nnwa/Doro Floating LNG plus an ExxonMobil LNG Plant on Bonny Island.

6. UNIQUE RISKS AND UNCERTAINTIES FACED BY NIGERIAN LNG LIQUEFACTION PROJECTS AND CONSEQUENCES FOR DECISION MAKERS

1) Gas supply availability: (i) Definition of gas supplies for the plant, which are from multiple fields or JV sources, and probably not from dedicated fields / resources, (ii) conflicting demands for reservation of volumes for domestic gas obligations versus for LNG export projects - given the current priority attached to domestic gas for power generation by the Government - along with the uncertainties as to the volume requirements and timing for the future, (iii) obtaining acceptable reserves certification at the outset and agreement how to handle shortfalls or increases that might surface in the future, (iv) obtaining delivery volume commitments in line with acceptable contractual and technical considerations that facilitate the LNG sales contracts and reasonable design conditions for the plant (turn-up, turn-down), (v) all the above will have to be acceptable to lenders with respect to project financing stipulations.

The key decisions flowing from the above risks and uncertainties relate to the finalization of the plant basis of design, the timing of FID, once reasonable clarity as to supply volumes and timings have been determined, and assurance of the feasibility of borrowings under acceptable terms.

2) Construction issues: As with the rest of the industry, the EPC Contracting sector has seen some consolidation over recent years resulting in a limited pool of international contractors which has reacted to last year's oil price escalation as expected with higher price quotations. Demand for construction services and for materials exceeded supply in 2008 and contractors were able to be selective about which job they chose. In Nigeria, quotes for all the 3 LNG projects under consideration have significantly exceeded expectations. It is clear that (i) some contractors are able to refuse to bid for work in Nigeria since they have easier locations available to them, (ii) if they do bid they will apply a significant premium for Nigerian safety, security and local content burdens which they see as adding additional layers of risk on their side, (iii) they will balk at providing full wraps (performance guarantees) and / or bidding on a lump sum turnkey basis.

Consequently for the owner the key decisions relate to overall contracting strategy, type of contract (which reflects the risk allocation between contractor and owner), timing of the bidding process and ensuring award to a qualified contractor / consortium. Achieving a timely buy-in from NNPC in these areas has to be achieved since a preference for lump sum turnkey bidding and maximum Nigerian content is considered the norm.

3) Capital Costs: Globally these have risen significantly for LNG liquefaction projects from below \$200 / MTPA of installed capacity in 2004 to well above \$1,000 / MTPA today, however, the recent dramatic fall in oil prices in the last 12 months, the deferral of projects for various reasons and the reductions seen in some raw materials and labor costs are now being seen coming through such that construction cost indices used in the industry are reflecting a downturn at long last. It is fair to say that the Nigerian LNG projects on the drawing board have all been victim of the overheated EPC contracting market and are contemplating what alternative approaches are open to them whether this means revisiting the plant concept, reviewing contracting strategies or taking a breather to wait and see.

The key decision under this situation is when to ramp-up effort towards FID given (i) the lead time of at least 1 if not 2 years to modify and revise FEED work (if this is contemplated), (ii) to finalize and negotiate commercial agreements, and (iii) to re-engage with lenders under the still uncertain credit environment. Coupled with this, decisions are needed with respect to the CAPEX to be utilized in the economic assessment of the project's viability; whilst deterministic and probabilistic analyses will be conducted, provision should be made for a stress case with CAPEX significantly overshooting resulting from any cause but, most likely, from excessive variation orders to EPC contracts (disregarding who is at fault for any such variations).

4) Conflict between NNPC / Government and IOC Goals: State-owned NNPC is directed by the Federal Government with respect to energy policy implementation and funding of the oil and gas industry - which while being largely operated by IOC's has NNPC as the majority partner.

