

A case for automation

Martha Rendon, Senior Product Manager of Gas Management Software, Emerson, USA, discusses optimising processes in commercial gas and transportation cycles.

The movement of natural gas from gathering systems and underground storage sites through transportation networks and to local distribution centres is driven by a series of complex, highly interdependent, and decidedly regulated processes. This includes all commercial activities, from nominations and scheduling to invoicing and balancing, which must be reconciled with physical flows as part of the gas pipeline transportation business cycle.

In recent decades, the rise of natural gas as a cleaner alternative to burning coal has been driving innovation of commercial gas structures. With the expanding presence of newer products including hydrogen, more pressure is being put on an increasingly diverse and tightly structured midstream energy segment working to optimise new pipe capacity, storage, shipping best practices and operational capabilities.

Transmission and distribution companies in greater numbers have been taking advantage of opportunities on the world stage. Safety, reliability, gas network security, and public image have each been identified as major, overarching themes for shippers and their counterparts thinking about expansions or new plays in up-and-coming regions.

On the business end of the commercial gas and transportation cycle, we often see shippers, transportation companies and local distribution companies (LDCs) searching for better insight

into future supply and demand, and overall gas transportation network performance. The desire is to optimise the planning and execution of gas deals, including accurate accounting and reliable records of gas received, purchased, transported, delivered, or sold.

All must consider both short and longer-term implications associated with critical technology requirements – for operational viability, network security and commercial longevity – in tandem with how hydrogen and carbon capture, utilisation and storage (CCUS) initiatives, emission-minimisation objectives, and renewable energy products may impact future operations.

Opening up

The global energy industry has undergone tremendous changes in the past two decades. Persistent growth in the natural gas market and other on-ramps to the decarbonisation pathway are being developed with future implications for energy purveyors on an international scale.

Open access regulations facilitate price transparency in markets for the wholesale of physical natural gas. From the US and Mexico to Brazil, Ghana, Malaysia and other parts of the world, the presentation of new gas pipeline transportation systems standards and regulations – including those influenced by international open access transmission system practices – have

helped level the playing field and create a progressively diverse and competitive scene.

Mexico, as one example, in 2013 amended its constitution to allow private investment in both the electric and petroleum sectors. A series of enacted laws would follow, intended to attract domestic and foreign investment into the energy sector and harness substantially underdeveloped resource potential. Since taking effect, the new rules have promoted several new companies in the midstream market, and empowered users to take control of their own supply as the country advertised an aggressive programme for natural gas transmission infrastructure.

With commercialisation activities open to private companies and a new set of modern institutions aimed at facilitating competition, Mexico went on to witness a profound and rapid opening of its oil, gas, and electricity sectors.

Managing risk

Cybersecurity has been identified as one of the leading priorities and a national security issue for governments in places such as the US, where, following a 2021 ransomware attack on a major pipeline, authorities issued several security directives mandating that owners and operators of certain critical pipelines implement several urgently needed cybersecurity measures.

One directive includes guidance to implement specific mitigation measures to protect against ransomware attacks and other known threats to IT and OT systems, develop and implement a cybersecurity contingency and recovery plan, and conduct a cybersecurity architecture design review.

The US Transportation Security Administration recently released a revised and reissued cybersecurity requirement notification for pipeline owners and operators, advising them to develop network segmentation policies and controls that ensure both the continuance of OT systems and the ability to operate safely in the event of an IT system compromise.

Oil and gas majors have a tremendous stake in mitigating operational risks, including cyberthreats, that could jeopardise the reliable functioning of critical infrastructure. The management of change and configuration initiatives that centre on an organisation's OT and IT assets, including both hardware and software, have been pegged commensurate with the risk to critical infrastructure and organisational objectives.

Commercial shippers and pipeline transportation companies must act diligently when aligning technological solutions with their risk management, business administration, and operational needs against the backdrop of these energy paradigms. Realistically, technology seekers in this space are trying to find reliable, advanced solutions including vulnerability and consequence assessments that allow for simultaneous management of safety programmes, contractual obligations, and regulatory concerns.

A system-based approach affords the necessary flexibility and agility to respond to an ever-changing gas system and pipeline asset management environment. To meet all commercial structure requirements, the integration of leak detection tools, predictive modelling systems and flow condition validators with software that allows for capacity and nomination validations, as well as 'look-ahead' results, are more commonly being placed under a single umbrella.

