

FROM FIXED TO FLEXIBLE: **THE EVOLUTION OF WAREHOUSE SLOTTING**



Efficient, effective DC operations are foundational to helping you compete in today’s markets and into new ones. As this reality becomes more apparent, businesses are re-evaluating how they view their warehousing infrastructure and considering how they can evolve and adapt. This involves a focus on incremental process change, continuous optimization, and operational transformation. DCs need tools that can help them manage the week-to-week, day-to-day, even the hour-to-hour changes that occur. That requires dynamic optimization across work planning, work release and work execution.

An excellent example of this “new” type of thinking is reflected in the traditional warehouse process of slotting. Slotting is a critical inventory management technique that strategically determines the optimal location for each product within a warehouse or distribution center. Proper product slotting can significantly boost productivity, throughput, and order accuracy, but historically, less than a third of warehouses are optimally slotted, and doing it right meant bringing in expensive consultants or devoting internal engineering resources to build and maintain slotting models, leading to warehouse down times needed to change product location assignments and move inventory.

But a better way is emerging, one that moves beyond conventional slotting methods toward smarter, more adaptive strategies. Dynamic slotting represents a key advancement for modern distribution centers striving to stay competitive in today’s rapidly shifting landscape. By leveraging flexible, data-informed techniques, facilities can better align inventory placement with real-time demand, reduce picker travel, improve ergonomics, and make more efficient use of space. This evolution from fixed to responsive slotting unlocks greater operational agility and positions the warehouse as a strategic asset, not just a cost center.

In the following pages, we’ll take a comprehensive look at slotting, exploring the basics, reviewing traditional methods and the challenges of optimization. We’ll take a look at where and how re-slotting works best, and finally how automation, particularly AI and ML are setting new standards for dynamic slotting optimization.

TABLE OF CONTENTS

- The Basics of Traditional Slotting3
- Challenges with Traditional Re-slotting3
- Warehouses Benefiting the Most from Traditional Re-slotting5
- Where Static Re-slotting May be a Better Choice6
- An Alternative Approach-Continuous Optimization with AI and Machine Learning6
- Machine Learning Explained.....7
- The Benefits of Slotting Optimization.....8
- New Dynamic Slotting Approach9
- Table - Comparing Slotting Solutions 11

THE BASICS OF TRADITIONAL SLOTTING

So, how is it commonly done today? In most cases, it is accomplished by the same associates delivering the tactical day to day, periodically focusing their efforts on maintaining elevated levels of stock integrity and accuracy.

Often, the tactical day to day obviously takes priority. Usually, any stock movement of warehouses or picking zones are conducted outside of core hours in a controlled way. This is to ensure inventory status is neutral for safe movement of physical and systematic inventory.



WHAT ARE THE CHALLENGES ASSOCIATED WITH TRADITIONAL RE-SLOTTING?

Primarily, it is a difficult and complex process. It often requires single-threaded expertise, relying on individuals with specialized knowledge. Accurate and clean data sources are essential and understanding software packages that can automate aspects of re-slotting is critical. The process is also time-consuming, particularly when it comes to analyzing data and planning slotting changes. Resources often have to manually work data sets into a spreadsheet from multiple data sources prior to loading into the Slotting solution. Additionally, there are limited windows available to execute these moves, and sufficient resources and equipment are necessary to carry them out effectively.

It's also expensive. Large scale moves during core hours can impact picking service level agreements (SLA's), moves outside of core hours can incur premium rates of OT, and analysis may have to be conducted outside of core hours.

For these reasons and more, it could provide bad ROI. Static analysis with periodic reviews may present misleading benefits. If not dynamic and agile, a recommendation deemed good could quickly be the opposite.

STEPS IN TRADITIONAL SLOTTING

- Build as scale model of the warehouse, utilizing CAD drawings to build maps in Excel or some 3D modeling software.
- Accurate dimensions of all handling units for all materials + dimensions and weight constraints for location/bay configuration.
- Build and constantly fine tune a model adjusted any weighted scoring provisions that supports any calculated savings and recommendations as outputs.
- Periodically re-slot products, but working under operational constraints around priorities, equipment availability, resource availability.



Additionally, you have many factors that you want to influence slotting decisions. You also have thousands of SKUs and locations. Which simplistically means, it's a difficult problem with an exceptionally large set of possible solutions. Also, SKU profiles and other inputs can change rapidly so you need something that is going to keep up with those changes.

Today's techniques can range from engineering standards being robustly measured and applied in labor management software, to the most common being Excel spreadsheets with the added complexity of macros to support some level of automation.

