

# THE IMPACT OF ON-DEMAND PRINTING ON PRODUCTIVITY AND PRODUCTION COST IN A BOX PLANT

Talking about production equipment that has still to be built sounds futuristic. However, this is how changes start — it is all about finding new ways to improve what we are doing.

We are faced with two questions: Why are we doing what we are doing and why are we doing it the way we are doing it?

Although the equipment discussed may only be available 'on paper', the data used in this article is real — so is the potential for improvement. What is needed is vision to make it happen. On-demand printing equipment that provides an advantage could be available soon.

## The problem

Today, all boxmakers are under pressure from their customers to reduce prices yet keep the highest quality. Often, the boxmaker passes the ball to his raw material suppliers but there is a limit to everything — or is there still room for improvement? If cost reduction exercises result in making people redundant and putting suppliers under pressure to reduce their prices then good luck, but this strategy will backfire one day and that day may be soon. Most likely, it will result in you having very few suppliers left to choose from. They will confront you with price increases. Also, your cut back in personnel might result in your people lacking the skill or time to run your operation cost efficiently.

Is there room for improvement? The answer is yes, but then one has to look to new technology or production techniques. Your current equipment still has a value and it is still working. So what do you need to do in order to take the step forward that allows you to offer your customer that bit extra for which he is prepared to pay an additional price — but at the same time giving you a better balance in your factory.

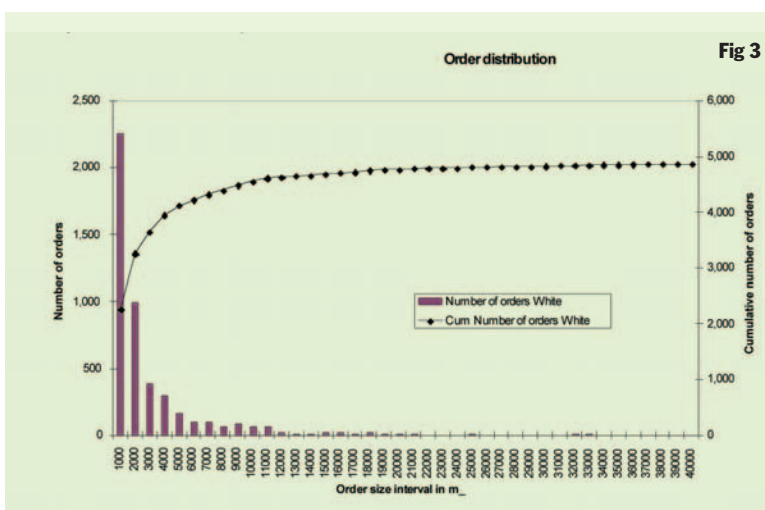
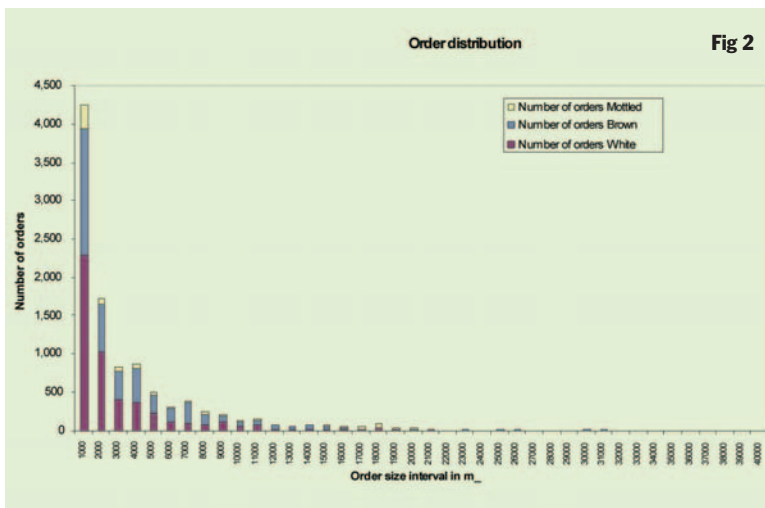
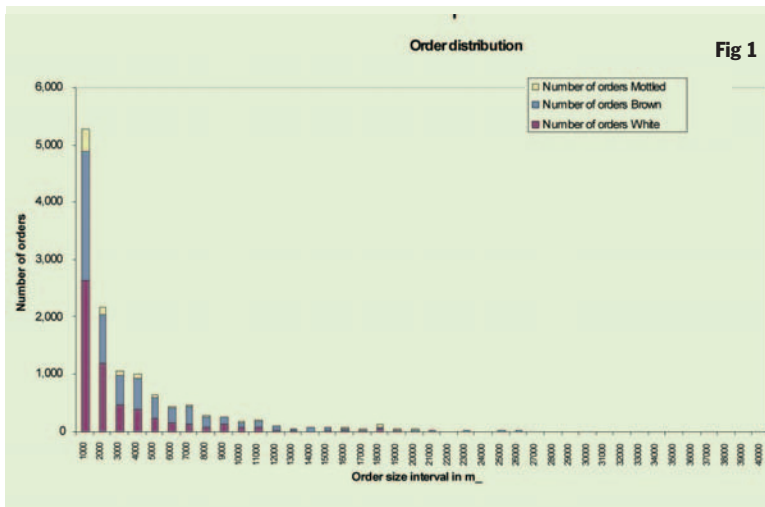
In this article we will look at on-demand printing on corrugated board and how you can balance your factory to improve productivity and reduce your total operational costs, add value to your products using digital print and reduce the cost of operating your existing conventional equipment. This will only happen if you have both systems in place — conventional flexo print and on-demand digital print. It also means that you need to know which process to choose for each individual order.

