LIDD SUPPLY CHAIN CONSULTANTS

DISTRIBUTION CENTRE OPTIMIZATION

Understanding the True Capacity of your Distribution Facility

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ABOUT LIDD

We help manufacturers and distributors build infrastructure that responds to consumer demand, protects capital and enables worldclass operations. From concept to deployment, LIDD provides services in facility design, software implementation, industrial real estate and demand chain strategy.

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INTRODUCTION

Capacity is one of the most fundamental concepts in distribution centre design, but what does it really mean? It's not as simple as quoting a number of pallet spaces or the total cubic volume in your building. How to define capacity, how to calculate it, how much excess should you have to operate and what to do when you don't have enough are all important issues to understand in running a distribution operation

Different stakeholders define capacity in diverse ways depending on why and how they view the facility:

- BUYERS look for empty space to fill with inventory and new listings
- DC MANAGERS look for flexibility to execute efficient operations
- OWNERS look to maximize the return on the distribution asset in which they invested through a lease or purchase

These stakeholders need a common approach to understanding DC capacity if they want to strike a balance between their competing needs, or at least agree on when it is time to address a capacity problem or plan for growth.

Reading this eBook puts you in a good position to answer the following questions:

- Have we reached the capacity of our distribution centre?
- How do we define our capacity needs?
- What is the roadmap to solve our capacity issues?

HAVE YOU REACHED THE MAXIMUM CAPACITY OF YOUR FACILITY?

THE THREE DIMENSIONS OF CAPACITY

The capacity of a distribution centre has three dimensions: **storage, throughput and pick facings.** A distribution centre reaches full capacity in each dimension independently, though limitations in one often affect the others.

We can define each dimension as follows:

1 STORAGE CAPACITY

The amount of physical inventory that can be stored within the distribution centre. This is a function of the total number of storage locations within the DC and the size of these locations. It is important to distinguish between the gross storage capacity and the operating capacity of a facility.

- Gross storage capacity represents the capacity if every location were full – a theoretical capacity that cannot be achieved in reality
- Operating storage capacity is the realistic capacity of the facility that accounts for operating constraints, such as the need to put away receipts into open locations, and physical constraints, such as the inability for product to perfectly fill any given location.



2 THROUGHPUT CAPACITY

The handling volume of the distribution centre, or how many orders, lines, cases and units a DC can receive or ship over a given period of time.

- : Typically, throughput capacity is limited by bottlenecks
- that arise from space and infrastructure limitations.
- These bottlenecks first appear during peak periods and
- then, as volumes increase, become chronic constraints.

3 PICK FACINGS CAPACITY

The number of pick locations that can be provided to support an operation's active SKU base. The number of pick facings is limited by the materials handling infrastructure that supports the pick line.

A well-engineered pick line provides locations sized to individual SKU requirements, balancing excessive travel during picking against frequent replenishments to restock locations. When the number of active SKUs increases, the size of locations on the pick line must be reduced to make room for new items. As the size of locations gets smaller, replenishment tasks and picker congestion increase, leading to lower operating productivity.

UNCOVERING OPERATING PENALTIES

While indicators of capacity shortages may be obvious (we do not have any space to put away pallets), others can be difficult to detect (the pick line is too short to place each SKU in its ideal slot size).

When a distribution centre operates beyond capacity, it pays both clear and hidden operating penalties.

By tracking capacity-related KPIs, you can identify these penalties and act rapidly to address them.



Here are some KPIs related to capacity:

Capacity Related KPI	Measurement	General Rule
SKU-to-slot-size assignments	Replenishment instances per week per SKU	Re-slot SKUs generating more than one replenishment task per day (fast movers) or per week (medium/slow movers)
Storage capacity utilization	Pallets on hand vs. pallet positions Cubic feet on hand vs. net cubic feet capacity	Keep 15% open reserve pallet spaces to facilitate putaway and replenishment (the amount is a function of inventory turns)
Pick Slot utilization	SKUs vs. pick slots	Keep 10% open pick slots to easily introduce new SKUs or provide a buffer during peak periods
Dock-to-stock time	Delay between receipt and putaway times	Reduce over time
Damages & mispicks	Rate as a percentage of units picked	Minimize over time
Throughput productivity	Units per hour, using the handling unit as the proper unit of measure	Improve over time



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Any KPI trending in the wrong direction indicates a capacity problem. Before hunting for a bigger, taller building, you may be able to resolve capacity limits by improving space configuration within your existing DC. If you find your KPIs declining, identify and explain the capacity elements hurting your ability to operate efficiently.