Ideally, the implementation of an integrated commercial gas business solution would support all commercial activities in the transportation process, including nomination management, confirmation, scheduling, allocation, balancing calculations, and invoicing – subject to general terms, conditions, and other contractual obligations associated with pre and post-flow tasks.

Logistics end

Pipelines have multiple restrictions on the logistics of natural gas flows in their systems, requiring strict adherence to avoid scheduling issues and balancing penalties. To move and transport natural gas from one point to another, a variety of coordinated activities must be undertaken.

A transformational approach employs a suite of integrated software tools to better inform and facilitate accurate forecasts and improve customer service, while aligning with pipeline modelling, simulation, and operational management solutions. The appropriate configuration of automated technologies can eliminate manual, time-consuming processes while optimising the logistics for improved results. These outcomes result in an acceleration, in terms of maturity in customer expectation levels, and provide an exceptionally reliable path forward by increasing efficiencies.

The management of nominations is #1 for gas pipeline transportation companies, and the first activity in the business cycle. Emerson developed PipelineTransporter™ as a logistics and commercial management system for pipelines and LDCs. The PipelineTransporter software, used widely as a transactional management tool to administer natural gas transportation contracts, enhances the ability of pipeline operators to manage third-party access to gas throughout the gas business cycle.

With the ability to handle nominations, generate schedules, balance accounts, and create invoices, PipelineTransporter was also built to integrate seamlessly with Emerson's PipelineManager™, an advanced online pipeline simulation engine for pipeline

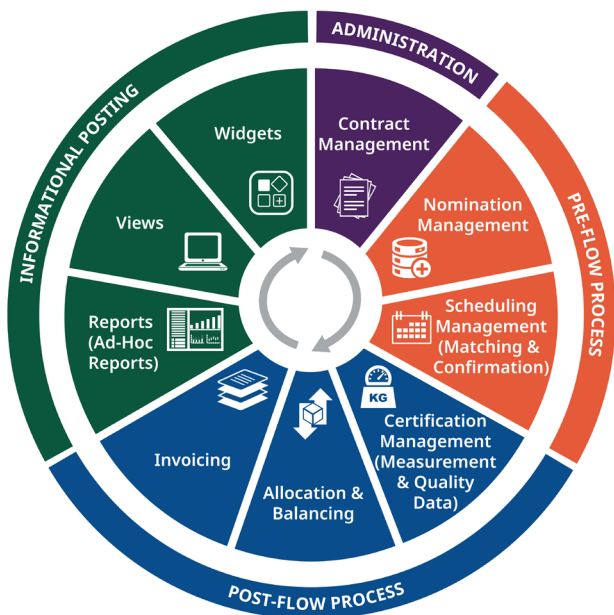


Figure 1. Integration of all commercial gas business activities allows companies to cohesively manage the complex, multi-stage process while mitigating risk.

