Back to Basics
Part 3: Slotting

This article is part 3 of a 12 part series where we focus on warehouse fundamentals that are critical to success. In any sport, hobby, or skill, a mastery of fundamentals means better performance. And we think warehouses are no different. Read on to learn more, touch up on the basics, or compare your operations to the best practices we'll highlight in each article of the series.

We continue our Back to Basics series with a focus on slotting. Slotting is the process of assigning a SKU to the most appropriate pick location.

In today's economic environment, companies often look for low cost and immediate ways to reduce operating expenses. The largest operating expense is typically labor, and picking usually ranks as the most labor intensive function. Picking productivity can often be improved with minimal expense.

Picking productivity is greatly influenced by the travel or walk time a person uses to go to each different item's location on an order. The bane of picking productivity is travel time. When items are improperly located, picking travel time increases and productivity decreases.

An item can have an inappropriate location due to improper location size or position. Picking productivity can be improved by determining optimal slotting locations.

SKU Profiling

There are several factors to consider when determining the optimal slot for an item. Factors include pick velocity, pick cubic volume and item relationships. In addition, the availability of item detailed order history, item dimensions and reliable forecasts can improve analysis results.

To begin the process, obtain a detailed order analysis. A longer timeframe will yield stronger analysis results. However, it is important to note that longer timeframes can result in cumbersome data volume.

Separate each order line item into its full case and split case quantity, then sum at the SKU level for the entire data timeframe: loose piece quantity, loose piece lines, full case quantity and full case lines.

Loose Piece Slotting

The maximum stocking quantity will usually dictate the slotting algorithm for loose piece slotting. The maximum stocking quantity is the greatest amount of an item to be located in a loose piece location at one time. This is typically the minimum quantity at the location (which triggers replenishment), plus the amount of the item moved from reserve or receiving to restock that location, rounded up to the next full case.

To determine your replenishment cubic volume, analyze two weeks of picking activity. For example, if a SKU XYZ had 16 loose units of orders over the last month, its two week average sales would be 8 units. If that item came in a case pack of 10 units, the location it would be assigned to would hold the cubic volume of 10 units.

Ideally, the volume used for the case would be an actual case volume. If that information is not available, use item level dimensional information to estimate the case's cubic volume. When estimating case volume by using unit dimensions, it is beneficial to add some safety factor to cover for carton packaging inefficiencies. For example, if the case volume for SKU XYZ from above had a unit volume of 12 in^3, an estimated case volume might be 132 in^3 (12 in^3 / unit x 10 units x 10% safety factor).

If item level information is unavailable or unreliable, the best course of action is to institute a dimensioning project to capture length, width, height and weight in unit and case quantities for each SKU. In some instances, it may be beneficial to group products and measure representative items. Then, take the representative dimensions and apply them to the whole family of similar SKUs.

Once the maximum cubic volume required for each SKU is determined based on replenishment quantity and associated trigger quantity, it can be assigned to an appropriate location type. The location type is based on the location types available or a set of location types appropriate to the cubic volume being picked.

Examine the pick lines associated with the item, as they may dictate the use of a location type different from one assigned based solely on cube. For example, there may be a small item where the cubic volume being picked is relatively small. However, the number of times the item is picked may dictate that the item be assigned to a location type typically used for larger cube items (faster moving cubic volume).

Table 1 represents a starting point for location types to be considered based on the combination of these characteristics:

	Line Velocity		
Cubic Volume	High	Med	Low
High ($>=10,000$ in^3)	A-Frame ASRS / OSR Pallet	Carton Flow Rack	Shelving Widespan
Med ($>=2,000$ in^3 and $<10,000$ in^3)	A-Frame ASRS / OSR Carton Flow Rack	Carousel	Shelving Widespan
Low ($< 2,000$ in^3)	ASRS / OSR Carton Flow Rack	Carousel Shelving	Shelving

Table 1

Once an item is assigned to a location type, requirements by location type can be summarized.

Full case slotting logic is similar to loose piece.

Move to Proper Locations

To move, determine if there is a sufficient amount of locations for each location type. Without a sufficient quantity of a specific location type, there are two possible courses of action.

One option is to construct the new locations. This plan of attack should only be undertaken after a thorough examination of seasonal and projected SKU growth factors, in order to ensure that locations are not constantly being constructed or reconfigured. Beware of the potential data volume issues associated with lengthy timeframes.

The other option is to assign an item to a location that is appropriate for either a faster or slower moving product. This option has inherent associated inefficiencies.

Once each SKU has been assigned to its optimal location type, the suggested location type can be compared to the item's present location type. The items with the greatest differential between current and optimal location types will yield the most improved picking productivity.

Finally, make the appropriate moves. To begin, determine the rate at which a location-to-location move can take place in order to allow for planning of the moves.

Often times, the lack of available empty locations to move into can present a major challenge. In some cases, product must be moved into temporary locations to allow for the slotting moves to begin.