Current government policy relates to (i) prioritization of gas supply to domestic needs versus export earnings from LNG, (ii) application of the Gas Master Plan which envisages the establishment of several Central Processing Facilities in which to gather and process gas to remove liquids producing a lean sales gas product thereby denying the extraction of liquids and capturing the associated revenue stream in LNG plants, (iii) conception of a Trans-Saharan Gas Pipeline which would allow for sales gas exports to the southern Mediterranean for onwards transfer to the European market, (iv) allocation of Federal budget funds - somewhat reduced as the oil price has declined from last year - to national priorities that appear to place LNG in the lower tier, and (v) moves to reorganize NNPC and various adjacent bodies to make them more efficient and accountable.

Meanwhile, it cannot be assumed that IOC promoters of the Nigerian LNG projects and as gas suppliers are necessarily fully aligned with each other as to business agendas, project priorities and timelines.

The upshot for decision makers is to try to gauge when clarity and stability has been achieved in government energy policy and its intentions have been legislated and NNPC are behaving in accord with such. Discussion amongst IOC's with respect to an individual LNG project should then be undertaken and if no alignment then reconfiguration of the

associations should be considered to enable those willing to proceed to do so and dissenters to part company. As a result, a new approach to government for support can be undertaken on a broad front aware that bureaucratic processes are long in Nigeria and, importantly, should a new administration or new high officials be in office by that time a process of orientation and garnering support will have to be undertaken in competition with other projects, interests and political initiatives.

5) Gas prices and increased gas price volatility: For export projects the issue of long term international gas price projections - whether based on Henry Hub, National Balancing Point or Japan Crude Cocktail - for DES / CIF sales or for netback formulae in the case of FOB delivery, is one that is usually solved by use of in-house or reputable consultants' projections or by taking a deliberately conservative trend based on history (often the approach taken by lenders). However, there is additional uncertainty related to increased volatility of prices, yet this is true generally for commodities, currency exchange rates and so on. We are going to have to live with this and to develop and apply models that give reliable long run price projections within bands of volatility perhaps derived by empirical means.

We are aware that CAPEX has responded to oil price increases and it can be expected that international gas price developments in general will be duly reflected in gas supply costs, overheads and plant maintenance costs.

For Nigerian domestic market sales transfer prices are under evaluation in connection with the GMP and its blueprint of 3 central processing facilities. Whilst it has been indicated that there is an intention to progressively move transfer prices up towards international levels expectations are that domestic users' ability to pay may be overriding.

Decision makers should not need to be concerned with absolute or relative levels of prices emanating from forecasts; more with the overall economic indicators for the project. However, decision makers should be comfortable that the price projections have been reviewed or independently derived and validated so that they are fit for purpose and within the limits of accuracy applicable to other parameters.

6) New / extended technology requirements and acceptability: (i) LNG is produced by cooling the gas in a series of refrigeration trains. The configuration of the heat exchangers and the refrigerant used is subject to proprietary know-how and licensed processes of which there are only a handful available with two main processes (or variants thereof) largely in use today. The size of a refrigerant train is essentially determined by the size of the refrigerant compressor and its driver (usually a gas turbine) which are manufactured in standard frame sizes for general industrial use. Pressing the limits of the equipment, hence train sizes, should result in economy of scale and hence lower capital cost per tonne of output: needless to say this approach has been pursued aggressively by the industry. The current generation of trains (1999: NLNG and Atlantic LNG) were set about 3 MTPA but these have risen today through 4 and 5 MTPA, with different turbo-compressor frame sizes and heat exchanger configurations, to beyond 7 MTPA per train. Another approach uses aero-derivative engines as drivers. It can be imagined that every step of the way industry has been "pushing the envelope" to design bigger and bigger trains each one of which has its own risks from applying scale-up or to the use of equipment or materials that have not been used before. Risks are also apparent with respect to operating the large trains - for one to go down and to lose say 7 MTPA is a serious matter. The normal way to prepare for this possibility is to have extensive spare parts (usually a complete turbo-compressor set) available on site - which costs money and becomes relevant in the operating and maintenance cost equation.

(ii) Materials to withstand the extreme cold that is required for production of LNG (-260F = -160C), such as 36% nickel / steel alloys, have evolved over time as have insulation materials designed to keep the cold in - for pipe and equipment lagging and for insulating storage tanks both at the terminal and in the LNG ships. Risks here are concerned with using extended or novel products that might not deliver or might fail when in use compared with proven materials that have stood the test of time but might have lower thermal efficiencies.

