



**Discovering The  
Lean Supply Chain III:**

**Transforming Distribution  
Operations Into Lean Profit  
Centers**

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***“Strategically Creating Value Through the  
Elimination of Waste”***



## Discovering the Lean Supply Chain III: Transforming Distribution Operations Into Lean Profit Centers

### Introduction

In our on-going series of articles exploring the migration of Lean concepts, disciplines and practices into the supply chain, one theme remains constant: An effective Lean supply chain delivers true value to the end customer; value of course being defined strictly as only those components of the end product (including supplier and manufacturing inputs) which the buyer is willing to pay for. Inherent in any Lean enterprise, waste (muda), at any level, detracts from the seller's value proposition and ultimately erodes margin where unnecessary product inputs fail to add incremental value to the customer.

We have discussed a number of key Lean supply chain concepts and required enablers including the role of Lean supplier development and the importance of sales & operations planning to provide the cleanest demand signal possible to align global demand with enterprise-wide capacity requirements. Over the past five to seven years, many organizations around the world have used core Lean tactics and tools to eliminate Muda on a number of fronts, including:

- Using Lean as a supplier differentiator to create the most flexible supply base
- Deploying Lean manufacturing techniques to compress lead times
- Aligning global supply and demand to radically decrease enterprise-wide inventory levels
- Increasing manufacturing yield to improve labor efficiency and lower total delivered costs
- Adopting rapid changeover techniques to increase flexibility and significantly improve variable demand response times

If you believe in the power of Lean transformation, the benefits are undeniable. Lean supplier rationalization programs, productive inventory investments, and increased manufacturing flexibility have all combined to generate enhanced value propositions for end customers while significantly lowering operating costs. Despite the clear gains, many organizations still struggle with a Lean detractor known as the "downstream bottleneck." While upstream processes such as supply base management, manufacturing operations and administrative functions have benefited greatly from the implementation of Lean disciplines and associated waste elimination efforts, many organizations fail to maximize margin by transferring service bottlenecks (value inhibitors) downstream into areas traditionally classified as inappropriate or incapable of benefiting from Lean practices.

Why the recent focus on distribution operations? Although distribution optimization programs ranging from inventory management to optimal network designs have been on the scene for years,



it has only been within the last two to three years that successful Lean businesses (e.g. those with quantified Lean processes across the supply chain in both operational and administrative functions) have discovered the untapped potential lying dormant in traditional distribution and logistics processes. Fast gaining momentum, many organizations are viewing the benefits of including distribution operations in their Lean transformation journey for a number of reasons including:

- Using Lean distribution principles to increase customer value and margin capture
- Utilizing distribution assets as vehicles for lead time compression
- Creating Lean centers of excellence to be deployed across the enterprise

Far from a single root cause, the facts that create such a compelling case for the migration of Lean philosophies into your distribution operations are as simple as they are far-reaching in their consequences:

- (A) **Asset Investment:** Distribution operations often account for some of the largest asset investments across the enterprise including distribution centers, warehouses, trucks, trailers, and, of course, inventory;
- (B) **Business Focus:** As a single function, distribution operations typically comprise an aggregated grouping of tasks and activities, often with decentralized management, where individual components seldom receive any real improvement focus;
- (C) **Face to the Customer:** As the last true customer-facing component of the enterprise, poorly managed and underperforming distribution operations can destroy any competitive advantage gained through upstream Lean investments, and,
- (D) **Execution vs. Margin Growth:** Despite their size, complexity, and sheer cost, distribution and logistics activities are generally perceived as a pure execution arm of the business and are seldom seen as instruments to drive revenue and margin growth.

While the scope of operations, mission, vision, asset investment and complexity of distribution processes vary across the industry landscape, the fact remains that if an organization's distribution capabilities do not reflect core Lean values and principles embraced by upstream supply chain functions, the organization does not fully embrace Lean or the transformative effects of enterprise-wide Lean adoption. As a direct result, core benefits capture rates typically far fall below what could be expected from a true end-to-end transformation.

