REINVENTING THE ENERGY VALUE CHAIN

SUPPLY CHAIN ROADMAPS FOR DIGITAL OILFIELDS THROUGH HYDROGEN FUEL CELLS

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use a large vehicle fleet to move it around. Therefore, infrastructure projects that allow them to reduce inventory, transportation costs, or fleet assets will have a big impact. Discrete manufacturers are the most common type of manufacturer.

4. Design-to-Order Manufacturing. Design-to-order manufacturers do not ship product until it has been ordered, and usually ship directly to customers. They are usually engineering intensive and hold low inventory.
5. Distribution. Distributors buy finished product, usually add value to it, and resell it. Their profit depends on their ability to move product quickly and reliably. Unique transportation or logistics capabilities allow them to create supply chain advantages.
6. Reselling. Resellers, for example retailers and e-retailers, buy finished product and resell it in its identical state. They spend relatively large amounts on transportation, largely because their retail outlets and/or their customers are widely dispersed. Their success usually depends on excellent inventory management and close collaboration with the end customer.

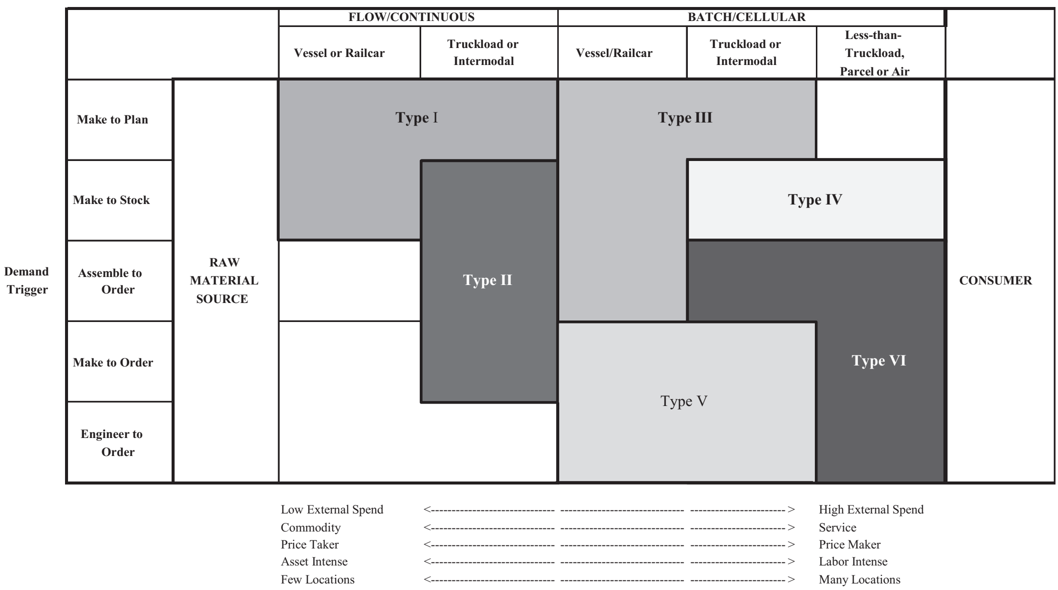

Figure 5. Supply Chain Types

(*Source:* Jacoby, David Steven, in *Guide to Quantifying the Economic Impacts of Federal Investments in Large-Scale Freight Transportation Projects.* Prepared for: Office of the Secretary of Transportation, US Department of Transportation, by: Cambridge Systematics, Inc., Economic Development Research Group, Inc., and Boston Logistics Group, Inc., August 2006. Page A-11)

Supply Chain Performance Management—Metrics and Targets

Executive management at most companies expects the supply chain management function to reduce cost and increase net margin and return on assets, and to improve operations, especially to increase quality and availability of raw materials, intermediate services, and finished product. However, the same tools can in many cases be used to optimize around other objectives (for example, environment or local content).

Rationalization efforts have been demonstrated to create at least a 13% improvement in net margin.[II] *Synchronization* efforts have been shown to create a 10% improvement on Return on Net Assets (RONA). Supply chain initiatives in the *synchronization* phase often achieve the improvement in RONA by reducing forecast error, and thus achieving level production both within the enterprise and across trading partners, which decreases the need for inventory and fixed assets.