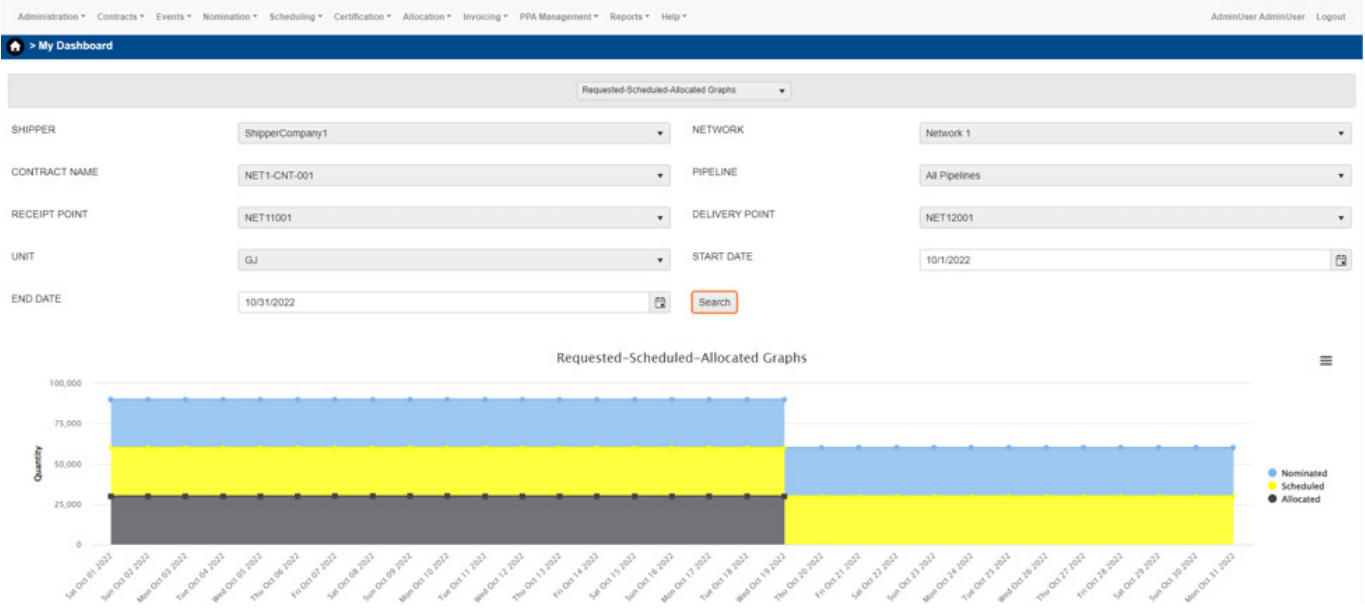


Figure 2. The single dashboard in Emerson's PipelineTransporter allows companies to easily monitor and manage nominated (blue), scheduled (yellow) and allocated (grey) gas.

operations, management, and leak and theft protection. It is based on real-time simulation of the flow in the pipeline with a rigorous transient computer model driven by real-time data retrieved from the pipeline. PipelineTransporter additionally integrates with PipelineStudio™, a state-of-the-art hydraulic simulation tool by Emerson that quickly and accurately performs steady state and transient analysis of single-phase fluid flow in pipeline networks.

TransactionManager™, another advanced Emerson software tool, is a gas transactional management solution for shippers and pipeline operators in regulated or merchant markets worldwide.

Depending on market requirements and regulations, PipelineTransporter or TransactionManager is used to manage the transport, sales, and purchase contracts, at the same time providing better transaction visibility via an off-the-shelf software solution. Both software tools have been designed to manage the commercial business aspects of the pipeline, providing the ability to operate safely and effectively with maximum business acumen and capacity for gas delivery to customers, satisfying demands.

The commercial solutions cover all integration points, including online or offline hydraulic validations and authorisations in the scheduling process by integrating with PipelineManager (simulation in real-time) and PipelineStudio (simulation offline) to ensure optimal capacity is being used and no operational violations are happening. Certifications and allocations are tied to SCADA or an alternative gas measurement system, and with reliable source data, invoices can be generated and transferred to the transporter's or LDC's accounting system.

Overall, PipelineTransporter or TransactionManager, solutions delivered on-premises or in the cloud, increases visibility by incorporating a powerful lens through which datasets, business transactions, balancing rules, tariff structures, informational postings, communication protocols, user experiences, blockchain conventions, and more, can be viewed. The software solutions can be set up to streamline opportunities and overcome limitations

by meeting legal, commercial, and operational objectives for gas transportation companies, shippers, producers, and end users.

In short, the solutions combine nominations, matching and confirmations, certifications, allocation, balancing tools and invoicing into a single operational structure. Via contract management modules, all transportation contracts negotiated between the transportation or distribution company and its shippers to move gas can be readily identified, allowing real-time data to be accessed, managed, and acted on as they relate to receipt and delivery points, penalties, tariffs, volumes, and more.

The gas load

With every gas day, expectations are set for an intricate sequence of processes to be executed in an exact order – all based on specific standards, regulations, contractual obligations, and transportation agreements, in addition to the needs of customers and fluctuations in energy demands.

Variables such as extreme weather conditions, heatload, other seasonal occurrences, occasional large swings in supply and demand, unforeseen events, even incremental growth in populations, can try the reliability of gas networks. Demand forecasts from electric generators, supply and demand forecasts from third-party storage providers, and supply information from interconnecting pipelines can each come into play.