(iii) The loading of LNG onto ships at the terminal is not a new technology, however the terminal and loading system should ideally be as close as possible to the plant for overall efficiency. In cases where the terrain is rocky the construction of a deepwater conventional harbor is not a problem. However in Nigeria the coast line is sandy with shallow water out for several miles and the Niger Delta consists of hundreds of rivers pouring massive amounts of sediment into the sea. Conditions for construction of the LNG marine terminal require to be thought through: dredging will probably be required on a grand scale because of siltation of ship channels; this is costly yet represents a low-tech solution. Novelty comes with modeling harbor configurations that are right in the zones of heavy sedimentation and with a shifting seabed: projecting deposition patterns out for some 20+ years can be a challenge. Alternatively, new or extended technology can be applied by consideration of an insulated subsea pipe that takes the LNG out into deepwater - which is up to 10 miles in Nigeria - but the design, laying and performance of such a cryogenic pipeline, let alone contingency plans in case it fails in use, represents a big risk for owners to take, yet this is what is being contemplated for one major new project.

Separately, technology continues to evolve in LNG carrier design in order to minimize loss of product during the ocean voyage to the destination, either by sloshing in the tanks or from evaporation. Novel techniques have been applied successfully in the past and are likely to continue to evolve further as ships get bigger and propulsion systems are subject to further innovation.

With a range of technology risks and uncertainties to contend with in Nigeria, decision makers have to weigh and balance the use of tried and tested solutions with their known costs (capital and operating) and performance versus the promise of new technologies that might offer reduced cost (usually on a per tonne basis of CAPEX) and improved performance versus the risks associated with costly downtime and actual underperformance. Again, competence of plant technicians and availability of vendors in country with spare parts are other considerations. Addressing these type of technical / cost evaluations and recommending decisions is an established subject which the industry is fully able to handle: it is just that here in the case of LNG the scale is so much bigger and the timescales to live with either the good or the bad outcomes are very long. Not surprisingly, some shareholders have had some concerns about applying novel technologies and about the operating and maintenance implications for the long run. These are valid issues which have to be addressed with hard-won experience and documented for decision makers so that the best solution is landed and the implications understood.

7) Financing: There is probably little to say that is not known to the audience with respect to seeking project financing for major LNG projects in today's "credit crunched" world. The competition for capital is high, not just in the LNG or oil and gas sector, and given the scale of double-digit \$ billion investments needed for LNG liquefaction plant, let alone the upstream, shipping and downstream elements, the challenge of obtaining adequate sources of funding at acceptable terms is daunting. It is worth noting that "project financing" does not take a lien on the new assets to be built nor is it backed by other securities, hence the due diligence that has to be carried out by lenders is most rigorous and often imposes conditions on borrowers that might not have been already addressed and hence might delay the project if financing is to be obtained on best terms.

The risk of not obtaining financing might well crater a project that cannot otherwise be supported; at least it might be put on ice until circumstances change or be fundamentally reviewed to improve its chances of being funded.

If external financing is a condition precedent to an FID decision - which is the case for some of the Nigeria LNG projects - then early engagement with lenders through an adviser is a wise decision. Such a financial advisor can point out the likely sources of finance and the conditions that might be attached to the funding. This way there should be no surprises when the Preliminary Information Memorandum (PIM) is issued to potential lenders (well ahead of FID) to test their appetite for the project and to see what conditions they might seek to impose. Overall, it is a good decision to engage with lenders via an intermediary as early as possible once a design and heads of commercial and fiscal agreements are settled.

8) Stakeholders / communities: The Nigerian oil and gas environment is such that engagement with local communities and local, regional and state government, plus representative groups and traditional leaders, etc. is of paramount importance to proceed with any project. 40+ years of oil and gas exploration and production in Nigeria have been a rocky ride between oil companies and the various stakeholders. Without delving more into the history suffice to say that open, frank engagement with all constituencies is well advised from an early date so as to foster dialog, get communities and officials on-board but not necessarily to kow tow to demands that may be publicly and pointedly directed towards a project's promoters or to individuals.

