



Taking the Lean Approach

Lean Distribution breaks the forecast accuracy barrier to improving customer service and profit with flawless execution of simplified operating processes

Competition is growing at an ever-increasing rate, and price tends to be the main battleground. Finding the lowest-cost source or manufacturing location has been the strategy with sourcing from China, the preeminent destination. Low cost sourcing is creating and extending supply chains across the globe making distributing products more challenging than ever. There is just no room for error when planning and moving products across complex, global supply chains.

Distribution in these price-sensitive times must evolve to meet the competitive threats and realities of global markets. In the past, distribution processes relied on customer order forecasts to find the most cost-effective plan, but forecast accuracy continues to be an elusive goal. Forecast-based plans are becoming less reliable, making cost reductions more elusive.

Some companies have been successful with new distribution processes and strategies that transcend the forecast accuracy barrier to lower costs. Dell Computer, Wal-Mart, Apple, and others are using advanced approaches combined with Lean principles to drive new levels of competition. The results are evident in any analysis of Dell's working capital: it is actually negative! With negative working capital, Dell's profit is increased by the leverage gained from current assets, a very uncommon effect. Can any other significant business boast similar results? Clearly, these companies are taking new approaches that their competitors cannot match.

Apple and Wal-Mart streamlined the global distribution model. Consider how some of the newest products are sourced, sold, and distributed without time moving through distribution centers in the United States. The model is to reduce contact, reduce time to consumer, and completely eliminate as much cost as possible. The ideal situation is direct from source to consumer.

Current operating paradigms, measures, and business processes that seek to forecast, plan, and optimize distribution into perfection stand in the way of the dramatic changes that Dell, Apple, and Wal-Mart are pursuing. Consumers and industrial markets are just moving too fast for forecasts to be sufficiently accurate to optimize and execute a plan. The alternative? A simplicity, flexibility, and market-driven approach built around Lean principles in distribution.

THE LEAN CHANGE IN DISTRIBUTION

Distribution operations are particularly susceptible to globalization trends due to the direct linkage to customer service, the limited value added, and the high levels of cost across distribution. Changes in plans quickly impact customer service and/or costs. Only well-optimized plans that are flawlessly executed meet distribution's exceedingly stringent standards for both service and low cost. Plan changes challenge distribution optimization and the organization's ability to meet performance objectives.

The Lean Distribution approach increases flexibility and simplicity and thus reduces the reliance on forecasts and optimized plans to achieve results. With Lean, process and performance improvement is focused on reducing lead time, reducing lot sizes, and increasing reliability, yielding the flexibility and simplicity required to achieve consistent results. Lean Distribution takes a very different approach from an optimization and planning approach that is based on fixed lead times and lot sizes. Forecast-based optimization seeks to reschedule the orders and inventory within the plan in order to reduce costs, whereas Lean seeks to create flexible distribution operations that respond to changing market needs.

THE RFID CHANGE DILEMMA

A customer-driven initiative to streamline supply chains and sourcing that is currently impacting distribution is radio frequency identification (RFID).

RFID is the latest initiative by Wal-Mart, the United States Department of Defense (DoD), and others to improve the flow of incoming products. These customer requests to tag pallets or cases with an RFID tag as well as the current bar code appear to add cost and time to each supplier's distribution process. The benefits are most evident in the customer's operations (Wal-Mart, etc.), yet these customers are not willing to pay increased prices that account for the tags and additional work suppliers must perform to transmit RFID data. As a result, suppliers are making limited efforts to comply, and distribution is where most of the added costs and time reside.

The majority of professional conversation around RFID tends to relate to technical standards or RFID costs rather than specific distribution transformation capabilities. Like the bar code transition of 30 years ago, the RFID movement will continue to raise cost-related objections until the technology becomes ingrained across nearly all supply chains and is nearly "invisible" to cost measurement. The benefit question remains focused on how the customer gains value and not how suppliers and their customers will transform supply chains and distribution.

This missing link to RFID benefits for suppliers is the fundamental disconnect for distribution processes. The operations paradigm is to reduce the most observable and measurable costs, such as transportation and warehouse labor. RFID technologies provide transformational capabilities, but ones that have not been sufficiently explored. The customers seek continual cost and service improvement, but how the supply chain will be operated differently has not been defined. With Lean Distribution, approaches to leverage RFID signals for replenishment can be identified.

THE FORECAST BARRIER

Customer order forecasts are the starting point for nearly all business, operational, and financial planning. It is very difficult to get around it: forecasts are the best estimates for the market directions, volumes, and pricing necessary to make many decisions across any business. Commitments to suppliers, setting operating levels, and projecting financial results are all driven from the forecast. These many decisions require review, revision, and change as forecasts are updated and revised, an almost daily process to keep pace with the market. So forecasts are absolutely necessary, but also have

the unintended consequence of producing continuous disruption as organizations strive to hit plans driven by forecasts that are moving targets.

Forecasts change frequently as customers change plans to adjust to market conditions. So why do companies spend so much time and place so much importance on demand forecasts that change frequently and at times change dramatically? The answer lies in the forecast as the foundation for all business, operational, and financial planning. The forecast initiates and dominates these business processes as the organization diligently works to ensure excellent customer service and low costs by planning from the forecast.

Distribution tends to be a lightning rod for forecasting issues and inaccuracy, because excess or inadequate inventory is highly visible in a distribution center. There are immediate impacts to service in distribution for inventory imbalances, many of which are “blamed” on poor forecasts. So the success of forecasting and the subsequent planning processes can be assessed with distribution service levels, inventories, resources, and costs. The effectiveness of these distribution measures typically is tied back to planning processes and in many ways is limited by the effectiveness of forecasting.

THE BALANCING ACT

The inevitability of forecast change builds contention into the relationship between supplier and customer. Suppliers desire certainty with fixed purchase schedules, and customers desire flexibility to change with their market. This contention is shown in Figure 1.1 as the difference in interests between customer and supplier. From a customer’s perspective, the flexibility to change on short notice is preferred over firm plans that cannot change as the market or competition changes. However, suppliers seek certainty, long lead times, and limited forecast changes. Clearly, customer and supplier interests may not be fully aligned. The root of their differences can be a supplier’s focus on controlling costs with stable plans and lead time, while the customer may have the “luxury” of making changes to forecasts without concerns that prices will increase.