Here are some potential reasons you might be having trouble with capacity in your DC:

Symptom	Potential Capacity Issue	
Increasing number of replenishment tasks per SKU	SKUs are assigned to pick slots that are too smallPick line is too short	
Less than ideal open reserve slots	 Incorrectly profiled reserve locations Fotprint is too small or clear stacking height is too low 	
Less than ideal open pick slots	SKUs are assigned to pick slots that are too largePick line is too short	
Increasing dock-to-stock time	Insufficient dock spaceNot enough open reserve locationsCongested aisles	
Increasing damages and mispicks	 Unergonomic pick slots Deficient slotting and sequencing SKUs crammed in slots too small Similar SKUs slotted next to each other Warehouse management system, or lack thereof, not set up properly 	
Production levels stall, even with additional labour	Poorly distributed workload across zonesCongested aisles	
Decreasing productivity	• All of the above!	

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So your KPIs point to a capacity problem. Before finding a solution, determine your current and future needs.

CREATE A BASELINE

A distribution centre is a dynamic environment with volume peaks and an ever-changing SKU base. Nonetheless, for design purposes it is necessary to frame a baseline which represents your operation – a description of the characteristics of an average week during a peak period of activity. Taking an average during a peak period ensures that capacity calculations cover most weeks throughout the year without oversizing for the peak week. The baseline should describe the active SKU base, quantities shipped and average inventory levels.

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PLAN FOR GROWTH

To plan a facility for the future, you must estimate how the operation will change in the future. Consider what changes might come in the following growth parameters:

- Sales an increase in sales affects throughput and the pick line
- > Variety an increase in variety affects the pick line
- > **Inventory** an increase or decrease in inventory turns affects storage

In sizing a DC, the target is to get about five years out of the upgraded infrastructure once all changes are in place. This means looking six to seven years down the road when beginning to define your needs. The objective is to balance the elapsed time between large scale projects – not so short that the workforce feels it is constantly in the middle of significant changes – and the capital investment – not so large that you are unable to achieve the expected return on that investment.

So, consult your crystal ball – or those in charge of defining sales projections, depending on your style – and apply these expected changes to your original baseline. **Capacity requirements must be calculated based on the forecasted future state.**



SIZE THE PICK LINE

Many operations grapple with SKU proliferation while working to lower inventory levels. The result is that pick lines – the size and arrangement of locations to pick from – have become more important in determining warehouse space requirements, often more so than storage needs.

There are three fundamental aspects to sizing a pick line:

1

Each item requires a dedicated slot along the pick line sized to balance keeping the pick line as short as possible while avoiding excessive replenishment activity.

2

A picking and order assembly strategy that minimizes labour and completes the order within the time frame set by customer service.

3

The sequencing of product such that the distribution centre delivers assembled orders in a stable, product-sensitive way (e.g., no crushables on the bottom of a pallet)

The objective is to assign a type of material handling equipment and a slot size to every single SKU, considering an item's velocity, inventory profile and dimensions. Combining these SKU-level needs determines the length and configuration of the pick line(s).

Strong analytical capabilities, as opposed to gut feelings, provides the best support for selecting appropriate equipment, whether conventional, mechanized or automated.

Read more about engineering a pick line in LIDD's eBook <u>A Guide to</u> <u>Distribution Center Slotting.</u>



SIZE THE STORAGE

It is impossible to use 100% of the gross storage capacity of a distribution centre unless that distribution centre receives and ships nothing (see page 17). The art and science of determining your true storage requirements come from properly matching the inventory you have to appropriate storage types.

For example, installing 5-deep pushback racking may result in a terrific gross storage capacity, but if the inventory profile consists of 10,000 SKUs with 1-2 pallets on hand of each, then you will never use more than 50% of that capacity

Defining storage requirements is a simple exercise:

- > Calculate the operating capacity provided by the equipment supporting the pick line (see page 17).
- > Compare your projected inventory to the calculated net capacity. Does it fit? If so, proceed to the next step!
- Otherwise, if the pick line does not provide sufficient storage capacity, add storage equipment to meet the need.

Whether you need to add single deep or double deep racking, drive-in racks or bulk space depends on the profile of the excess inventory that does not fit in the pick line.



SIZE THE DOCK

When a distribution centre works beyond capacity it loses its working space. For example, inbound and outbound pallets begin to clog operating aisles, slowing movement through the DC to a crawl and making it difficult, if not impossible, to access product in the racking.

For a distribution centre to function, it needs some empty, working space. That space allows the DC to receive, stage and move product within the storage area, pick product and pack and stage outbound orders. These functions require equipment that has minimum operating widths and turning radii. The equipment needs adequate space to meet expected productivity rates.

Congestion is corrosive to DC productivity. Gridlock is the distribution centre's death knell. To avoid it, you must provide sufficient space to complete the number of hourly tasks by function – across all functions.