## Production data evaluation

The biggest challenge when writing an article is having data available that provides evidence. This is even more difficult when writing an article based on production data. The following information is a representation of how the production order distribution of a corrugated plant might look. I do not claim that the order data of individual box plants looks like my representation. The order data presented in this article is



MR STREEFLAND HAS WORKED IN THE CORRUGATED INDUSTRY SINCE 1992. DURING THIS TIME, HE HAS BEEN TECHNOLOGY DEVELOPMENT MANAGER FOR SCA PACKAGING AS WELL AS TECHNICAL MANAGER AT STORK SCREENS. HE STARTED TECHNOLOGY COACHING BVBA IN FEBRUARY 2005.



of an average box plant. It is based on one year's production.

This box plant produced 45 million sqm of corrugated board in a year representing 12,900 orders. Fig 1 shows

the order distribution histogram, with an interval of order sizes of 1,000sqm, colour coded for the type of outer liner used. It shows that the average order size is 3,500 sqm but this value is not very meaningful.

The most common order size is between 0 and 1,000 sqm. This result will not differ for many corrugated production plants.

If we do an evaluation on cost reduction for on-demand printing then we need to look at the distribution of the orders that were printed. In this case 10,465 orders with print (1 or more colour) were recorded — 5,160 using a white liner, 845 using mottled and 4,460 using a brown liner.

Note in Fig 2 that the highest order frequency is below 1,000 sqm.

Normal converting machines can handle board with a width of 1.6 m or larger. It is possible to build on-demand printing equipment with a width of 1.8 m but this would not be very cost effective. If you turn the board 90° for on-demand printing then you can set the height of the board as the limiting factor for printing. So let's just take the production data for white top liner board and a board height of 1,000 mm or less (Maximum distance between the slitting knives on the corrugator is 1,000 mm). The result is shown in Fig 3. The highest order frequency is still below 1,000 sqm (about 2250 orders). In total there are 4870 orders on white top board. So with the previous graph showing 5160 orders on white top board, there are only 290 orders that could not be digitally printed due to the board height restriction to 1,000 mm.

## Digital Print Technology

We all have a printer connected to our computer and that printer prints on-demand. For home or office use, we utilise LaserJet and Inkjet printers. If you want to print on corrugated board, for various reasons, the LaserJet printer creates problems. The biggest problem is the bending of the substrate when passing it through the printer. This might be resolved in the future. At the moment, all on-demand printers are based on inkjet technology. This technology falls into two groups:

- Drop on-demand inkjet;
- Continuous inkjet;

The drop on-demand systems are mostly

Single pass, fixed array technology  
CMYK & varnish  
UV curing system

Print heads	480
Print nozzles	60.000
Print speed	max. 1,6 m/s
Capacity	up to 6.000 m <sup>2</sup> /h
Print width	1.040 mm
Sheets	1,2 x 1,7 m
Thickness	1-10 mm
Resolution	300 x 300 dpi

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based on scanning heads. The scanning head makes the system slow. Every printed dot in a row has its "own" nozzle. The number of dots to be printed requires a large number of nozzles that all have to work, or it might result in streaks if one nozzle is blocked. The manufacturers of these printers and heads are working on developing technology to resolve the problem (this will also reduce the productivity). The inks used are mostly UV or oil based. If non UV inks are used then often pre-coating of the substrate is needed. There are several systems on the market today, mostly used for printing displays.