KEY CHALLENGES TO RE-SLOTTING:

1. High labor costs and time requirements
2. Disruption to ongoing operations
3. Data complexity and management
4. Unpredictable demand
5. Limited space and physical constraints
6. Warehouse layout and automation systems
7. Capital costs and technology limitations
8. Complex product mix and handling requirements
9. Resistance to change
10. Cost-Benefit uncertainty

WHAT KINDS OF WAREHOUSES BENEFIT MOST FROM RE-SLOTTING?

Warehouses that benefit most from re-slotting are typically high-volume operations with specific characteristics that make re-arranging inventory essential for efficiency. Here are the types of warehouses that benefit the most and the characteristics or thresholds they tend to exhibit:

» HIGH SKU COUNT WAREHOUSES

Especially if SKUs have varying demand patterns. Typically, 10,000+ SKUs, though even smaller SKU counts can benefit if inventory turnover is rapid or if there's a wide variance in product dimensions.

» HIGH VOLUME, HIGH THROUGHPUT WAREHOUSES

Warehouses with daily pick volumes exceeding several thousand orders or cases.

» SEASONAL OR PROMOTIONAL WAREHOUSES

Warehouses that experience significant seasonal shifts in product demand or run frequent promotions. For example, seasonal peaks where demand for specific items spikes by 2-3x or more.

» FAST FASHION AND APPAREL WAREHOUSES

Warehouses with a high turnover of SKUs and frequent product introductions and discontinuations that experience frequent product churn, with SKUs staying in the warehouse for only a few months.

» E-COMMERCE AND OMNI-CHANNEL DISTRIBUTION CENTERS

Facilities that handle a mix of small parcel shipments (for e-commerce) and larger, bulk shipments (for retail or wholesale). This includes warehouses handling both e-commerce fulfillment and store replenishment operations.

» BEVERAGE, FOOD, AND PERISHABLE GOODS WAREHOUSES

Warehouses storing temperature-sensitive or perishable items that require specific storage conditions (e.g., refrigeration or temperature control), and having high turnover rates for perishables (daily to weekly inventory cycles).

» MANUFACTURING WAREHOUSES (RAW MATERIALS AND FINISHED GOODS)

Warehouses attached to manufacturing facilities, where both raw materials and finished goods need to be efficiently stored and retrieved for production and shipping. These facilities can exhibit high variance in demand for specific materials or products, especially if JIT (Just-In-Time) principles are applied.

THRESHOLDS FOR RE-SLOTTING FREQUENCY

- **Daily to weekly:** For high-velocity, fast-changing environments (e.g., e-commerce).
- **Monthly to quarterly:** For stable operations with some variability, such as retail distribution centers.
- **Seasonal or event-based:** For warehouses with predictable peaks (e.g., holiday seasons, back-to-school periods).



WHERE STATIC SLOTTING MAY BE A BETTER CHOICE

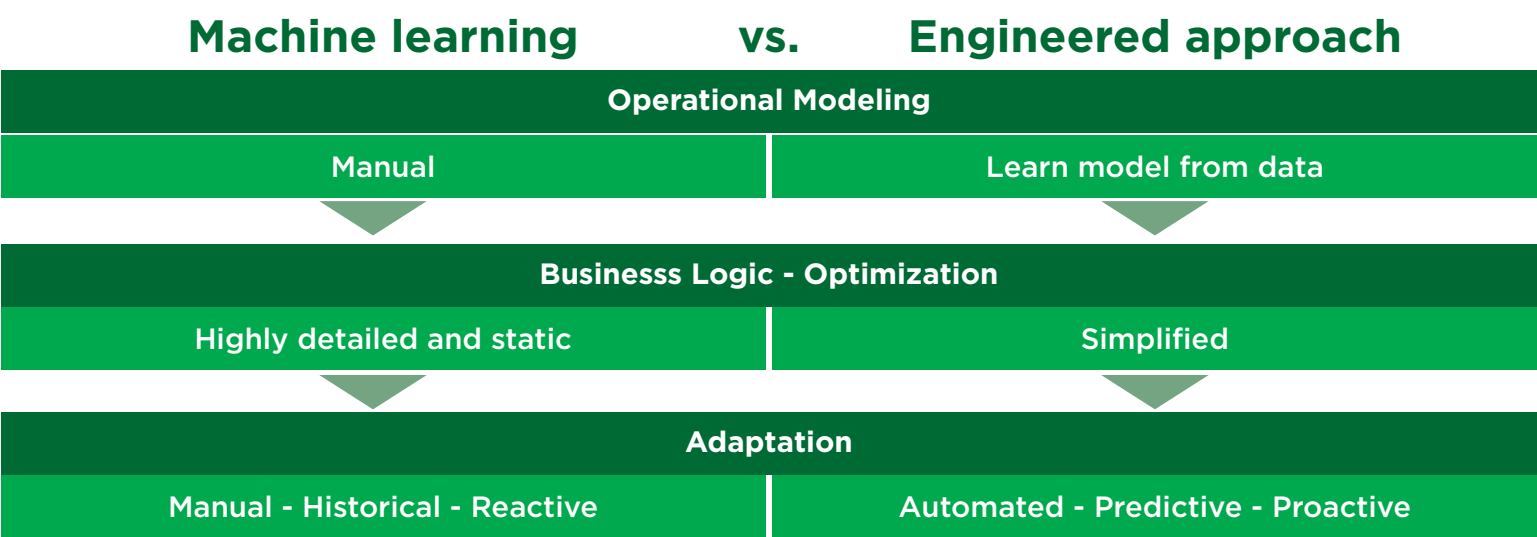
That leads us to scenarios where more traditional, static methods might be better suited based on the nature of their operations. For instance, low-SKU, high-volume facilities—such as bulk commodity warehouses or pallet-in/pallet-out operations, which typically handle a small number of items in large quantities. These items are often stored and moved in full pallet loads, making frequent slotting changes largely unnecessary. Similarly, warehouses with static or predictable demand, like those storing spare parts for long-term use, or archival inventory, gain little from dynamic slotting since item movement is infrequent and highly predictable.

