

ONE MORE SHIP:

AI drives competitive advantage



Artificial intelligence-driven analytics, digital twins, and enterprise automation help speed time to first production, minimise downtime, and extract extra performance, says **Nathan Pettus, President of Process Systems and Solutions, Emerson.**

LNG
INDUSTRY

The LNG industry is undergoing a structural shift in how facilities are conceived, built, and operated. Historically, LNG organisations built mega train plants. These facilities could typically produce 5+ million tpy per train, with somewhere between 2 – 4 trains per site.

These mega facilities take a long time to build, from final investment decision to first liquids. Typically, a 3 – 5 year timeline is expected, and the larger the plant, the longer the lead times on critical compressor equipment and overall construction. Ultimately, those five-year timelines often resulted in equally mega CAPEX outlays, all up front, before production could create cash flow.

In recent years, longstanding industry goals have not changed. High uptime, reliability, and throughput are all still critical metrics for LNG production success. What has begun to change is the project execution model. Smaller trains with more modular designs and rapid sequencing now compete alongside traditional

mega trains. These shifts lower CAPEX commitments and make speed, repeatability, and operational resilience more critical than ever (Figure 1).

A new path forward

Meeting this new LNG build model requires automation that scales with both mega projects and rapid small train programmes. Mega trains will continue to exist and be developed, but today's standalone LNG organisations are leaning more towards deploying numerous 1.5 million tpy trains that can start production in under two years. Such rapid timelines are enabled by modular construction and forward funding. Once the first train is online, the revenue produces funds for the construction of subsequent trains, creating a system of rapid CAPEX recycling.

Such a strategy can prove highly successful, but automation strategy will always be a bottleneck, unless it scales and accelerates in parallel. Teams not only need ways to deploy equipment quickly, but also to ensure it delivers the highest operational efficiency so they can drive fast return on investment – the core goal behind this new strategy. Fortunately, just as LNG projects of all sizes begin to gain increased momentum, an optimal technology for project improvement and driving increased operational excellence has emerged in the marketplace: artificial intelligence (AI).

AI streamlines projects of any size

AI accelerates project execution by learning from proven designs and generating automation configurations faster

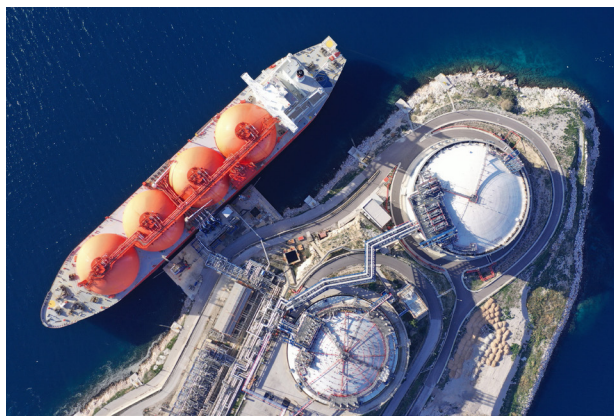


Figure 1. Success in LNG relies on a multitude of factors, all coming together to drive efficient operations.



Figure 2. AI tools can help unlock advanced adaptive process control strategies.

than ever before. New cloud-based AI project engineering tools deliver fully integrated digital workflows to help teams modernise, streamline, and standardise their automation configuration. These tools use AI models to evaluate tremendous amounts of historical process data – both an organisation's own historical data from existing facilities and projects, and domain expertise from the automation supplier's decades of experience in LNG and other industries.

Armed with this data, the tools can quickly identify best practices in control configuration. The software then automatically generates configuration templates for new control solutions, dramatically reducing the manual workflows that delay results and lead to errors in configuration.

This automated process empowers project teams to stamp out trains with consistent quality and reduced engineering burden, making success endlessly repeatable. Whether building a large or small train, the project team can ensure consistency of best practices, while more easily delivering new sites that operate nearly identically to existing ones.

AI drives successful simulation

Teams have long used simulation tools to help them build better plants. Process simulation software helps teams build digital twin replicas of plant operations to enhance engineers' workflows, simplifying equipment design, costing, testing, energy management, and safety analysis long before equipment begins arriving on site. This helps eliminate errors and reduce the late-stage project changes that delay launch and lead to cost overruns.

Today's most advanced simulation tools leverage AI to help teams build better models even faster, driven by guidance from AI agents compiling and processing both first principles information and historical project data. These hybrid models, built on decades of engineering expertise, collect, and analyse an organisation's data. They then combine it with the insights and guidance from machine learning to simulate more plant conditions and automatically generate a wider range of solutions, making it easier for engineers of any experience level to generate 'right the first time' results.

Well-designed plants still require highly effective operation

Even if a plant is built perfectly to ideal and exacting specifications, its performance will only be as good as operations allow. Yet, LNG operations are exceedingly challenging. Today's LNG plants run lean, have no buffer, and face extreme consequences for downtime. Their 24/7 operations must run flawlessly if they are to compete in an increasingly crowded and competitive marketplace.