Most often, improvements are measured at the project level, where they are sought in targeted areas that contribute to a higher net margin and a higher return on assets such as:

- Reduced upfront purchase cost. Lower upfront cost is the most intuitive savings framework. However, it can be complicated by tiered pricing, promotions, discounts, and volume rebates.
- Reduced operating cost. Energy savings is a common way to reduce operating costs. Operating assumption variables can affect the savings, especially for large turbines and electrical distribution and control equipment.
- Increased throughput, or productivity. Improvements that increase the speed of a process such as drilling or refinery expansions can lead to higher production overall. Savings for these types of improvements can be calculated on the basis of either cost savings or profit enhancement. Cost savings might be estimated by, say, the reduction in the number of rig-days needed to drill a well. The savings per well then can be multiplied by the number of rigs in operation and the number of wells that need to be drilled over a period of time. If the increased productivity leads to reduced time to first production, the benefit may be improved profitability. To quantify this benefit, take the number of extra days of production and calculated additional profit based on a typical well, then apply an average output price per unit to get the profit margin, and multiply the resulting benefit by the number of units producing.
- Shorter lead times for the delivery of equipment or services. For capital items, one might determine that order lead times are constraining production that would otherwise be occurring. In this case, the decrease

[II] Based on a prototypical operation

Introduction

Large capital projects are characterized by risk-reward trade-offs such as market (price and volume) risk, materials supply risk, supplier risk, construction risk (sometimes offloaded to an EPC firm), and operational, supplier, technology, political, and regulatory risk.[43]

Capital project managers can seek market risk analysis from a number of specialist consulting firms; political and regulatory risk are special types that extend well beyond supply chain management. These are not covered here.

General Approaches to Managing Risk

Supply chain policies, processes, systems, and organizational structures can be used to avoid, diversify, minimize, or hedge risk (see Figure 21). While the bulk of this chapter will provide tools and techniques for managing each of the eight trade-offs cited above, a general framework for managing risk can guide and inform some of the more detailed tools and techniques.

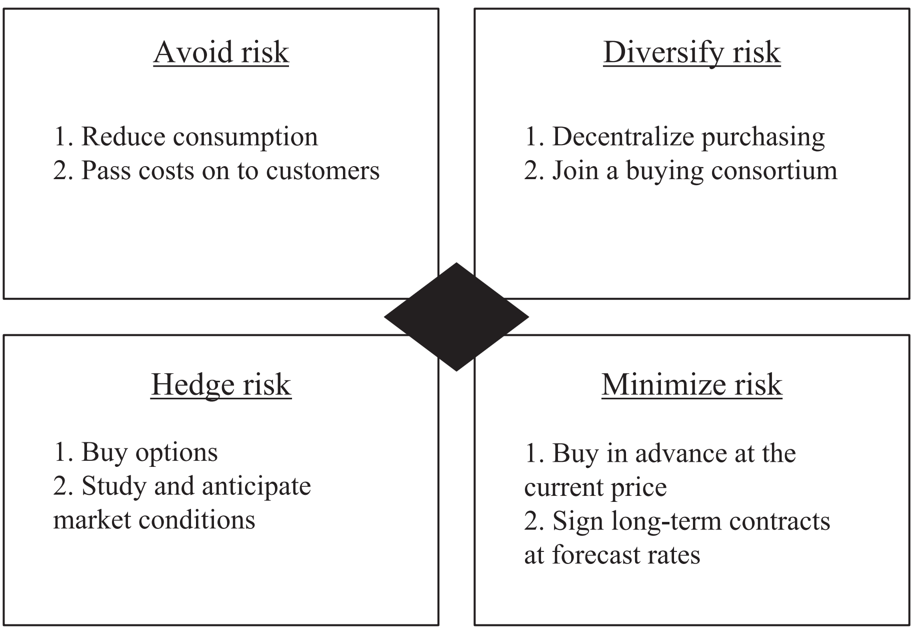

Figure 21. General Strategies for Managing Risk
(*Source:* Boston Strategies International)

The easiest and in many cases the most effective risk management strategy is to avoid risk entirely by passing it through to customers.

