NAC Executive Insights

Inventories – A Key EPC Consideration for Achieving Capital Efficiency

Key Points

- Optimizing plant inventory levels begins with the supply chain driven design decisions.
- Supply chain decisions may drive life cycle supply chain direction and flexibility.
- Logistical constraints experienced in the capital expenditure (CAPEX) phase may be harbingers of later life cycle constraints.
- Engineer-procure-construct (EPC) stage decisions can result in elements of the project having limited or no substitution options.
- Inventories represent a major lever to be pulled to achieve capital efficiency.

Inventories represent a major opportunity with respect to achieving capital efficiency, yet adequate focus on this important element at the project development stage is often missing. Today's lean business processes and operations inventories are a critical aspect of not only plant capacity, but also operational flexibility and business continuity. Inventories involve costs: those spent in initial acquisition as well as sustaining costs associated with preventing inventory degradation.

A key element in optimizing plant inventory levels begins with the **supply chain driven design decisions** and the associated procurement and supply chain decisions made at the EPC stage. This Executive Insight explores these aspects of driving inventories to optimal levels. Not covered here, however, are some of the more traditional aspects of inventory optimization that occur with marketing and sales campaigns and incentives.

Optimization at the Design Stage

Inventory optimization begins at the project's design stage. It is here where we consider tradeoffs and make design decisions related to:

- Throughput capacity
- Number of process trains
- Required operating margins
- Initial, intermediate, and final storage and surge requirements
- Non-process infrastructure design and ownership models
- Operating and maintenance philosophy and strategies

Supply chain capabilities of the owner's EPC are critical in ensuring a broader supply chain discussion occurs within the owner's organization. Also, it assures the owner's sustaining supply approach has been considered in plant design and in EPC supply chain decisions.

Capital efficiency pressures facing all industries are driving an increased focus on "fit for purpose" design and a reduction in layered "design margins." These actions reduce CAPEX, but also reduce the inherent capacity and margins of plants from what an owner may have previously experienced, thus increasing the importance of understanding required inventory levels.

The use of advanced modularization concepts and tighter plant layouts may influence decision making on intermediate stage inventory levels and process sizing and designs on the number of process trains.

Standardization practices adopted at the earliest design stage may effectively limit spare part and consumable inventory requirements, which in turn creates a positive influence on overall plant capital efficiency in a number of ways.

Increasingly, non-process infrastructure, defined here to include power, water, and the plant logistical chain (road, rail, port) are experiencing higher degrees of uncertainty as these vital supply chain links:

- are taxed as plant usage grows.
- degrade from under investment by responsible third parties (national and local governments; port and road authorities; private rail, port, and road operators).
- experience competition for capacity from other existing and later developed or expanded projects.

Design stage strategies may offer confidence building approaches through consideration of:

- creation of project dedicated infrastructure.
- co-investment with existing infrastructure providers.
- alternative ownership and service delivery models that act to take capital intensive project elements off balance sheet and translate them to a pay for performance basis. Particular opportunities exist with respect to power and water dimensions of today's projects.

Inventory Optimization at the EPC Stage

As we move into the EPC phase, we make supply chain decisions that may drive life cycle supply chain direction and flexibility, including:

- the number of SKUs embedded in the plant and maintenance supplies and spares.
- implicit logistical chains, including exposure to common infrastructure choke points.
- limitations on available substitutions.
- source country supplier risks

Standardization decisions made at the earliest design stages may now be translated to more granular applications and are a function of the linkage within the owner's EPC of supply chain and engineering

and construction functions. Let's look at some opportunities to reduce inventories through supply decisions made at the EPC stage.

- **Small motors** limited to three sizes from a singular manufacturer with common components across the family of motors.
    - Motor spares limited to three types and, depending on supply chain resiliency and speed, the number of onsite spares may be limited to one or even none. The situation on motor spares is exacerbated in a multi-vendor situation or one with a large number of alternative sizes.
    - Concerns on single vendor supply can be addressed at this stage as well with a conscious tradeoff process occurring. The key is early supply chain engagement to ensure these decisions are deliberate and well thought out.
- **Filters and lubricants** can be coordinated across similar component types, reducing the need for inventories on a wide range of filters and lubricants while reducing the chance of the wrong consumable component being used.
- **Nuts, bolts and other common fittings and the accompanying tool sets.** Many of the standardization drivers for the CAPEX phase can be extended into operating expenses (OPEX) and inventory considerations.

