Over the past decade, companies have been using unconventional drilling technology to extract gas and liquid from the readily available shale formations in North America. As the industry gains experience, the production rates continue to rise based on better use of technology to locate resources and to decrease the time from exploration to production. The use of technology is allowing operators to manage their drilling teams more efficiently, helping to drive down their investment in each well.

This rapid build-up of both gas and liquid wells has resulted in an abundance of natural gas, driving the price of natural gas in North America to an all-time low. With the abundant supply and favourable reserve estimates, the global market is driving many companies to develop projects for the export of LNG from North America. The slate of proposed and potential export terminals includes grassroots land based projects, floating facilities and the addition of liquefaction processes to existing gasification operations. These LNG liquefaction projects are being justified on a perceived market pricing gap and continued overseas demand.

PARTNER UP
Greg Hallauer, Yokogawa Corporation of America, USA, discusses the importance of selecting a reliable automation partner.
If all of the projects currently announced are implemented, with an estimated cost for each plant between US$ 4 – 8 billion, a conservative projected total of US$ 56 billion could be spent from 2013 to 2020 on LNG liquefaction infrastructure. Initial business partners who have announced LNG terminal projects continue to develop relationships for supply and delivery contracts, as well as financing for these projects. At the same time, they are required to begin the permitting process, which does not appear to have an established timeline under the current US energy policy. This permitting process has a direct connection to partner commitments and financing required to move forward with a project.

To add to the overall feasibility and risk assessments, the actual global market needs to be considered. Several studies have recently been issued to somehow document all the variables associated with exporting LNG from North America. These studies and reports do not always align and highlight the potential challenges of competing with existing LNG export facilities in the Middle East and Africa, with more capacity coming online in Australia. These documents also consider the ramifications of introducing additional capacity between 2014 and 2020, based on current conditions and what may happen to current LNG pricing.

Small but crucial
As these LNG projects begin to develop, owners will have their hands full with many decisions. Added to this long list of considerations is a rather small and often overlooked, but very crucial component of these multi-billion dollar liquefaction processes. This crucial component is the automation partner. While it is a relatively small initial financial impact, it can significantly help get an operation into production. Delivery contracts require on-time startup and targeted production levels, making the integration of automation not only a requirement for successful project risk/cost trend will start to accelerate, potentially creating cash flow issues for the project management.

Enhancing the process
Along with the MAC/MIV methodology, specific engineering tools and procedures have been developed by companies to enhance this process. Offered with these tools and procedures is a level of standardisation combined with an open and interoperable environment, allowing for best in class technology utilisation. Global engineering standards and procedures, based on proven support. This experience will also bring with it an understanding of the different automation requirements in liquefaction, carriers, gasification and terminals.

MAC/MIV methodology
When it comes to execution, a proven method to reduce the risk associated with an automation partner is to look for companies that also have successful main automation contractor (MAC) or main instrument vendor (MIV) experience. Engaging a partner with these capabilities will help manage risk and lower the overall cost associated with the project. The MAC project execution method was first introduced in the early 1990s for offshore platform development and has been successfully applied in the oil and gas industry. It is a methodology that helps owners and partners to reduce project risk and cost, while improving the owner’s or partner’s return on investment (ROI).

**Figure 1. MAC risk/cost reduction trend.**
project experience, increase the flexibility of the owner and EPC wherever they choose to execute the project. These standards include specifications for components, such as process control systems, emergency shutdown system (ESD) and fire and gas system (F&G), console design, HMI, and alarming, to name a few. Activities will also be included in the standards. Some of these standards include fundamental work breakdowns per activity, including descriptions, objectives, detailed steps to execute, required input and delivered output. More specific engineering tools will include plant knowledge libraries that contain standardised configurations for LNG applications in liquefaction, gasification, carriers and terminal automation. These should be a part of the functional design specification and documentation available from experienced LNG automation partners. These plant knowledge libraries are compiled through professional experience and records from projects executed over many years in the LNG industry.

The plant libraries will cover all process facilities for a plant type and allow for development of the plant master logic. They help provide high quality optimum control from basic design, improve engineering efficiency with fewer man-hours, and reduce project schedules. The library contents may include elements such as process models, graphics, I/O lists, functional specifications, drawings, logic diagrams, and cause and effects tables.

