* **Supply Chain Design**
* **Supply Chain Management**
* **Role of aggregate planning in a supply chain**
* **The aggregate planning problem**
* **Aggregate planning strategies**
* **Implementing aggregate planning in practice**
* **UPS Supply Chain Solutions 1**
* **Introduction**

Chances are you’ve heard the term supply chain strategy. Used informally, it is often confused with supply chain management, where supply chain operations are controlled to reduce costs. There’s some truth to this definition, but supply chain strategy really is broader; it defines how the supply chain should operate in order to compete. Supply chain strategy is an iterative process that evaluates the cost benefit trade-offs of operational components. Business strategy involves leveraging the core competencies of the organization

to achieve a defined high-level goal or objective. It also includes the analytic and decision-making process surrounding what to offer (e.g., products and services), when to offer (timing, business cycles, etc), and where to offer (e.g., markets and segments) as a competitive plan. While the business strategy constitutes the overall direction that an organization wishes to go, the supply chain strategy constitutes the actual operations of that organization and the extended supply chain to meet a specific supply chain objective. That being said, most companies have a business strategy, but are unlikely to have overtly designed a supply chain strategy. So, why is a supply chain strategy so important? Well, one good reason is to operationalize and support your business strategy. At some point, a business strategy must be executed and

typically this is done through the operational components of a company. Supply chain strategy also focuses on driving down operational costs and maximizing efficiencies. For example, an organization may choose a strategy directed at supplier management as a way to remain competitive. By providing a clear purpose, the organization keeps sight of the strategy and is able to devise tactical steps to achieve these goals. Another reason for having a supply chain strategy is to establish how you work with your supply chain partners, including suppliers, distributors, customers, and even your customers’ customers. As the marketplace becomes more competitive, it is critical to reinforce existing relationships and work together. And for all these reasons, a well executed supply chain strategy results in value creation for the organization.

* **Developing a Supply Chain Strategy**

**Understand the Business Strategy**

The first step is for supply chain executives to clearly understand how the enterprise chooses to compete. This is important not only for the obvious reason of working off the “same play book,” but also for the reason that it forces the supply chain operation to see itself as a customer facing entity serving the competitive goals of the enterprise—not merely an operational department. Supply chain strategy is not simply a linear derivative of the business strategy. At best, supply chain strategy can be the enabler of the business strategy. If the business strategy is to be the low cost provider, the supply chain strategy should support this. And just like when developing a business strategy, look to your core competencies, focus, and means of differentiation when developing a supply chain strategy. Being able to strategically source parts at an attractive price may support **ecuted supply chain**

* **strategy results in valuereation for the organization.**

**A formal supply chain assessment by a non-biased outside party may assist you in better understanding your...opportunities for improvement.**

both your supply chain strategy and business strategy, but only if you have the capabilities to do so effectively. Look to your supply chain competencies and leverage what you do well. You may want to focus on a particular market or segment in which to gain supply chain efficiencies. Or you may want to

differentiate your organization operationally by providing lower costs to customers or providing services that other industry players are unable to do.

**Assess the Extended Supply Chain**

The next step is to conduct a detailed, realistic assessment of the capabilities that exist within the organization and even the extended supply chain. Begin by closely scrutinizing your organization’s assets and evaluate how well they support the strategy. Old machinery and disparate systems may mean high operational overhead and costly process inefficiencies and redundancies – clearly not supportive of a low cost provider strategy. A formal supply chain assessment by a non-biased outside party may assist you in better understanding your operational strengths and opportunities for improvement. Look for a firm that can provide you with operational benchmarks both inside and outside of your industry in order to gauge core competencies. Once the assessment is complete, assemble a team to review and prioritize recommendations, validate the opportunities, define the risks, and the requirements for implementation. Ultimately, if there is a disparity between the supply chain strategy and the operational assets, you may have to make capital investments. Of course, the other alternative is to change your assumptions and alter your strategy all together!

**Develop an Implementation Plan**

From this critical work emerges the “go forward” supply chain strategy – directly tied to the business strategy, highly specific as to enablers and metrics, and with a defined set of implementation requirements and contingencies. The development of an implementation plan should include activities and tasks, roles, responsibilities, a corresponding timeline, and performance metrics. Establish a sub-team to shepherd the execution and provide project management responsibility to resolve issues and track status.