Depending on their relative negotiating positions and strengths, this balancing act may shift toward one or the other party. Tilting toward the customer tends to focus more on maximizing the total sales through the

FIGURE 1.1 PLANNING BALANCING ACT

Lean Distribution

- Flexibility to avoid trade-offs
- Simple, cost-effective operations
- Reliability for flawless execution

***Customers Desire Flexibility***

- Minimal ownership of finished inventory
- Easy forecast changes
- Short lead time

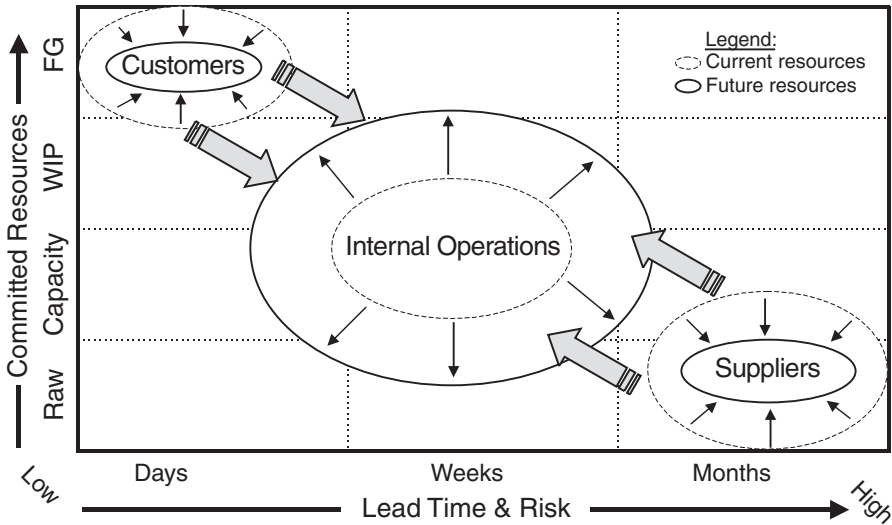
Suppliers Seek Certainty

- Customer commits to inventory in process
- Limited forecast changes
- Long lead time

supply chain with quick responses to market changes, despite concerns over cost implications at the supplier. Conversely, strong suppliers will receive more assurances and control over forecast changes that may impact their costs or profitability. Frequently the struggle is really within the supplier as Marketing seeks to maximize sales while Operations and Finance struggle to maintain profitability. In a “sales”-driven organization, the internal struggle may not be pronounced, because the operators know the changes must be accommodated and they may have some level of inefficiency budgeted to compensate.

Another view of the flexibility dynamic can be found by assessing the risks and resources across the supply chain. Figure 1.2 has circles representing the amount of inventory, resources, and risk across the supply chain. Customers typically desire to push inventory responsibility back to their suppliers, displayed with arrows toward Internal Operations. On the other side, a supplier’s supplier will likewise seek to receive commitments and push inventory and commitment toward the Internal Operations of their customer. The longer the lead times and higher the inventories are, the more risk across the supply chain. The only question becomes which parties carry the risk.

FIGURE 1.2 THE RESOURCE COMMITMENT AND RISK SQUEEZE



Mapping the extent of resource commitment for each party can assess the risk inherent in a specific supply chain and across distribution operations. Contract and business relationship negotiations tend to move these commitments around rather than reduce or even eliminate them. The key to successful relationships across the entire supply chain lies in reducing risk and eliminating resource commitments, the fundamental tenets of Lean.

With Lean Distribution, the approach is to clarify how risks can be mitigated, total supply chain costs reduced, and service improved, while increasing focus on maximizing total sales and volume throughput. The Lean approach requires a thorough reevaluation of current processes and practices to break the trade-offs inherent in most forecast-based planning and optimization processes.

BUSINESS AND OPERATIONAL PLANS

Business planning may seem like a “necessary evil” to meet customer orders, reach financial results, and optimize performance. Planning requires detailed customer demand forecasting, which can be time consuming, con-

tentious, second-guessed, and frequently inaccurate. Executives' time and energy can be sapped by these processes due to the need to synchronize business plans to meet financial objectives. In the end, the business plan may be less a true reflection of the market and more a set of plans and objectives necessary to meet the financial performance required by shareholders and financial markets.

Planning processes are focused on these important objectives because of the pressure executives are under to perform. Due to the difficulty of meeting ever-increasing objectives, the tendency may be to increase the detail of plans to improve execution, ownership, and accountability across the organization.

What may be curious is the inaccuracy of the underlying assumptions for these increasingly detailed and complicated plans. Market forecasts are the starting point and the data with the greatest degree of error and change. Forecasting customer demand may range from highly sophisticated analytics to rudimentary estimates, but ultimately it requires frequent updates. Markets move fast, and organizations devote an extensive amount of time and effort to forecasting and planning in a quest for accuracy.

As forecasts are revised and business plans updated, problems are created in the form of changing schedules across and down through the organization. The revised plans require many reactions to change all of the inputs to business planning: purchase orders, production schedules, transportation plans, and many others. Planning today creates numerous "ripple effects" in nearly all functions of the organization. These ripple effects can be frustrating for the organization as more and more details are created and then changed with every new revision of the forecast.

FORECAST ACCURACY

How accurate are forecasts? Have they ever been sufficiently accurate for the planning, sourcing, operations, distribution, and logistics users? Are there complaints about inaccuracy? This may seem like an odd question, since logic dictates that forecasts are not correct, yet nearly all daily schedules are driven by detailed forecasts and commit large portions of resources based on them. In fact, these plans are the cornerstone for nearly all operational performance and cost reduction efforts despite the fact that forecasts are rarely accurate, except in total sales dollars or an aggregate volume measure.

But accuracy in aggregate units does not support operational planning and cost reduction efforts. If a product-level forecast does not exist, Operations Planning must create another forecast by product, which may need more work to make it accurate and consistent with the business plan forecast. Any planning based on the “operations forecast” may be called into question due to differences with the real forecast that has proven to be accurate for business and financial planning.

Collaborating with customers to improve forecasting may be a worthwhile initiative, but does not guarantee accurate forecasts. Collaborating should improve forecasts by tightening the communications of market changes. Faster and better communications means being more responsive to changes in the customer’s market rather than creating a “fixed” forecast for the supplier. Is it in customers’ best interests to stick by their input to the forecast despite the market changing? Since customers must respond to changes in their markets, having their suppliers respond in kind is more beneficial than having their suppliers demand frozen schedules. Collaboration in actual practice creates more changes to a forecast rather than less.

In the final analysis, forecasts are the best attempts to tell the future and by their very nature will always require revision and be challenged over accuracy. Detailed plans driven from forecasts are the first cause of instability in daily operational schedules that are well intended but are based on hitting a moving “target,” the forecast. A cycle is created starting with forecasting, then planning, and then revising the forecasts to keep the plans current and accurate. For the folks down the line, the daily schedules are either a moving target or artificially “fixed” to appease suppliers, operations, and distribution. Hence, today’s planning driven by an inaccurate market forecast creates tomorrow’s operational problems, as schedules must be continually revised.

