NAC Executive Insights

Artificial Intelligence-Enabled Supply Chain

Key Points

- Digital transformation is changing the supply chain more than any other functional area.
- Supply chains face two major gaps:
    - An analytics gap, where even artificial intelligence (AI) capabilities are not keeping up with the growth and diversification of data sources.
    - Attention and knowledge gap.
- The AI platform is the modern supply chain's control tower.
- Potential use cases include:
    - Supply chain insights, sourcing, and negotiation.
    - Intelligent control towers that provide deep supply chain visibility.
    - Logistics, adapting the transportation route algorithms already used in the logistics industry.
- The business transaction landscape becomes readily visible, enabling real-time information and intelligence.
- AI-enabled supply chains represent the ultimate cyber-physical convergence.

Introduction

Across industries, digital transformation is changing the supply chain more than any other functional area. It is driving efficiency and resiliency to disruption. The supply chain is transitioning to a "thinking" supply chain, one broadly and tightly connected to all data sources. In industry after industry, it is enabled with Big Analytics, providing collaborative efforts through cloud-based networks, and with a focus on cyber threats. This transformation has yet to be realized in the engineering and construction (E&C) industry.

Supply chains face two major gaps. The first, an analytics gap where even AI capabilities are not keeping up with the growth and diversification of data sources. Available data must be fully leveraged—structured, unstructured, and dark data (defined as data that is not yet visible to the organization).

Organizations have a great deal of data buried in contracts and transactional systems and externally, among regulators, that could be applied for intensified procurement insights. Using cognitive computing

capabilities to parse through unstructured data such as news feeds and social networks can augment learning for supply risk-scoring and supplier performance.

Unstructured data such as major project approvals, contract awards, unscheduled manufacturing plant shutdowns, or complaints about delays along logistic routes of interest all represent valuable data for analysis within an AI-enabled supply chain. This data will be found in news feeds and social media posts.

The AI-enabled supply chain must have access to the data and be able to analyze it for value in real time. These data include:

- **Customer communications** of all types, recognizing the value hidden in unstructured data.
- **Transportation modes, routes, and rates.**
- **Competitive pricing and news,** including information available through social media.
- **Weather/storm disaster data,** including AI assessed visual roof, road, and other damage, accelerating claims and materials procurement.
- **Geopolitical data,** including sanction or embargo impacts or increased challenges from kinetic actions along critical trade routes (Ukraine War).
- **Global inventory,** facilitating identification and development of mitigation measures against pricing spikes or extended delivery time frames (global diesel inventories as an example).
- **Procurement processes,** highlighting delayed or extended procurements and challenged vendors.
- **Spend analysis** and tie-outs to earned value and earned schedule performance which aids in fraud detection and investigation.
- **Supplier evaluations,** including schedule, quality (including visual and voice), and environmental, social, and governance (ESG) performance.
- **Contracts,** including approved and pending changes and modifications.

Contract Life -Cycle Management

AI software is improving a wide range of business functions. AI functionality streamlines the process of drawing up contracts.

An intuitive interviewing function presents relevant clauses based on answers provided by the user. The smart software automatically evaluates answers and selected clauses and alerts to potential issues and conflicts. Not only does this make the contract drafting process faster, it also removes some of the guesswork and potential for human error that could cause problems down the road. For example, when using an AI-enabled contract life-cycle management (CLM) tool to develop a contract with a company outside of the U.S., the program will automatically inform the author that the contract needs a currency fluctuation clause. This information is based on the context of the contract. Not only does the context of this contract dictate the appropriate clause, but future contracts with similar characteristics will also receive the same recommendations.

AI streamlines the contract development process and it also is rising up in the contract management space as well, making data extraction painless for legacy contracts and providing faster and better insights into contractual data. Technology uses advanced algorithms to turn contracts into data, providing insights into existing contracts—and predictions for future contracting. Rather than spending weeks or months analyzing existing contracts to glean insights that may be skewed, contract management AI can quickly extract relevant data, letting the team spend more time on analysis and less on investigation.