Start with a manageable amount of SKUs and locations. After making the moves, monitor the effect the reslotting effort has on each area's productivity rate to determine the schedule and extent of the slotting project. It will also help to validate the original data assumptions.

Advanced Slotting

After an initial timeframe, it may be beneficial to examine advanced slotting techniques. These techniques are extensions of the original analysis, to be done after the standard analysis is complete.

Work load balancing is an advanced slotting technique typically performed first. If there are very fast movers, it may be necessary to consider this technique at the very beginning of the process. The overall concept is to spread out the pick effort within a specific location type to avoid contention during the pick process.

One method to implement this is to rank the SKUs for a given location. The fastest SKU is assigned to the best location. The next fastest SKU is assigned to a similar location, but separated by some fixed distance within location type. These steps are repeated until all the SKUs are assigned for that location type.

The second technique, **golden zone assignment**, is often complementary to work load balancing. For example, if assigning SKUs to a five level flow rack set of locations, the middle level is considered the best of the five levels. Typically, the fourth level is then considered the next best. Whether alone or in combination with work load balancing, the process is to assign the first X number of SKUs to the X number of locations on the middle level. The next Y SKUs are assigned to the Y number of locations in level four. This technique reduces the amount of reaches to harder to pick locations. Golden zone assignment can also be used to assign heavier items, regardless of cubic movement to locations that are ergonomically better for the picker.

The figure below illustrates an example of how **work load balancing and golden zone assignment might be accomplished at the same time**. The example is for 250 items which are being assigned to two aisles of carton flow rack. The first item is assigned to the best location in aisle one. The second item is assigned to the best spot in aisle two. The third item is not assigned to the second best location in aisle one (the one next to the location for item one), it is assigned to a similar location downstream. In this example it is only one bay of carton flow rack downstream but in practice it would likely be further downstream. The first 100 items are assigned in this manner to the best 100 locations denoted in blue. The next 100 are assigned to the

next best 100 locations denoted in green. The remaining items are assigned to the least desirable 50 locations. This strategy balances the work between the two aisles and within each bay of carton flow rack.

The third technique is **SKU group slotting**. In many instances, specific SKUs pick together on an order. For example, consider a cell phone model typically ordered with a specific set of accessories. In this case, the complimentary SKUs might pick at a different cubic volume or line rate. This situation can present several possible courses of action.

One option is to utilize the base SKU's location type to hold the slower moving complementary SKU. There is a gain in the speed of completing an order, but there may be a loss of productivity in space or cube utilization.

Another option is to configure a different location type. This option presents a compromise between the speed of order completion, cube utilization and space utilization. For example, utilizing carton flow rack and shelving locations in close proximity will often result in a footprint larger than the result of all shelving in one grouping and all the carton flow rack in another. There may be combinations of these two options that may prove to be viable options.

A fourth technique is **mirrored locations**. In the simplest form, it is using multiple locations of the same type for a single SKU. In a more complex form, it is using duplicate "setups" for a set of SKUs. For example, in the publishing industry, a "new release" is a first time distribution of a specific set of new SKUs. For the initial shipments of these SKUs, several separate but identically stocked sets of locations are employed. This technique is used to spread out the workload for high volume SKUs while still maintaining a relatively small footprint for the locations utilized.

Important Considerations

There are two high level considerations to make prior to embarking on a slotting project.

The first is to determine whether to use internal resources or external consultants for the analysis. Previous experience and a thorough understanding of concepts are critical to the success of a slotting project. If utilizing external consultants, be certain that their process is thoroughly understood by the management team. Also confirm that the tools the consultants use are accessible after the initial analysis.

The second is to determine what tool will be used to complete the analysis. Options include:

- **Spreadsheets** -Analyses can be accomplished in spreadsheets, but this option must be considered based on the number of locations or SKUs. Spreadsheets may be a less effective option if there are too many locations or SKUs, or if the level of advanced slotting techniques is highly complex.
- **Database tools** – Database tools can tailor analyses to specific needs very explicitly and handle large volumes of data more readily than spreadsheets. However, the management of the moves and the justification of the moves will need to be manually completed.
- **3rd party stand alone tools** – Impressive advances in 3rd party stand alone tools have been made over the past several years. These programs are able to handle very large and complex scenarios, offer economic analysis for projected savings, generate move sheets, and provide three dimensional graphical views.
- **Integrated WMS tools** – Many WMS systems include slotting tools that provide the ability to easily access SKU and order data, along with the ability to generate RF-directed moves. WMS implementation must be carefully managed due to cost, complexity and integration with key production systems.

A slotting project can improve productivity dramatically, particularly if slotting has not been a focus in the past. While the "science" of slotting has been discussed here, some of the real gains can be made by practicing the "art" of slotting. Truly outstanding slotting results are achieved by those who continuously practice and tweak the craft.