ANOTHER APPROACH

But is there another way to plan and manage? This is not obvious, because optimizing distribution requires some method to plan and take actions in advance that reduce costs, such as scheduling carriers with the most cost-effective rates. Unfortunately, these plans are subject to change as forecasts change, which happens frequently. Forecast changes create a ripple effect of increases to other costs, such as inventory, as attempts are made to retain

the cost reduction obtained in freight. A conflict exists between attempts to reduce costs using the forecast and daily efforts to serve customers and revise the forecast as business conditions change.

An alternate approach to planning and optimizing must accommodate the variation that creates instability in forecast-driven plans. Variation comes in many forms: customers demand changes, operations have good days and bad ones, suppliers may not deliver, and many other factors affect the daily plan or forecast. An approach to optimization that embraces variation rather than being whipsawed by it could greatly improve performance and total cost across the business.

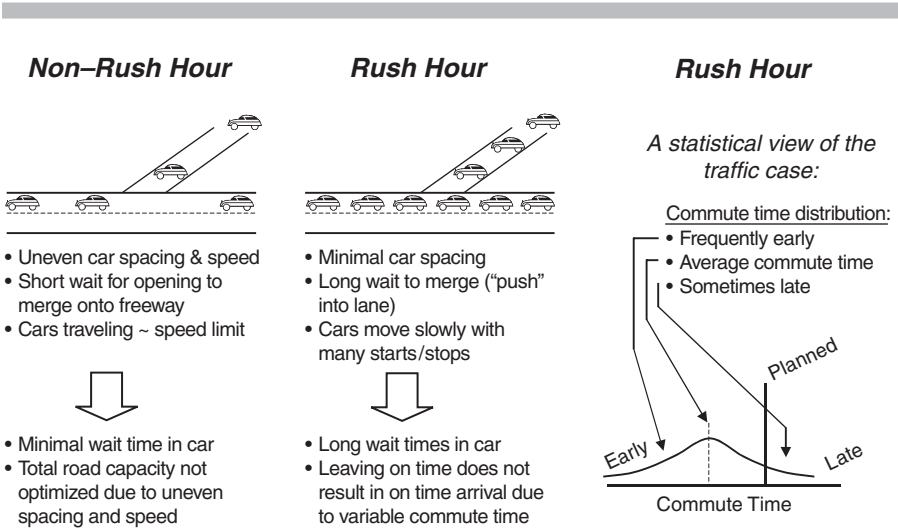
The roadblocks to a new approach are the planning processes and optimization mind-set. Organizations “teach” and measure their people based on the assumption that forecasts provide sufficiently reliable plans and productivity follows solid planning. Variability has only recently become a topic as quality improvement initiatives such as Six Sigma challenge traditional “inspect in” quality approaches. It is becoming accepted that variation in the production process is the cause of quality problems, but this concept has not moved into forecasting, planning, and scheduling.

THE TRAFFIC ANALOGY

Consider the dilemma of answering the question “How long does it take to drive downtown?” For anyone in a major city the typical answer is “It depends.” There are many qualifications related to time of day, weather, carpool status, and other factors necessary to provide even a rough estimate. Answering the question may end up as a range of the best-case to worst-case scenarios, to ensure the driver allows sufficient time.

The dilemma for this driver is not unique; it involves many factors to ensure on time arrival, as shown in Figure 1.3. For the non-rush-hour case, getting to and merging onto the freeway does not encounter lines or a wait. Once on the freeway, cars move at the speed limit, allowing a predictable commute time and on-time arrival based on the distance to be covered. For the rush-hour case, there is a wait to merge onto the freeway and many starts and stops once on the freeway, causing a highly variable amount of time commuting. During rush hour or any other high-traffic-volume time, the commute time varies greatly, requiring the driver to allow “more than enough” time in order to rarely be late. The variation in

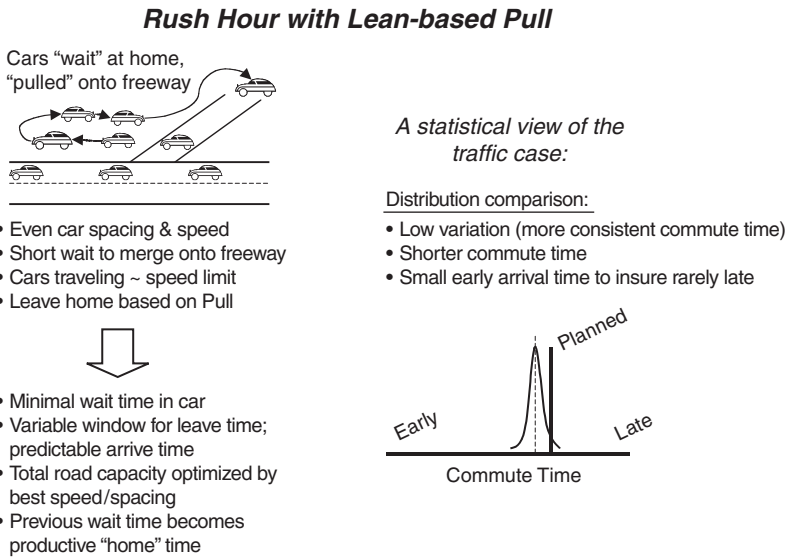
FIGURE 1.3 THE TRAFFIC ANALOGY



commute time is represented by the statistical curve on the right side of Figure 1.3. A wide and low profile indicates a highly variable commute time, which requires allowing more time to ensure on-time arrival. The more time allowed, the higher the chance that arrival will be very early. An on-time arrival is purely chance rather than good planning or driving. Unless the arrival time really does not matter, the statistics show that very early arrival must occur much more frequently than on-time arrival

Solving the traffic case requires reducing the variability for the commute time and maximizing the total volume. This can be addressed for all cars by maximizing the total flow of cars by moving from push to Lean Pull. During rush hour, speed and spacing between cars deteriorate as cars “push” their way onto the freeway, reducing the total flow. Once on the freeway, the variability of each driver’s speed reduces spacing, causing the average speed and volume for all cars to deteriorate. Because the flow of cars is dependent on the speed and spacing of cars, an optimal combination must be enforced for all cars to maximize flow. Improved speed and spacing could be accomplished by using Lean-based Pull to bring cars onto the freeway up to the point where optimal speed and spacing start to deteriorate. Then maintain that level of Pull (number of cars allowed on at each entrance) during rush hour. This Pull approach to the traffic analogy is shown in Fig-

FIGURE 1.4 LEAN PULL-BASED COMMUTE TIME



ure 1.4. For the Lean Pull approach to work, each driver must be ready to depart home on fairly short notice (the Pull signal) and able to maintain a constant spacing for the given speed (imaginary linkage to the next car).

These two principles of Lean—Pull and linkage across operations—improve total flows across distribution. The Pull signal (time to leave home for the freeway) moves the current wait time in a commute to the beginning, and the linkage (maintaining the proper speed and spacing) maximizes how much gets through existing capacity (the freeways). As Pull and linkage are combined, the right products (cars) get to their destinations fastest (commute time).