In regulated storage environments, such as those handling hazardous materials or pharmaceuticals, slotting is dictated by strict safety and compliance rules, leaving little room for adjustment based on efficiency considerations.

Warehouses with constrained physical layouts, such as urban micro-fulfillment centers with fixed shelving or limited slot flexibility, also face practical barriers to re-slotting. In these cases, spatial limitations outweigh potential efficiency gains. Lastly, small-scale operations with low throughput or manual tracking systems, common in smaller businesses, may find the cost, time, and complexity of re-slotting unjustifiable, especially in the absence of enabling technologies or significant order volumes.

AN ALTERNATIVE APPROACH - CONTINUOUS OPTIMIZATION THROUGH AI AND MACHINE LEARNING

For those who may benefit from more consistent slotting optimization, to drive more value from slotting, the objective is to negate the need for specialist engineering resources, and the time-consuming exercise to gather engineering standards, updating static, reactive data models or convoluted spreadsheets that require expertise to create and maintain as data models. So, all this adds up to the perfect kind of problem for AI and Machine Learning to tackle.



WHAT DOES MACHINE LEARNING LOOK LIKE?

- Build a digital map to scale of the warehouse.
- Develop compatibility matrices for warehouse layout to cover location and bay configurations for cube and weight constraints. Then factor in Product compatibility within the warehouse layout, considering chambers, temperature conditions, weights, etc.
- Learn the costs and timings of the current operation from existing data sources.
- Recommend new slotting options for products that will yield the greatest benefits in a relatively brief period of time.

Classified as opportunistic re-slotting, with the purpose to gradually execute small incremental changes that yield large operational benefit, with focused objectives of optimizing picking and reducing travel time and frequency of replenishments. This method also ensures product placement mitigates risks of damage during picking, balanced with factoring in the ergonomics and safety for the picker, and ensuring optimal fill of locations. Space is a commodity in a warehouse, so to improve space utilization, essential locations s fully utilized with inventory.

So, how does it work in this context? We are taking multiple feeds of data, from automation, picking devices and potentially AMR's. This is then combined with IOT data (Internet of things) to bring multiple large data sources together, and by applying machine learning algorithms we can create a predictive model.

What data and variables need to be taken into consideration? There can be many variables, but here are some of the key considerations:

VELOCITY – Number of lines, grabs, units.

AFFINITY – Refers to the correlation between the purchase of one product and the likelihood of a customer purchasing another related or complementary product.

SEASONALITY – “As Is,” could be specific to periods in the year or even certain days of the week.

BATCHING – Ranges of products that are commonly grouped together as picking batches by the host system.

COMPATIBILITY – Consider the compatibility of product in location/location types, picking zones, picking chambers or constraints like storage conditions or weight.

DIMENSIONS – Considering product dimensions and weights.



VELOCITY



AFFINITY



SEASONALITY



BATCHING



COMPATIBILITY



DIMENSIONS

The core objective is to get insights around both recommendations and predictions into the hands of both managers and engineers who can influence change.