AI-equipped CLM software can help monitor compliance and trigger specific actions based on the treatment of contractual obligations. Where AI really comes into play, however, is in the realm of risk management. By evaluating the data collected on contract performance, machine learning-capable CLM software can develop improved algorithms. It will learn from contract performance, both positive and negative, and create better risk profiling tools based on real-world performance—all without human interaction. Eventually these tools will be able to glean insight from other factors, including social media sentiment, to develop better risk profiles and improve contract negotiations.

Data validation becomes extremely important.

Validation

Data validation is the process of ensuring that the data one has are valid so that they are fit for purpose rather than being contaminated with rogue data. Scraping information for later analysis is particularly vulnerable to rogue data issues because of the problems of inconsistency while blending data from different sources into one data repository. To blend these data together successfully so they form one large whole requires that each and every one of the data are properly validated.

The second gap is one of attention and knowledge. Supply chain organizations have pursued cost reduction and lean practices. While this may be productive in the short term, as data analytics capabilities grow there likely will not be enough "eyeballs" to act upon the resulting insights. The role of AI and machine learning is critical. Big data can create information overload; AI can help filter the insights from big data and make it actionable, allowing iterative decisions faster than a human could.

Supply Chain Use Case

To gain insights from project data in nearly real-time and to understand the implications of changing factors, a large EPC firm introduced an innovative tool that helps identify dependencies and provide actionable insights by fusing thousands of data points across the entire life cycle of capital projects. The system is designed to transform complex data into actionable business insights using domain-driven semantic models to guide artificial intelligence-based predictive and diagnostics modeling. A unique feature of the systems is the blending of data with domain expertise to learn models that are operationally insightful. An advanced cognitive user interface provides seamless access to the data, reports, and results of the analysis using an EPC domain-sensitive natural language conversational interface. The underlying domain understanding is used to guide project diagnostics and provide natural language summaries based on the reports, with data visualization techniques to ease its quick consumption and understanding.

The AI platform is the modern supply chain's control tower, collating, coordinating, and conducting decisions and next best actions across the chain in an automated and timely fashion. AI can prioritize attention based on potential impact. It aids in risk management, spend analysis, logistics, and distribution.

Machine learning applies algorithms to Big Data to discover insights to track and predict supply chain disruptions, providing new levels of visibility. These can recommend alternative actions for unplanned events and transportation disruptions. Weather data integrated with operational data can predict potential problems and alert transportation and logistics service personnel with recommended actions.

It pulls together diverse unstructured data from within and outside the company and visualizes it in a way that helps specialists make quick and accurate decisions.

AI is More than Big Data

Although most think AI is driven by Big Data analytics, the scope of the technology under the umbrella term that is AI falls into three distinct categories: Big Data, vision, and language.

- ***Big Data**: Raw data such as sensor feeds, market indicators, patient data, or cybersecurity threats are analyzed to detect patterns, anomalies, and surface correlations. This is followed by recommended actions and outcomes.*
- ***Vision**: Image or video-based applications recognize objects, people, faces, emotions, and other items in the physical world.*
- ***Language**: AI is used to process and understand human speech, text, and dynamics, syntax, and nuances of language itself.*

In essence, vision and language are related to machines being able to imitate and enhance human perception capabilities, while Big Data is related to how machines can analyze large amounts of data quicker and more accurately than humans, find correlations, and even make predictions of how systems will behave in the future.

Use Cases in an AI-Enabled Supply Chain

AI is already being applied in a wide range of supply chain use cases. Efforts are underway to extend the approaches and benefits being realized in the industrial sector to engineering and construction. Potential use cases include supply chain insights, sourcing, and negotiation; so-called intelligent control towers that provide deep supply chain visibility; and logistics, adapting the transportation route algorithms already used in the logistics industry and potentially extending these algorithms into areas such as project planning and scheduling.

More projects are using offsite construction for large quantities of materials, creating an even greater need for enhanced supply chain coordination to control costs and cash flow.

Supply chain optimization solutions leverage the power of AI to build a smarter supply chain, more resilient, and agile. AI provides comprehensive search, visibility, and insights across the entire supply chain that allows owner, program management, and construction organizations to predict, quickly assess, and effectively mitigate disruptions and risks. This facilitates supply chain decision making and performance.

