Sizing the Capacity Decision

> Finding out a warehouse breaches capacity in year 2 is not the end of the decision, it is the start of three more: how much room is actually needed, what kind of storage fills it cheapest, and whether expanding pays for itself. One chain, three engines, walked in order.

A capacity warning is not a single decision, it is the first link in a chain of them. Knowing a warehouse will run out of room is only useful once it leads somewhere: how much more room, filled with what kind of storage, and whether the investment to add it actually pays back faster than living with the constraint. Each of those is a separate engine, and each one only makes sense once the answer to the step before it is known.

Step one: does the warehouse actually breach, and when

A 500-location warehouse storing 40 units per location has 20,000 total capacity. At 15,000 units currently stored, that is 75% utilized today, comfortably under a common 85% practical ceiling (the point past which picking efficiency and put-away speed start to suffer, well before literal 100% is reached). Growing at 8% a year, that utilization crosses the 85% ceiling in year 2, not year 5 or year 10. That single number, the breach year, is what turns "we might need more space eventually" into "we need a real capacity decision within the next two years."

The practical ceiling matters as much as the growth rate here. A tighter ceiling (90% instead of 85%, treating the warehouse as usable almost to its literal limit) delays the breach by roughly two years in the same scenario, since there is more usable room before operations actually degrade. Getting the ceiling assumption right, not just the growth rate, changes how urgent the next step is.

Step two: once more capacity is needed, what fills it cheapest

A breach finding says how much more capacity is needed, not what kind of storage should supply it. Comparing two rack types on the same 500-location footprint: Rack A at 40 units per location, $100 per location, yields 20,000 units of capacity at $2.50 per unit stored. Rack B at 60 units per location, $200 per location, yields 30,000 units at $3.33 per unit stored. Rack A wins here on cost per unit stored, even though Rack B holds more per location, because the higher density comes at a cost premium that outpaces the density gain.

That is not a universal result. When the required capacity exceeds what the cheaper rack type can supply at all (only the denser option physically fits the need), the decision is no longer about cost

per unit, it becomes whichever rack actually clears the requirement. Density and cost per unit only trade off against each other within the range where both options are viable.

Step three: does expanding actually pay for itself

Knowing the cheaper rack type answers how to fill space that is already available. It does not answer whether to invest in more space in the first place. That is a full capital decision: a warehouse running near capacity, growing fast, facing an expansion that costs $800,000 for 50,000 additional units of capacity over a 10 year useful life, against a $15 per unit overflow cost if the space constraint is not resolved. Compared on equivalent annual cost, holding (absorbing the overflow cost as the constraint bites) costs $1,153,369 a year against $660,734 a year to expand, a $492,634 annual case in favor of expanding, with the capacity breach itself arriving in just 1 year under this growth rate.

That verdict is not automatic. The same expansion investment against ample existing capacity and slow growth (200,000 units of capacity, 3% growth) never even reaches the breach point within a normal planning horizon, and holding becomes the correct call instead, since there is no overflow cost to avoid in the first place.

Why the chain has to run in this order

Deciding on a rack type before confirming a breach is coming risks solving a problem that may not exist for years. Deciding on an expansion investment before knowing which rack type fills it cheapest risks sizing the capital case on the wrong cost-per-unit assumption. Each step narrows the question the next one has to answer, which is why running them out of order, or skipping straight to "should we expand," tends to produce a less defensible number than working through all three.

> **Key takeaway.** A capacity breach finding is the start of the decision chain, not the end of it. Confirm when the breach happens, then what kind of storage fills the gap cheapest, then whether the investment to add it actually pays back, in that order.

Assumptions

- A 500-location warehouse at 40 units per location, 15,000 units currently stored, growing at a stated annual rate, is used as the running example across all three steps.

Sources

- Equivalent annual cost (EAC) framing, standard capital-investment comparison method used across the platform's expand-vs-hold and repair-vs-replace decisions

Frequently asked questions

What if the warehouse never actually breaches within the planning horizon?

Then the rest of the chain is not urgent. Rack-type and expansion decisions are still worth understanding in principle, but there is no forcing function to act on them yet, and resources are better spent elsewhere until growth or a shorter horizon changes that.

Can the rack-type decision change the breach year found in step one?

Yes, indirectly. A denser rack type raises total capacity on the same footprint, which pushes the breach year further out even without adding square footage. That is often a cheaper first move than a full expansion, worth checking before committing to step three's bigger capital decision.

Why use equivalent annual cost instead of just comparing total costs?

Equivalent annual cost puts a large one-time expansion cost and an ongoing overflow cost on the same yearly basis, accounting for the expansion's useful life, so the comparison is fair even though the two options have completely different cash-flow timing. Comparing raw totals without that adjustment would unfairly penalize whichever option front-loads its cost.

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