* **Development Considerations**

**Cooperate and Collaborate with Your Partners** – Throughout the development process remember to include your supply chain partners. While you don’t necessary need to divulge the full details of your strategy, you can certainly communicate how you would like to do business. Ideally, seek out mutual goals that both organizations can execute on. Not only will you be one step closer to realizing your supply chain strategy, you will learn more about the companies that you do business with. For example, collaboration in product design may meet your need to stem R&D costs and also alert you to new product concepts that you wouldn’t discover without working with your customer.

* **Outsource Where Appropriate** – Part of developing a supply chain strategy includes evaluating opportunities to outsource areas that are not your core competency. If someone else can do it cheaper, it may be worth outsourcing not only to drive down costs, but also to focus more resources on the core competencies your organization does well. Rising from humble beginnings, Inamed, a leading medical device company, has seen itself grow to become a $300 million dollar company with its stock value increasing almost 200% over the last year. The company is credited with a clear business strategy of growth through acquisition and new product innovations. Anticipating continued growth and business success, Inamed needed a supply chain strategy consistent with an expanding organization. Faced with such challenging supply chain questions as “what is our optimal distribution network?”; “should we outsource some supply chain activities?” and “how can costs be better managed and contained?” the company conducted a global supply chain assessment to identify supply chain costs and opportunities. In addition to offering supply chain strategy recommendations, the study provided a total picture of Inamed’s supply chain costs and compared them to industry and non-industry benchmarks. Over $4 million in process improvements and cost saving opportunities were identified. Now armed with a supply chain strategy, Inamed is in the process of implementing these changes.
* **Case in Point:** Inamed
* **UPS Supply Chain Solutions 3**
* **Executing Supply Chain Strategy**

**Performance Management**

Execution involves closely following your implementation plan and applying good project governance. You can improve your chances for success by managing performance throughout implementation and beyond. Tracking performance allows an organization to measure how successful it is in realizing the goals of a strategy. It also makes people understand their contribution and responsibilities, creating a more cohesive, in tune, organization. Performance management works best when people are rewarded for their performance and reporting is conducted on a regular basis. Moreover, performance goals should be used to communicate business expectations to outside entities as well. The more the extended supply chain is involved, the more the supply chain strategy is supported and reinforced.

**Iterate the Cost – Benefit Evaluation Process**

On a periodic basis (e.g., annually) you should formally revisit your supply chain strategy. Did you meet the goals of the business strategy? Have the needs of your supply chain partners changed? How has the industry changed i.e., new competitors, business practices, products, technology? At this time, you may even want to reassess your supply chain organization, if the changes are significant enough to warrant it. Also, use this effort to look for new opportunities to further position your organization for success.

* **Keep Communicating with Your Partners**
* Executing a supply chain strategy means dealing with many different entities, both internally and externally. Just as it is crucial to align the supply chain strategy with the business strategy, it is equally important to execute in a manner consistent with these different groups or stakeholders. The goals of your supply chain components and those that you deal with must be similar and conducted at the same speed. Your organization may be able to move at speeds other supply chain entities are unable to maintain, resulting in misalignment and poor efficiencies. And some of your supply chain partners may not have the resources to commit to realizing these goals. Good communication can keep the extended supply chain in sync.
* **Good communications can keep the extended supply chain in sync.**
* **Avoiding Potential Pitfalls**

Even before the well-publicized dot com collapes, business failures due to poorly implemented strategy were very frequent. Fortune Magazine reported in a study that CEO strategy failures occurred primarily (est. 70%) because of failure in execution, not with the vision and strategy development. “The real problem isn’t the high-concept boners the boffins love to talk about. It’s bad execution. As simple as that: not getting things done, being indecisive, not delivering on commitments.”1 And supply chain strategy is no different! During the build & implement phases, there are additional challenges including:

* **Align the Supply Chain Strategy with the Business Strategy**

Most companies develop a supply chain strategy after the business strategy has been defined. While this approach can deliver some value, it does not support the infusion into the business strategy development of very powerful supply chain model options, which could significantly improve the business strategy. A supply chain strategy should always support the intent of the business strategy

Dell broke into the big time by developing a business strategy and supply chain strategy that worked together. In the late 1980’s and early 1990’s Dell’s business strategy was differentiation through low cost, speed of delivery, and customer service. The major channel for sales was from customers to call centers. However, the emergence of the internet called for more differentiation and fundamental change. With a well understood business strategy, Dell began to formally integrate operational components (e.g., logistics, manufacturing, distribution, inventory management) and develop a supply chain strategy. The supply chain strategy focused at driving costs out of the supply chain – being the low cost provider – while at the same time supporting a business strategy emphasizing customer service.