ELIMINATE CONFIGURATION PAIN AND GUESSWORK



Automatically handle change with continuous optimization



Make proactive slotting adjustments with product velocity forecasting



Improve productivity, efficiency and safety with horizontal and vertical slotting optimization

This predictive model will provide insights directly to end users upon request, for them to validate, interpret and implement in a fraction of the time and effort taken today. The model adapts and predictions improve over time, so, machine learning then becomes an attractive alternative to highly engineered approaches for things like workforce planning, performance management, dynamic slotting, and process orchestration.

WHAT KIND OF FINANCIAL BENEFITS AND OPERATIONAL BENEFITS CAN SLOTTING OPTIMIZATION BRING?



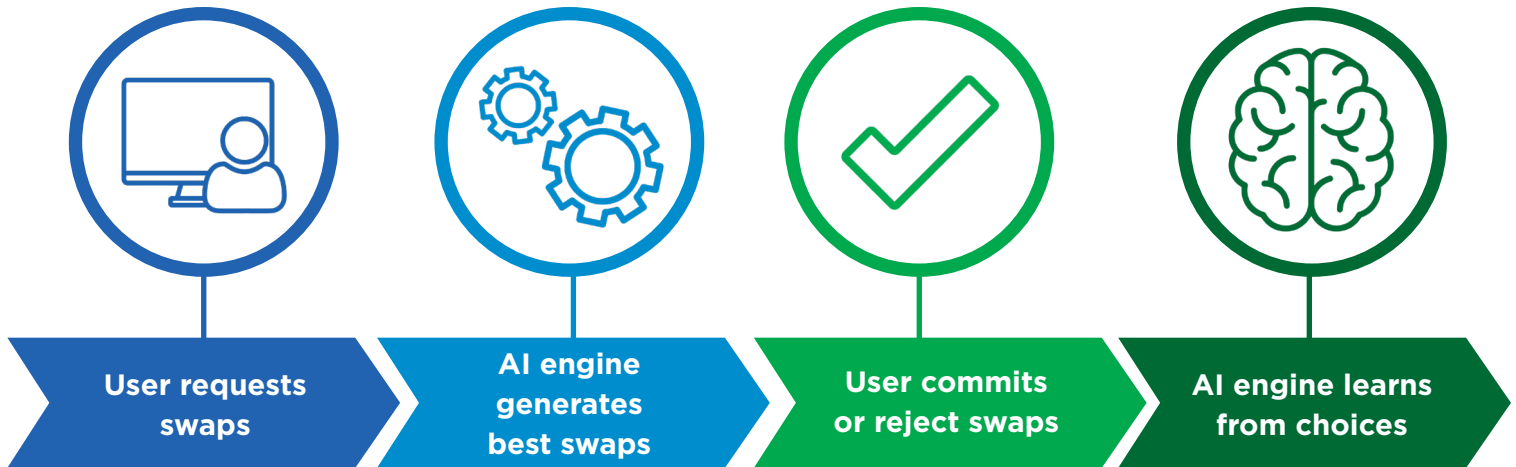
In most cases, AI-based slotting can deliver **10-20% labor cost savings**, a **1-5% improvement in accuracy** and **20-40% increase in throughput**.

- **Improved space utilization** - Move product into appropriately-sized slots.
- **Reduced picking and replenishment costs** - Reduce picking travel distance and replenishment frequency.
- **Enhanced safety and ergonomics** - Frequently picking products moved to “Golden Zone”.
- **Lower labor costs** - Faster picking times and reduced errors translate to lower labor requirements.
- **Improved worker satisfaction** - A well-organized warehouse with clear product locations can enhance employee morale and productivity.
- **Better customer service** - Faster order fulfillment and increased accuracy lead to improved customer satisfaction.

THE NEW DYNAMIC SLOTTING APPROACH

Dynamic slotting utilizes “swaps” or AI-powered recommendations that recommend swapping the pick locations of two products take “Product A” in “Slot 1” and swap it with “Product B” in “Slot 2”. The software tells you which products/slots to swap, project savings and ROI #s, and provides a reason for the recommendation.

HOW TO USE LUCAS DYNAMIC SLOTTING



DYNAMIC SLOTTING ELIMINATES THE CONFIGURATION PAIN AND GUESSWORK OF MORE TRADITIONAL, STATIC METHODS. HOW?

- » Dynamic Slotting is designed to learn by continuously ingesting data, built to automatically manage change. With an occasional one-shot or total re-slot approach, unfortunately the optimized state deteriorates quicker than you think due to changing conditions.
- » Product velocity forecasting, allowing for proactive slotting moves ahead of changing conditions. So, we have ML within ML. Order history used to establish product velocity, affinity, and to make velocity predictions using ML to identify seasonality trends and so forth. Forecasted order data from the customer can be utilized if they have it. May include things like upcoming promotions indicating a spike in that product's demand, or the discontinuation of a product.
- » Vertical and Horizontal optimization = reducing travel distance and lift times for picking equipment. Golden zone considerations of knee to shoulder level, for high velocity and heavy/awkward products. Goes to ergonomics, work efficiency, and safety.

