WhatTheyThink

WHITE PAPER

BEYOND THE PRINT ENGINE:

WHAT IS PRODUCTIVITY?

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ABSTRACT

One of the biggest challenges in wide-format printing—or indeed any printing—is increasing/improving productivity. Wide-format print service providers especially are challenged by getting jobs on and off press as quickly as possible. At the same time, printing equipment manufacturers are constantly increasing print engine speeds. But, at the end of the day, what is productivity? Is print engine speed the be-all and end-all of productivity? In flatbed printing, other issues can impact the overall throughput of a machine. And if you could cut at least four minutes off job set-up time, would that not be a compelling productivity boost?

This white paper will look at those other aspects of flatbed wide-format productivity, specifically focusing on one chief bottleneck: board loading. Automation options, such as robotics, have started to appear, but one approach—Canon's FLOW technology—provides a unique strategy for boosting flatbed printer board loading.

INTRODUCTION: WHAT DO WE TALK ABOUT WHEN WE TALK ABOUT PRODUCTIVITY?

There are many kinds of "productivity" and many different ways of measuring it. In economics, productivity or "labor productivity" is the measure of output per unit of input, be it labor, capital, or some other resource. It's often expressed as gross domestic product (GDP) per hours worked.

For companies, productivity is the measure of the efficiency of a company's production process, whatever that process may be. It is usually expressed either as the number of "widgets" produced per employee hours or as the company's net sales per employee hours.

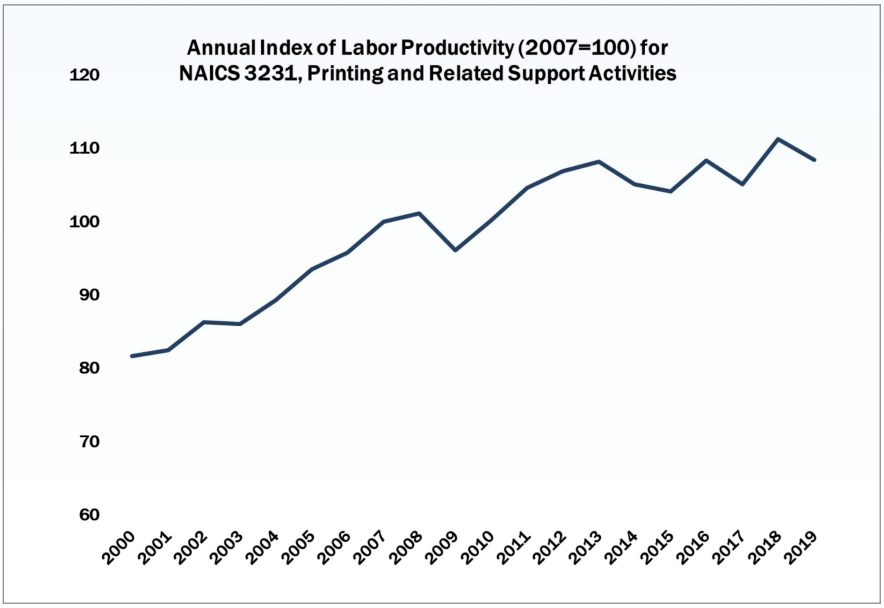
Ultimately, productivity refers to "how much work gets done."

In the printing industry, analysts often keep an eye on government productivity data, such as the reports issued by the Bureau of Labor Statistics (BLS). For example, we can look at the BLS's productivity index for NAICS 3231 (Printing and Related Activities):

A traditional challenge for the industry (see below) has been "increasing productivity" and according to the BLS's productivity data, that productivity has indeed been on the rise in the industry, despite some recent choppiness. Productivity can also be somewhat of a gauge of automation (although not a 100% reliable one). For example, if we look at the period from 2015 to 2017/2018, productivity rose even as the average number of employees per printing establishment remained relatively stable. That's automation in action.