How does this apply to distribution? Consider the similarities between inventory and the cars during rush hour: both must endure long transit time and arrive early to avoid being late. For inventory arriving late, customer service is impacted, which must be avoided at nearly all costs. So inventory arrives early, increasing the requirements for capital, warehouse space, handling, and tracking. The time for inventory to move may seem small for any one rushed shipment, but overall is long due to time taken to maximize shipments (freight) and operate efficiently (labor). If inventory

can be moved faster and more reliably, then it could arrive closer to actual customer need and reduce many distribution costs and resources.

But what if the planned arrival time varied as well as the commute time? This does not happen for people heading to a sporting event or the symphony, because the event's starting time is fairly well fixed; although an event may start a little late, it would never start early. For the event attendee, arriving late may not be an option, making early arrival mandatory. But what if the event's start time changed during the commute? A variable expected arrival time makes trip planning even more complex and risky.

The uncertain length of the commute time represents a company's lead times to respond to customer needs. These times are not easily estimated and are subject to the conditions at the time, hence they are highly variable. Unlike the typical commuter, customer needs are highly variable. So there is a variable time to respond and uncertain arrival time. Planning can only come up with the best estimate (forecast) of the needed arrival time and allow plenty of commute time (lead time), resulting in lots of excess time, except for the rare occasion when start time is early and drive time is long.

Planning becomes difficult for this commuter, who eventually decides to move downtown. By living in the city, the commute time is low and responding to a variable arrival time is easier. Relocating to a downtown home is like setting up a local warehouse for a customer; it decreases lead time to respond. The downside is that if the customer moves or the mix of customer requirements change, the warehouse location may become obsolete or at least suboptimal. This is why many workers choose long commutes over relocating their residence: The commute may change, requiring another move anyway, and living outside the city is less expensive. Moving can be expensive as well and would limit other opportunities; for example, moving to the south end of town might limit taking a new job on the north end because it would require yet another move.

The moral of the commuter's tale is that estimating an exact departure time is near impossible due to the variable time to drive downtown. An estimated time to depart is the best case, using an assumed commute time and whatever amount of safety time the particular driver is comfortable with, but in no case does a driver realistically expect to know exactly when to leave to arrive exactly on time.

For a business with physical distribution of products, lead times vary and have many of the same patterns as the commuter. Unfortunately, businesses

attempt to obtain an exact expected arrival time from customers (a forecast) and then calculate an exact start time for operations and suppliers (a schedule or purchase order). A major difference with companies is the propensity to establish a local distribution center or warehouse to serve the customer, which is difficult to change as customer demand patterns change. Unlike the commuter, companies frequently err on the side of the added cost of warehousing facilities and operations close to customers rather than the long commute (being more flexible) to respond to the changing arrival times.

IMPROVING DISTRIBUTION OPERATIONS

As initiatives to reduce cost are implemented, other areas across the distribution chain may be impacted that are described in Chapter 8 as the Distribution Cost Waterbed. The analogy represents that pushing down costs in one area may actually increase costs in another, as reducing freight can increase inventory and handling costs. This identifies a conundrum: Do all cost reductions reduce total cost? Some of the initiatives distribution operations have employed are shown in Figure 1.5 along with common downsides.

The question may arise whether the improvements for one year are enough or are the best that can be achieved. Is this question answered with the pound-of-flesh approach? Or pushing for “cuts” until the organization nearly breaks?

Another approach requires a better understanding of the levers that can be “pulled” to consistently and productively reduce total costs in all distribution and logistics operations. But another approach also means focusing on flows and customer service rather than individual departmental budgets and isolated areas of spending.

LEAN PARADIGM SHIFTS

Lean Manufacturing started as the Toyota Production System (TPS) in Japan and later caught on in the United States as companies studied Japanese methods. As the domestic automotive industry embraced TPS practices, such as kanban, the movement became known as just-in-time (JIT). Subsequently, the JIT movement transitioned into Lean Manufacturing as a more holistic approach to enterprise productivity was taken. So Lean

FIGURE 1.5 DISTRIBUTION IMPROVEMENT INITIATIVES

Initiative	Description	Downsides
Improve forecasting	Collaborate with customers and work with Sales to make product-level forecasts more accurate to reflect the customer orders expected over the near-term planning time frame.	All forecasts are wrong, requiring significant time to revise and then re-plan. Lower-level operating schedules are not stable or are fixed and not responsive to customer demand.
Reduce freight	Ship full truckloads, eliminate expedited delivery, and negotiate favorable rates with carriers.	Freight flexibility may become limited, which can be critical to reducing total supply chain costs.
Automate warehouse labor	Install material-handling equipment and information technologies to speed material flow and reduce put away/pick times.	As capital investments are made, the distribution network becomes more difficult to change as market and operating conditions change.
Automate data entry	Implement bar code, wireless terminals, and RFID to automate and increase the accuracy of data capture.	Increased tracking requires more controls to validate accuracy and complicates planning processes.
Maintain inventory for service	Place inventory in warehouses (public or owned) close to customers to enable quick response and readily available inventory for customer orders.	Inventory and planning complexity dramatically increase as locations are added, which actually slows response to major market shifts.

Distribution is the natural extension for companies using Lean practices within their own operations or that have customers that embrace Lean.

Lean works to systematically improve the parameters that drive performance across the entire supply chain rather than to take independent actions seeking to improve departmental costs, service levels, and inventory. The main levers of a Lean Distribution approach are cycle time, variation, and flexibility. These parameters become the drivers for inventory levels, cost profiles, and other aspects of the distribution chain so the relationships and interactions are readily apparent.

Lean takes the approach that markets move and the supply must move quickly with them; it is not a forecast- and plan-based approach that attempts to optimize and execute a “frozen” plan. With Lean, market shifts

FIGURE 1.6 LEAN DISTRIBUTION PARADIGM SHIFTS

Paradigm	Traditional Approach	Lean Distribution
Customer service	Collaborate to forecast, then ship to firm orders/releases.	Manage flow as customer consumes, “owns” replenishment.
Forecasts	Are accurate enough, but should strive to make more accurate.	Limited accuracy, use for longer-term and aggregate planning only.
Inventory	Is an asset and should be close to the customer to meet lead time demands.	Consolidate at the source and redirect flow quickly for changing replenishment needs.
Variability	Not explicitly used in planning, but measured in operations if Lean and Six Sigma are embraced.	Operational, customer demand, and supply chain variability factors used in Lean processes.
Transportation	Changes with forecasts and orders; seek to reduce.	Replenishment cycle driven; stabilize lanes to reduce.
Optimization	Reduce each component of cost while filling forecasted demand.	Streamline distribution total cost to replenish actual demand.
Assumptions	Forecasts are sufficiently accurate and stable for planning. All cost reductions add to net profit. Inventory costs less than labor.	Pull reduces variation and improves service. Only <i>total</i> cost reduction adds to profit. Inventory, handling, and storage costs are understated.

are expected and taken in stride because variability and flexibility are built in. A forecast and plan approach resists market changes, because changes upset the plan and all of the actions being taken to optimize and execute. A more complete comparison of the traditional forecast and plan approach and Lean is provided in Figure 1.6, which tackles each of the main paradigms related to managing distribution.

