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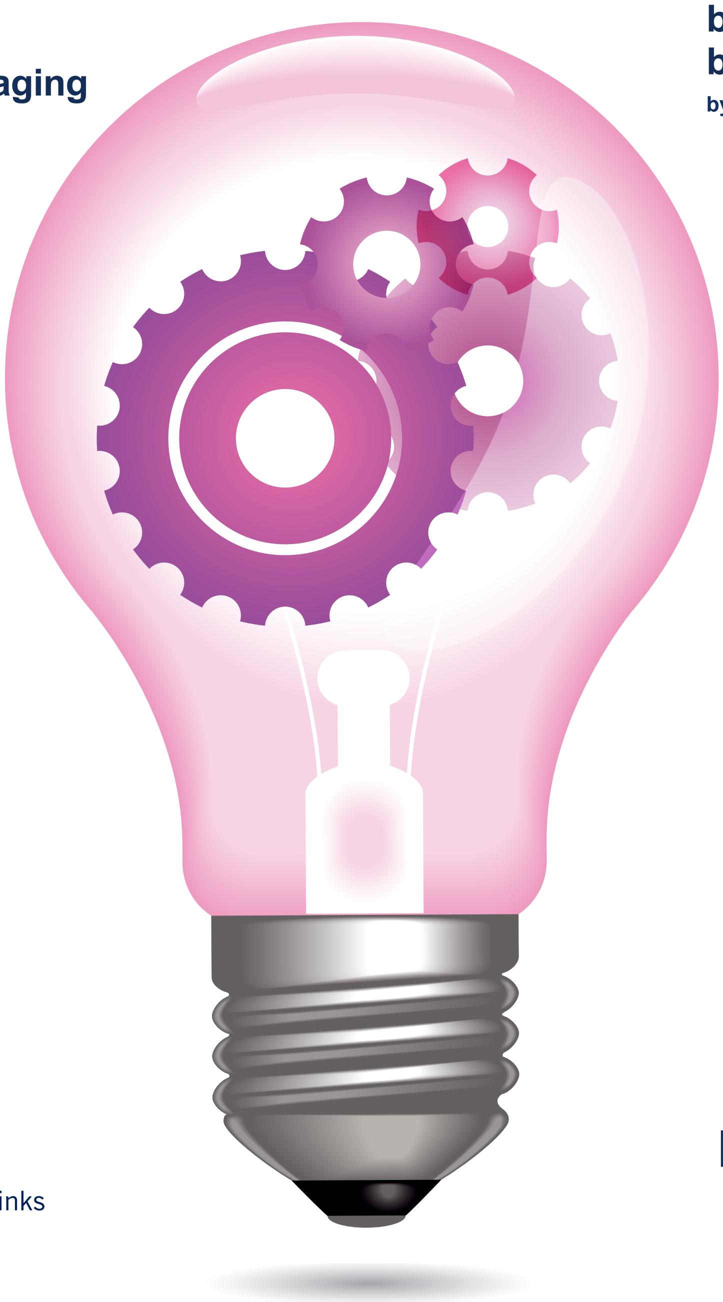

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Boosting revenues in the self-storage warehouse industry

by René de Koster

Self-storage is a booming industry, one that has seen remarkable growth in the United States and Europe, and across the rest of the world. While an obvious success story, new research shows that by taking a unique facility design approach, warehouse operators can do much to maximise their revenue potential.

There is good reason to be optimistic about the global self-storage warehouse business. In the United States, this type of warehousing generates some US$22 billion annually, with one in ten households renting self-storage space. Between 2007 and 2008, European countries reported an increase of between 19 and 117 per cent in self-storage warehouses. And in the rest of the world, this business is also growing rapidly.

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The self-storage business focuses on providing private individuals, households and small businesses with public, temporary storage at centrally located facilities. Importantly, with self-storage customers handle storage operations themselves and without the intervention of warehouse personnel.

A typical self-storage warehouse contains storage spaces of varying sizes and qualities. A customer rents a storage unit of an appropriate size for one or more months. Such a facility is of course ideal for university students, for instance, who need a temporary place to store their belongings during their summer break (when they are required to vacate their dormitories until the start of the next scholastic year).

