

Selecting the right box size saves up to 17%

Due to the tight labor market and rising salaries, a growing number of warehouses are switching to automated packaging processes. However, decisions about how many packaging machines are claudius PRINSENLAAN 132A required and which box sizes they should be able to handle are 4818 CP BREDA often made without full consideration of the actual situation. THE NETHERLANDS Groenewout offers an innovative approach to packaging process optimization that enables companies to save as much as 17% on packaging, labor and shipping costs. Logistics consultants Étienne Teunissen and Mark van der Boor explain more.

In many warehouses, the order picking process starts with one or more box assembly machines preparing the boxes. They unfold and assemble the flat-packed boxes, and seal them at the bottom so that employees can start order picking without delay. But how many of these machines does a warehouse actually need, and which box sizes are required? "In practice, we often see warehouses opting for the largest possible box size, even though they might only need it once a year. As a result, the majority of orders are packed in boxes that are far too big," says Étienne Teunissen, logistics consultant and warehouse automation specialist at Groenewout. "Based on the cost of cardboard alone, it often turns out to be cheaper to choose a slightly smaller box size, and to manually assemble the occasional boxes that are needed for very large orders."

According to Teunissen, packaging machines are increasingly becoming part of warehouse automation concepts. "Packing is very labor-intensive, so automating this process soon pays for itself – but only if you know which orders can be best packed in which boxes, and how many machines need to be installed to handle everything. Companies often choose the most common box sizes based on historical data or typical order volumes. But that approach doesn't always result in the most optimal solution."

Complexity surrounding box choice and machine utilization

It is not easy to determine the optimal box sizes and number of packaging machines. "There are trillions of possible combinations of box sizes," says Groenewout's Mark van der Boor, who was responsible for developing the consultancy company's tool to calculate the optimum box sizes for its clients.

"Another thing that makes this so complex is the large number of options within the process itself," adds Teunissen. "The box assembly machine

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can often handle three different box sizes. The box closing machine looks at the depth of the contents and adjusts the height of the box accordingly. So what are the optimal dimensions for the base? And what height should the boxes have, knowing that they will be cut to size later? It can be tempting to go for the maximum possible height, but that can mean that the box closing machine cuts away a lot of cardboard that has already been paid for."

The packaging issue is especially topical now that the European Union is introducing a directive requiring transport packaging to have a maximum empty space ratio of 50%. "However, it's not always possible for companies to comply with this guideline. For example, if you try to pack an atlas and a globe in the same box, you will never achieve the maximum 50% empty space ratio," Van der Boor states.

"For one warehouse, we calculated that even 15 automatically assembled box formats and 70 manually assembled ones aren't enough to ensure you achieve that maximum 50% empty space ratio. But the results from our data analysis did enable us to offer the client realistic and achievable advice."

Together with Van der Boor, Teunissen has developed a tool in which one algorithm calculates the optimal box size for each order. A second algorithm then calculates the optimal box sizes for the entire packaging process, and whether the boxes can best be assembled automatically or manually. Using this optimization tool, logistics consultancy Groenewout helps companies to make practical and financially viable improvements based on thorough data analysis.

Data-driven approach

To optimize packaging processes, it's first necessary to analyze data on order patterns, product dimensions and costs (i.e. depreciation costs, maintenance costs, cardboard costs, shipping costs and any additional labor costs). This data forms the basis for arriving at the most efficient packaging solutions. "We consider around 4,000 different box formats," states Van der Boor. "The large number of possible combinations makes this a complex problem."



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"It's not just a matter of choosing the right boxes. It's also about the ratio between automated packaging and manual packaging, the seasonality of products, and operational peaks during busy periods," explains Teunissen. By considering all these aspects, companies can develop a packaging concept that not only saves costs, but is also flexible enough to cope with fluctuating order flows.

Teunissen: "For example, we think about whether or not the package will fit through the letterbox. And we know that product ranges can vary per season. Needless to say, we also take the empty space ratio into account, such as by imposing an imaginary fine if the box is less than 50% full. This results in an overview of the optimal box sizes, how many of those boxes are needed, and the required investment in machinery – including the total cost of ownership. This ultimately determines how the ideal packaging concept will look."

Warehouse peaks

The order flow is not the same every day, of course. Many warehouses are currently experiencing a peak. "Based on the order pattern, we know how many orders to expect on a particular day. This allows us to calculate how many boxes are needed on a peak day, and how much capacity the machines should have at peak times," Teunissen comments. "But it's not realistic to invest in a machine with a particular box size for a peak that only occurs once a year. In such cases, it makes more sense to pack some of those orders in a slightly bigger box or to employ extra staff to assemble boxes manually."

Order patterns and product ranges are changing constantly, so it can be a good idea to periodically review whether the right box sizes are still being used in the warehouse. "And if this means that the machines must be adapted, it's important to also take the alteration costs into account," adds Teunissen.

Up to 17% savings

Groenewout's approach has already resulted in significant cost savings and process improvements at several companies. The majority of the savings come from lower costs for cardboard and labor, but adjusting the packaging process also reduces the amount of empty space. "Some of the



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companies we've advised have already purchased packaging machines and just want to optimize their box sizes. At others, packaging is currently done manually but they are considering purchasing machines. The potential savings are between 14 and 17% of the total packaging costs," says Teunissen.

One such company is Omoda, a fashion retailer that is best known for shoes. Groenewout's advice led to 17% cost savings at Omoda's warehouse in the Dutch town of Zierikzee. "One of the most commonly used box formats was tailored to the size of the average shoe box. That might seem logical, but many Omoda customers don't only order a pair of shoes, but also a shoe spray – and that didn't fit inside the outer box, meaning that the entire order had to be shipped in a much larger box. We were able to save a lot of cardboard simply by using a slightly larger box size for shoe orders," states Teunissen.

Sustainability and carbon reduction

Besides achieving cost savings, a more efficient packaging process also contributes to sustainability. If the size of the outer box is better aligned with the dimensions of the order, it saves cardboard and also improves the load factor in transport. This results in lower CO₂ emissions, which is a very welcome development now that many companies have to comply with the Corporate Sustainability Reporting Directive (CSRD). "We are investigating how to calculate the precise amount of CO₂ emissions saved due to improving the empty space ratio. However, it's clear that it has a positive impact on both the financial performance and the sustainability performance of companies," concludes Van der Boor.

About the authors

<u>Mark van der Boor</u>



Mark has been working as a consultant at Groenewout since September 2021. Mark is specialized in (logistics) modeling, decision sciences (operations research), data analysis and programming/simulation. At Groenewout, he focuses mainly on data-driven supply chain and logistics optimization projects.



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Étienne Teunissen



Étienne joined Groenewout as a logistics consultant in November 2021. At Groenewout, Étienne deals with the mechanization of logistics centers on a daily basis. To support this, his projects range from warehouse design and supplier selection, to implementation and realization in the warehouse.