Measuring and Improving the Effective Storage Capacity of Distribution Warehouses

by

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A quote that characterizes one of the successful American business principles of this century is:

> In order to improve the performance of any asset, it is essential to measure the productivity that asset produces.

Imagine where we would be if we had no measures to guide us in the following examples:

Work force:	Units per man hour
Airlines:	Passengers per seat-mile
Baseball pitchers:	Earned run average (ERA)
Baseball batters:	Ratio of hits to times at bat
Capital dollars:	% return on investment (ROI)
Farm land:	Bushels per acre
Warehouse space:	??????

If we want to improve the performance of warehouse space, we must first measure it. But what are the units of measure? Typical measurements of the performance of warehouse space have been many and varied:

Tons per 1000 sq. ft.:	Is this tons of canned goods or tons of fresh mushrooms?
Cases per sq. ft.:	Are these big or little cases?
$ inventory per sq. ft:	Is this $ of meat or $ produce?
% building cost to sales	

The unit of measurement recommended for warehouse space is:

Cubic Feet of Inventory per Square Foot of Storage Space

This is the storage density of the space:

$$\text{Storage density} = \frac{\text{Cubic feet of inventory capacity}}{\text{Square feet of storage space}}$$

Example:

Warehouse space	=	125,000 sq. ft.
Storage space	=	100,000 sq. ft.
Inventory capacity	=	375,000 cu. ft.

$$\text{Storage density} = \frac{375{,}000 \text{ cu. ft.}}{100{,}000 \text{ sq. ft.}}$$

$$= 3.75 \text{ cu.ft./sq.ft.}$$

Farmers have been making similar measurements on their "agricultural space" for over 100 years.

1890 corn yield (western Minnesota)
= 40 bushels/acres

1989 corn yield (western Minnesota)
= 150 bushels/acre

Does anyone believe that this agricultural progress would have occurred without measuring the performance of the major asset farmers own?

This same pursuit to improve the performance of food distribution warehouse space is gaining more and more interest. A logical starting point is to have a measurement that can be used for comparison, for tracking improvements, and for sifting through economic choices.

It has always been important to measure and improve the use of warehouse of space. A few leading firms have been doing it for years. But they are the exceptions.

The space itself can cost from 1 percent to 3 percent of the retail price of food, depending upon refrigeration requirements, geographical location, and, of course, the storage capacity. The long-term utility costs associated with square-footage have been determined by one leading wholesaler to be 1.5 times the building's cost over a 30-year period.

There are many economic opportunities for reducing this cost and the cost to food. The food distribution industry now averages approximately 4 cubic feet of product per square foot of warehouse storage space. This is in buildings that are typically 28 to 30 feet in clear stacking height. A few leading firms are achieving well over 6 cubic feet of product per square foot of space using conventional equipment. Many firms are still struggling to get over 3 cubic feet per square foot in these 30-foot buildings.

Our measurement of warehouse space is a bit more complicated than counting bushels of corn at harvest time, and dividing by the acreage that was planted. We must be concerned with not only stacking height, but also whether the storage area in the warehouse is used for the selection of merchandise for retail store orders, or for reserve bulk storage only. The measurement of storage capacity is easy to do, but subject to procedural rules to ensure uniformity.

Various techniques for storing product, whether selective pallet racking, drive-in racking, floor storage, etc., have differing characteristics that lead to a little or a lot of "honeycombing" or "lost cube." This has led our firm to develop our own set of factors so that we can down-rate the theoretical capacity of a storage system to what can practically be stored. A good example of this is a selective rack that can store pallets five high off the floor. If the first two pallet levels are used for order selection and the upper three levels are used for reserve storage, then I would down-rate the capacity of the racking with a factor of .69. In other words, if the racking can theoretically hold 1,000 pallets, in practice it should hold 690 when at capacity.

The bottom two levels from which order selection occurs, cannot possibly be more than 50 percent full (on average) as the pallets go from full to empty. Our experience indicates that 45 percent is more realistic. Similarly, the overhead storage in a working warehouse, cannot be rated at 100 percent. That is like asking two checker players to play with a full checker board. We also need some squares left open in the warehouse to operate.

As the capacity of warehouse space is measured, some economic decisions about that space get easier.

Assume:

Building cost	= $30 per sq. ft.
Existing storage space	= 60,000 sq. ft.
Existing storage density	= 4 cu.ft./sq.ft.
New building storage density	= 6 cu.ft./sq.ft.

and

We need 120,000 more cubit feet of storage.

Question: Should we reset the existing space to get the needed 120,000 cubit feet or add 20,000 square feet to the building.

It will cost $600,000 to add 20,000 square feet.
It will cost $100,000 to reset existing space.

Answer: The answer to reset the existing space is easy. But it would not have been so obvious if we did not know the storage densities and how they compare.

When you start measuring the productivity of any asset and begin the quest for improvement, new designs are developed. Some will last; others will fail. For example, there is a new storage technique that uses conventional forklifts in a -17 degrees fahrenheit freezer. This new racking system has the storage capacity of bulk type slots. It uses deep reach forklifts, but not the narrow aisles. Aisles are 12 feet wide. This is an operator's dream, and an owner's delight. A freezer, originally designed to be 35,000 square feet and having a storage density of 5.64 cubic feet per square foot, was redesigned to 19,000 square feet using this racking technique with no loss of storage capacity or selection slots. The extra cost for the racking was about $50,000 more than the 35,000 square foot freezer required. The capital cost for the freezer was $1.5 million less. I think this design will succeed.

If you are convinced that measuring storage density in food distribution warehouses is an important first step in reducing costs for storage, then you should be asking: What is the storage density of this new freezer? It is 10.5 cubit feet per square foot.

Maybe we in distribution can catch up with farmers. They have been measuring and comparing the productivity of their chief asset for over 100 years.