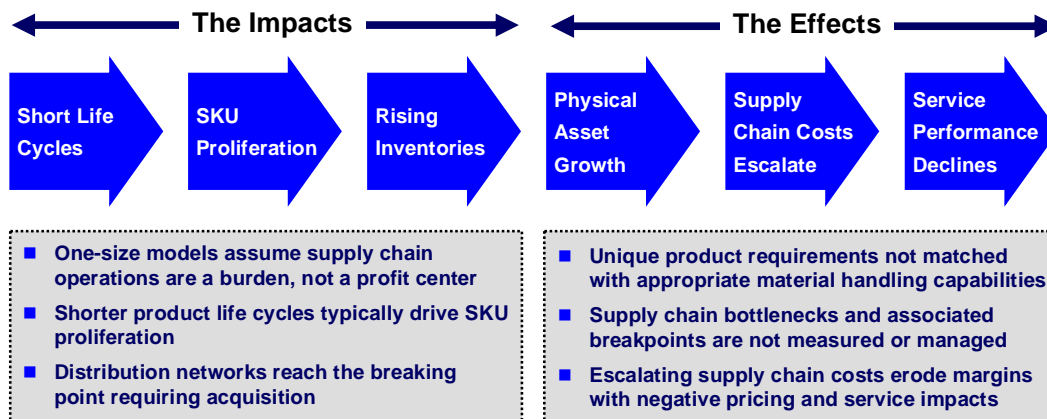


**Distribution in the Non-Lean Environment: Leaning Towards Margin Erosion**

Ranging from fuel surcharges to excess inventory, the financial and customer service pressures on distribution operations are growing. Key trends permeating a host of industries ensure that you are probably not alone in experiencing the issues and problems contributing to the downstream bottleneck:

- Sophisticated customers are demanding a wider variety of SKU’s
- Order profiles are becoming more complex with customer-specific “bundles” of products
- Lead time compression vs. “the higher quality product” are no longer customer trade-offs
- Population growth requiring expanded service delivery footprints
- Price pressures mandating low-cost country sourcing which, in many cases, dramatically extends lead times and buffer stock investments.

Bottoming out in 2003, logistics and distribution costs now account for nearly 10% of GDP in the United States according to the Department of Labor, with current forecasts predicting 12% to 13% by 2010. Based on a 2005 report, a staggering \$393 billion was incurred in 2005 just to cover carrying costs with a further \$744 billion devoted to transportation expenses. Clearly, the financial investments alone mandate the intensive devotion to waste elimination within your distribution operations that Lean disciplines require. Combined with ever-expanding service area requirements and highly demanding customers clamoring for additional product attributes and product line offerings, the results are predictable:



Long consigned to the role of cost center in the overall supply chain, distribution operations are one of the last vestiges of waste demanding the application of Lean practices and disciplines. Typically, warehousing practices and distribution operations (including product staging, transportation and inventory deployment algorithms) suffer from a number of ailments fatal to Lean customer service performance including:



- Lean concepts are often confined purely to manufacturing and are not deemed “of value” to the distribution function
- One-size-fits-all distribution formulas default to single-mode service capabilities
- Distribution operations are not synchronized with customer demand or level-pull scheduling
- Space management increasingly monopolizes supply chain planning regimens
- Physical asset network growth (e.g. warehousing) increases cost and complexity

In order to avoid these service and margin-reducing impacts, progressive manufacturers are encouraged to deploy Lean practices to the logistics and distribution arena in order to avoid the “manufacturing only” Lean journey trap. Moving forward, our goal is to provide readers with a strong understanding of what truly constitutes “Lean distribution” and to identify the most fundamental steps required to achieve it:

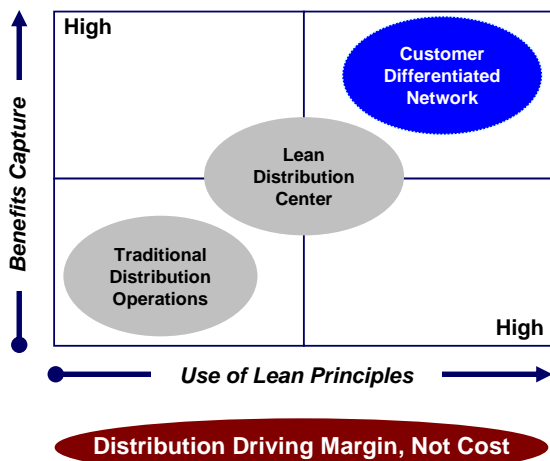
- (A) **Defining The Lean Distribution System:** Clarify what constitutes a Lean distribution and logistics system and how it’s differentiated from traditional practices;
- (B) **Identifying The Appropriate Launch Point:** Assist organizations striving to migrate Lean beyond manufacturing operations and evaluate how best (and where) to launch your Lean distribution journey;
- (C) **Adopting the Lean Distribution Center Proof-of-Concept Model:** How to architect and deploy the Lean distribution center as a showcase for the entire logistics network complete with core Lean tools and disciplines;
- (D) **Utilization of S&OP to Ensure Enterprise-Wide Pull:** How organizations can maximize the use of their S&OP platform by integrating supply-demand planning with distribution operations, and,
- (E) **Migration to the DC-Within-A-DC Concept:** For larger, multi-purpose and multi-customer distribution centers, how organizations can fully optimize their Lean centers of excellence through customer volume segmentation and management.

