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Warehouse capacity explained

Just about anyone who has responsible for the daily operations of a warehouse has either already experienced this situation (probably many times over) or likely will at some time in the future. You're struggling with a lack of warehouse space and your cries for help are pretty much ignored by those with the power to do something about it.

And here's why. They (upper management, the owner(s), alien life forms, the usual "they" suspects) simply don't believe you. They've heard these complaints before and yet somehow you (or someone else in your shoes) managed to still get the job done. In addition, they may have occasionally walked down into the warehouse and observed empty space, maybe some partially empty shelves or completely empty pallet locations. "Plenty of space here, I don't know what the hell [INSERT YOUR NAME] is whining about".

So either you are way too needy, or they don't understand warehouse capacity. While I won't completely dismiss the former, I think the latter is the more likely problem here. The problem is they are looking at "theoretical capacity" and you are dealing with "working capacity" (also called "effective capacity", "practical capacity", "rated capacity").

Theoretical Storage Capacity, Utilization, and Working Capacity.

Theoretical capacity is easy to explain. It's the actual physical capacity of the space dedicated for storage. So if you have a simple warehouse setup with 1,000 pallet locations all designed for 40" x 48" x 72" pallets, your theoretical capacity would be 1,000 full pallets or 80,000 cubic feet (80 cubic Ft. per pallet times 1,000 pallets).

I call this theoretical capacity because, for a variety of reasons related to your specific inventory and storage characteristics, you cannot actually use all of this capacity. If you have a WMS and have all location cube and item cube information set up, you could run utilization reports that shows you how much of your theoretical capacity you are using. Assuming this is a case-pick operation, you may find that when you run a utilization report to prove to upper management how "full" you are, you find you are only at 70% utilization. And that's what brings us to working capacity. Depending on the characteristics of your inventory and storage configurations, 70% utilization may indeed be "Full" for you. Now before any of you rule-of-thumb fanatics start thinking 70% is some industry standard, it's not, it's just an example. One warehouse may be able to run at 90% or more while another starts struggling at 60%. Yeah, that's right, 60% utilization could be full for some operations.

As I mentioned before it has to do with inventory characteristics and storage configurations. Inventory characteristics include the number of items, the physical size of the items, how much you carry, and the characteristics of inbound and outbound orders. And all of this works within the characteristics of your storage configurations. For example, let's go back to the 1,000-pallet scenario, and say this is a full-pallet-in/full-pallet-out operation. If your warehouse was made up entirely of selective (single-deep) pallet rack and you had steady inbound and outbound volume, you should have no problem running at 90% or better utilization. However, if this same inventory was stored in floor-stacked bulk storage with pallets stacked 3 high in lanes ranging from 4 deep to 8 deep, you may struggle to maintain 60% utilization. That's because in the selective-rack scenario, whenever you remove a pallet from a location, that pallet location is available for another item. However, in the floor-stacked scenario—assuming you can't mix items or lots in storage lanes—you need to wait until that lane is completely emptied out before stocking something else in it. Now before you start thinking you should be converting your bulk floor stock to selective racked storage to get better space utilization, you need to realize that even at 60% utilization, the floor-stacked scenario may be able to store 1,000 pallets in less space (depending on other variables).

And if we went back to the selective-rack scenario and changed the operation from pallet-pick to case-pick, our cube working capacity would be reduced because we would have many locations with partial pallets in them. How much would it be reduced? Again, that depends on the characteristics of the operation. If you only had one item in that warehouse (unlikely, but this is just an example), the utilization reduction would be negligible, but if you had 1,000 items the utilization could bring you down back near that 60% level or even lower.

So now let's get back to explaining to management how even though the warehouse guys are whining about a lack of space, they still manage to get the job done. This is where "working capacity" gets a little fuzzy. When we go back to the previous scenarios that showed lower working capacities, there is a point at which you will not be able to put away inbound receipts without doing some level of consolidation or relocation of existing inventory. For example, in the floor-stocked pallet scenario you may have initially put a receipt in an 8-deep 3-high floor stocked pallet lane. As you use up that inventory, you could move the remaining inventory into smaller locations. The more you are willing to do this, the higher your utilization will be. If you're one of those folks that are fanatical about not doing any "non-value-added" activities, you probably don't want to do this at all, so you will need to accept that low utilization. Then again if your space costs are very high and your labor costs are very low, you may find that it makes sense to move that inventory from an 8-pallet deep lane to a 5-pallet deep lane, then to a 2-pallet deep lane, then maybe even eventually to selective pallet rack as the inventory depletes. That's a lot of work, but it will get you higher utilization. In selective racked storage, consolidation would include moving palletized product into smaller locations as inventory is depleted, and/or mixing multiple items or lots in the same location. And, of course, there is plenty of middle ground here where you do some level of consolidation, but don't go nuts with it.