Continuous inkjet systems are known for printing labels, envelopes or marking products. They mostly have a narrow print width but print very fast. The key difference is that a continuous stream of very small dots is ejected from the nozzles and that the printing drops are deflected. It is possible to deflect the drops to various positions on the substrate so that one nozzle can print a certain width and not just one dot. The other advantage is that any ink can be used and less nozzles are needed for covering the full width of the machine. In advanced continuous ink jet technologies using heads with multiple nozzles arrays, each of these nozzles can be controlled accurately to cover a large width. Allowing the nozzles to overlap the width they print provides a guarantee that streaks will not appear on the print. Due to its continuous jetting mode of operation, the chances for nozzle clogging are almost non-existent and if occurring can be easily handled during the warm up of the system. The only disadvantage might be the recirculation of the ink, however that problem is relatively straightforward and good solutions have already been established. The distance of the head to the substrate is significantly larger than for drop on-demand. This has a positive impact on sensitivity to dust.

### Cost argument

In this case, we will focus on the cost for continuous inkjet printing with the following specifications:

- Resolution: 300-400 dpi;
- Printing width: 1,000mm;
- Ink: water based;
- Production speed: 7-14 m/min (about 1000 sqm/hour).

The following data for conventional flexo printing is used for the cost comparison:

- Total print plate cost for this plant: 500,000 €/year
- Average cost per plate: 163 €/plate
- Flexo ink cost: 315,000 €/Year
- Ink consumption: 125,000 kg/Year
- Total ink loss: 32,500 kg/year
- Ink loading: 2.5 gsm
- Flexo ink cost: 0.0025 €/g
- On-demand ink cost: 0.0450 €/g
- Labour cost flexo set-up: 100 €/hour
- Board value: 0.5 €/sqm
- Board loss during flexo set-up 50 Sheets

All this information was entered in a spreadsheet including the order/production data. The order production data also contained information about the printed area and the number of colours used.

The general cost difference between on-demand printing and flexo printing is that the ink is much more expensive for on-demand printing, but then there are no printing plates needed. The set-up time is zero and there will be no board or ink waste, thus the first sheet can go to the customer.

The real problem today is the short orders. Therefore, let us only use on-demand printing for orders of less than 1,000 sqm. In this case 2,250 orders (nearly 50 per cent of all orders printed on white top board) but less than 3 per cent (1 million sqm) of the total board area produced. Producing this on-demand would result in an estimated cost reduction of 215,000 euro/year (all costs included). Remember this is assuming that the conventional equipment will be used for longer order runs. The capacity increase of the conventional printing equipment will be close to 20 per cent because of few set-ups and increased run time. The sales person now has to find more customers with long orders!

My conclusion of this evaluation is that there is room for improvement by introducing new technology alongside current equipment. The current equipment is not obsolete, but should be used for what it was designed for — and that is running long orders. Corrugated boxmakers will also have the opportunity to ask a premium for short term supply of new products. Another opportunity for cost reduction might be to operate 2 shifts instead of 3 on conventional equipment.

### Recommendation

- Look at your order size distribution and forget about average order length.
- Short orders are your problem, because most equipment is not designed to efficiently run short orders. It does a good job running long orders.
- Consider carefully your sales strategy for your on-demand printing facility.
- New technology can be used to make new products and open new markets which should be its first priority. But the free capacity can be used to solve production problems on current production equipment which might well pay for the investment.
- In addition to finding new orders for on-demand printing, find longer run work to fill the free capacity on your current equipment as a result of moving short order runs to the on-demand printer.

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*Wilbert Streefland can be contacted at: wilbert@tcbvba.be*