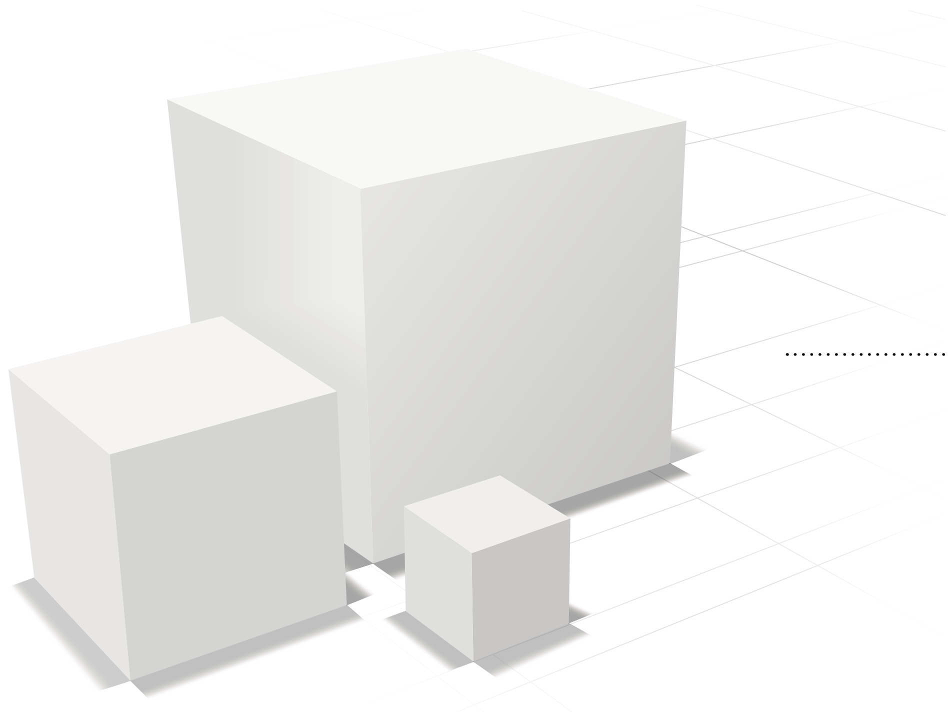
Designing for maximum revenue

With decades of management experiences in cost-control, this industry has been able to manage costs well. For example, large self-storage facilities in the USA only employ an average of 3.5 employees per facility, where traditionally in warehouses labour is the largest cost-component. However, there are good reasons for improvement.

For instance, the existing storage sizes or the number of storage units available per size may not fulfil the needs of the market: certain storage types may be scarce, while others plentiful. This results in either lost customers and revenue, or inefficient utilisation of capacity of one type, and the potential loss for another. In short, these self-storage operators should seriously consider taking steps to maximise expected revenue at a stable cost-level.

Now, the design of self-storage warehouses differs from other facility designs in its focus on revenue maximisation. An obvious question is therefore whether it is possible to design such a facility so that it offers a better fit between storage design (types and numbers) and market demand, and at the same time maximises the revenue based on limited and somewhat "perishable" capacity. If it is indeed possible, the next question is: how do you design self-storage facilities so that they fit market segments and accommodate volatile demand, and thus maximise revenue?

In seeking answers, there are two key issues to consider: customers who cannot be accommodated with a



storage-unit size of their choice can be either rejected or upgraded to a larger space; and demand forecasts (based on historical data) should trigger a space allocation and division into the necessary unit sizes that reflect this demand.

Change is just a snap

In general, warehouse facility design is a tactical decision: once a facility has been designed and built, it is difficult to adapt it to a changed environment. This is of course true of “traditional” warehouses. With self-storage, warehouse designs appear to be more flexible, thanks to the wide application of modular steel-base products, like modular corridors, standardised internal wall panels, standardised swing doors, and roller doors.