Regarding dock space, while different operations have different needs, following these guidelines is a good start:



- You should be able to unload and stage your largest inbound load without spilling over to adjacent doors.
- > The space between each staged pallet should be sufficient so that receivers can access all sides.
- Allow room for a two-way travel aisle between dock staging and storage racks.
- Incorporate more space if specific requirements warrant it (e.g. reverse line picking)





Sample Dock Space Design

Some argue, with valid reasons, that these guidelines result in too much dock space, and that working on streamlining processes enables you to function within a smaller dock. But a million square feet of storage space does not count for much if the dock is constantly congested. **The dock is and always will be the heart of the distribution centre; don't undersize it.**

Comparing your combined capacity needs in the future to your current infrastructure guides the next steps of drafting potential solutions, both short- and long-term

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Capacity expressed in cubic volume is the most accurate representation of what a facility can store.

INOPERABLE GROSS CAPACITY

- All loaded pallet heights are a perfect match with the maximum slot opening heights. It includes a 4" gap between top of product and the load beam above.
 - Every pallet position holds a pallet.



Figure 1. Two-level pick rack with gross capacity 100% utilized.

This state does not exist in a working distribution centre. Holding a variety of SKUs inevitably means that there are multiple pallet heights.

Load beams should be installed to create openings that are a good match with pallet heights but creating too many differing "custom" slot heights reduces flexibility.

A large warehouse with well arranged rack elevations may only have six different pallet rack profiles to a handle all the different loaded pallet heights.

CALCULATING OPERATING (NET) CAPACITY

AVERAGE PALLET LOAD HEIGHT AFTER LOAD UTILIZATION FACTOR (85%) IS APPLIED

OPEN POSITION AFTER RESERVE SLOT UTILIZATION FACTOR (85%) IS APPLIED

PICK SLOT PALLETS START OFF FULL AND ARE ALMOST EMPTY. ON AVERAGE OVER TIME, EACH SLOT IS 50% FULL.



Figure 2. Two-level pick rack with operating (net) capacity 100% utilized.

1. Calculate the gross capacity for every slot: length * width * height of area which can hold product.

2. To account for variety in pallet heights, apply an 85% utilization factor to the capacity of the tallest loaded pallet that can be stored in each slot. This factor also covers loss in volume due to any spaces between stacked cases that might occur.

3. Apply the second 85% factor to allow for open reserve slots. To handle product there must always be open slots in pallet rack reserve positions. Experience tells us that 15% open slots works well. Fewer open slots begins to negatively affect productivity.

4. For pick positions, apply a 50% utilization factor. These pick slots go from full to empty. On average over time they are half full.



THE ROADMAP TO SOLVING CAPACITY ISSUES

IT'S IMPORTANT TO UNDERSTAND AND MEASURE CURRENT AND FUTURE CAPACITY BEFORE DETERMINING HOW TO INCREASE CAPACITY.

Changes to equipment, processes and inventory management strategies can boost capacity in an existing facility. But if those improvements are not enough, a facility expansion or move to a new building may be necessary.





RESET, EXPAND, MOVE: WHAT IS YOUR INFRASTRUCTURE STRATEGY?

The gap between your current and future capacity needs and your facility's size and configuration dictates when significant changes must take place.

If capacity issues do not threaten your ability to operate properly in the foreseeable future, direct your planning efforts to reset existing space. The goal is to match the layout, equipment and systems you have with the requirements for each dimension of capacity.

However, if your facility is already bursting at the seams, and projected growth will only make matters worse, an expansion or move should be your main focus.



Moving your distribution operation to a new facility? Learn more about negotiating your new lease from a position of power in <u>LIDD's eBook Should I Stay or</u> <u>Should I Go?</u>



Each approach brings a set of specific challenges:

REENGINEERING EXISTING SPACE

> How will you operate while implementing changes, since resetting existing space implies temporarily "losing" capacity?

EXPANDING THE FACILITY

While expanding offers the luxury of creating a larger footprint to occupy, the final design shouldn't be just an "add-on." Rather, the configuration and resulting flows of the final state must create a single, unified operation – something easier said than done.

MOVING TO A NEW BUILDING

If you can't perform a hard cutover (i.e, transition over a single weekend), you may have to operate two sites for a period of time. This creates labour issues and complicates the I.T. strategy.

One challenge holds true regardless of the approach that suits your situation: **you need to involve the right stakeholders to reap the benefits of augmented capacity.**



GATHER ALL STAKEHOLDERS

Numerous parties play a role in the planning and execution phases of a major operational change. It might be tempting to delay some stakeholders' involvement until later in order to streamline the planning process. But this creates the risk of having to revise midway if a legitimate omission (say, not enough charging stations) or a design flaw (the column spacing does not permit the minimum required aisle width) is uncovered during the approval stage.