Logistical constraints experienced in the CAPEX phase may be harbingers of operating or later life cycle constraints. CAPEX stage solutions considered by the EPC should be further tested for OPEX relevance, and should explicitly consider the extent to which these logistical constraints influence required inventory levels. These inventory levels may be coupled with feed stocks of various types as well as intermediate or finished products to ensure an ability to address logistical uncertainties. The consideration of inventory related factors is not regularly addressed, and often CAPEX stage solutions have not been evaluated for potential OPEX applicability.

Many sites are logistically constrained but well served by major elements of the supply chain. In these instances, vendor maintenance of inventories, either directly contracted for or implicit in a supply contract with stringent delivery regimes, can act to reduce CAPEX and OPEX phase inventory requirements.

EPC stage decisions can result in elements of the project having limited or no substitution options. These supply chain decisions have potential impacts on plant risk levels, which are often mitigated through inventory-based decisions as part of a broader business continuity evaluation. Material tradeoff studies, especially for feedstocks and consumables, need to recognize the inventory implications and costs of decisions made on specialty or hard to source materials.

Strategic global sourcing decisions made during the EPC stage must be evaluated for longer term relevance as cost advantages between sourced and other markets will likely change over the life of the capital asset. In those instances where CAPEX is the dominant life cycle cost, these evaluations may be less important. In some instances, however, life cycle costs for a system or component are dominated by

the operating phase costs. Short- and medium-term source market cost trajectories can influence inventories, potentially allowing them to be used as natural hedging strategies.

Finally, integration of vendor data, at an appropriate level of granularity, into the building information model (BIM) or its equivalent can provide insight into spares and inventory requirements as procurement activities advance.

Inventory Optimization Benefits from Capital Programs

Major capital assets are not merely built and then maintained. A significant sustaining capital effort is required to keep these facilities in good operating order. It is not unusual to see company-wide sustaining capital investments that equal or surpass those allocated to new greenfield project capacity. Each of these sustaining capital programs represents a significant opportunity to improve inventory optimization by prioritizing investments that:

- reduce inventory requirements through plant and process debottlenecking at all process stages.
- increase fill rates, reducing requirements for sustained on-site storage.
- maximize or balance plant capacities, both across multiple associated plants and also across process lines in a given plant and, importantly, between asynchronous process stages such as the interface experienced between batch and continuous processes.
- address non-process infrastructure bottlenecks influencing inventory levels.

Efficient operating plants often are run with reduced working capital requirements as a result of more rapid inventory turnover. Required inventories to deal with common plant bottlenecks are reduced and, therefore, working capital advantages must be included in project prioritization for sustaining capital investments.

System fill rates can be adjusted to influence on-site storage and inventory requirements, replacing these capabilities with just in time deliveries or on demand flows. Decisions in this regard should be made at the earliest design stage, but may also be positively addressed as part of subsequent sustaining capital investments.

Plant capacities and operating modes must reflect a broader plant portfolio as well as whether the owner's operating philosophy is principally a "push" or "pull" one. The role of inventories that act as buffers changes under each model. The mining industry utilizes both models with different buffering strategies with associated differences in inventory costs as an example. Like all costs associated with capital efficiency, inventories are just one of the levers we must consider.

Required inventory levels are also influenced by the strength of the coupling across the supply chain and the owner's visibility into this supply chain. The EPC stage represents an optimal point to gain multi-level visibility and insight into the degree of coupling that exists. In tightly coupled supply chains, all partners may accrue benefits in the form of reduced inventory requirements through coordination of the timing of plant shut down and major maintenance activities.

Conclusion

Inventories represent a major lever to be pulled to achieve capital efficiency, but to be effective consideration needs to begin at the earliest stages of the CAPEX phase. Inventories are a key consideration in supply chain decisions.

Reference

Capital Efficiency: Pull All the Levers; Construction Management Association of America (CMAA); August 2014; 978-1-938014-08-6 (eBook); ISBN 978-1-938014-09-3 (Print)

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