Risks of not engaging early, openly and professionally with all stakeholders directly can result in non-implementation of a project: it can be that serious - examples abound.

Correspondingly the best decision is to appoint a team of Nigerian professionals experienced in community relations, and who might be supplemented by international consultants or relevant NGO's active in the field, to dedicate themselves to realizing harmonious relations with the communities and other stakeholders. It is important, in passing, to note that programs of sustainable development, compensation schemes for damage and disruption including for resettlement of communities, education, training, health initiatives, etc. should be handled openly and legally so that corruption and any suggestion of illicit payments are avoided which could run into FCPA issues.

9) Others: (i) Risks of labor / staff shortages (skilled and professional) for construction and operation of oil and gas facilities are very likely in Nigeria such that it is a good decision early on to have the HR department evaluate the appropriate numbers and levels of personnel needed at the various stages of the project and how these will be resourced: Labor for the plant construction phase will be the responsibility of the main and sub-contractors but the owner will need at least HSE, project engineers, expeditors and inspectors on his staff as well. For plant operations, maintenance, management of gas supply, product sales and general corporate needs a trained team of skilled operatives through to senior professionals and managers will be needed in a fully Nigerianized state. This will require careful pre-planning and adequate lead time for the selected individuals to acquire the skill sets and experience needed.

Decision makers should note that the Nigerian experience is that a major recruitment exercise will be needed to engage prospective employees from thousands that will apply for the available jobs. Fair and documented selection processes will be needed and then extensive education and training in the unique areas of the oil and gas sector, LNG business and international corporate practices should be scheduled including cross-assignments to existing sites and plants, in country or abroad, so as to have new personnel fully up to speed to take on their duties when the time comes.

(ii) Risks exist with the commercial agreements related to supply of gas (GSA) and the sales of LNG (SPA or Offtake Agreement) and products (LPG, Condensate Handling Agreements). Whilst these agreements will have been developed and negotiated over a long period (often over 2+ years) before being signed by parties, the risk exists that should a buyer's or seller's market materialize at a later stage, a party who feels in a strong position might seek re-openers to existing agreements to further their interests at the detriment of the other party. This is a two-way street of course and the pendulum might swing one way and then the other over the life of the various contracts. Decisions makers should go into initial negotiations with these possibilities in mind but really to establish a state of mutual trust and commitment between contracting parties so that disruptions from market conditions or trends do not cause knee-jerk reactions to take advantage of a situation. Nevertheless provision for genuine hardship affecting one party resulting from adverse market conditions should be recognized and processes stipulating how to address these situations provided for under the relevant agreement.

(iii) Environmental regulations, e.g. related to CO₂ emissions, disposal of wastes, clean-up liabilities, etc. are, as in most countries, continuing to evolve albeit from a low starting point in Nigeria but the adoption of Equator Principles by most of the industry should be an appropriate response. However, there is a risk that novel regulations will materialize and that retroactive actions may have to be taken.

(iv) Additional risks and uncertainties can also be imagined: (a) Currency exchange risk both in the CAPEX stage and when the LNG is sold onto international markets (in the USA, Europe or elsewhere), (b) Impositions by government to either provide for excess capacity in new infrastructure development or to utilize, at a cost, existing infrastructure. This concept can extend to impositions to provide for, e.g. electricity supply or potable water to the national grid or to adjacent facilities or to communities from the new plant, (c) Gas (LNG) quality in end markets is not identical (specs. in the USA vary across regions), so there is a decision to be addressed that sales are limited to certain markets or that flexibility is built into plant design to accommodate differing market requirements, (d) The philosophy taken by an company in approaching risk management and uncertainty in general presents a risk in itself: namely the subject can be handled as singular exercises at the early stages of project conception, detailed definition, construction and operations; it can be handled by a dedicated risk management team who interface with all functions to capture risks and uncertainties, document them, rank them, identify mitigation measures and pursue a process whereby the highest risks are "owned" by senior management and lesser ones down line; it can be contracted out to a consultant who has flexible resources, specialist computer applications and trained moderators who engage with the project team; or, recognizing the status of "megaproject" that is associated with LNG opportunities today, the best decision is probably to find a way to engender throughout the project team, its shareholders and contractors an appreciation of the necessity for a structured risk management process and a commitment to follow it through to achieve ultimate success: such an approach needs unequivocal leadership from the top of the company.