Unpreparedness or inaccuracies associated with gas load forecasting can be costly, resulting in higher prices, the possibility of being penalised, the inability to satisfy needs in the marketplace, or requirements for extra capacity to store excess gas. Shortcomings in these regards can reduce profitability, have a resounding negative impact on the perception of utilities, and tarnish the reputation of shippers and transporters tasked with maintaining continuity in the necessary organisational and operational procedures.

Events currently unfolding on an international level are drawing attention to the types of volatilities and uncertainties that are

exacerbating concerns over the ability to keep up with increasing demands – to secure the required quantities of natural gas and keep right-priced products flowing. Added to this list of complexities are new pipelines being commissioned or being developed, pipelines being taken offline, unscheduled fluctuations related to weather conditions or unexpected events, geopolitical concerns, louder calls for energy independence and security, and rising consumer demands.

Increasingly, in terms of reliable gas management solutions, companies are moving away from traditional problem-solving and traditional calculation or cumbersome problem-solving methods involving the use of spreadsheets and mathematical approaches, to applying simple averages or statistical procedures. In lieu of these conventional methods, there has been a turn toward integrated solutions based on AI, the field of study that empowers computers to learn without explicit programming.

Pipelines need to be notified daily or even hourly of expected volumes with precise demand forecast for every receipt meter and delivery meter. The analysis of historical data and flow patterns can be used to predict future market and gas network behaviour.

Emerson's GasLoadForecaster™ utilises neural network modelling and regression analysis to help decrease supply risk and drive operational efficiencies by significantly minimising forecast calculation times. GasLoadForecaster is a gas demand forecast software tool for predictive management and modelling – a gas measurement model for official volume and standard composition – which can be aligned with purchase and sales agreements and alongside invoices and statements. It is a critical-decision-making support tool, providing greater flexibility and agility by eliminating the need for manual inputs when entering nominations.

Managed as an enterprise risk, companies are more likely to have greater success when working to overcome various risk factors via the implementation of a well-planned, comprehensive approach. GasLoadForecaster easily implements and integrates at a corporate enterprise level, delivered on-premises or in the cloud, to provide short-term hourly and daily load shapes and results, as well as long-term forecasts to LDCs and other load-serving entities.

By correlating historic load, weather, nomination, and calendar and economics data, future gas loads can be predicted by leveraging the widest variety of data sources, translating them reliably into an accurate load forecast – scheduled or triggered when new data is received while actionable reports serve to inform all relevant stakeholders. It offers calendar and seasonal adjustments, in addition to manual modifications to the gas load due to known factors, such as an outage. Users can download interactive reports based on select parameters and in various formats.

GasLoadForecaster has been proven to significantly improve efficiency and the forecast accuracy associated with customers' gas demand. This is achieved by minimising person-hours associated with forecast calculation downtime – perpetuating the ability to automatically generate current, one-day out, or two-day out forecasts, as well as predict gas loads at a meter level or meter group level for each hour of each day. An Emerson user reported immediate, favourable results based on an uptick in forecast accuracy of more than 95% following implementation of the software.

GasLoadForecaster can be fully integrated with PipelineManager and PipelineTransporter or TransactionManager to ensure a more robust solution and a cohesive approach.