**How was Dell successful with such conflicting charters?**

Internally, Business Performance Contracts (BPCs) were crafted that defined formal, but flexible operational greements between each operational process area. These contracts tied to individual performance targets so that imperatives were clear. Execution concentrated on four areas: collaboration, value engineering, outsourcing, and the Out-of-Box Experience (OBE). As part of the process, the BPCs were also shared with the extended supply chain

and similar operating agreements were arranged. These processes effectively kept the organization’s focus on strategy through performance management. Externally, Dell worked with suppliers to help control costs and improve customer service. Dell’s retail direct strategy requires processing orders direct from customers, building the omputers to a customers specification, and delivery within a matter of days. To support this model, Dell asked suppliers to keep inventories within 15 minutes of the manufacturing locations. Virtually all products are made to order. “Every two ours, the factory planning system sends out a computerized message to suppliers detailing what parts the plant needs. That means there is almost no inventory of parts or products in the factory.”2 Besides excellent working capital advantages, Dell also sells computers that are about two months newer than the competition! In an industry where component prices fall about 20% per year, this means significant cost-of-goods-sold advantages for Dell.

**The Future of Dell**

Dell has continued to refine its business strategy, most recently by entering new markets such as printers and electronics in order to grow revenue. The company has set aggressive revenue targets –$60 billion by 2006 – almost double the earned revenue today. To meet these goals and the changing business environment, the company proactively reevaluates its supply chain strategy. This is not only to make sure that the supply chain is strategy aligned with the business strategy, but also to keep ahead of the competition. According to CEO Rollins, Dell “manages the value chain better than anyone else on the planet; the only one who might come close to us might be Wal-Mart.”3 **Case in Point:** Dell1 “Why CEO’s Fail,” Fortune Magazine, June 21, 1999. 2 “Dell: One Company, Two CEO’s,” CEO Magazine, November 2003, pg. 34. 3 Ibid

and it is precisely because of these different “levels” of the enterprise at which strategies necessarily must be developed, that companies so often have major gaps between their highest level business strategy and their supply chain strategy. There are some additional risks associated with developing these separately, which

include:

• Developing a supply chain strategy without a true understanding of the business case and value propositions – the costs and benefits are not known

• Utilizing different or new resources in the operational model development that weren’t exposed to the original business strategy thinking, thereby diluting and weakening the supply chain strategy

• Confusing or conflicting communications to the organization where objectives may be contradictory

**Organization Challenges**

The company and its organizational culture play a key role in developing and executing a supply chain strategy. The following are some common organizational challenges found in many companies:

**Lack of ownership –** many supply chain processes and value levers do not have an owner in the traditional sense

**“Tower of Babel” problem –** most organizations across the enterprise do not speak a common supply chain language

**Organizational focus –** some managers are functional or process oriented and do not understand the value levers’ multiple drivers model

**Extending the Supply Chain –** most supply chain initiatives involve external parties (trading partners) which makes strong collaboration a requirement

**Conclusion**

As supply chains have moved from a cost focus to a customer focus and now currently to a strategic focus, the need to think strategically about the supply chain has never been more important. The success of a strategy is only as good as the company’s ability to fully and properly execute it. A great supply chain strategy, linked with operational excellence, can provide success for not only the company in question but also its partners and customers.

**Role of Aggregate Planning in a Supply Chain:**

**Capacity has a cost, lead times are greater than zero**

**Aggregate planning:**

* + process by which a company determines levels of capacity, production, subcontracting, inventory, stockouts, and pricing over a specified time horizon
  + goal is to maximize profit
  + decisions made at a product family (not SKU) level
  + time frame of 3 to 18 months
  + how can a firm best use the facilities it has?