7. EXTRACTING THE LESSONS LEARNED AND APPLYING IN A BROADER CONTEXT

(i) Applying a hierarchy: We are now going to move from the specific to the generic in order to uncover what risks and uncertainties should be actively managed in connection with major capital project decision making processes. The guiding principle will be those parameters which add most economic value to the project, taking note of those that absolutely must be managed in order to avoid adverse consequences.

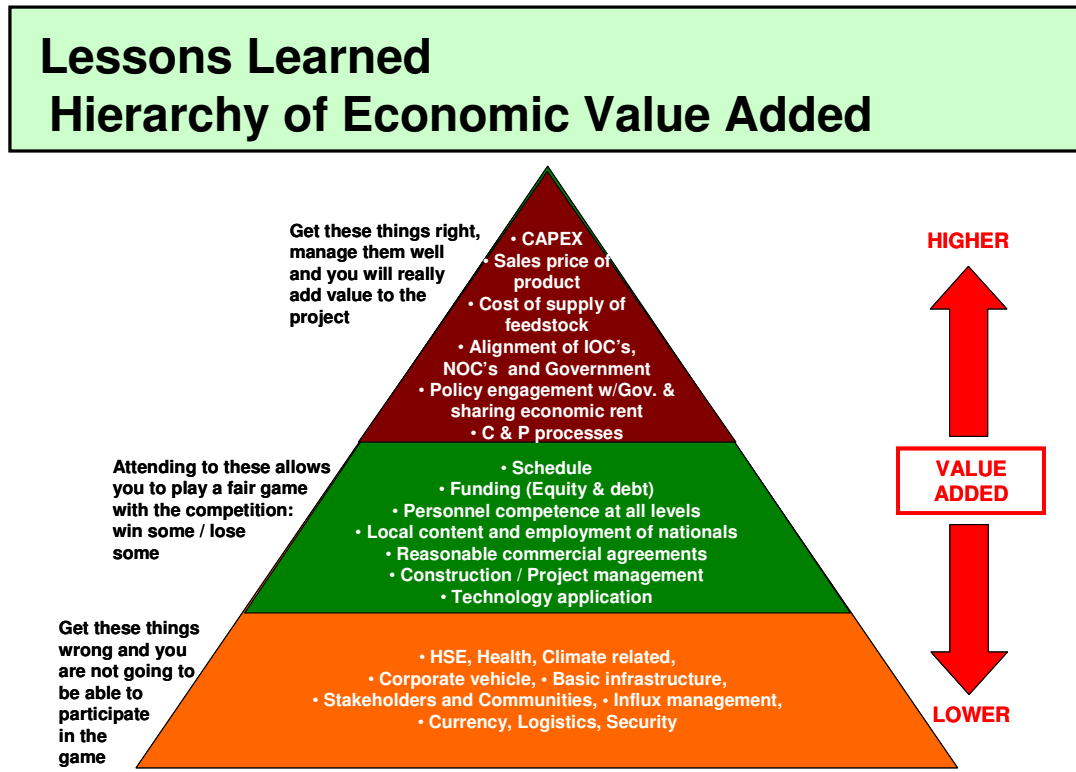
Firstly, we know from anecdotal economic analysis of major capital projects that most value is added if the CAPEX and the sales price of the product and cost of feedstock are managed vigorously. It is apparent that mutual alignment of shareholders and government entities is vital to success so that all parties have the same positive objective whereas any misalignments can nag away and obstruct real progress to the detriment of the project. With respect to government it behooves project promoters to engage directly and positively in policy decisions that might have impact and to be ready to argue about economic consequences for investors, government and other stakeholders if onerous fiscal terms of regulations are contemplated. Contracting and procurement processes we have seen can result in inefficiencies if not handled well whereas if handled better than the norm they can save time and result in positive effort by contractors and suppliers and minimize variation orders.