Fence, during which manufacturing assets can be redeployed. If planners wait until the Manufacturing Time Fence (line scheduling), there is a much greater chance of material or component unavailability or high prices. Stretching from a shorter to a longer time horizon allows more flexibility to pursue alternative strategies if there are any available.

Acquire the source. If material shortage appears to be chronic, it may make sense to acquire the source. Vertical integration makes sense when the cost of acquiring the materials through external sources exceeds the cost of procuring them internally.[56] Even if they could be procured at lower unit prices on the outside, the cost of searching for sources of supply and negotiating prices, and arranging logistics, transportation, and payment may be complicated in a tight market, and if sustained for long periods might justify vertical integration.

Refurbish, recycle, or renew. Over the last five years refurbishment has become a fairly popular alternative to buying new for a variety of equipment. Refurbished equipment is often less expensive and can have a shorter lead time, especially if the supplier builds refurbished equipment to stock. Recycling component materials has also become more prevalent, as evidenced by the introduction of new recovery processes for rare earth metals on the part of refinery catalyst manufacturers. For example, Grace Davison installed metal traps on its catalyst production lines, which recover about 2% of the total rare earth metal volume used to make the catalysts.[57] Using a larger analogy, enhanced oil recovery (EOR) is a large-scale analogy to the refurbishment concept: depletion has reached the point where recovery processes are widespread.

Outsourcing Risks and Mitigation

The decision about whether to insource or outsource an activity ("make vs. buy," as it is commonly called) drives cost in the same way as the ownership control decision discussed immediately above.

In addition, deciding to rent vs. buy can similarly change the risk/return profile of a work process by outsourcing part or all of it. Outsourcing affects not only risk profile, but also cost, effectiveness, and sustainability. Potential reasons for outsourcing may include:

- Lower cost and capital requirements. For instance, one production chemical supplier does not make any chemicals. It buys the base chemicals, mixes them, and resells them to the oil producer or service company. This allows the supplier to avoid tying up capital in facilities and gives it the flexibility to choose the best supplier for a given type of chemical without developing the chemistry itself.

8. Require vendors to use strong authentication and cryptographic methods
9. Require vendors to manage credentials stringently, including periodic deprovisioning
10. Require vendors to deny communications with risky profiles and log denied access incidents
11. Use intelligence about active and potential threat sources to mitigate active threats
12. 1Require vendors to establish a documented patch process with safeguards against malicious actors
13. Verify patch authenticity via cryptography, hashes, certificates, or two-factor authentication

For further information on cybersecurity measures, readers may refer to the guidelines prepared by the Critical Infrastructure Protection Committee of the North American Electric Reliability Council, including provenance guidelines prepared by a working committee chaired by David Steven Jacoby.[76]

Peak Capacity Strategies

Overall Equipment Effectiveness (OEE) and Return on Net Assets (ROA)

The Overall Equipment Effectiveness (OEE) framework measures asset effectiveness by defining three types of capacity:

- Rated capacity (as determined by the original equipment manufacturer)
- Standard capacity (driven by equipment availability, which is based on scheduled uptime vs. total available time). Most often, this corresponds to the operator's normative, or expected output.
- Demonstrated capacity (actual production vs. the standard), which is affected by product quality or yield (good output vs. total output)

Actual capacity is equal to rated capacity times standard uptime times efficiency, or put another way, Time Available x Utilization x Efficiency, where Utilization = [Actual hours worked / Standard hours available] and Efficiency = [Standard hours produced / Actual hours worked].

The best performers have an OEE averaging 90%, whereas laggards have an OEE averaging 74%, according to a study by Aberdeen Group. The differences are due to:

- 2% unscheduled asset downtime vs. 12% unscheduled asset downtime
- 12% reduction in maintenance cost vs. 2% increase in maintenance cost
- 24% improvement in ROA vs. plan, compared to a 5% decrease in ROA vs. plan[77]