The Lean paradigm is to work with the realities of the market and improve “internal” flexibility and cycle time. These two components of distribution and operations are within the control of all businesses, whereas market fluctuations may not be within anyone’s control. The beauty of taking the tack to control what can be controlled and be flexible is that market variation frequently can be reduced with Lean replenishment. The

faster and better a supplier responds, the less customers induce variation into the market shifts they experience, because they will “hedge” market shifts less. Customers hedge market shifts by ordering more than needed for an uptick in the market and then later ordering less to compensate for the overordering, causing an ever-increasing seesaw effect. This trend has been called the bullwhip effect to illustrate the reactions to market change become larger for suppliers.

BOOK APPROACH AND CONTENTS

Lean Distribution is a guide to assessing current distribution practices and paradigms to enable greater flexibility and lower costs. It takes a general approach based on Lean Manufacturing to streamline and optimize product flows, enabling a simpler customer service and inventory replenishment model. The general theme is that forecasts are not sufficiently accurate to plan and execute short-term customer service requirements. A Lean Pull replenishment model delivers lower total costs while maximizing customer service.

Chapter 1 sets the stage by describing the overall approach and serves as an executive overview to align the leaders of the organization on transformation. In many cases, executives may need to read only Chapter 1 and perhaps one or two other chapters or chapter summaries to appreciate the implications of a Lean model to their portion of the business. For example, Sales and Marketing executives may read Chapter 1 and then focus primarily on Chapter 6, “Customer Service Policy.”

Lean Distribution starts in Chapter 2, “Distribution Challenges,” with perspectives on the business and competitive drivers that have led to today’s intense pressure to reduce each element of distribution cost. The short historical discussion enables a common view of business issues that have impacted various industry segments at different times over the past decade, resulting in today’s distribution focus and challenges.

The underlying structure and configuration of distribution networks is addressed in Chapter 3, “Optimizing Distribution.” This chapter describes how organizations responded to the profitability pressures with the design of distribution facilities and operations in order to optimize total distribution costs while still meeting customer service requirements. The various optimization techniques are presented and contrasted to link the decisions

for physical layout and location of distribution assets to the quest to lower overall costs.

As information technology (IT) developed over the past decade, applications in distribution have multiplied. Chapter 4, “IT Transforms Distribution Processes,” addresses how IT has been employed to automate many distribution processes and to enable forecast-based optimization. Freight, labor, and warehouse expenses have been prime targets for automation with IT by cost cutters and operators seeking to excel. IT has transformed distribution in a number of ways and delivered many benefits, but also has created complexity and a set of processes that stymies improvement past the limits of forecast accuracy.

An overview of the content and concepts in Chapters 1, 2, 3, and 4 is provided in Figure 1.7. These first chapters form the basis for the background on distribution that has led to the relevance of Lean practices. Themes for each chapter indicate the concluding ideas being presented that challenge existing norms and paradigms.

The IT transformation has been beneficial in many ways, but has tended to focus performance improvement on planning-based optimization and automation. This future focus places too much emphasis on data for forecasts, customer orders, and operating schedules that are all changing more rapidly than ever before. It is an attempt to plan based on a number of moving targets that can be most successful only over the longer term. The organization can balance the “futures”-based plans with Lean-driven execution to be more flexible and responsive to day-to-day customer needs.

LEAN DISTRIBUTION FRAMEWORK

The Lean Distribution approach is shown in Figure 1.8. The five elements of the framework form the solution to a Lean transformation. The top and most critical element is customer service policy, defining the lead times, order parameters, and service levels for specific customers, groups of customers, and/or products. All aspects of the Lean approach must be focused on these policies, which are frequently not formalized or well communicated. On the bottom, operational capabilities are the foundation for the approach to ensure the Lean processes can be successfully executed. Operational capabilities can be defined to drive a Lean Distribution approach,

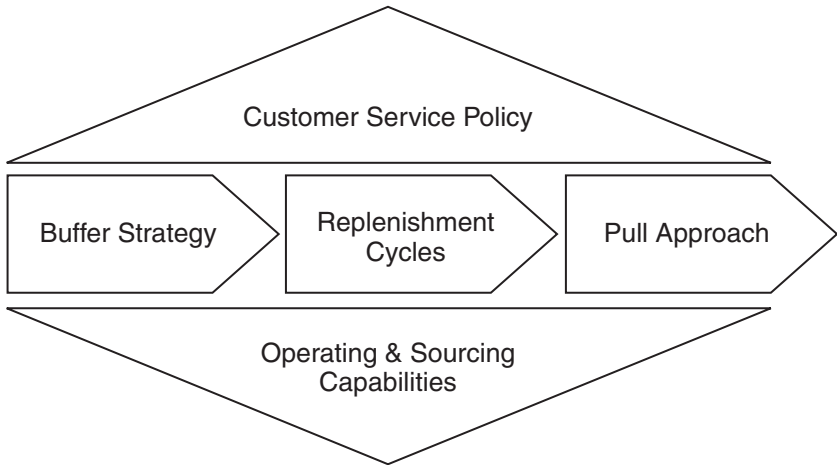
FIGURE 1.7 DISTRIBUTION TRENDS LEADING TO LEAN

	Chapter 1 Lean Distribution	Chapter 2 Distribution Challenges	Chapter 3 Optimizing Distribution	Chapter 4 IT Transformation
Theme	<i>Lean simplifies distribution to flawlessly execute and break the forecast accuracy barrier to service and profit.</i>	<i>Distribution: from silos to streams.</i>	<i>Networks are like people: they grow and mature but are difficult to change.</i>	<i>Technology implies accurate planning, when businesses must concentrate on flawless execution.</i>
Overview	Customer order forecasts are the basis for business planning and optimization, yet forecasts are always wrong and create as many problems as they solve.	The pressure on distribution has been increasing as customers streamline their supply chains, as companies globalize, and as cost scrutiny intensifies.	The distribution optimization cycle has been broken as fewer networks are modified to demand changes resulting in excessive cost reduction investments.	Information technology has taken a large role in distribution success as processes have become highly automated, but difficult to manage.
Concepts	Forecasts are inaccurate. Variability stymies cost reduction. Lean enables execution and reduces reliance on forecasts.	Organization silos. Customer-driven streamlining.	Optimization framework. Technology-enabling capabilities. Asset structure alternatives. Inventory tracking points.	Planning process maturity levels. Forecast usage tug-of-war. Snowball effect. Forecast confidence over time.

even if the current operations are not Lean Manufacturing enabled, but the benefits will not be as substantial.