For print business owners and operators, productivity in the context of print production refers to the efficiency of a shop's production process. Basically, it refers to how many jobs get out the door in a given period of time—or "getting more stuff out faster."

Productivity has long been a business challenge—certainly for any manufacturing company, but also for print businesses. As five years' worth of WhatTheyThink survey data show, productivity has generally been a top challenge:



Source: Bureau of Labor Statistics

In wide-format printing, productivity is often thought of as "feet/boards per minute" (if we're talking about rollfed vs. flatbed printing), but as we will see later in this white paper, that isn't *necessarily* what productivity is, but can be a part of it.

Automation is also an important element of productivity, and there are some economists who consider increases in macroeconomic productivity data to reflect the adoption of

[1]Which is not to say that there is no such thing as machine error, but properly programmed and configured and once up to speed, the potential for artificial error is dramatically reduced or eliminated. (Hey, if we can have artificial intelligence why not artificial error?)

automation, and few would deny that automation increases productivity by increasing speed and/or removing the potential for human error[1]. Automation has been making inroads in commercial printing for more than a decade (at least), although it's not often perceived as a major business opportunity:

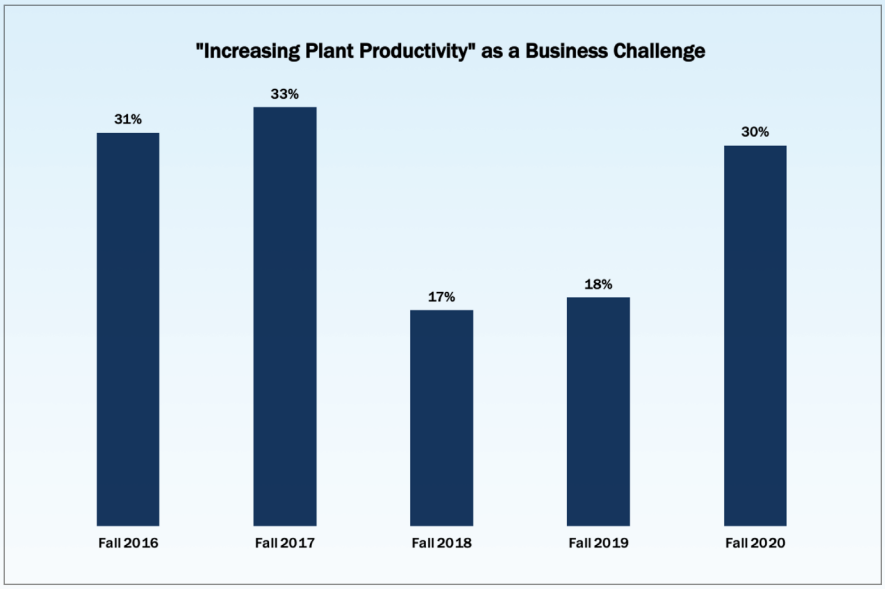
Anecdotally, we have evidence that the pandemic has spawned either renewed or all-new interest in automation, as printing plants had to contend with work-from-home, furloughed, or laid off employees. Now, post-pandemic, they are faced with difficulties in finding production employees. So printing isn't always about increasing productivity—sometimes it's about having any productivity at all.

One of the factors that influence productivity is print engine speed, or how fast a machine can lay down ink or how many square feet the machine can produce in an hour. But the speed of a printer is only one part of the productivity equation. Substrate handling—how quickly materials can be loaded and unloaded from the machine—is also an important element in the productivity calculus.

In this white paper, we will be concentrating specifically on productivity in the context of flatbed wide-format printing. Rollfed printing—and indeed other forms of printing—have their own productivity nuances.

FLATBED PRINTING: AN OVERVIEW OF PRODUCTION STEPS

Ever since the first flatbed wide-format printer hit the market in 2001, each generation has boosted print speed and improved materials handling. But the basic steps involved in flatbed printing haven't changed all that much, and the sheet/board loading process barely at all, although the advent of multi-zone vacuum tables has enabled more efficient printing of different size substrates.