Finding an automation partner with proven engineering and execution experience is an important part of the project. An automation partner should provide unmatched process control systems, emergency shutdown systems, fire and gas systems, console design, human machine interface (HMI) and alarming. These standards include specifications for process control systems, emergency shutdown systems, and fire and gas systems, console design, HMI and alarming. More specific engineering tools will include plant knowledge libraries that contain standardised configurations for LNG applications in liquefaction, gasification, carriers and terminal automation. These should be a part of the functional design specification and documentation available from experienced LNG automation partners. These plant knowledge libraries are compiled through professional experience and records from projects executed over many years in the LNG industry.

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selection criteria. Whether it is C3MR, DMR, SMR or Cascade chosen for the project, one should expect the deliverables provided by an automation partner to be capable of working with all of the process technologies available today.

Other important elements included in the deliverables are awareness of technology, safety and lifecycle support. These will be integrated with the engineering as part of the implementation and hardware deliverables provided by the automation partner working side-by-side with the EPC.

The automation architecture

The outcome from all the planning, design and engineering built into the MAC process will provide an equipment list that becomes the automation architecture. The automation in an LNG plant stretches across the entire facility, ranging from the inlet facility, gas treatment, acid gas removal, dehydration, refrigeration preparation, boil-off gas, LNG storage, loading and of course liquefaction. The same system also needs to be integrated into the business to take complete advantage of its capabilities. The technology platforms most commonly employed by an automation partner to handle multiple trains are a distributed control system (DCS); safety system (SIS); ESD; F&G; smart field instruments; advanced analytical packages; electrical control systems; CCTV; UPS systems; valves; vibration monitoring; asset management; leak detection; advanced process control (APC); sequence of events recorder (SER); operator training simulator (OTS); information management systems and potentially more depending on their role as the MAC. These systems and packages are seamlessly integrated for implementation into the project. They provide the solutions platform from field sensing, production control, production management and on to corporate management.
Safety

As part of any successful business strategy today, safety has become a top priority in all areas of a business’s operations. This is true of the automation partner as well, from safe working practices to actual implementation of safety related systems to fulfill the functional safety management strategy for an LNG project. An automation partner should be capable of supporting the development of hazard and risk analysis, overall safety requirements, safety requirement allocation and implementation of the safety related systems. The process involves following specific steps outlined by standards such as IEC61508, using integrated safety controllers as a hardware platform, and implementing it to specific commissioning and validation specifications. The safety controller performing the safety inputs and outputs must meet certain SIL ratings defined by hazard and risk analysis. Certification of these platforms is often provided by organisations such as TÜV Rheinland. These ratings and certifications are best met with ultra-high reliability systems using multiple processors and hot-swappable I/O modules with advanced diagnostics capability. Automation companies have also developed technology allowing safety data communication from the safety controllers over a common control network to communicate with their process control systems. This provides the plant with isolated safety control where needed, but also makes this data available for viewing on the process display. This once required two different interfaces and displays, complicating the work load for operators during critical events. A well implemented highly reliable system platform brings with it increased plant availability and greater opportunity for sustainable profitability.

Training simulator

Beyond the implementation of safety control, another helpful automation deliverable being used by LNG operators today is the operator training simulator (OTS). The OTS provides a dynamic simulator for LNG processes that can be used in various ways. By working with an automation partner that has plant libraries, it becomes easy to develop plant master logic that can be used to provide a complete virtual process of the LNG operations in an online training simulator. This simulator combines the process unit modeling with the control logic and allows for unit management or critical situations to be loaded as training scenarios. Potential benefits of using a dynamic simulator are the realisation of stable and robust production, operator training tool based on processes and a sustainable method to reduce the knowledge gap as operators change over time. The thoroughly trained operators and a well-engineered automation platform also provide more confidence to operate at maximum capacity. This takes full advantage of the assets capabilities.

Conclusion

The information presented in this brief article is not intended to be a specific roadmap but rather to stimulate dialogue regarding the selection of an automation partner and potential project execution methodology. Regardless of which method is chosen, it should always include the operation phase. A MAC methodology includes the planning and definition, implementation and operation phase. The operations phase is really a way to sustain the large investment associated with LNG liquefaction process. A truly experienced MAC provider will discuss the entire lifecycle roadmap from feasibility to decommissioning or migration, so every aspect is considered prior to commitment.

When spending US$ 4 – 8 billion to develop an asset expected to produce for years to come, it makes sense to engage potential automation partners with an open mind, and expect them to be a member of your team for the next 15 – 20 years.