Then there are a cluster of activities which represent standard practice in the industry, and therefore they are familiar territory, comprising: scheduling, funding arrangements (debt and equity), engaging competent personnel at all levels, addressing legislation regarding local employment and contracting, negotiating commercial agreements typical of the trade, managing contractors and overall project management of the construction activity, and ensuring the appropriate application of technology. Higher effort on these aspects should give an edge over the competition or industry at large while neglect or poor handling would detract from optimum value.

Thirdly, items that can be considered "deficiency needs" - borrowing the term from psychology - are those that if not attended to properly can actually result in reducing the economic value proposition of the project. Each of these are individually important and need planning and resourcing to ensure that they are managed pro-actively. The list comprises: HSE, health and climate considerations (for personnel and construction), establishment and management of the corporate vehicle and attention to its governance requirements, addressing basic infrastructure needs whether at an office of a remote site location, identifying and engaging with all stakeholders and particularly local communities,

being ready in case site work underway creates a magnet for influx of persons seeking employment or spin-off advantage, handling normal business issues such as currency issues, logistics and security for people and assets.

All these issues are illustrated in the attached diagram which for economists is like an inverted tornado diagram but without any quantification.



(ii) **Looking at more conventional approaches:** Formal, structured analysis of the risks and uncertainties identified from the various viewpoints we have covered should be carried out using tools and techniques that are well-known to economists, decision analysts and risk practitioners: identification of the issue owner, decision makers and the process facilitator, defining the question to be answered, framing the problem / opportunity, predefining what criteria indicate an acceptable outcome from the analyses, setting the hierarchy of objectives to be achieved, preparing a (qualitative) influence diagram, using unbiased interview techniques with subject matter experts to capture ranges of parameters, using brainstorming and support and challenge sessions, developing risk identification / risk mitigation registers, preparing quantitative data for use in modeling and decision analysis, use of ranking tables and breakeven analysis techniques, preparing an economic model and having it independently audited to test its logic, input and output limits and overall applicability.

8. CONCLUSIONS

(i) LNG has undergone a roller-coaster history but today is regarded as an internationally traded commodity with a widening supply and consumption base from the time that the first commercial shipments started 45 years ago (1964: LNG from Algeria to the UK and France). The Atlantic Basin trade witnessed a decline from 1980 following a rapid expansion from about 1970 (Alaskan LNG to Japan 1969 and Algerian LNG to Boston, MA in 1972). In parallel, there was a major shift of emphasis to the Pacific Basin with Japan expanding its appetite for LNG in the 1980's such that by 1984 it was purchasing 72% of the world's LNG and using 75% of that for power generation. The decline of LNG trade in the Atlantic Basin reversed in 1999 when Atlantic LNG (Trinidad) and NLNG (Nigeria) both came onstream followed by Egypt, Equatorial Guinea and Norway

(ii) LNG Projects can be classified as megaprojects in that they have a scale, uniqueness and complexity that demands a distinctive approach and establishment of a large and well-resourced management team who are not only capable of handling the technical and other functional issues but the often challenging relationship between and amongst all categories of stakeholders as well.

(iii) From an energy economists' point of view the decisions necessary to be taken with respect to major capital projects, characterized by the risks and uncertainties identified here, can be rationalized by looking at their impact on

the fundamental project value proposition. Extensive experience from economic modeling of oil and gas and LNG liquefaction projects tells us that there is a hierarchy of economic sensitivity (expressed in NPV terms) as follows:

Most sensitive

- Revenue stream (i.e. Product price and sales volumes)
- CAPEX
- Purchase price of feedstock (Raw material value at entrance to facility)
- Delayed start-up
- Operating and maintenance expenses

Least sensitive

Note that the above are for unleveraged economics. With financing, the fact that interest expense will most likely be tax deductible - assuming that there is tax to be paid in the early years in parallel with loan repayments - then the situation can become a little more complex because (i) interest expense will reduce tax payments, but (ii) the early years are often sheltered from tax anyway by a tax holiday or by depreciation of the huge capital investments. It is best to seek recourse to professional economic modeling expertise to properly address leveraged economics.