Source: WhatTheyThink Business Conditions surveys

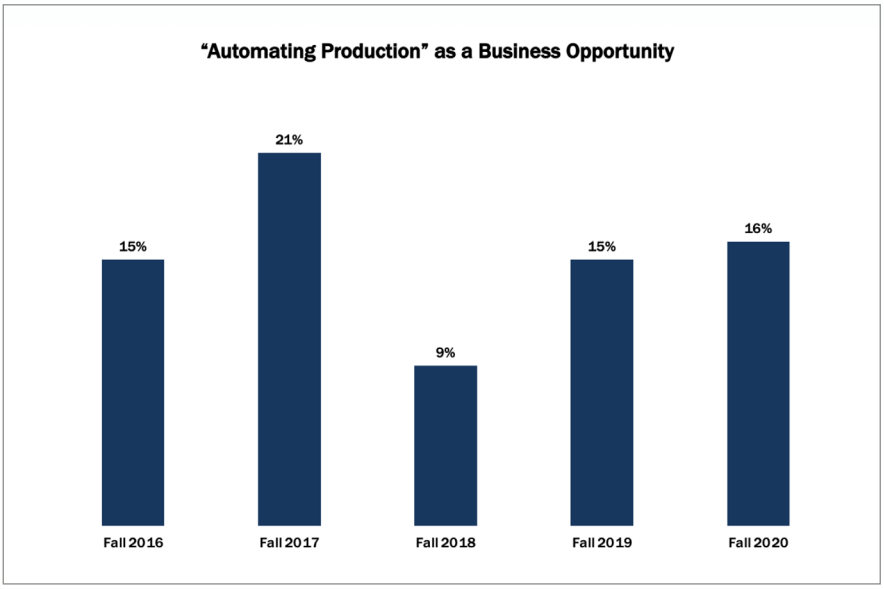
In a very general sense, there are three basic steps to flatbed wide-format printing:

- **Loading** (getting boards/sheets on the printer)
- **Printing**
- **Unloading** (getting boards/sheets off the press and to finishing)

Let's look at each briefly in turn.

LOADING

Different flatbeds from different vendors operate a little differently, but this is the basic process: Blank sheets or boards are stored on a pallet and



Source: WhatTheyThink Business Conditions surveys

brought to the printer. The operator physically removes the sheets/boards and places them on the printer's vacuum table. On many models, the operator uses registration or positioning pins to position the board correctly. The vacuum is then engaged which secures the board to the table.

The operator then goes to the RIP, opens the print file, and sizes and positions the image to be printed, and performs any other adjustments that need to be made for printing (e.g., color management settings, etc.). This is also where any step-and-repeat (printing multiple copies of the same image on a single board) is set.

Once the printer is started, the operator continues to load blank sheets/boards until the desired number of images has been printed.

Accurate placement of sheet/board on the vacuum table is essential. This is less of a problem with square or rectangular sheets/boards, but when printing on unusual or pre-cut shapes requires careful placement. With hybrid style printers, where the media moves through the printer while printing, an additional "jig" consisting of a square or rectangular piece of substrate with matching shaped holes cut out to hold the individual pieces, must first be produced. These items may also require taping and/or masking (called "bed masking") to protect the vacuum table (especially in the case of full-bleed printing) and to ensure sufficient suction (see below).

PRINTING

Before printing begins, the operator, or the printer itself, needs to determine the board thickness and adjust the carriage height to avoid costly collisions. Some printers offer an automated process which at first sounds appealing however, compared to an operator manually measuring the board and entering the value, the automated process will more often than not take a considerably longer time to perform the same function and only measures in one location.

