Roll Size Optimisation in Action

Roll Size	Usage
1640	4,1%
1750	6,2%
1850	4,4%
1950	4,5%
2050	10,5%
2200	15,0%
2350	23,8%
2500	31,4%
Trim %	Avrg Width
2,93%	2203

Creating a Basis of Comparison

In our example initially the Roll Size Optimisation is run with the eight roll sizes used in actual planning on a 2500 mm corrugator. The result shows 2,93% trim and an average roll size of 2203 mm.

This first result is usually better than the actual figures for the period and orders given because the simplified planning process differs slightly from actual planning under the restrictions and pressure of day-to-day business. However, it accurately reflects how the given orders fit on the given roll sizes. Improvements found using different roll sizes in subsequent runs are very likely to occur with the same magnitude in real-life planning, too.

Roll Size	Usage
1640	2,7%
1750	1,3%
1850	1,0%
1950	1,9%
2050	4,1%
2200	6,3%
2350	10,6%
2500	17,8%
2650	24,3%
2800	30,0%
Trim %	Avrg Width
2,54%	2483

Scenario 1: More Roll Sizes on a Wider Corrugator

The second run is done using two additional given roll sizes on a large 2800 mm corrugator.

The trim has improved by 0,4% to 2,54 %, the average width has increased to 2483 mm.

Roll Size	Usage
1640	3,7%
1800	2,2%
2050	4,9%
2350	13,0%
2580	21,9%
2690	18,5%
2740	18,5%
2800	17,3%
Trim %	Avrg Width
2,50%	2519

Scenario 2: Determining a Set of Ideal Roll Sizes on a Wide Corrugator

In the third run, the program was asked to propose the eight ideal roll sizes on the 2800 mm corrugator. With the same number of sizes as today, the new machine would yield 2,50% trim, and the average roll size would improve to 2519 mm.

Roll Size	Usage
1640	4,1%
1800	2,4%
2050	5,4%
2350	12,4%
2600	23,9%
2700	17,5%
2750	19,0%
2800	15,3%
Trim %	Avrg Width
2,57%	2514

Scenario 3: Adjusted Roll Sizes for Scenario 2

Now the uncommon 'ideal' sizes are replaced by more normal neighboring widths. The result has just a little more trim but is still much more efficient than the original roll sizes: The total trim is 2,57 %, the average roll size is down a little to 2514 mm.

Data Required by Roll Size Optimisation

Order Data:

- Order Number
- Customer Name (not mandatory, but nice to have)
- Due date
- Board grade
- Flute type
- Quantity to produce (finished goods)
- Number out in conversion
- Corrugator sheet width
- Corrugator sheet length
- No Trim Required (flag indicating orders that can be run on the corrugator without side trim)

Corrugator Data:

- Machine width
- Minimum roll size which can / should be used
- Minimum trim
- Minimum run length
- Overrun tolerance
- Cost per production hour
- Machine speed per flute

Treatment of Problematic Orders

During the first optimisation run, orders may be left out for various reasons (full machine size etc.) for which actual planning obviously had solutions. We eliminate those 'idiot' orders and repeat the first analysis without them to avoid having optimisation make efforts to find solutions where a known solution obviously exists.

During subsequent runs, again orders may be left out or be partially scheduled, in particular when small roll sizes are eliminated. Typically only a very small percentage of orders is concerned, and it can be safely assumed that a solution would be found for them in real life planning.

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Roll Size Optimisation

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The Experienced Scheduling System

New Service: Roll Size Optimisation

Neugebauer Rhapsody GmbH is starting a new service designed to help plant managers, production managers or technical directors to find answers they have long been looking for:

What if I reduce the number of roll sizes? What do I gain if I add a roll size?

Reducing the number of roll sizes sounds scary and tempting at the same time: Side trim will almost certainly go up, but by how much?

On the other hand, fewer roll sizes mean fewer changes, smoother production, higher productivity … and reduced paper stock cost.

Or, if your plant has trim figures that are way above industry average, you might ask yourself whether adding a roll size could help. How much trim reduction can you expect? How will production be split up between those new roll sizes?