So-called control towers monitor and govern operations proactively and provide alerts for exceptions and disruptions. Cognitive-enabled insights and recommendations drive intelligent responses. They offer considerable benefits and capabilities, including the following:

- End-to-end visibility – visibility across supply chain partners, including suppliers, contract manufacturers, transportation carriers, third-party logistics. Increases visibility into sub-tier performance.

- Collaborative information sharing – share information and collaborate in real-time. Reduces supply chain cycle times.
- A framework for streamlining existing supply chain processes.
- Early warning alerts and exception management – resolving supply chain disruptions before they disrupt business.
- Predictive and prescriptive decision-support – using predictive and prescriptive analytics.
- Real-time estimating and scheduling data for new project pursuits.
- Cognitive – the self-correcting supply chain with decision-making and machine learning.
- Single version of truth (SVT) contract compliance and payment basis (blockchain enabled capability).
- Project and portfolio risk assessments.

Deeper databases curate organizational knowledge and leverage AI to better respond to future events. Information retrieval and disruption management time is reduced from days to minutes.

Engineering & Construction Industry Supply Chain Use Cases	
Large engineering company	Has used software apps to strengthen its supply chain by using a software suite for critical business processes such as supply chain management. It helps the engineering company automate and streamline front- and back-office processes, enabling the company to tighten the procurement cycle, regardless of where inventory is received.
EPC 1	Through AI, the company is able to find connections and learn new solutions that it could not be able to find if every possibility had to be tested. Faced with unexpected weather, material, or labor shortages, project teams are able to ask: “What is the best approach from this point forward?”
EPC 2	To gain insights from project data in nearly real-time and to understand the implications of changing factors, EPC 3 introduced A market dynamics/spend analytics software. This innovative tool helps identify dependencies and provide actionable insights by fusing thousands of data points across the entire life cycle of capital projects. The system is designed to transform complex data into actionable business insights using domain-driven semantic models to guide artificial intelligence-based predictive and diagnostics modeling.
Large Construction Company	This science and technology-based constructor uses AI technology throughout its supply chain. One example: as raw material enters through a sorting machine, it utilizes AI to measure and evaluate every single piece of wood. An algorithm then matches up boards, based on where some may have knots or other irregularities,

Engineering & Construction Industry Supply Chain Use Cases	
	to turn them into walls or flooring panels, making sure that nothing is wasted and the resulting product is perfectly pressed.

AI-Enabled Supply Chains Transformed to Supply Chain Networks

Digital connections with suppliers and partners automate and digitize supply chain transactions, delivering deeper AI-enabled search and visibility into the transaction life cycle and partner performance. The entire business transaction landscape, both structured and unstructured data (including visual and voice), becomes readily visible, enabling real-time information and intelligence that today's construction supply chains require. There is an inherent ability to drill down to the granular detail of a specific transaction. Previously dark data is now available.

Shared ledger technologies, such as a blockchain (a distributed database or ledger that is shared among the nodes of a computer network to store information electronically in a digital format), provide permissioned trading partners with a transparent shared record of real-time digital transactions that leverages existing investments with data privacy and security. Shared visibility is the first enabled capability.

AI provides the engine to make sense, not just of individual supply chains, but how they will behave and respond with changes in the broader network of interlinked supply chains.

Summary

AI-enabled supply chains are common and growing aspects across industries. Early developments within engineering and construction point the way. The potential is significant. AI-enabled supply chains:

- Provide real-time or near real-time information in a multi-tiered supplier environment, i.e., precision planning
- Provide a foundation for machine learning supply chain optimization within a dynamic environment, i.e., market shaping (Sourcing, packaging, pricing, negotiation); faster logistics.
- Streamline both front and back end processes and, when coupled with ledger-based systems, offer an unambiguous "single version of the truth."

In some ways, AI-enabled supply chains represent the ultimate cyber-physical convergence.

About the Author

Bob Prieto was elected to the National Academy of Construction in 2011. He is a senior executive who is effective in shaping and executing business strategy and a recognized leader within the infrastructure, engineering, and construction industries.