Once the operator hits Start, the print carriage moves back and forth over the sheets/boards. Depending on the model, the sheets/boards remain stationary and the print carriage moves down the sheet/board, or the sheet/board is advanced under the print carriage. Regardless, printing and ink curing happen at this stage. During this process, there is nothing required from the operator. They can simply walk away and let the machine print, freeing them up to be more productive with other tasks in the shop such as finishing, RIPing the next job, or talking to a customer. The is a truly overlooked aspect of printer productivity—how much labor is required.

UNLOADING

The printed boards are then removed from the printer and sent on to the next step in the process, usually some kind of cutting or finishing process. Cutting and other finishing processes may also be performed inline with the printing.

At each of these three stages, there is the potential for bottlenecks to occur and thus slow down productivity—and thus there are opportunities for innovative solutions to eliminate these bottlenecks.

SPEED VS. PRODUCTIVITY

When you read the spec sheet of a flatbed printer (or any printer), you will see a print speed—say, 550 square feet per hour.[2] This is the print engine speed[3] and, as we said earlier, is only one part of the productivity equation. Sure, it's an important one, and every new printer introduction ups the print speed. When manufacturers are selling and marketing their machines, this spec is usually the most important and most touted selling point and is calculated at the maximum image area the printer is able to print, which if it is larger than the 4 foot by 8 foot board you will be printing represents a speed you will never achieve. With that in mind, the quoted print speed shouldn't be the only spec that matters. Think about the other two steps in the flatbed printing process—board loading and unloading. What if there were improvements in those steps that could speed up production. Wouldn't that constitute an increase in productivity? Let's see how.

BOARD LOADING: A DEEP DIVE

As described above, most flatbeds on the market today, especially entry-level and mid-range machines, rely on a human operator to manually load boards onto the machine. The basic nature of the substrates used in flatbed printing as well as the design and functionality of the machines itself preclude the ability to use the kind of sheet feeder found on sheetfed presses that automatically feeds sheets into the press (although see "Automation" below). As a result, sheets/boards are manually placed on the table, one, two, or maybe a few at a time, depending on the width/configuration of the printer.

AUTOMATION

It's worth mentioning automated board loading/unloading at this point. At the very high end of the flatbed market, there are units that have robotic arms or other feeding mechanisms that can automatically load and unload boards much more quickly and accurately than a human operator can.[4] Some models are "semi-automatic" meaning they feature manual loading and automatic unloading. While this kind of automation does boost productivity, there are certain limitations with these kind of autoloaders beyond the high cost. For example, in order to optimize productivity with automatic loading/unloading systems, users need to print high volumes on the same substrate. After all, the goal is to replicate the sheet feeder used by small-format machines: stack a bunch of sheets/boards on a pallet and have the automatic loading system do its thing with minimal, if any, human intervention. But if, like a lot of wide-format print providers, someone is printing small quantities of a wide variety of sheet and board materials and sizes, the set-up time for the automation system between jobs may offset any productivity gains. Robotic arms, for example, need to be programmed for specific board sizes. At the same time, if the substrate is thick enough, it may not be possible to stack very many boards on a pallet before they need to be reloaded—again cutting into any productivity gains.

There are many nuances to autoloading units and robotic arms which are beyond the scope of this white paper. Ultimately, human-based loading is going to be the prevailing option for the foreseeable future.

ZONES

Most if not all flatbed printers use a vacuum table to secure the media prior to printing. That is, a sheet/board is placed on the table and suction from below holds it down as the print carriage prints the image. Many flatbed vacuum tables are zoned, or divided into different regions in which the vacuum can be turned on or off. When a printer is first installed, it will often have one large zone corresponding to the maximum media size, or it will have some preset number of zones (usually four, sometimes more, sometimes less). Vacuum zones can also be customized, either during installation or during a later service call, to correspond to specific commonly used media sizes.

Here's the thing, though. In order to work efficiently and create enough suction to hold the substrate securely to the table, traditional vacuum tables require that all the vacuum holes in an active zone be covered securely. If the size of a zone exactly matches the size of a sheet or board, the board can be loaded, only that zone needs to be turned on, and printing can start. No fuss, no muss.