Every stakeholder has expertise and valuable experience which must be incorporated in the design of the solution. Gather all internal and external resources at the beginning of the project, present the strategy and ask everyone to highlight where and how it affects elements under their area of responsibility.

A common error in planning, for example, is to assume that the Warehouse Management System "simply" adapts to new processes. But that is often not so easy. Such a mistake can bring a project to a halt until a solution is found – do we change the layout and processes, or do we spend time and money on I.T. development?

As an operations leader, you define the needs, drive the solution and lead the initiative, but stakeholders outside Operations are crucial to the planning of a capacity improvement strategy. Get their perspective early to solidify yours. Once all parties have had their say, it's time to get to the drawing board.



KEY STAKEHOLDERS OUTSIDE OPERATIONS

	Internal		External	
	I.T.		Architect	
> > >	Participate in creating the transition plan Consider possible improvements that could be made at the same time Run test scenarios	>	Determine impact on structural/electrical/ mechanical elements	
	Purchasing		MHE Suppliers	
>	Communicate pallet configuration changes to vendors Understand potential future changes in volume or variety	>	Validate equipment specifications Propose alternatives	
	Executives/Finance		General Contractor	
>	Buy in for investment and risk	>	 Assess feasibility of proposed changes 	
	Marketing/HR			
>	Potentially uses storage space for marketing items (promotional items, brochures, samples) or internal HR materials			

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DESIGN SOLUTION ALTERNATIVES

With capacity needs precisely defined, input from stakeholders and a clear canvas in which you can work, you have all the elements to develop a solution.

Doing so involves not only changes to equipment and layout but potentially modifying operating methods and adapting software functionality.

Whether or not you should introduce new kinds of material handling equipment and/or modify how you work is a function of various factors including:

- > How the business has evolved since the last major reset
- > Changes in order profiles (e.g. introduction of e-commerce activities)
- Available space to reset or expand and the necessity to increase the density of storage and work areas
- > The need to increase throughput
- > The implementation of new software (or functions) enabling improved processes

As you elaborate layout alternatives that support capacity requirements, don't forget to account for elements that do not relate directly to inventory and orders, such as:

- > Battery charging for mobile equipment
- > Storage of packing supplies or other internal supplies
- > Lockers and cafeteria
- > Offices for operations personnel
- > Parking (for trucks in the yard and for employees)
- > Any other ancillary services



Regardless of your immediate strategy, always consider how subsequent phases of expansion may unfold as you lay out your ideal solution. A good example taken from the food industry is building a new cooler with floors strong enough to become a freezer; the initial investment might be larger, but it provides great flexibility in an industry with rapidly evolving customer trends.

To evaluate the range of options, create a scoring matrix to weigh the pros and cons of feasible solutions on the following criteria:

- > Ability to support projected capacity needs
- Investment required (capital investment and operating expenses)
- > Flexibility towards changing business conditions
- > Ease of transition

With the winning solution in hand, you must create a detailed transition plan so that stakeholders can orchestrate their work and plan for required resources. Set a realistic, but aggressive goal to go live and accept schedule changes only when events happen that are out of your control.

FINAL THOUGHTS

Capacity problems in a distribution centre can be crippling for a business. Recognize their existence and determine what causes them.

Then, to tackle the problems you must:

1. Calculate your needs in all three dimensions of capacity (storage, throughput and pick line)

Issues in any of these dimensions hurt your operation, and it's important to understand them individually.

Calculating your needs precisely requires complete, valid data and strong analytical capabilities to ensure that design decisions are made on facts, not gut feelings.

2. Forecast your future needs based on your current volumes and projected changes to your business

FINAL THOUGHTS

3. Elaborate and evaluate solutions to solve capacity problems

- Deciding which strategy to employ should be based on how much your needs differ from your current capacity and your planning time horizon.
- Having all stakeholders around the table from the start ensures that you obtain a complete and coherent perspective. Your team can lay out a detailed plan, minimize the risk of surprises and develop a solid solution with a streamlined approval process.

The course of assessing and planning how to solve capacity issues is just the beginning. An implementation is never easy, but with a well-thought-out design and robust transition plan, you can manage it properly.



Please share this with your team as well as with all the players in your value chain and join in the discussions on <u>our blog</u> and <u>LinkedIn page</u>.



We'd like to hear your opinions and learn from one another's experiences. After all, in a world filled with noise, the only way we can win is to cut through the clutter and invest time and effort in making real connections.

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Learn how to build world class supply chain operations.

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