It all comes down to getting the right balance of space utilization and productivity for your operation. The problem often encountered here lies with managers that have expectations of high space utilization but don't accept that it takes more labor and/or investment in equipment to achieve that. And that there is a very real point at which even with a lot of consolidation and relocation of product, the warehouse is full. And that point is still below the theoretical capacity.

Calculating working capacity?

So the big question here is can you calculate a "working capacity"? Well . . . yes . . . sort of . . . maybe. If you have the data (would need detailed cube data by item and location) and are willing to do the analysis you may be able to calculate things like the point at which you will need to start doing some level of consolidation, or to take it a step further try to calculate the amount of consolidation to get to higher levels of utilization. Depending on the complexity of your operation, this could range from not-too-bad to near impossible. Pallet-pick or case-pick operations have a better shot at this than piece-pick (especially small parts piece-pick), but you really don't know until you try.

Another way to try to calculate a "working capacity" is to just track inventory levels (in cubic ft.) over time and also track labor associated with consolidation activities. Under this scenario you would need to hold off on consolidation activities until it is absolutely necessary, then have the labor available to complete the consolidation activities before the lack of space starts to impact other processes. This can be a bit tricky and may not be practical for your operation (it's usually better to do plan consolidation during slow times). You will still need to figure out what level of consolidation makes sense for your operation, but this should get you going in the right direction.

Speaking of impacting other processes, it's important to realize what happens when you exceed your working capacity. When you get to the point where you end up with staged inventory blocking aisles, docks, staging areas, and production areas, you will find you start having all kinds of issues. When workers have to work around stuff, or move stuff to get at other stuff, or have to search through vast areas of staged inventory looking for product, you end up with lower productivity, increased risk of errors, increased risk of product and equipment damage, and safety issues. There are very real costs associated with running a warehouse beyond its capacity.

Calculating a working capacity and understanding the relationship between working capacity and theoretical capacity can prove very useful in planning staffing, storage contingencies, and new warehouses. As someone that prefers to be prepared, I would much rather know in advance that I'm going to be "Full" than just wait until it happens. Quantifying "full" is the first step in that process. Once that is done, you can use projected inbound and outbound volumes to identify problems.

So just to sum things up, theoretical capacity is the actual physical capacity of all storage locations in your facility. Working capacity is the point at which you decide your warehouse can still run effectively, but to go beyond this level you will start to have serious problems. This doesn’t mean everything is fine as long as you are below working capacity. Depending on where you set your working capacity, you may have to do some consolidation and relocation of inventory as you approach your capacity. But that’s a tradeoff you analyzed and determined was appropriate for your operation, and therefore staffed accordingly. Right?

Warehouse space utilization versus storage utilization.

I just want to add that in the article I focused on utilization of dedicated storage space. This would be the capacity of the actual storage slots. So for a pallet slot in selective pallet rack it would the the capacity of the space where I could actually put product. It would not include the clear space to the sides of the pallet, the flue space behind the pallet, or the empty space above the pallet or the space occupied by the rack structure itself.

There are other ways people calculate utilization. For example, you may want to determine the actual cube of your entire warehouse and compare your dedicated storage cube to that to see how you are utilizing your warehouse. For example, you may find you have 2,000,000 cubic feet of warehouse space, within that you have 500,000 cubic feet of space that is can fit product in it, and of that you have 375,000 cubic feet of product stored. So under this scenario your dedicated storage slots take up 25% of your overall warehouse cube, and your inventory takes up 75% of your dedicated storage slots, or about 19% of your overall warehouse cube. This may sound like an empty warehouse, but it could easily be full with these numbers. People like to use these types of numbers to benchmark warehouses, but there are so many variations on how you measure this that it can get very confusing. For example, I used the cubic feet of the dedicated storage slots themselves (excluding space between pallets, above pallets, rack, aisles, etc. Some may include the cube of the storage spaces including racking and space between and above pallets, but not the aisles, Others may also include the aisles in the storage areas, but not the main traffic aisles. Others may compare the cube of the actual storage slots to the cube of the warehouse space dedicated to storage only (this would the cube of the areas of the warehouse that have storage, but not the production/shipping/receiving areas).

So where our previous utilization calculation told us how much of our dedicated storage slots are being used, these calculations could tell you things like how much of your warehouse is actually dedicated to storage. Any of these numbers can be useful for a very specific purpose, you just need to make sure you are using the correct measurement for your purposes.