EXPANSION FOR THE FUTURE

Praveen Lawrence and Briain O'Dowd, Royal HaskoningDHV, UK, detail how predictive simulation can aid with managing LNG terminal demand.

The war in Ukraine created an urgent need to replace Russian natural gas, with LNG representing the best alternative. To meet the spike in LNG demand, Europe is aggressively ramping up its regasification capacity by bringing FSRUs online and expanding land-based facilities. Europe has so far been able to manage its gas requirements thanks to the mild 2022 winter, but it is not out of the woods yet. Countries are facing many uncertainties with how to deal with the 2023 winter and beyond, especially when:

- The war in Ukraine is ongoing without signs of de-escalation.
- Europe still relies on Russia for 25% of its gas imports.[1]
- Europe needs to further reduce gas consumption to improve its energy security.[2]

To meet the growing need for LNG processing, Europe is investing hundreds of millions of euros in building new, and expanding existing, regasification terminals. For projects of this scale, there is usually intense scrutiny of operational contingencies, technical assumptions, and commercial risks to ensure that investment is appropriately channelled. However, the geopolitical situation means the industry is now working under tight timescales to deliver these projects of national significance. As a result, scrutiny processes must be expedited – with stakeholders needing a reliable way to de-risk projects.

Business logistics simulation software and verification services play essential roles in delivering that speed and risk reduction. This article will look at the role of predictive simulation in LNG terminal logistical performance and planning, along with two use cases.

Predictive simulation de-risks terminal logistical performance and planning

LNG terminal operations involve complex and interdependent supply chains, as well as dynamic uncertainties such as the knock-on effects of seasonal gas demand nomination, tides, and large weather disruptions (Figure 1). While scheduling tools are appropriate for short-term and tactical decision-making applications, they fall short when dealing with long-term planning and annual demand plan (ADP) assessments accounting for real-world risk factors. Business logistics predictive simulation software helps operators address these complexities, inter-dependencies, and uncertainties. It is therefore a vital tool for testing and verifying terminals' logistical performance as part of long-term planning.

Historically, due diligence and verification exercises have been kept for later stages of design. However, when large strategic projects are delivered to very tight deadlines, there is not much leeway for delay. Using predictive simulation to verify plans as early as feasibility and pre-FEED stages helps to pick up unforeseen issues and minimise the risk of schedule slippage/asset under-performance.

Another important benefit of predictive simulation in LNG terminal planning relates to project management and co-ordination. Projects involve multiple stakeholders, ranging from marine and terminals to commercial, marketing, and legal. Predictive simulation enables commercial analysts, operation professionals, and designers to bring together all information in one environment and creates a single source of truth for all these stakeholders – helping avoid the risks associated with information silos.

Supply chain stress-testing is another valuable use case. Verification studies using high-fidelity dynamic business logistics simulations provide accurate insight to pinpoint supply chain inadequacies, find alternatives to mitigate risks, exploit any resilience in the system, and thoroughly test terminal design and shipper contracts.

The role LNG regasification terminals play is rapidly evolving. As global LNG trade patterns change, the supply of LNG to terminals has become more flexible, with shippers mixing both long-term contract and spot market cargos to meet their demands. Moreover, terminals have become gas hubs that serve multiple shippers, including gas customers, LNG trucking and rail transfer, as well as providing bunkering. The flexibility and ability to serve multiple customers brings operational complexity and more contractual uncertainty. Therefore, those crafting and verifying terminal use and shipper contracts need to analyse the greater marketing and commercial options when balancing the needs of multiple shippers. Predictive simulation can handle this dynamic push/pull of many-to-many shipper/buyer combinations to generate, test, and optimise advantage parts solutions.