It’s not easy. Think about your Lean manufacturing journey. “Thinking Lean” will not enable anyone to migrate core Lean tools beyond the four walls of manufacturing into the logistics network. By focusing on the most appropriate launch points and implementing the right tools, organizations committed to the elimination of Muda can achieve great success with Lean distribution concepts and continue their enterprise-wide Lean supply chain transformations unabated.



## A. Defining The Lean Distribution System

Keep the end-state front and center, and you can't go wrong in your Lean transformation journey. Lean distribution systems are integrated network-wide profit centers, fully enabled through Lean business practices providing differentiated, customized service levels in order to drive margin growth across the customer base. Far from a one-size-fits-all (standard lead times, single-mode transportation models) program, Lean distribution systems segment customer service needs and requirements and offer compelling service offerings which not only add value to end customers but increase revenue. The key to such flexibility? Lean methodologies. Muda, long lead times and excessive inventory all deplete the enterprise of much-needed flexibility and only through Lean disciplines can maximum flexibility be restored in order to offer the capabilities required to match disparate customer requirements. As described below, it starts with a single Lean showcase distribution asset (most commonly a representative distribution center) and then scales across the global network:



- Completes the Lean supply chain from suppliers, to manufacturing and distribution
- Lean principles adoption to create the lean DC profit center
- Serves as an integrated extension of the manufacturing process
- Minimize inventory across the network
- Provide flexibility to meet disparate customer demands and service needs
- Move product quickly and accurately backed by standard work & kanban
- Effectively managed across corporate boundaries through S&OP
- Intra-DC Takt drives each facility operation

Central to the Lean distribution system is Lean-derived flexibility promoting differentiated service offerings across the customer base. Considering the plethora of delivery service options available from LTL, TL, premium freight, customer-managed delivery and cross-docking to name a few, Lean distribution systems start with the notion that customer segmentation and customer value are the key drivers of network design and must be backed through standard work to ensure predictability and sustainability. While optimal network design often implies (by definition) the most economic deployment of assets, based on required location and function, Lean-based distribution operations mandate deep commitment to customer segmentation and value analysis programs which confirm a broad range of strategically valuable information including:

- Which customers are truly contributing to overall business growth?
- Which customers provide a threshold margin level worthy of continued service?



- What delivery options are required by high-margin customers?
- What are the cost components of each delivery option and who bears that cost?
- How will lead time be used in the marketplace as a competitive weapon?

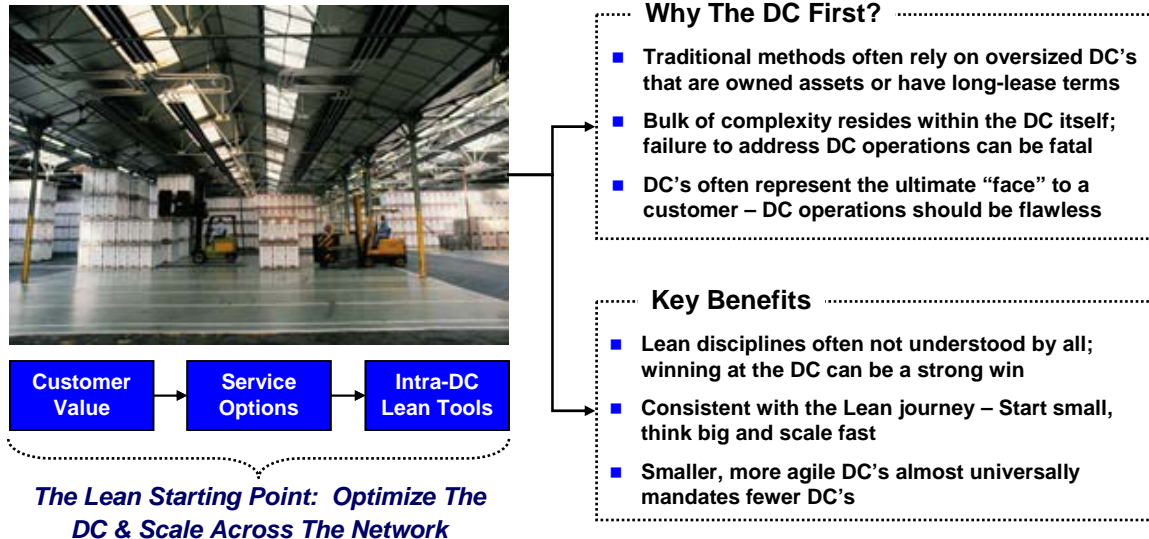
Lean tools can remove muda, but Lean tools combined with high-impact customer service data will allow for targeted improvements that can rapidly produce industry-leading service levels and lower costs.

