NAC Executive Insights

Logistics

Key Points

- Logistics may be thought of as the "management of inventory at motion and at rest."
- Logistics in many ways represents the "connecting arrows" along the entirety of the supply chain.
- Elements of logistics management include:
  - Resource assessments
  - Lead times
  - Supply and demand management
  - Sourcing and procurement
  - Packaging, shipment protection, labeling, and tracking
  - Inventories
  - Transport
  - Consolidation centers, warehouses, and laydown areas
  - Site-based logistics
  - Waste management
- Construction sites include the final facility site as well as intermediate fabrication, preassembly, or module yards.
- Other logistic flows of growing importance include information, finance, and risk.

Introduction

Major industrial players are increasingly emphasizing the putting in place of modern supply chains, managed by so-called control towers that deploy elements of artificial intelligence (AI). Efforts to modernize supply chain management recently have been accelerated by the COVID-19 pandemic and the resulting and sudden reconfigurations of supply chains globally. Supply chain challenges have been further aggravated by emerging trade policies from nations around the world.

This Executive Insight looks only at one element of the supply chain: logistics. It does so from a procurement and construction perspective.

What is Logistics?

Logistics may be thought of as the "management of inventory at motion and at rest." Within a construction context, logistics relates to the planning, procurement, transport, delivery, inventory

management, and staging of resources for a construction site. As discussed later, logistics as a minimum relates to the movement of labor, equipment, and materials, which all are driven by construction site demands and that are constrained by supply chain capacity and the efficiency and effectiveness of logistical flows.

Logistics in many ways represents the “connecting arrows” along the entirety of the supply chain.

What are the Elements of Logistics Management?

The primary elements for logistics management include:

- Resource assessments
- Lead times
- Supply and demand management
- Sourcing and procurement
- Packaging, shipment protection, labeling, and tracking
- Inventories
- Transport
- Consolidation centers, warehouses, and laydown areas
- Site-based logistics
- Waste management

Each of these will be discussed in the following paragraphs.

Logistic management efforts must begin with basic **resource assessments**. This is true for large scale projects, but equally true in industries or regions experiencing high demand for construction materials. Resource assessments often are seen in peak markets, where global demand for steel is constrained as much by mining rates for iron ore as it is by steel mill capacity. Also, projects in remote locations are required to assess local, even national, labor and skill shortages. The result may mean moving labor and certain skill sets from other countries to the new construction sites.

Some projects of scale have been required the logistical task of operating substantial bus operations to move up to 100,000 workers a day to and from the construction site. On-site bus operations for routine movement of some staff also are common at many large sites.

High quality labor market assessments are another element of resource assessment for logistics management. One emerging example is worth noting. Market conditions in the U.S. have made the prospect of multiple offshore wind turbine farms entering construction simultaneously a real prospect. A key equipment resource will be the necessary offshore vessels for turbine erection. U.S. law, specifically the Jones Act that focuses on issues related to maritime commerce, requires these vessels to be U.S. flagged as well as U.S. manufactured. Today those vessels do not exist in the quantities the market requires.

Lead times are a second element of effective logistics management and require a continuous up-to-date assessment for acquiring, producing, and transporting the various resources that a project requires.

Lead times for labor acquisition and provision to the site must consider recruitment and training periods; time allowances for relocation, including any construction camp resources that must be put into place; and time to obtain any required passports and visas.

Construction material lead times will be influenced by overall market demand and queuing times for mill or fabrication capacity. Additionally, local shortages of sand, aggregate, or concrete may require material importation to the construction site or a nearby staging area. Similarly, temporary batch plants or quarry facilities may be needed, thus impacting lead times for even the most basic materials. Equipment lead times, such as mentioned previously regarding specialized offshore wind turbines, also may involve shop capacities, especially for heavy mechanical and electrical components. Such components may largely determine equipment lead times, which must be reflected in the overall project logistical chain.

A third element of logistics management relates to **supply and demand management**. This is one area where today's modern supply chain control towers are showing good results across several industries even though lagging in construction[1]. Supply management may be better described as awareness of the dynamic behaviors and trajectories of the various elements of supply the project requires. Sourcing decisions must reflect supplier-specific lead times, capacities, and associated logistical times and costs for ultimate delivery to the site. Demand management requires interaction with construction planning to ensure project demand. The timing of those demands must meet the supply chain and its inherent logistical realities. This may necessitate a resequencing of certain construction activities, previously planned in an unconstrained environment, to reflect the very real imbalances that may exist between supply and demand.