What are the ideal roll sizes for my plant?

More radically, your approach could be to completely question what you have been doing in the past. Are the roll sizes we've always been using really suitable for our mix of orders?

What would we gain if we replaced most – or all – sizes by a new set that is optimally adapted to our orders, based on long term analysis?

For our new corrugator, should it be one of the new, wide models, or should we stick to the traditional 2450mm?

Clearly, a 2800 or 3000mm wide corrugator will boost productivity not just by the higher speed of a new machine, but also by increasing the average width and thus the effective area produced per lineal meter.

But will we be able to go from 3 shifts to 2 as result of the combined effect of higher speed and larger width? Or are our orders so adapted to the old paper sizes that the new possibilities will be beneficial only rarely?

How Does Roll Size Optimisation Work?

What we need from you is order data from several months of the past, and of course your current roll sizes. PC-Topp customers can take a shortcut: We can find all required data in your production statistics; all you need to tell us is the time period to look at.

We recommend a period of about three months, but are also able to work on a full year, or several sections of a year to allow for seasonal influences.

(For more details about the data required for our analysis see the section "Data Required by Roll Size Optimisation".)

Starting Point: Our Results Using Your Current Roll Sizes

We always start by running our algorithm on your orders using the current set of roll sizes. This gives us a reference to compare all future results with.

That result will almost certainly be different (and usually better) than what you actually find in your statistics: While we try to approach the scheduling process as realistically as possible, we will never be able to accurately simulate the situation your planner was in when he had to schedule those orders.

How Roll Size Optimisation Selects Orders to Schedule

When trying to schedule the orders of several months in retrospect, it is unknown which orders were available for scheduling when the planner planned them, and which paper sizes were available. Therefore, Roll Size Optimisation (RSO) can only try to simulate realistic conditions, and does this the following way:

First RSO assumes that the date given in the order is the date the order should run on the corrugator. Then, RSO creates a schedule for each date for which there are orders, by scheduling each grade of that date.

For a given grade, RSO first attempts to schedule exactly the orders of that day. If it can successfully plan them all, it continues with the next grade. If not, RSO will try again including of the next day; if it finds a complete result, that result is used; if not, RSO adds another day (up to 5 work days may be added).

If no complete solution can be found, then RSO will leave the problem orders (completely or partially) behind.

Our selection of orders will thus be different from his, and in addition we assume that all roll sizes are actually in stock which in reality is not always the case. (For further remarks refer to "Simplifications of the Roll Size Optimisation".)

But Roll Size Optimisation (RSO) results are based on realistic schedules for the given orders and roll sizes. The effect of a different set of roll sizes on trim and productivity seen in RSO's results will very likely occur in real life planning in a similar way.

The Optimisation Process

Next, we ask the software the questions *you* are asking. This can be done interactively, with you asking new questions after seeing the reaction to a change you made.

For example, you might want to find out what will happen if you change from your previous roll sizes to a new set of roll sizes, adding or removing roll sizes to see how this affects the result.

Or you can ask what the ideal roll sizes would be for your orders, if you were to use 3, 4 or any other number of sizes. (You can set the minimum desirable width. If the optimisation process yields odd roll sizes that may not be available on the market, a re-run with those sizes manually adjusted to the nearest 'normal' roll size is done.)

Or you could compare productivity and trim on a new wider machine, and find out what the best roll sizes would be under the new conditions.

Simplifications of the Roll Size Optimisation

Roll Size Optimisation must function in reasonable time, with data limited to what can reasonably be provided. This means that certain restrictions are disregarded:

- Orders are selected for optimisation schematically, but the actual orders available for planning at any given time are not known (see the section "How Roll Size Optimisation Selects Orders to Schedule").
- All roll sizes are supposed to be available; in reality there might sometimes be no stock for some grades and sizes.
- Orders are scheduled without observing limits for the number of scores or tear tapes, or scorer distance problems.
- Cut-Off and Take-Off length limitations are ignored

Only very few runs will actually violate limitations, the bulk of the orders are not affected. Thus, the grand picture doesn't change much.