## B. The Right Launch Point For The Lean Journey

Traditional network optimization programs typically begin with the core questions of customer geographic dispersion, modal requirements, manufacturing-to-DC replenishment time and other key factors. Most traditional network designs (e.g. altering the current configuration either to lower costs or improve existing service levels) suffer from an often fatal flaw in that they focus first on network requirements and not the needs or complexities typically found in the warehouse or distribution center itself. While the required number of assets, asset location and purpose of each asset are critical decisions (and certainly not to be undertaken without the requisite due diligence), such approaches generally fail to first identify core workplace methods, operating practices, inventory issues and other problems that combine to limit service capabilities and increase delivery costs. As is often the case, unless these critical issues are identified and corrected first, any network model design chosen may properly locate facilities in the right geographic location, but will also bake in institutionalized waste unless surgically removed. By using Lean tools and methods early in the process, these costly mistakes can be avoided.

- Traditional approaches, while starting with the “right asset in the right place” thinking, are generally grounded in the desire to raise service levels especially in growing or high-risk geographies
- Key problems inherent in the current network, such as excess inventory levels (and the processes that enabled the inventory to build) are lost in the design and execution phases
- Traditional, goals, such as lead time compression often take a leading role over margin capture and differentiated services
- Internal capabilities of the individual asset must assume a front-line position with classic “where and how many” decisions
- Accurate performance measures are not used leading to muda infestation
- Labor is not precisely planned resulting decreased productivity and labor efficiency

By using Lean tools and methods early in the process, these costly mistakes can be avoided. Based on our experience with network design combined with launching and sustaining Lean transformation journeys, LHC recommends starting with an individual distribution asset, most often a representative distribution center servicing a broad range of customers and locations:



While starting with a single distribution center hardly captures the entire network or solve global distribution issues, it represents the most logical launch point for the Lean distribution journey by forcing a number of limited, highly critical issues to the forefront including:

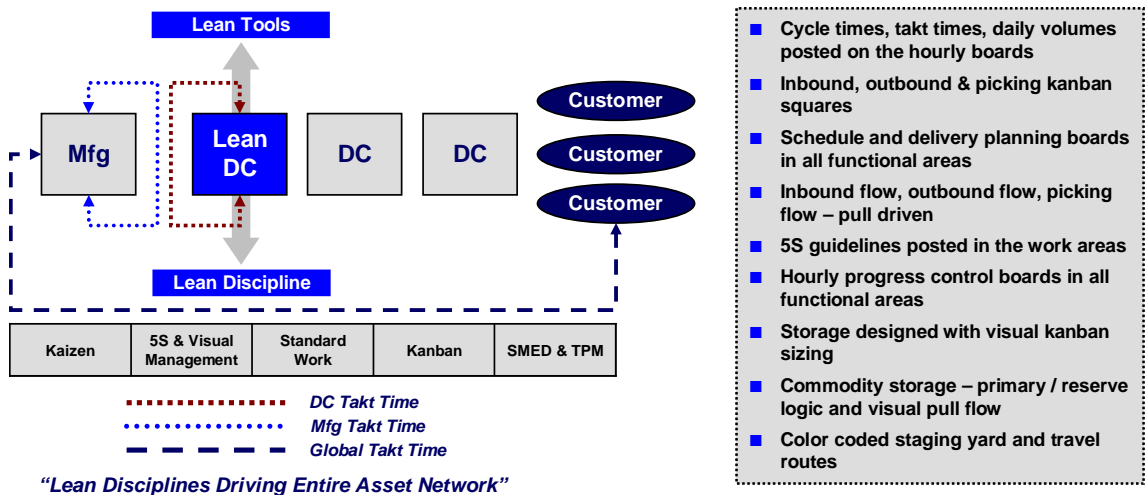
- Often, successes brought about through Lean are limited to manufacturing; “unproven” concepts or skeptical distribution team members will require a relevant business case before buying into Lean distribution concepts;
- By focusing on a single asset during the early stages of the journey, core practices that produce waste can be attacked and eliminated with Lean tools and disciplines (described more fully below), and,
- If the organization is successful at transforming a complete asset such as a distribution center or critical warehouse, improvement opportunities such as SKU rationalization, inventory reduction (or improved velocity), reduced asset footprint, standard work-based operating practices and other improvements can be systematically built into a new network design with easy replication throughout the operations via standard work.