However, if a sheet or board is smaller than the size of a zone, or is larger than the largest zone and thus needs to have a second zone activated—or is a non-rectangular shape—any exposed vacuum holes need to be covered. Which then leads to…

[2]Spec sheets also often use the term "boards per hour" and sometimes they use metric. The principle is the same regardless of the units involved.

[3]And at a specific quality setting.

[4]Some Canon Arizona models offer robotic loading.

MASKING

Unless you are printing very limited sizes of materials that correspond exactly to the size(s) of your vacuum zones (and some shops do configure their zones to fit the most common sizes they print), a common step in the loading process—a "necessary evil"—is bed masking. Bed masking is required in order to cover or "mask" the exposed vacuum holes of an active zone in order to create a tight vacuum seal. Masking the table involves taping scrap media or other material—that is equal to or less than the thickness of substrate on which you are printing—around the edges of the substrate to be printed until all the exposed vacuum holes are covered. A vacuum gauge on the printer will let you know when you have a tight enough seal to proceed.

The masking process can be one of the most time-consuming parts of the flatbed printing process. It is also especially time-consuming when printing on many oddly shaped or pre-contour cut shapes, which will likely need to be masked individually.

The masking process can have the biggest negative impact on overall productivity—all before the print engine is even started. Without bed masking, sheet/board loading can take less than a minute. Masking and taping can add four, six, eight minutes to the media loading process—maybe even more if it's a complicated job or involves multiple boards, duplexing, or odd, pre-cut shapes.

This, combined with other slow-downs in the board loading process, can be the biggest bottlenecks in flatbed wide-format printing.

CANON ARIZONA FLOW TECHNOLOGY: AN INTRODUCTION

In late 2020, with the release of the Arizona 2300 Series of flatbed printers, Canon introduced its new FLOW technology, the goal of which is to boost productivity by "unbottling" the bottlenecks in board loading. Specifically, eliminating the concept of vacuum zones, and thus the need for masking.

FLOW technology comprises a unique zoneless vacuum system that applies the suction only where it is required, regardless of how much of the table is covered or uncovered by media. At the same time, three-sided pneumatic registration pins allow edge-to-edge printing as well as the ability to align the substrate to either the left or right edge—or both edges—of the vacuum table.

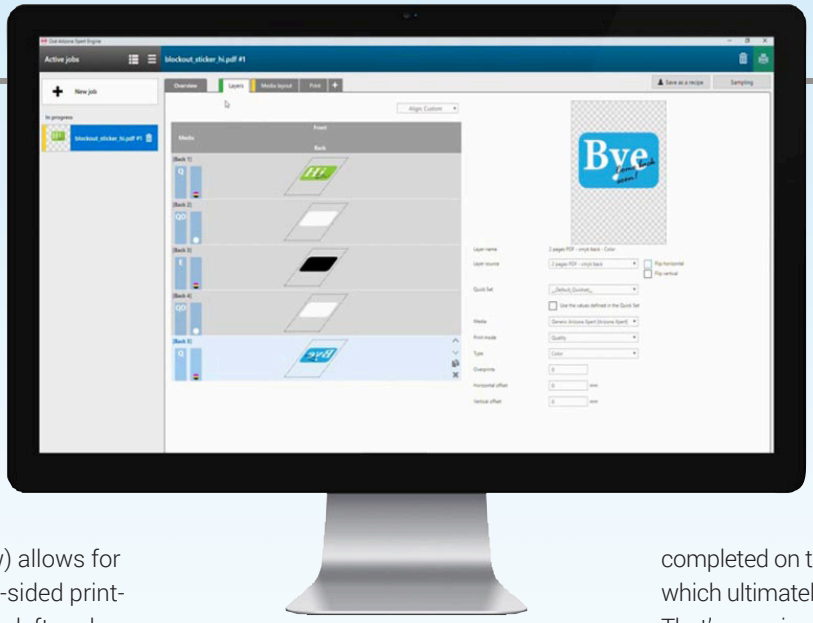
Some of the ways FLOW technology can increase productivity are:

NO MORE MASKING

This is the biggie. The architecture of the vacuum table and suction system enables the media to "stick" securely to the bed without the need for bed masking or taping the media down, since the table only activates the vacuum holes that are needed for a given substrate. This leads to faster set-up times and quicker job changeover, as each board can be loaded in under—even well under—a minute.

MULTI-ORIGIN REGISTRATION

The extra registration pins allow for multi-origin registration, which means that boards can be placed to the left, right, or in the center of the bed, and



multiple boards can be printed simultaneously—whether they are all the same image or three different images.

DUPLEXING

The combination of the registration pins and a recipe (or preset job settings) in Arizona Xpert software (see below) allows for easy and accurate double-sided printing. Media is placed on the left and right side of the table, one side of the substrate is printed, then it's flipped, and the second side is printed. And again, no masking required.

UNUSUAL SHAPES OR MATERIALS

FLOW technology also makes it easier to accurately print on oddly shaped, heavy, smooth, or pre-cut media without the use of a jig or other kinds of alignment tool. It can print on canvas, wood, glass, and other challenging substrates and large images can be easily tiled across multiple boards.

An important complement to the FLOW technology is the Arizona Xpert software that interfaces the printer. By using a preset "recipe" in Arizona Xpert, the machine prints a faint outline of the media on the table itself and the user can quickly line up the pre-cut shape(s) using that outline. The outline can be easily removed when the job is finished.

These are not unique operations or applications, but the ability to perform them quickly and easily provides a measurable boost in productivity.

MEASURING THE PRODUCTIVITY

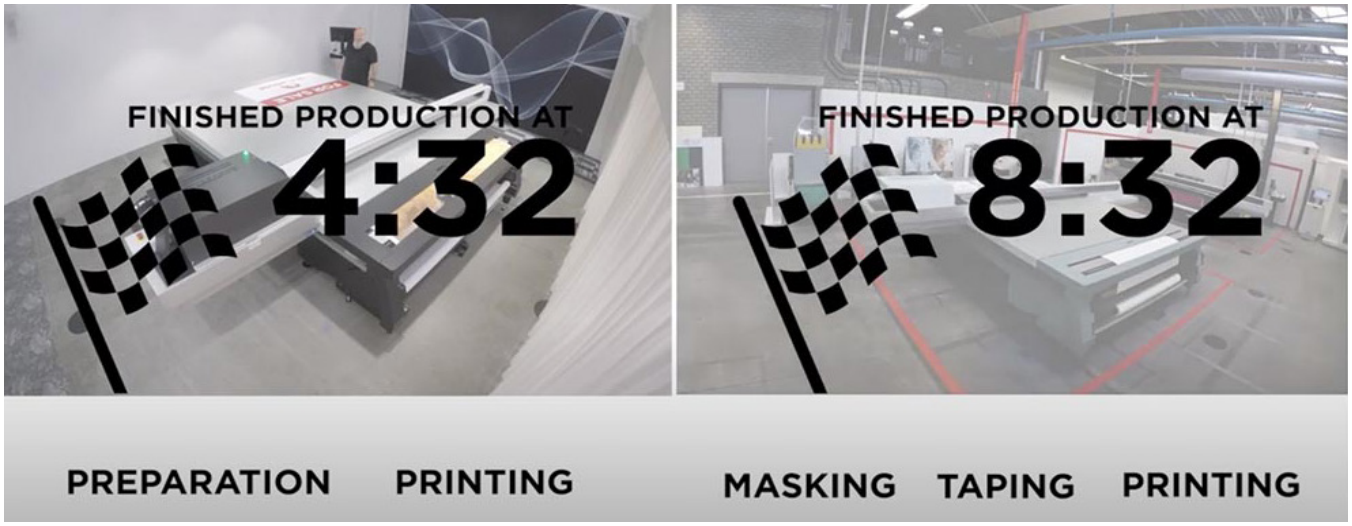
And, yes, it can be measured! All jobs are different, of course, and your mileage will vary, but this video features a side-by-side face-off between the Arizona 2300 featuring FLOW technology and the traditional taping-and-masking method of board loading: (www.youtube.com/watch?v=jy-0Qws9FlGI). The job output on the Arizona 2300 was loaded and printed in 4:32—even before the taping and masking had been completed on the competing machine, which ultimately finished printing at 8:32. That's a savings of four minutes—time for almost a whole other job.