Twinn LNG Logistic Simulator (previously under the Lanner brand) has been trusted by many of the world's leading LNG terminal operators – both liquefaction and regasification – for nearly 20 years. Powered by Twinn predictive simulation software, large European facilities, such as Fluxys Zeebrugge LNG and other new regasification terminals, use it for long-term horizon planning and verification assessments, either utilising in-house resources or, if an independent verification is required, using Twinn LNG expert services. Here are a couple of examples of how the Twinn approach to LNG logistics simulation benefits operators in practice.

LNG terminal expansion planning in four weeks

A major LNG terminal operator was looking to capitalise on market conditions to diversify and expand. It needed to take a risk-based approach to this expansion – ensuring asset optimisation and a high standard of service for all traffic coming in and out of the terminal. The company therefore needed to understand what was operationally feasible and commercially viable.

Stakeholders from operations and business development were tasked with exploring what was possible given all the moving parts involved in terminal operation – from ship sizes and traffic patterns to tides, weather events, and port operator delays. This formed part of the due diligence process that would set the framework for the engineering, procurement, and construction phases to follow.

The stakeholders did a base level of static analysis internally, but as the variables

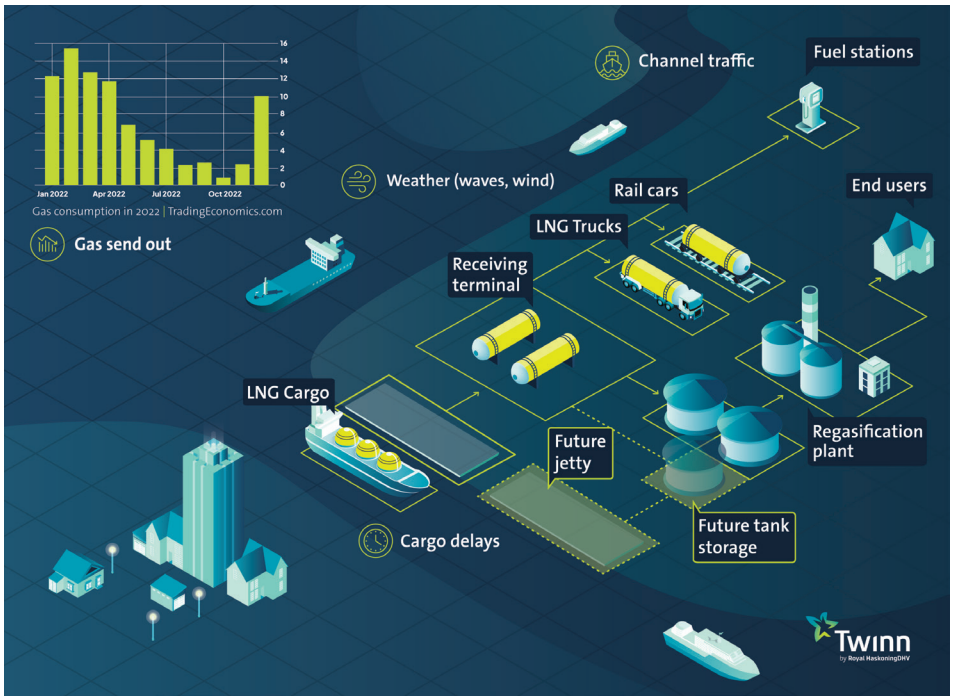

Figure 1. Twinn LNG Logistic Simulator helps regasification terminals plan future assets and manage the uncertainties associated with ADP planning.

became increasingly complex, the limitations of their in-house tools became apparent. Having worked with Twinn experts in the past and benefited from their predictive simulation expertise, the Twinn experts were to help define the operating boundaries for this expansion project. Not only would the LNG Logistics Simulator facilitate more informed decision-making, but the independent validation would give stakeholders more confidence in the due diligence.

Importantly, the operations and business development stakeholders were working to a tight project timeline – they needed to present their findings to senior management within four weeks.