Logistics management is an integral part of **sourcing and procurement** of labor, materials, and equipment. Logistical factors including cost and time must be part of any sourcing evaluations and final procurement decisions. Logistics management requires a high degree of granularity around supplier schedules as well as that of key sub-suppliers and subcontractors. Supply chain control towers are focused on achieving this visibility, but more traditional methods still allow focus on critical items of supply (major equipment; large bore and special piping) and major commodity categories such as concrete and steel.

Logistics management requires granular input into **packaging, shipment protection, labeling, and tracking** capabilities. For example, for major equipment for which requisite spares have been identified, should these be shipped with the principal equipment or separately? Should components be labeled with barcodes or RFID tags? Should written documentation related to installation be included with shipped components, mapping them to site installation needs?

One aspect of packaging that is often underserved is its impact on the waste stream. Mixed waste packaging (steel bands, plastics, and cellulose materials such as wood or cardboard) is more likely to end up in a rubbish heap when contrasted to single material packaging (all cellulose, for example). Similarly, structural aspects of prefab assemblies or modules are often strengthened with temporary steel to

[1] COVID-19 has exposed many problems due to rapid shifts in demand and lack of buffers due to inventory optimization.

address transport load. This steel needs to be removed at site. It then usually ends up in the waste stream. An alternative would be to design the assemblies or modules to eliminate this extra packaging component so it can be removed from the construction site waste steam.

Inventories may be stored at or obtained from multiple locations throughout the logistics chain. An important question to be addressed is: where is the most desirable point in the logistics chain for such inventories? Just-in-time supply chains have relied on vendors maintaining inventories to meet both the project's needs as well as that of other customers. In the COVID-19 pandemic, the industry has witnessed the vulnerabilities of over-reliance on suppliers as a single point of inventories. Similar impacts are noted when major adverse weather events occur. Inventories may also be held at consolidation centers and off-site warehouses as well as on-site warehouses and laydown areas. Inventories act as buffers against risks (such as accelerations, late deliveries, necessary resequencing, and others) and the inventory strategy is important to think out on a complex project.

Irrespective of where inventories may be held, **transport** to and from these intermediate or endpoints is a major element of logistics management. Transport along the logistics chain may require a combination of:

- Ocean transport
- Special marine vessel transport
- Barge transport
- Air transport
- Rail transport
- Highway and off-road vehicular transport
- Self-propelled modular transporter (SPMT) or other specialized transport

In addition to these various forms of horizontal transport, vertical transport will most likely be required. These can include marine shipping cranes and crane loading of rail and road vehicles.

Packaging of items in transport may include bulk and containerized cargo as well as shipping of large-scale modules.

Transport considerations must reflect the different modes through which the item of supply will transit; weight and dimensional limitations at each stage; any special environmental considerations along the transport link (marine environment; excessive heat or dust); and whether the transport packages represent singular items of supply or a consolidated shipment. The consolidation of shipments is a key consideration, where one is paying for shipping volumes (within weight limits), such as seen in a marine container or truckload, and in physically constrained links along the supply chain (port or railroad capacity limitations; last-mile delivery truck and driver constraints; and physical access limitations to the site).

Capacities and locations of any **consolidation centers, warehouses, and laydown areas** are key logistics considerations. Effectiveness and efficiency of each of the points along the logistics chain is influenced by the thoroughness of planning that has taken place; continuous awareness of the overall supply chain condition and trends; predictable demand management (execution of project per plan); and technology

enabled inventory tracking (bar codes; RFID; and inventory management systems, including AI enabled inventory management).

Construction Consolidation Center:

A distribution center supporting project logistics by channeling material deliveries to one or more project sites (intermediate and final). It facilitates load consolidation, relieving logistical pressures on constrained sites and supporting just in time delivery. This latter consideration is essential on highly congested sites, sites co-located with operating facilities, and congested urban areas with zero-laydown.

One example is the Heathrow Consolidation Center (HCC), established in 2001, to support work at Heathrow Airport.

Advantages include significant reductions of freight traffic to the site; increased workforce productivity; waste and carbon emission reductions; and improved sequencing of materials to the site.