Launching the Lean journey beyond the four walls has significant ramifications for the business itself as well as the human assets that will be required to operate and sustain the results. Start small, but think big and scale appropriately. By generating a Lean distribution showcase prior to a full network assault, the bulk of the Lean tools, concepts and disciplines will not only be at your disposal, but they will be battle-tested in a location representative of your complete operation.



**The Lean Distribution Center Model: Creating a True Lean Showcase Facility**

Dedicated Lean practitioners that have made the Lean transformation journey appreciate both the benefits captured and the cultural changes achieved. Starting with manufacturing, the journey often started out in a single product line or facility. 5S doctrines were introduced, kanban provided true materials flow disciplines, standard work generated reliable, predictable yield, SMED converted batch processing into flexible, level-pull scheduling and visual management tools tied it all together. Welcome to the Lean distribution center (LDC). For those Lean believers who are successfully navigating through their Lean manufacturing journey, you are fully prepared to launch the next phase. Your new Lean tools? You already have them. In its simplest form, the LDC is a distribution facility that incorporates core Lean tools, disciplines and methodologies to ensure that that the “final mile” of customer service delivers value-based differentiated offerings that systematically eliminates waste and generates superior margins:



As demonstrated in the above diagram, the LDC operates as a fully integrated, synchronized supply chain asset that compresses lead time and reduces costs by accelerating the Lean benefits already captured through upstream operations and, with the increased velocity, provides a delivery vehicle for total customer value. Lean concepts can either stop at the four walls of the manufacturing operation, or they can continue to enhance the customer experience through six core LDC beliefs:

- (A) **Intra-DC Takt Time Adherence:** In the manufacturing context, Takt time mandates a production cadence precisely matched to end-customer demand. LDC Takt time ensures that all LDC activities (e.g. picking, staging, and sequencing) are performed to the same cadence. Detailed further below, if the cadence required by an S&OP-based demand signal is broken at any supply chain juncture, lead times and service levels will suffer.



- (B) **Visual Kanban Flow with Color Flow Lanes:** Manufacturing lines use kanban to effectively replenish materials; so too with the LDC. Kanban logic ensures that LDC replenishment activities are highly coordinated with manufacturing output while color flow lanes provide highly visual tools to rapidly move materials through the facility at maximum efficiency and velocity.
- (C) **5S Management Philosophy:** Every piece of equipment and every SKU have a dedicated function in the LDC, and must have a dedicated location. Materials cannot move efficiently if lanes are blocked, SKU's are subjected to random storage logic or racking schemas generate excessive effort to pick and restock products.
- (D) **Storage Medium – Product Flow Match:** The type of storage equipment must match the products and the planned flow of products through the LDC. LDC fast turn flow through logic simplifies the need for various types of storage mediums and reduces them down to 3 or 4 main types, floor stack, flexible selective rack, deck rack, and each pick carton flow rack, all with a specific supporting role adding to overall efficiency.
- (E) **Continuous Product Velocity:** A critical hallmark of the LDC as they are not storage centers but (by the Lean definition) highly productive assets accelerating the flow of products to various customers and geographies. In the LDC, 95% of all products are picked straight from the floor (no need to reach into the air) while all products are turned generally 2-3 times a week. Ask yourself. If you are always in the air, or turning products a few times a year, why was the product made (and in that quantity) in the first place?
- (F) **Zone Pick Logic:** Integrating takt time with standard work and product control boards (think visual management), zone pick logic maximizes the value of kanban-based replenishment systems by creating standardized fixed-path processes effectively linking pick, pack and ship functions to specific order profiles and delivering products to specified dock locations on time, every time. Through zone pick logic, the flexibility required to differentiate service options becomes reality.