OTHER PRODUCTIVITY ELEMENTS

Wide-format printing is about more than a machine, which is one component of a larger production ecosystem, all of which work in tandem to achieve a certain level of productivity. Other components of this ecosystem include:

SOFTWARE

One important piece of the productivity equation—for FLOW, for wide-format printing, or even for printing in general—is software automation. In the case of the Canon Arizona series, that automation is performed by



Arizona Xpert, a software "workflow assistant" that makes it simple to set up complicated jobs—like multi-layer or duplexing—and save them as "recipes" so they can be repeated. Actually, you don't even need to save them. Set up a job once, and Arizona Xpert learns the steps on its own and saves the recipe for future use.

The Arizona series lets users add texture or three-dimensional effects to prints by layering the ink in select spots. To add these effects, Canon's Touchstone dimensional printing software allows the designer creating a print file to specify where they would like texture effects applied (via a Photoshop extension), and the print provider's full version of Touchstone applies these effects via ONYX Thrive and the Touchstone ALPS Engine, which then generates a layered batch file that an Arizona printer can then print automatically.

BEYOND THE PRINT ENGINE

So you can see that productivity is about far more than print speed. It's about optimizing all the steps in the production process. And sometimes productivity enhancements are not always obvious. When we think of boosting throughput, the first thing we think of is a faster print engine—not a more sophisticated vacuum table. And yet, taking the onerous task of masking and taping out of the process can potentially have a greater impact on productivity than an increase in print engine speed.

THE CANON ARIZONA 2300 SERIES

The Arizona FLOW technology was introduced with the Arizona 2300 series UV wide-format flatbed printer. At its launch, there were two configurations in the Arizona 2300 series, the 2300 Series GTF and XTF, which can handle media sizes of, respectively, 49.2 x 98.4 inches and 121.3 x 98.4 inches, and a media height of two inches. Print speed is rated at up to 958 square feet per hour (GTS) and 1,023 square feet per hour (XTS).

In terms of inks and colors, there are three models in the 2300 series: the 2340 Series features four ink channels (CMYK), the 2360 Series six ink channels (CMYK plus double white and/or varnish), and the 2380 Series eight ink channels (CMYK, double white and/or varnish, plus light cyan and light magenta). The 2340 is upgradeable to the 2360 and the 2360 is upgradeable to the 2380.

It uses LED UV curing, which means that the curing lamps don't need to heat up so it is instant on—another boost to productivity.

The 2300 series also has a rollfed option for printing on flexible media.

And it supports Arizona Xpert and Touchstone software.

CONCLUSION

Productivity. We always want more of it. But to achieve real increases in productivity, we need to consider *all* of the elements that constitute it. It's tempting to look at specs like print speed, but as we have seen throughout this white paper, the fastest print engine in the world will only marginally improve productivity if other parts of the workflow are bottlenecks. It is by reducing the time it takes to perform these ancillary steps—like board loading—that print providers can get the most out of their print engines, speed throughput, get more jobs—especially complex high-value jobs—on and off press, and improve profitability, which is ultimately the goal of productivity.