Site-based logistics management may include various activities, including storage and dispatch of bulk materials and handling of material, equipment, and tool flows from warehouses and laydown areas to various construction work fronts and crews. Measurement, logging, and tracking of these flows are important for quality, safety, and inventory management. Site-based logistics management also requires provision, maintenance, and fueling of on-site vehicles as well as management and maintenance of logistics-related plant equipment and tools. Worth noting are the huge energy requirements, both fuel and electrical, of construction sites. Large projects, especially those in more remote environments, require special attention to fuel movements (truck or pipeline) and on-site storage (how many days of fuel). Similarly, large projects with multiple diesel generators may benefit from the fuel savings that come through use of a microgrid sharing this distributed resource. Increased focus on carbon may influence fleet composition and sources of energy for construction.

Water and wastewater flows along the logistics chain often do not receive adequate logistics attention. Some sites may require potable water to be trucked in and in some instances non-potable water may be needed for dust suppression. Depending on the particular circumstance, the logistics of water may prove to be especially challenging.

Waste management is another important link along the logistics chain. Up to 25 percent of materials arriving at a site leave the site as waste. Logistics management has a key role in influencing designs that minimize waste materials (temporary steel, for example). Additionally, waste stream flows can add to congestion in an already constrained logistics chain. Increasing environmental, social, and governance

(ESG) considerations, especially around net zero carbon (achieving carbon neutrality or net-zero carbon dioxide emissions), can be well served by attention in waste management.

Additional Considerations

Traditionally, a "construction site" is defined as that location where a final delivered facility is being built. While still true today, the definition must be broadened to reflect changes in the construction process. Now a site also includes off-site fabrication and preassembly facilities as well as module yards.

Recognition of the multiplicity of intermediate and final sites is important as they further complicate overall logistics management. What materials must be delivered where and when? Consider a situation where a degree of preassembly is to happen off-site, but because of supply delays, the assembly must now occur at the final site location. The entire logistics chain around this activity and item of supply must change.

Other Flows along the Logistics Chain

So far, flows related to labor, materials, and equipment have been highlighted. Other flows, however, are important in logistics management. These include **information, finance, and risk**.

Information can be thought of as the lubricant of a smooth running, efficient, and effective supply chain of which the logistics chain is a binding element. AI-enabled supply chain control towers seek to integrate all elements of the supply chain, gleaming deeper insights from dynamic information flows. Information flows take on a deeper and extended importance when considering their resulting extensions of the traditional supply chain into the realm of on-site logistics.

Finance represents a second lubricating element in an efficient and effective supply chain. Positive cash flow is happiness, not just for the construction contractor but also for the various suppliers of materials and equipment supporting the project. Logistics contracts need to be well designed, especially with respect to payment and pain points. Decisions on when a supplier has met its obligations must be carefully considered. Is it freight on board (FOB) or drop shipment at site? What are the provisions for acceptance and how do they relate to payment? What flexibility is provided for in delaying receipt within a window (to address inventory or construction progress concerns) or diverting shipment to the final site versus a previously selected intermediate fabrication or consolidation site.

Logistical **risk** flows need to be separately considered and tracked. Logistical flows represent a coupling mechanism across various project execution streams. In effect, they provide the potential for a high degree of constraint coupling. Consider the impacts of a general labor strike on a key element of a supply chain. Consider as well a trade embargo that has an impact on a prominent offshore sourcing country. As supply moves through the logistical chain toward the construction site, logistical risks should be expected to be reduced over time. While generally true, deteriorating conditions at key points in the logistics chain can simultaneously contribute to increased logistics risks going forward.

Summary

In many ways construction is about the management of risk. It also very much about the management of logistical flows.

In this Executive Insight various links in logistics management and the importance of each have been presented. Each link has been highlighted with regard to its individual importance. In the process both the responsibilities for a project's logistic management function and the duties of the logistical manager (planning; programming; mobilization of logistics chain and site logistic facilities; management of key portions of the supply chain; and inventory and delivery management) have been discussed.

This Insight also draws attention to some key flows beyond labor, materials, and equipment. These include information, finance, and risk flows.

Effective logistics management opens the door to project cost savings, improved productivity, waste reduction, improved site safety (as the site is decluttered), and higher confidence in timely project deliveries.

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.