You have to use them all. If the goal is waste-free, predictable customer service levels that maximize margin capture, all the Lean tools available are required for success.

### **The Role Of S&OP: Ensuring Complete Demand Signal Integration Across The Network**

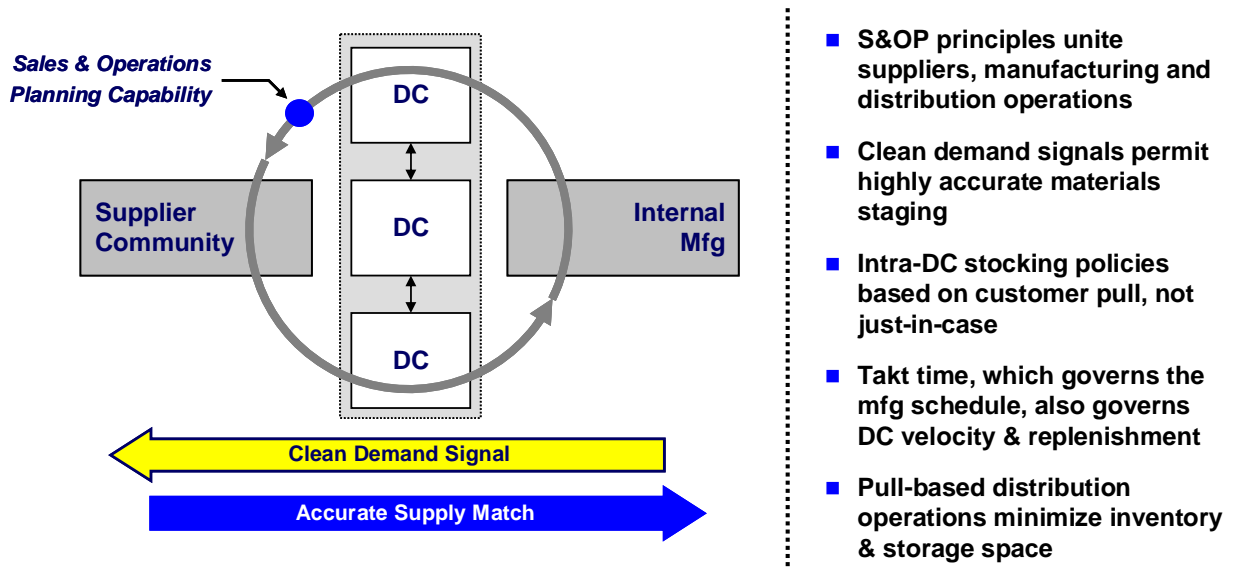
Successfully implemented, sales & operations planning can transform the business planning process into a highly accurate customer service plan that translates consensus-driven demand planning information into an asset deployment plan that maximizes per-period margin capture and end-customer service levels. Once the demand plan is converted into a physical level-pull production schedule, S&OP becomes demand-driven operations planning by connecting available assets to actual unit build plans.



The benefits of S&OP have been known for some time; minimization of forecast errors, lower inventory buffer stocks, reduced overtime and other valuable benefits all combine to drive margin performance. By definition, S&OP is an enterprise-wide business planning process that, through the use of Lean tools, disciplines and practices, customer service performance effectively becomes supply chain-wide standard work driving predictable and sustainable service performance. Traditional S&OP implementations, however, often suffer from a number of defects that have significant impact on distribution capabilities including:

- Many organizations take a highly limited view of the “assets” to be governed by the per-period S&OP plan; as a result, distribution assets are seldom considered part of the S&OP asset deployment plan;
- The resulting per-period (e.g. monthly) S&OP plan, while accurately translating demand into a production schedule, often produces highly flexible supply base and manufacturing performance capabilities that far outstrip distribution flexibility, and,
- With other supply chain operations operating at peak efficiency, the flexibility required to produce superior margin and customer service performance ultimately is derailed because key bottlenecks (e.g. inventory) are simply transferred into the distribution operation defeating many of the gains captured from Lean manufacturing.