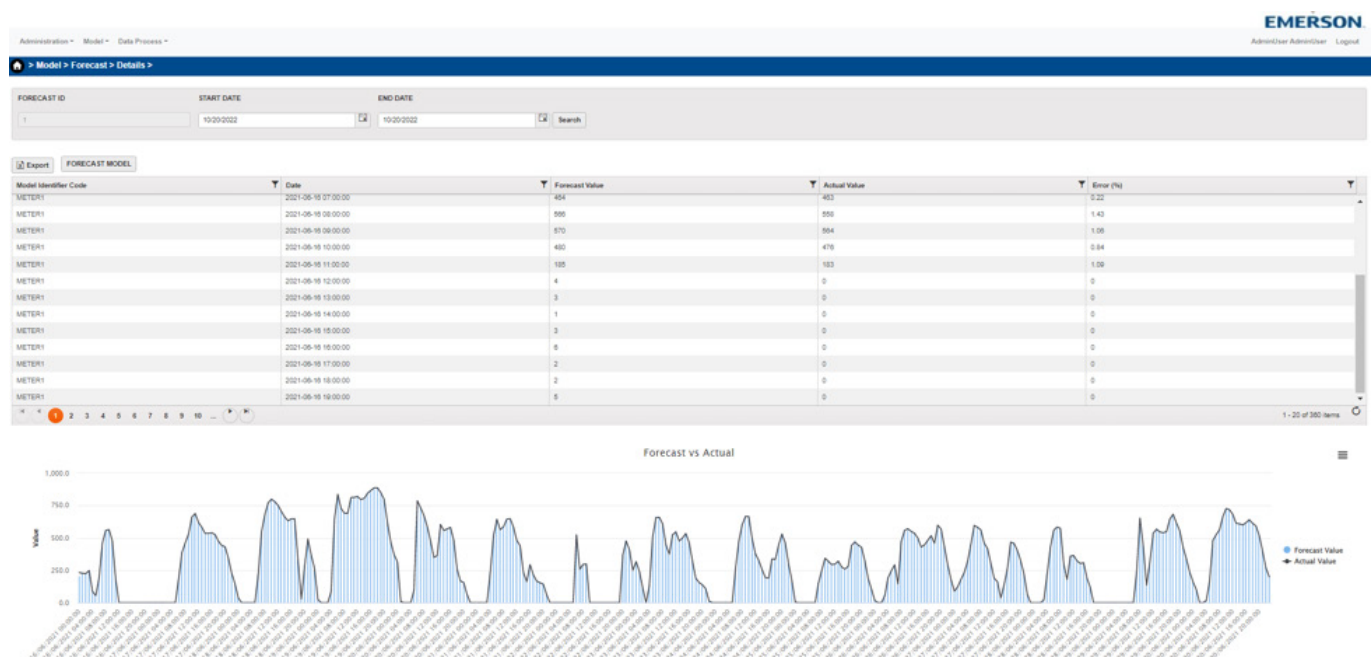


Figure 3. Emerson's GasLoadForecaster provides a model forecast with users able to predict gas loads at the meter level or meter group level on an hourly basis.

Aligned integration

Effective integration among commercial and operational activities simplifies daily routines and enables greater optimisation throughout the gas transportation business cycle. In quick order, a pipeline operator's business processes can be established as a series of user-defined, managed workflows with initial business inputs fine-tuned into administrative menus and dialogues.

Implementation of the solutions are based on each customer's special conditions as defined in various contractual arrangements. For instance, PipelineTransporter accurately allocates capacity to shippers with higher priority contracts, while PipelineManager accurately predicts and plans for safe operation of the pipeline, in turn maximising the ability to deliver a variety of gas products to paying customers. Real-time integration and streamlined operations occur through effective scheduling and automation of manual processes, linepack management, unaccounted-for calculations, and identifying additional capacity.

The PipelineTransporter toolbox acts as a virtual configuration point for imbalance management, allowing for quick adaptation to the ranking scheme for nominations as part of a contractual agreement. The mechanics for hydraulic validation in the PipelineManager interface allow schedulers to validate operational conditions under a proposed schedule, optimise any imbalance status using ancillary services, and schedule by nomination priority.

This integration of solutions represents a comprehensive approach with an elevated level of connectivity and real-time

simulation capabilities – a model that's been vetted with effective outcomes in validation scenarios on a cyclical basis.

Energy complex

As the energy industry continues to evolve, the natural gas pipeline business is marked with signs of increased competitiveness, regulation implementation, and a lean in favour of fewer emissions on a global scale. Alternative energy spaces are becoming more competitive, diversified, and complex.

Using advanced software to achieve real-time integration of commercial gas and pipeline operations affords greater visibility into activity and inventories, and greater connectivity with customer requirements. Emerson's software is enabling companies to meet commercial demands, while helping keep gas pipeline flows moving efficiently and safely – as well as accurately accounted for – to end users around the globe.

The oil and gas majors are preparing to ride a new wave of technological innovation to achieve challenging goals related to regulatory compliance, risk management, and cybersecurity in the commercial gas business. Adopters of a fully aligned software solution cite increased safety and security based on capacity optimisation, better imbalance management, and highly effective hydraulic validations among the expected benefits of automating processes.

This adoption will result in increased efficiencies in the transmission and distribution markets by encompassing all pre-flow and post-flow tasks in the transportation process, with effective integration between commercial and operational activities intertwined with overall business processes. 