DYNAMIC SLOTTING ALSO UTILIZES OTHER FEATURES TO GROW ROI:

- **“WHAT-IF” RECOMMENDATIONS** – Assess things like, Is there a better slot for this product? Is there a better product to put in this slot? Is this a good swap?
- **WAREHOUSE HEATMAP** - Get insight into detailed picking and replenishment information over any period, presented in an easy-to-use heatmap format.
- **REJECT RECOMMENDATIONS** - User can provide a reason for the rejection, and the AI engine will incorporate that feedback.
- **CUSTOM COLUMNS** - See current stock levels, allocations, or other metrics you can provide data for.



With dynamic slotting, one can make a few changes every day, either during the workday or at the end of the day. If workers have a few moments, they can make slotting changes (moving 5-10 SKUs) and proceed to continue their job. Moving 5-10 SKUs every day in a 4,000 SKU capacity warehouse will not interrupt the daily workflow. Moreover, during a period of a few weeks, all the low hanging fruit (high impact SKUs) can be captured.

Static slotting benefits are realized during the first few weeks of implementation but then start to diminish over time because of ever-changing SKU velocities. On the other hand, dynamic slotting benefits are seen more frequently and consistently realized because products are continuously being moved based on the latest velocities.

While dynamic slotting may not be as beneficial in certain situations, if your warehouse meets any of the below factors, dynamic slotting is worth investigating:

- Your SKU velocities are constantly changing
- You are in a market which is affected by seasonality
- Your business provides forecasted data on SKUs
- You have a small warehouse, and are constantly moving products from put-away to pick faces
- You cannot afford to interrupt the workflow in the warehouse



Dynamic slotting is also an affordable solution, leveraging the scalability of cloud-based microservices hosted on Azure. This ensures access to continuous innovation with quarterly updates, all without disrupting service levels or requiring costly upgrades. The return on investment is substantial, often paying off within 12 months. Even minor changes in slotting can lead to significant financial gains, making dynamic slotting a strategic, cost-effective investment for long-term operational efficiency and performance optimization in warehouses.

Moving from traditional to more intelligent, dynamic slotting strategies is a prime example of how modern distribution centers can evolve to meet the demands of today's fast-paced market. By adopting agile, next-generation approaches to slotting, DCs can optimize not just for efficiency, but for continuous adaptability. This shift enables businesses to respond in real-time to changing demands, reducing travel time, improving ergonomics, and ensuring capacity constraints are managed effectively. As DCs transition from static processes to more dynamic, data-driven strategies, they unlock new levels of operational performance, positioning distribution as a true competitive advantage.

WHICH FITS BEST?

COMPARING SLOTTING SOLUTIONS

Category	Traditional Slotting	Dynamic Slotting
Slotting analysis frequency	Periodic (e.g., quarterly or annually)	Continuous or real-time
Data used for decisions	Historical data only (e.g., last 30–90 days)	Real-time data + historical + predictive analytics
Response to demand fluctuations	Reactive (lag in adjusting to demand spikes/drops)	Proactive (adapts quickly as patterns shift)
Product movement consideration	Basic velocity grouping (A/B/C classification)	Holistic view: velocity + affinity + pick paths + constraints
Placement of new products	Manual or rules-based (e.g., “find the nearest empty slot”)	AI-driven: identifies optimal available slot based on similarity
Same product, multiple slots	Typically avoided due to tracking complexity	Embraced if it reduces travel or balances workload
Forecast incorporation	Rare or not used	Frequently used to anticipate seasonal or promo-driven shifts
Labor efficiency impact	Lower efficiency due to suboptimal walk paths	Higher efficiency via minimized travel time
System adaptability	Static (requires re-slotting projects to adjust)	Dynamic (adjusts on-the-fly based on live conditions)
Integration with other systems	Limited integration with execution systems	Fully integrated with WES/WMS/voice-directed systems
Slotting decision ownership	Dependent on human analysis/tribal knowledge	Data-driven recommendations with minimal manual effort

Lucas Systems helps companies create a dynamic warehouse, enabling distribution centers to compete more effectively under ever-changing market conditions. We harness the power of data with AI, Machine Learning, speech recognition, and optimization models to provide operational agility and improved distribution center performance. Unlike fixed or mechanical automation, Lucas delivers a flexible, software-based approach, that can adapt to future business needs cost effectively.



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