Through S&OP, you do not produce to imaginary numbers such as budgets or asset utilization. As a cornerstone of Lean supply chain operations, S&OP is, by design, an enterprise-wide business planning process that critically evaluates the use of *all supply chain assets* to ensure that Lean disciplines are universally applied and managed. In that regard, organizations seriously considering a Lean supply chain transformation must link distribution improvements to their S&OP program:





Distribution capabilities, flexibility issues, buffer stocks and other limitations must all be factored into the complete S&OP plan if the most accurate asset deployment plan is to be developed and implemented. As an example, any muda-based practices in the DC such as poor picking and staging practices, random-access storage logic, or other poorly-designed operations procedures will most often defeat the plan and inflate lead times.

As the last true customer-facing operation, distribution operations are tasked with the “final mile” of customer service performance delivery. If these critical assets are not physically linked to the S&OP planning cycle, institutionalized muda across the logistics function will continually erode service performance and effectively block the migration of Lean disciplines across the extended supply chain. Removing bottlenecks in manufacturing and the supply based may be a hallmark of any Lean transformation, but the bottlenecks themselves can't be conveniently transferred to distribution if the transformation is to be a success.

### **The DC-Within-A DC: DC For The Masses Or Margin-Generating Customers?**

As discussed earlier, customer segmentation, customer value and long-term margin growth are critical aspects of supply chain management. Properly evaluated and integrated with supply chain strategy and scalability requirements, these valuable inputs can dramatically increase supply chain effectiveness and drive the implementation of customized solutions for high-margin customers.

Often times, as the size of a distribution asset grows, physical performance generally declines for a number of reasons:

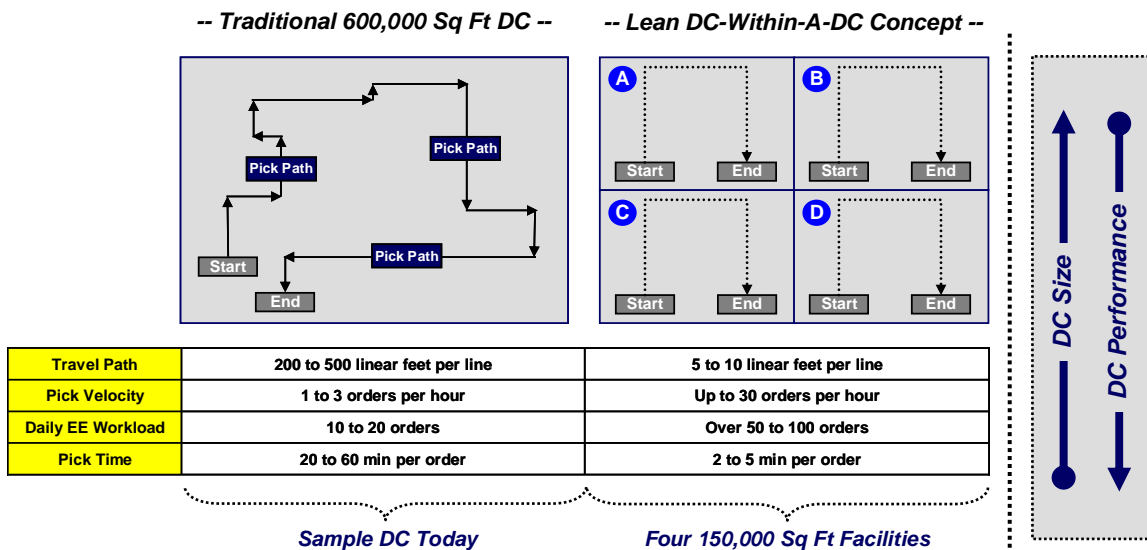
- Typical one-size models are simply scaled across a much larger facility or multiple large facilities, feeding the “more space needed” engine.
- Picking, staging and replenishment travel paths naturally increase, destroying labor efficiency and reducing total productivity.
- Asset management focus typically does not scale with the physical size of the facility, reducing key oversight and standard work enforcement regimens.
- Internal flows, layouts and area changes occur at various times with no real connectivity to the global operation (or customer requirements) leaving pockets of waste throughout.
- High-technology investments such as bar coding, warehouse management software programs (WMS), RFID and other tools are often deployed as substitutes for standard work and simply automate waste without first removing it.