Because LNG operations lack intermediate storage, any upset across the process has the potential to cause immediate instability across the entire operation, resulting in severe negative consequences. Missing a contracted ship can easily force the need for a spot-market replacement costing upwards of US\$70 million, but avoiding upsets is difficult for facilities running the lean

teams common in today's LNG operations. Deviations often go unnoticed until they are urgent.

For example, many LNG operations are located in places with very hot days and very cool nights. In these locations, the diurnal weather effects can significantly impact fin fan cooler performance. In many cases, ambient temperatures change just as a shift change occurs, making it easy for operators to miss a performance swing in the heat exchangers, leading to a process deviation.

What teams need is an always-awake master operator who can monitor such situations in real time to ensure process deviations are not missed, even when plant activities make it hard to stay focused. However, today, master operators are few and far between, and even the best ones cannot monitor the plant every waking hour.

Enter the AI advisor

AI is emerging as the 24/7 master operator to watch the plant continuously and quickly identify issues humans cannot see. AI can correlate data across all a plant's equipment – turbines, pumps, compressors, heat exchangers, and more – in real time, all the time. Because AI tools can process multivariate data extremely rapidly, they can detect slow degradation patterns, like compressor fouling, well before they are visible to operators or technicians.

This allows the software to alert teams before alarms trigger, which empowers plant personnel to schedule maintenance when it is convenient, rather than when it is critical. The resulting avoidance of unplanned downtime is often the key enabler of a team's ability to drive the extra production necessary to fill one additional ship (Figure 2).

Moreover, AI captures institutional knowledge, delivering decision support to every operator on every shift through expert guidance, interactive training, and operational coaching. Though many of today's remote LNG production facilities are in areas with few experienced master operators, AI-enhanced operator training systems can help close that experience gap.

Dynamic digital twin models help training software simulate full facility behaviour, mimicking the exact control systems operators will use in the plant, while virtual trainers monitor operator actions and coach in real time. This creates faster ramp-up, with more consistent confidence and competence across shifts.

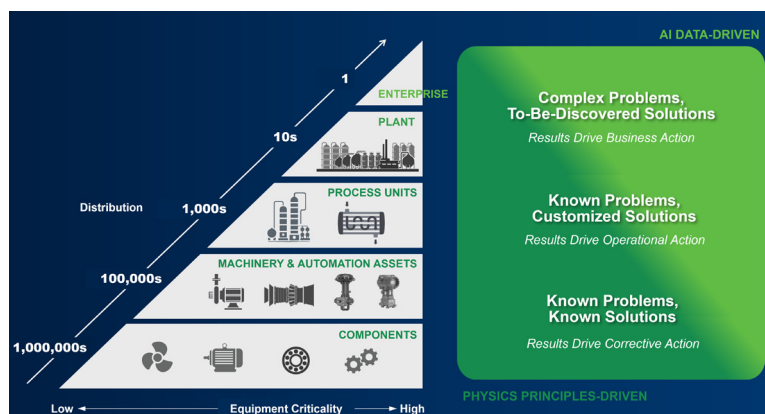


Figure 3. AI-ready automation technologies and an enterprise operations platform are the next frontier for LNG operations.

The automation evolution

So, how do today's LNG plants, greenfield and brownfield alike, put these capabilities into action? Most organisations are carefully examining their current capabilities and using that knowledge to promote a 'good, better, best' adoption path to ultimately reach enterprise scale optimisation. At the most basic level, today's plants need a modern distributed control system with carefully tuned loops, embedded analytics, and digital oversight. This level of automation is effectively 'table stakes' to enter the modern LNG marketplace.

Once the core automation competencies are locked in, plants can begin to move to a better automation architecture where they employ predictive reliability technologies, failure mode and effects analysis-based analytics, health scoring, intelligent field devices, and more. This more advanced level of automation will improve visibility across the plant and begin to move both operations and maintenance personnel from reactive mode to predictive mode – intervening before process deviations or equipment failures turn into unplanned downtime.

Today's most advanced and productive facilities are further improving their automation infrastructure by moving towards an enterprise operations platform architecture of seamless data mobility from the intelligent field, through the industrial edge, and into the cloud. These organisations are implementing next-generation automation technologies built to be AI-ready, with a seamless data fabric that can move contextualised data anywhere across the enterprise for instant consumption by the people and tools that need it. This seamless connectivity and instant contextualised data access is empowering them to use advanced analytics to unlock the cross-train performance comparison and advanced process control technologies necessary to achieve the throughput increases that unlock one extra ship per month (Figure 3).

AI is an enabler

The long-term destination for today's LNG producers is enterprise-level optimisation powered by digital twins, contextualised data, and AI – regardless of plant size. Whether they deploy one mega train or 12 small trains, operators need unified insight across assets. Moreover, at the enterprise level, cross-train optimisation is becoming a competitive differentiator. AI and digital twin technologies, built as part of a seamless enterprise operations platform, create the data ecosystem that supports this enterprise-wide approach.

In the project phase, AI accelerates capital projects by automating configuration and leveraging past designs. Yet it also carries its value into operations, strengthening them by acting as an ever-present master operator, and by supporting the workforce through advanced training, guidance, and knowledge capture.

In an industry where speed and reliability define competitiveness, AI is no longer optional – it is foundational. **LNG**