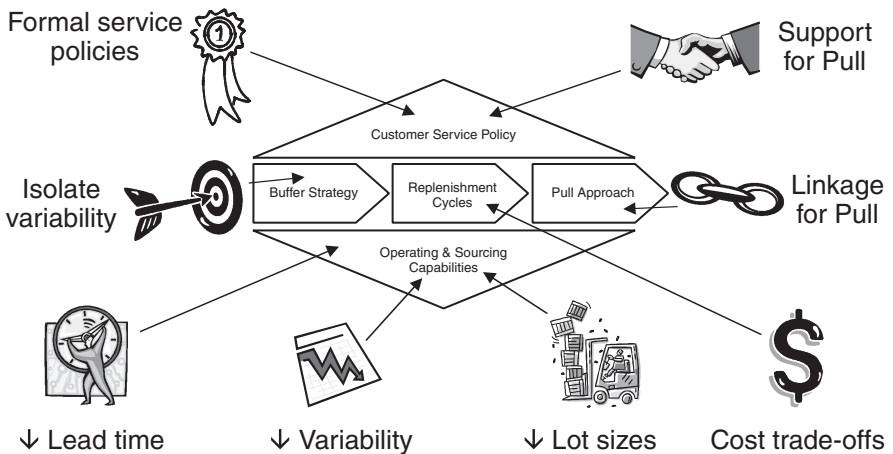
These five elements of the Lean Distribution framework contain the paradigm-shifting enablers necessary to break the forecasting barrier to customer service and profits. Figure 1.9 displays the critical enablers in each element. These eight enablers come from Lean Manufacturing and supply chain practices as tailored to the distribution environment:

FIGURE 1.8 LEAN DISTRIBUTION FRAMEWORK



- *Formal service policies.* All organizations have some established “norms” and guidelines for customer service, but few examine and formalize policies to optimize the entire supply chain. The formal policies required for Lean Distribution revolve around articulated customer needs and key internal capabilities.

FIGURE 1.9 LEAN DISTRIBUTION ENABLERS



- *Support for Pull.* Customers seek dependable service and generally are willing to allow suppliers more latitude and responsibility to deliver. Support for Pull signifies that the customer recognizes the advantages and allows requirements to flow to the supplier without undue modification or hedging.
- *Isolate variability.* Variability exists in all environments and requires at least some buffer to isolate both customers and internal operations from daily gyrations in forecasts and orders. The trick is to have buffers in the most advantageous places rather than in many or all places customer demand occurs. Strategically placing and managing buffers enables Operations and Sourcing to hit more stationary targets rather than the ever-changing and moving target of a forecast-based plan.
- *Cost trade-offs.* Assess and decide cost trade-offs on a structural level rather than obsess on cost trade-offs for specific transactions every day. It may seem counterintuitive to increase profit by cost optimization of the distribution paths rather than individual replenishment shipments. This more structural approach addresses the variability that is a major barrier to most forecast- and order-driven cost reduction.
- *Linkage for Pull.* Making the links between customer usage or consumption and distribution replenishment processes is the tactical connection required to synchronize the supply chain to consistently meet customer requirements. Pull is more than a kanban or an “ordering” signal; Pull is the philosophy for replenishment and customer service excellence.
- *Reduced lead times.* Lead times are generally too long. Lead times for internal operations and from suppliers include a high level of safety time to accommodate unforeseen events. Lean helps reduce lead times, improving flexibility and responsiveness. Short lead times enable many wonderful cost and service improvements in distribution, particularly when paired with Pull.
- *Reduced variability.* Despite variability existing in all processes, few organizations focus on quantifying and reducing variation in the supply chain. The typical focus is product quality. The first step is to quantify the current variation in order to operate distribution processes based on the limits of current capabilities. For example, distribution center replenishment times may vary, causing Planning to use a “high-end”

time for all planned shipments “just to be safe.” This longer lead time results in excess inventories and a realization that not all orders must be shipped on the day planned, requiring expediting and overrides to ensure priority orders are shipped when needed.

- *Reduced lot sizes.* The quantity produced or sourced at one time or lot size has a direct relationship to flexibility and total costs. Larger lot sizes appear to lower costs in sourcing or production but can increase cost and reduce service across the rest of the supply chain. Lean Manufacturing practices help reduce lot sizes while eliminating waste, thereby enabling both low product and supply chain costs.

The eight enablers combine to form a cohesive system to improve distribution costs, asset utilization, and customer service. These enablers must be linked and implemented to leverage the overall approach and not as a series of disjoint cost reduction initiatives. The approach is tied together by the Lean waste reduction philosophy and the transition away from forecasts to serve daily customer needs. The end result is a new paradigm to view profitability and customer relationships, shown in Figure 1.10. As lead time, variation, and lot sizes decrease, profit approaches gross margin (excluding other general expense items). When these factors decrease sufficiently, there is a net addition to profit above gross margin from the effect of negative working capital, an example being Dell Computer (where accounts payable is three times the amount of inventory and accounts receivable combined).

FIGURE 1.10 PROFITABILITY AND TOTAL DISTRIBUTION COSTS

$$\text{Profit} \cong f [\text{Gross Margin} - (\text{Lead Time} - \text{Service Policy}) - \text{Variability} - \text{Lot Size}]$$

The problem:

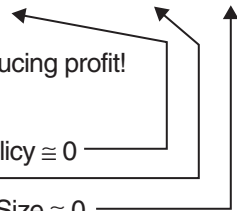
- All of these factors currently result in costs > 0, reducing profit!

Consider the possibilities:

- Short lead time; therefore: $\text{Lead Time} - \text{Service Policy} \cong 0$
- Minimal variation; therefore: $\text{Variability} \cong 0$
- Lot sizes < customer order quantity; therefore: $\text{Lot Size} \cong 0$

The result:

$$\text{Profit} \cong f [\text{Gross Margin} - (1 - 1) - 0 - 0] = \text{Gross Margin}$$



This total cost paradigm is more than just adding up all the usual department budgets into a total. It is a view of the *drivers* of cost rather than the results. Results are the freight, labor, inventory, overhead, and other costs included in financial reports and departmental budgets. These results are driven by other factors, such as lead times and lot sizes. It is these drivers that require the cost-reducing focus; budgets and financial reports are the measures of results.