Lean distribution systems employ a broad range of both simple Lean tools (e.g. kanban flow and 5S) along with sophisticated enterprise-wide Lean disciplines such as S&OP. Combined with customer segmentation practices and customer value analysis, operators of complex supply chain processes serving multiple geographies and disparate customer service requirements can learn to embrace scale and transform large-volume distribution facilities into highly profitable, quick-turn customer service centers. Just as customer segmentation tools and techniques differentiate



customers based on service needs, product requirements and growth potential, distribution centers can apply the same principles and use facility size as a true competitive weapon.

As the general size principle holds, distribution centers maximize economies of scale between 180,000 and 200,000 square feet. Once the footprint of the facility exceeds those limits, operational efficiencies including labor productivity and customer service performance generally decline as management capabilities and uncontrolled materials flows fail to scale in proportion to asset size. A brick wall? Hardly. By combining customer segmentation principles with Lean distribution concepts, supply chain operators can segment large-volume facilities into zoned operations dedicated to servicing specific customers with highly differentiated requirements or service level needs:



If Lean distribution concepts and practices can be applied to a stand-alone 180,000 square foot facility, they certainly can be applied to multiple segments or zoned areas within the same four walls. Essentially, the Lean DC-Within-A-DC concept is grounded on the economic reality that as service levels and customer requirements become more complex (and therefore costly), reliance on a one-size application for all customers will eventually fail at two critical levels:

1. High-margin customers will generally receive lower-priority service levels not reflected in their margin status or pricing agreements
2. Low-margin customers will generally receive excellent service levels that are not reflected in delivered pricing.

By segmenting the large-volume facility by customer type (such as geography, order patterns, order complexity, etc.) and then applying Lean distribution disciplines to each segment,



organizations can radically alter and customize service policies to ensure that higher-margin customers receive preferential treatment while lower-margin customers receive service levels aligned with their pricing structures. All the while, each square foot of the facility is being used in the most appropriate fashion based on the end customer for whom it is dedicated. One of the chief detractors from the Lean DC-Within-A-DC concept are the critics who cry foul that the methodology violates the standard work maxim in that different operating practices are permitted within a single facility. While different service offerings are provided, all are backed by the same levels of standard work including kanban replenishment, zone pick logic, intra-location 5S, takt time adherence, and the other tools considered mandatory to achieve the benefits associated with the Lean distribution system concept.

If you can segment your customers by value, growth potential and service requirements, you can add core Lean disciplines to the recipe by transforming large-volume assets into segmented, individual Lean showcases providing differentiated service offerings backed by standard work. Travel times? Dramatically reduced. Labor productivity? Exceptional. Margin protection and growth by customer? Secure. Singular assets do not require singular treatment; Let lean principles guide the deployment of your largest facilities and how they may be best utilized to service your broad customer base.

**Summary: YouCan't Stop the Lean Transformation at Manufacturing's Dock Door**

Paralleling the Lean manufacturing transformation, Lean distribution concepts and disciplines allow progressive operations to differentiate service offerings and maximize margin capture by closely aligning service requirements to delivery capabilities. Through the application of core Lean tools such as kanban, visual management, 5S and takt time adherence, supply chain executives can achieve a much greater degree of control over downstream distribution operations (including inventory deployment & management and per-customer service levels) while lowering overall supply chain costs. Used in conjunction with Lean immersion across other supply chain functions such as supply base management, demand planning and production, the benefits are compelling:

Metrics	Improvement Range	
	Low	High
Space Consumed	6%	32%
Annual Inventory Turns	9%	23%
Inventory \$\$ Value	7%	16%
Volume Processed/Daily DC Velocity	4%	17%
Quality -- % Accurate Shipment Improvement	8%	14%
On Time Delivery (Orders Shipped On Time/OSCOT)	10%	26%
Operating Costs	5%	30%
Lead Time Compression	10%	45%
Expedited Monthly Freight Cost Reductions	5%	32%



Clean demand signals. Level-pull production scheduling. Responsive supplier capacity. Combined, they can significantly enhance supply chain performance while improving customer service levels across the board. Used alone, they can only provide the benefits attainable at the weakest link. Used in conjunction with Lean distribution concepts, organizations can successfully complete their Lean transformation while utilizing their supply chain as a competitive weapon to capture and sustain profitable growth.

### About the Authors

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