**Specify operational parameters over the time horizon:**

* + production rate
  + workforce
  + overtime
  + machine capacity level
  + subcontracting
  + backlog
  + inventory on hand

All supply chain stages should work together on an aggregate plan that will optimize supply chain performance

**The Aggregate Planning Problem**

Given the demand forecast for each period in the planning horizon, determine the production level, inventory level, and the capacity level for each period that maximizes the firm’s (supply chain’s) profit over the planning horizon

Specify the planning horizon (typically 3-18 months)

Specify the duration of each period

Specify key information required to develop an aggregate plan

Information Needed for an Aggregate Plan

**Demand forecast in each period**

Production costs

* + labor costs, regular time ($/hr) and overtime ($/hr)
  + subcontracting costs ($/hr or $/unit)
  + cost of changing capacity: hiring or layoff ($/worker) and cost of adding or reducing machine capacity ($/machine)

Labor/machine hours required per unit

Inventory holding cost ($/unit/period)

Stockout or backlog cost ($/unit/period)

Constraints: limits on overtime, layoffs, capital available, stockouts and backlogs

**Aggregate Planning Strategies**

Trade-off between capacity, inventory, backlog/lost sales

Chase strategy – using capacity as the lever

Time flexibility from workforce or capacity strategy – using utilization as the lever

Level strategy – using inventory as the lever

Mixed strategy – a combination of one or more of the first three strategies

**Chase Strategy**

Production rate is synchronized with demand by varying machine capacity or hiring and laying off workers as the demand rate varies

However, in practice, it is often difficult to vary capacity and workforce on short notice

Expensive if cost of varying capacity is high

Negative effect on workforce morale

Results in low levels of inventory

Should be used when inventory holding costs are high and costs of changing capacity are low

**Time Flexibility Strategy**

Can be used if there is excess machine capacity

Workforce is kept stable, but the number of hours worked is varied over time to synchronize production and demand

Can use overtime or a flexible work schedule

Requires flexible workforce, but avoids morale problems of the chase strategy

Low levels of inventory, lower utilization

Should be used when inventory holding costs are high and capacity is relatively inexpensive

**Level Strategy**

Maintain stable machine capacity and workforce levels with a constant output rate

Shortages and surpluses result in fluctuations in inventory levels over time

Inventories that are built up in anticipation of future demand or backlogs are carried over from high to low demand periods

Better for worker morale

Large inventories and backlogs may accumulate

Should be used when inventory holding and backlog costs are relatively low

**Aggregate Planning at , Red Tomato Tools**



**Fundamental Tradeoffs in Aggregate Planning**

Capacity (regular time, overtime, subcontract)

Inventory

Backlog / lost sales

**Basic Strategies**

Chase strategy

Time flexibility from workforce or capacity

Level strategy

**Aggregate Planning**



Aggregate Planning (Define Decision Variables)

Wt = Workforce size for month t, t = 1, ..., 6

Ht = Number of employees hired at the beginning of month *t*,   
*t* = 1, ..., 6

Lt = Number of employees laid off at the beginning of month *t*,   
*t* = 1, ..., 6

Pt = Production in month *t*, *t* = 1, ..., 6

It = Inventory at the end of month *t*, *t* = 1, ..., 6

St = Number of units stocked out at the end of month *t*,   
*t* = 1, ..., 6

Ct = Number of units subcontracted for month *t*, *t* = 1, ..., 6

Ot = Number of overtime hours worked in month *t*, *t* = 1, ..., 6

**Aggregate Planning (Define Objective Function)**



Aggregate Planning (Define Constraints Linking Variables)

Workforce size for each month is based on hiring and layoffs



Aggregate Planning (Constraints)

Production for each month cannot exceed capacity



Inventory balance for each month



**Over time for each month**



**Scenarios**

Increase in holding cost (from $2 to $6)

Overtime cost drops to $4.1 per hour

Increased demand fluctuation

Increased Demand Fluctuation



**Aggregate Planning in Practice**

Think beyond the enterprise to the entire supply chain

Make plans flexible because forecasts are always wrong

Rerun the aggregate plan as new information emerges

Use aggregate planning as capacity utilization increases

**Summary of Learning Objectives**

What types of decisions are best solved by aggregate planning?

What is the importance of aggregate planning as a supply chain activity?

What kinds of information are needed to produce an aggregate plan?

What are the basic trade-offs a manager makes to produce an aggregate plan?

How aggregate planning problems are formulated and solved using Microsoft Excel?