LEAN DISTRIBUTION TRANSFORMATION

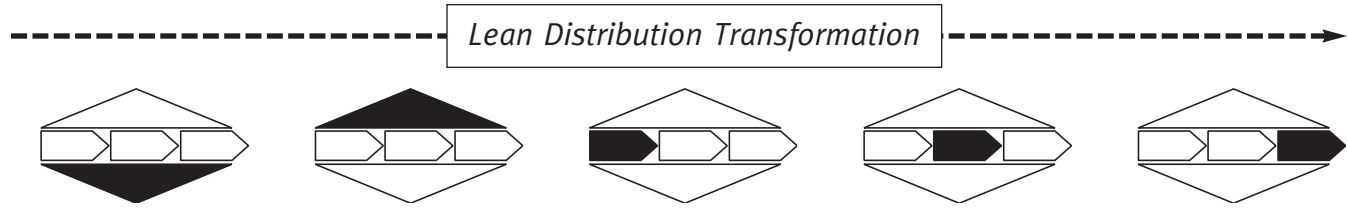
The Lean Transformation is built on the eight enablers to achieve new operating and customer service paradigms that leverage inherent capabilities. The enablers in Figure 1.9 and paradigm shifts in Figure 1.6 provide the flexibility required for short-term customer requirements with simpler distribution planning and replenishment processes, transforming the forecast into a longer-term and more aggregate focus. But to make this transition, an organization must thoroughly and critically reevaluate current processes and ensure that the paradigm shifts are well understood and articulated. The Lean Distribution Transformation is summarized in Figure 1.11 to show the major themes, steps, and concepts involved in moving to Lean-enabled operations.

To initiate the transformation, Chapter 5, “Lean Operating Capabilities,” describes the differences between traditional planning-based processes called distribution requirements planning (DRP) and Lean. The emphasis is on responding to actual short-term customer needs rather than planning far into the future. The Lean processes are described and contrasted to DRP. Pull is defined and contrasted to Push-based replenishment within DRP. Pull is shown as the key ingredient for the Lean Distribution approach to responding faster to shifts in market demands, product life cycles, and customer relationships.

The implications and need for customer service policies is presented in Chapter 6, “Customer Service Policy.” These policies can be taken for granted, just assumed, or possibly not communicated, but are fundamental drivers for all Lean Distribution process design. Meeting customer needs is paramount and the primary driving force for Lean Distribution.

Making the transition from a forecast-driven process to Lean-based Pull is accomplished with a combination of buffer inventory, replenishment

FIGURE 1.11 LEAN DISTRIBUTION TRANSFORMATION



	Chapter 5 Lean Capabilities	Chapter 6 Customer Service	Chapter 7 Buffer Strategy	Chapter 8 Replenishment	Chapter 9 Pull Approach
Theme	<i>Pull Ship one, replenish one, and make one is Pull perfection.</i>	<i>Service excellence builds sales confidence.</i>	<i>Murphy says: Variation happens, so don't self-inflict it.</i>	<i>Create distribution pipes and let replenishments flow.</i>	<i>Customer orders may not be Pull demand.</i>
Overview	Lean Manufacturing practices provide the underlying capability to transform distribution from planning to executing.	Customer needs and value must be aligned and improved with the distribution transformation.	Buffers are necessary due to demand or other variation with a strategy that supports excellent customer service.	Replenishment processes are the structure enabling reduction of total distribution and logistics costs.	Pull creates the actual link with customers to ensure the supply of product and respond quickly to changes in demand.
Concepts	DRP versus Lean. Summing demand.	Segmentation. Service strategies.	Service buffers. Demand patterns. Service policies. Variation and lead time.	Distribution cost waterbed. Delivered cost analysis. Distribution pipes.	Replenishment triggers. Replenishment process. Inventory graphs. Inventory zones.

processes, and Pull-based execution. These elements of the Lean Distribution framework are described in Chapters 7, 8, and 9. The general principles are presented and then applied to specific environments. Each principle must be tailored to meet the unique aspects of an organization's environment.

Last, Chapter 10 provides some perspectives on implementation and how to view the dynamics of a Lean Distribution transformation. Lean Distribution provides a transformed view of the organization and operating dynamics. The paradigm shifts shown in Figure 1.6 are the visible indicators of change, but a much deeper principle must be embraced: an organization's flexibility is the key to customer relationships, profitability, and performance improvement.

ROLE OF INFORMATION TECHNOLOGY

Information technology plays a pivotal role in optimizing distribution and executing Lean processes. The Lean approach is to simplify processes, especially replenishment and inventory targets, but they still should be automated to leverage the time of people and provide fast response to customers. Some of the technology investments that leverage the Lean Distribution approach can include:

- *Delivered cost.* Delivered cost calculates the total of all costs to source/produce, inventory, sell, and deliver to each customer or similar group of customers. This delivered cost concept is critical in developing customer service policies and distribution processes that maximize profit potential for each customer or group.
- *Delivered profit ratio (DPR).* This is a comparison of the revenues to the number of products and locations providing a summary level assessment of the difficulty to operate the network and serve all customers, a group of customers, or an individual customer. Typically it is calculated manually, but for more complex environments it may require specific reports and analytics.
- *Total cost view.* This view combines all departmental budgets and costs into a total supply chain cost picture. It uses activity drivers, such as orders picked and shipped, to identify trends affecting the cost picture, especially variable costs.

- *Replenishment order triggers.* These triggers obtain customer daily demand (point of sale [POS] for retail, consumption for other customer industries) and processes against inventory targets to identify replenishment quantities and timing. They generate replenishment orders and communicate back to the customer status for their planning system. These processes may also be called electronic kanbans.
- *Variation and cycle time analysis.* These two key drivers of the replenishment process must be tracked and quantified in order to drive the entire Lean transformation. The inventory levels and replenishment cycles are determined based on these two parameters, which should be quantified and tracked, even though they may initially only be estimated. Variation can be split into multiple components, such as demand, supply, and lead time, each of which requires different actions to improve.
- *Buffer management.* This tracks and monitors inventories across the three zones: green, yellow, and red. It calculates the buffer inventory target levels, establishes the three zones, flags items based on time in zone, and reports aggregate statistics.
- *Forecast confidence.* This establishes the level of confidence in forecasts across the planning horizon to drive the planning system. Forecasts are more accurate in the near term, but also change frequently, creating ripple effects.
- *Network modeling.* This uses the forecast to simulate changes to the network and make changes over the long range. It uses modeling capabilities to determine the trade-offs for freight, warehouse size/location, inventory, and other costs to best meet customer delivery requirements.

Technology investments are critical for fast response to customer demand and effective Lean Distribution. Technology serves to automate replenishment processes, provide the consumption signals, and measure the entire supply chain. The Lean measures can be new views of the supply chain that are holistic and cut across current departments.