In particular, the internal panel has a special patented “snap together” interlocking seam rather than fixed jointing, which makes repartitioning of warehouse space easier. Most self-storage warehouses use a limited number of storage sizes (in the United States, usually eight types) and most sizes are an integer multiple of a standard size. It is usually possible to remove (or add) non-supporting walls, for example, to create one $9m^2$ room from a $3m^2$ and a $6m^2$ one. (Admittedly, there are some constraints: it is impossible to merge split rooms while they are still occupied; and adding a wall still requires that both newly created rooms have an access door). This space flexibility enables self-storage operators to adapt the layout of their facility to a changing demand at relatively short notice (like six months).

With no reservations

We started our study by formulating three different model sales policies where:

1. The warehouse company simply rejects customers (typically in a high-demand situation) if the requested space is not available. In this case, the company does not try to convince customers to upgrade to a larger, more expensive space.
2. The company does try to convince customers to upgrade, and extra spaces of the popular types (based on historical data) are reserved.
3. The company tries to convince customers to upgrade, but no extra spaces are reserved.

Thanks to 54 self-storage warehouses in Europe, Asia and the USA, we had access to historical business data (including demand, contract type, price, and storage-space configurations) to help us investigate our three sales policies to determine the best at maximising total revenues based on optimised space allocation and division. We did this by inputting this data into mathematical models to which we subsequently applied dynamic programming (a useful mathematical technique for creating a sequence of interrelated decisions) to determine the optimal combination of decisions.

Let me use an example to illustrate how we conducted our experiments. If we received a company’s data over, say, the last four years, we used the data over the first three to forecast demand in the fourth year, and to optimise space allocation and division accordingly. We then tested all three sales policies using the scenarios we created and subsequently compared the “simulated” results to the actual fourth-year ones.

Boosting revenues
in the self-storage warehouse industry (continued)

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Experiment results showed that a new space-allocation design could indeed improve expected revenue of self-storage warehouses. Furthermore, small changes in load and upgrade-acceptance probabilities will not affect the overall design. Therefore, we recommend that self-storage warehouses review and adapt storage-space distribution as frequently as possible in order to benefit from changing demand rates. Considering how easy it is to redesign the storage space of a self-storage warehouse, there is no reason not to do it.

In addition, we discovered that the "upgrade without prior reservation" policy yields larger revenues than the one with prior reservation, although the differences in revenue are slight. However, a prior-reservation policy may slightly outperform the no reservation policy for low demand and occupancy times that increase with unit size. In both cases, the difference in revenue decreases with increased load. Hence, selecting the prior-reservation policy may be justified due to its simplicity and near-optimal revenue.

However, because there are so many factors (some unknown) to consider, the best course of action may not always be that obvious. For example, a warehouse we investigated is in Chicago, close to the central business district and a university. Surprisingly (or perhaps not), this warehouse did not allocate and divide its storage space according to the needs of its two main customers with contrasting storage demands: small for students, and large for small businesses. By optimising space allocation based on customer demand and applying the rejection sales policy (policy number 1) our experiment achieved a revenue increase of 14.7 per cent.

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Wider applications

Notably, this study is one of the first to apply capacity and revenue management to facility design and management, taking into consideration market segmentation and uncertainty of data. In fact, our design approach can be applied to other fields as well, particularly to hotel design and management (in deciding which room types to build), parking-lot businesses (a parking lot layout has features similar to the layout of a self-storage warehouse), or to restaurant revenue management (to determine the optimal table mix). Equally interesting is applying it to construction equipment leasing. This is a huge market, since most civil construction engineering companies tend to rent such equipment as bulldozers, shovels, and cranes. Here our algorithms can help these leasing companies to determine the types and quantities of equipment they need to stock.■

This article is based on the paper *Increasing the revenue of self-storage warehouses by facility design*, written by Yeming (Yale) Gong, René B. M. de Koster, J.B.G. (Hans) Frenk, and Adriana F. Gabor, and published in *Production and Operations Management* Vol. 22, No 3, May-June 2013, pp. 555-570. DOI: 10.1111/j.1937-5956.2012.01380.x

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