The terminal operator had loose boundaries they wanted to investigate based on their static analysis, so the Twinn team started by refining these to define the scope of the parametric study. The first step was to define the finish line – the key questions stakeholders needed answering using the LNG Logistics Simulator. Following discussions with stakeholders, two key areas were identified:

- Berth occupancy and utilisation – and whether there was a business case for investing in another berth.
- Risk of delays associated with different traffic levels – including which customers would be affected and what the impact would be on ship movements, storage capacity, and demurrage.

Then the Twinn team looked at a matrix of variables, including factoring in seasonal probabilities based on external data around weather, wind, and visibility. Other variables related to the terminal operating rules and the number of berths and ships.

Then, using the LNG Logistics Simulator, the terminal operator stress-tested different demand levels across several operational scenarios. By factoring in current import ship contracts and forthcoming partnerships, they experimented with different small scale traffic levels, docking and mooring patterns, ship loading times, and storage tank capacities. This enabled the team to identify sensitivities at the upper and lower limits, home in on the tipping point for an additional berth, and frame the operational boundaries for future contractual arrangements regarding delays and demurrage.

Within four weeks, the terminal operator had a precise and complete analysis to present internally. Importantly, there was validation behind each figure, helping stakeholders understand the story behind the data and make decisions with confidence. This creates deep knowledge of the constraints and the trade-offs involved in strategic expansion, with quantifiable solutions to uncertainties and challenges. The company also has a wealth of operational and commercial data to inform the investment case for an additional berth and storage tanks. Key strategic questions such as, 'Under what circumstances would delays be incurred that are contractually and operationally destabilising?' are now easy to answer, and the terminal operator can take proactive measures to avoid these situations and optimise services as it grows.

The data can also be used in commercial discussions as part of the sales and relationship-building process, demonstrating the business case for why their terminal is an LNG terminal of choice. The terminal operator is now in a stronger position to capitalise on demand, develop a competitive advantage, and forge mutually beneficial partnerships.

Shipper ADP contract negotiations get 6% boost

In the current environment, operators must deliver robustly tested ADPs to ensure energy security and keep to their committed targets. This use case illustrates the key role that predictive simulation plays in this process.

A large LNG operator was experiencing serious market interest in booking its capacity. To meet this additional demand, the operator needed to undertake significant expansion across storage, send-out, and conversion.

During negotiations, shippers expressed concerns over the guarantee of their individual access in a multi-shipper environment. Most of the terminal's equipment blocks needed to be expanded, and failing to create the right capacity at every point would cause a range of problems including insufficient storage space, inability to discharge tankers at the right time, not delivering the required send-out rate, and lower-quality gas reaching networks.

The operator chose Twinn LNG Logistics Simulator to model the expanded facility and inform ADP planning. The model incorporated each prospective supplier's shipping activities and accommodated dynamic delivery scheduling to coincide with available slots, tidal and weather behaviour at the port, as well as the terminal's operational constraints and processes.

The model of the proposed facility allowed the company to experiment with and fine-tune the planned extension while proving the viability of its plans to meet suppliers' needs. In fact, the modelling even demonstrated that there would be capacity above initial projections, allowing the operator to set contracts for 6% more.

Additionally, because the team ran scenarios for different capacity expansion opportunities, the terminal operator could determine which design would deliver the best return on investment. This helped them direct US$165 million of capital investment in the most effective way – with the simulated terminal of the future providing certainty and confidence.

Working towards a more secure future

With European LNG terminals rapidly being brought online to ensure energy security, it is essential that all the moving parts within the LNG terminal supply chain work together to meet its dynamically changing logical performance requirements. As most of the terminals involve brownfield expansions, re-purposed FSRUs, and/or use of existing ports, business logistics simulation studies are vital to ensure terminals are built without delays and provide the energy security Europe needs. LNG

References

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2. MASTERSON, V., 'How the European Union can avoid gas shortages in 2023', *World Economic Forum*, (12 January 2023), www.weforum.org/agenda/2023/01/iea-europe-gas-shortages-2023/