APPLICATIONS FOR LEAN DISTRIBUTION

Lean Distribution provides capabilities that address a variety of business situations and challenges. Lean Distribution is not necessarily a “solution” to

these business issues, but it can provide the necessary responsiveness and cost reduction to address the underlying issues driving many current topics on executive agendas. From customer-driven cost reduction to considering the implementation of new technologies, Lean can provide a framework to assess the benefits and construct approaches for success. Lean Distribution practices link the operational cycle times and variability to all aspects of process, enabling a clearer link between operations and results. As various initiatives alter operations or customer demand characteristics, the benefits and implications become more readily apparent and easier to deliver.

Customer Service

Customer service is the top priority for most distribution operations. It can be measured in order fill rates and inventory stock-outs to identify when customers are not receiving products when needed. If these measures fall, the typical reaction is to increase inventory levels. The difficulty can be that service level is a function of a number of parameters, and increasing inventory tends to mask the parameter causing the problem rather than to address the root cause.

With the Lean approach, customer service levels are well defined and communicated prior to designing service processes. Defining service helps to minimize differences in expectations or communications such that the main parameters required are documented and quantified. With the service policy, actual levels that depart from expectations can be addressed with root cause analysis to seek out and address the real underlying problem.

Vendor-Managed Inventory

Inventory at a customer's or distributor's location such as vendor-managed inventory (VMI), supplier-managed inventory (SMI), or consignment inventory is intended to provide better customer service with inventory "always available." Although service may be improved, it may present challenges to controlling costs and inventory. The customer's demand variation and desire to control inventory may be obstacles to managing this relationship effectively.

Using the retail industry as an example, point of sale (POS) data provided to suppliers enabled the transition of responsibility for replenishment from the retailer to supplier. As suppliers receive POS data, they can produce and ship to actual sales rather than to a series of purchase orders from the retailer.

For other industries, there may be a parallel to manage VMI using a Lean Distribution approach. The starting point is actual demand from the customer that drives replenishment processes geared to Pull rather than customer-order-based Push. The trick to effectively managing the relationship is designing the replenishment process on operational and demand statistics rather than gut feel and intuition. Inventory can be managed and service maintained while keeping costs in line using the Pull-based approach in Lean Distribution.

Radio Frequency Identification

Collecting data as inventory moves through the supply chain has been increasing since the introduction of bar codes and POS data collection. As technology progressed, radio frequency identification (RFID) has become the latest capability to collecting data by attaching a tag to the product, case, or pallet that can be “read” remotely via radio waves. The cost of tags and commercial standards has been the main obstacle to broad application, but as they continue to improve, applying RFID tags will be less expensive and adoption will increase.

Wal-Mart, the Department of Defense, and others have successfully piloted RFID applications and require some level of support from major suppliers. For suppliers, RFID efforts appear to increase their costs as tags and radio frequency devices must be purchased and implemented. The debate for suppliers relates to finding the benefits for RFID, because customers are not willing to pay extra to receive products that are RFID tagged.

A Lean Distribution viewpoint on RFID is to determine whether a more effective trigger for replenishment can be obtained. For the retail industry, this may be product movement from the backroom to the sales floor. These moves are not tracked by the retailer’s inventory system, but are crucial to maintaining sufficient inventory at the store. Store backroom space is limited, making a quick response to an empty backroom shelf critical.

Using POS data can be a proxy, but includes assumptions about backroom inventory and movement to the shelf rather than positive tracking.

Cost Reduction

The pressure to reduce costs across the entire supply chain comes from nearly all directions: customers, executives, and channel partners. What is driving the demands and expectations for cost reduction? Increasing profitability is the most likely answer, but could some derive from the perspective that applying pressure will produce at least some results?

In distribution, the challenge for cost reduction efforts is to ensure that customer service or other cost reduction efforts do not suffer. As one cost reduction idea is contemplated, can all of the other “balls in the air” be maintained? For example, it can be complex to assess freight savings opportunities when shipping schedules continually change.

A Lean Distribution approach to cost reduction is to clarify the factors driving the existing cost structure. Each parameter for the Lean design can be assessed to determine cost reduction opportunities that can be implemented with fewer impacts to other portions of the distribution processes. Customer service policy, variability, and supply lead time are the three primary examples of these parameters. With a Lean approach, changes to any one can easily be translated into savings potential. In this way, cost reduction efforts are focused on sustainable and measurable change.

Other Business Situations

Consider a water pipeline analogy: The utility can “push” water into the pipeline, creating the pressure that enables immediate flow to each point of use, the faucet. The pipeline has a fixed volume that allows pressure to build. Unlike the pipeline, supply chains allow materials to build up at numerous points prior to the consumption point; therefore, pushing materials into a supply chain creates excess cost and inventories. So the trick is to find material movement and consumption data that limits inventory build-ups to further synchronize the entire supply chain, improve service and reduce total cost.

As information technologies and Lean practices make further inroads across all industries, additional opportunities to apply Lean Distribution will

be presented. The transformation seeks to synchronize the supply chain by using actual sales and material movement data rather than various “orders” that are processed from forecasts by planning systems.

SUMMARY

The traditional forecast, plan, and then execute approach to managing Distribution has a lot of appeal and momentum for serving customers and achieving profitability objectives. It developed from the progression of information technology applications that translated detailed customer order forecasts into operational plans with a high degree of precision. Organizations assumed these detailed plans would improve execution, ownership, and measurement. This is a logical approach, but was built on a shaky foundation, as a forecast will always be inaccurate, resulting in higher than necessary inventories and complex business processes.

Improving forecast accuracy can be a tough task, even with customers willing to collaborate. The resulting “consensus forecast” may have significant customer input, but not much commitment to meet the numbers. For organizations seeking to maximize market share and meet all customer commitments, there is a tendency to plan high. Optimistic planning can create a frustrating cycle with a risk of obsolescence for forecasts that are high and expediting cost incurred to react to forecasts that are low.

Despite long sourcing and production lead times, a Lean Distribution approach can improve response to shifting markets without relying on more accurate forecasts or higher distribution costs. This paradigm shift can be tough to believe, because the forecast presumption is so strong. Evidence can be found in the difference between attempting to plan with an inaccurate forecast and then control variability to flawlessly execute versus the Lean approach to operate to actual customer demand and operate around variation inherent in all processes. With Lean, the focus is on flawless execution based on the realities of current operational processes rather than on assuming a forecast is correct and then hoping execution can be flawless.

Lean Distribution also delivers lowest total costs with a flawless execution and demand-driven approach. In the traditional plan and execute approach, variation from suppliers, operations, or customer orders may lead to some portion of the plan being off. As the plan is adjusted and changes

made, costs can easily be impacted. With Lean, variation is expected and built into the total cost picture rather than being a surprise that upsets the plan. With the focus on customer demand, Lean consistently delivers to customers while streamlining total distribution costs.