The above listing consists only of 5 items whereas we have identified some 30+ risks and uncertainties in this paper: what happened to the rest of them? Acknowledging that there is duplication under the various headings the fact is that the other issues largely boil down, in quantified terms, to these 5.

Examples:

(a) JV partnerships / alignment with NOC's and with Government: the quantified risk here is not the cost of the effort required by staff to manage these interfaces - that is trivial for a major project - but it is the consequences of getting things wrong that can cause delay by prolonging the period that funds are at risk (e.g. by taking longer to reach FID) and by causing rework to design bases or to commercial agreements if less than 100% support from involved parties has been achieved at the outset. These issues can translate into increase in CAPEX, revisions to product price and volumes, to purchase price of feedstock and to delay in start-up.

(b) Similar observations apply to other stakeholders and communities where lack of mutual understanding can result in disruption of one form or another that could impinge on CAPEX, start-up or operating costs.

(c) Contracting and procurement processes can significantly help or hinder the progress of the project. Effective processes can move the project forwards on its timeline and result in tight budget control of contracts. Shortcomings in the process can result in delays all along the line and disputes, frequently court cases, to resolve disagreements can be costly. CAPEX is impacted under these circumstances.

(iv) To ensure quality decisions we note the importance for comprehensive risk and uncertainty data to be provided to decisions makers and their analysts, shareholders and other constituencies in a timely manner. There is a need to avoid irrational decisions, done under an urgency to "do the deal" or to make a decision because it is set by a deadline - which could be altered if necessary in order to make a better quality decision. Economic decisions assume things like full risk mitigation - which might not be achieved in practice - so the decision makers need to factor in plans to monitor this and to make contingencies available but for these to be held externally. Trust and open discussion is needed between the project team and the decision makers - not the taking of advocacy positions but more of seeking support and accepting challenges to the materials presented.

APPENDIX

With regards to the approach herein to Risk and Uncertainty, some definitions are necessary for the avoidance of doubt. For this paper we will define as follows:

RISKS: Future events, having adverse / undesirable impacts, measurable / definable / can be quantified within a range of probable outcomes. If we have a risk we have uncertainties to contend with. In risk we are much more concerned with the variability of an event, e.g. the price of oil - not whether the price is high or low but with the problem of predictability of the price. The industry will adjust to one price level or another in the long run, but it is uncomfortable with choosing which way the trend will go at what time. This is even more dramatic when you look VERY long into the time horizon.

UNCERTAINTIES: Future events, having more than one outcome which is ill-defined / impossible to define, cannot be quantified but estimates can be given in terms of a chance or likelihood of occurrence. Uncertainty is concerned with the variables THEMSELVES that are changing, e.g. government policies / new or revised legislation - which we cannot predict. We can have uncertainty about the outcome of something but if we don't have a stake in it we don't have any risk: just because you have an uncertainty does NOT mean that you have risk.

Then, if you know that you are faced with 100% loss, then you do NOT face a risk but a CERTAINTY!

SYSTEMIC RISK: Applies to a whole system or business sector not to an individual entity or component. Systemic risk does not apply to market or price risk since these are unique to the commodity or product being traded and not to the entity that is dealing in the commodity or product. Systemic risks cannot readily be managed.

NOTE - we are talking here about SYSTEMIC risks and uncertainties of the whole of the oil and gas industry that cannot be managed and which are a feature of the whole of the oil and gas sector - like “when one oil and gas company catches a cold (or, actually, encounters a real catastrophe) all the others do as well” - before moving to unique / specific risks and uncertainties of LDC’s, Nigeria, LNG and so on.

We are not talking about SYSTEMATIC risks and uncertainties meaning those related to the market, the sector, that cannot be diversified away in a portfolio of assets of, e.g. oil and gas properties.

UNIQUE or SPECIFIC RISK: Applies to your own business in its environment. These risks can be identified and quantified in terms of frequency of occurrence and magnitude and plans put together to manage them.

Disclaimer: This paper is the work and opinions of its authors and does not necessarily represent the views of companies that the authors have worked for at any time either at present or in the past.

Reference: BP Statistical Review of World Energy, June 2008