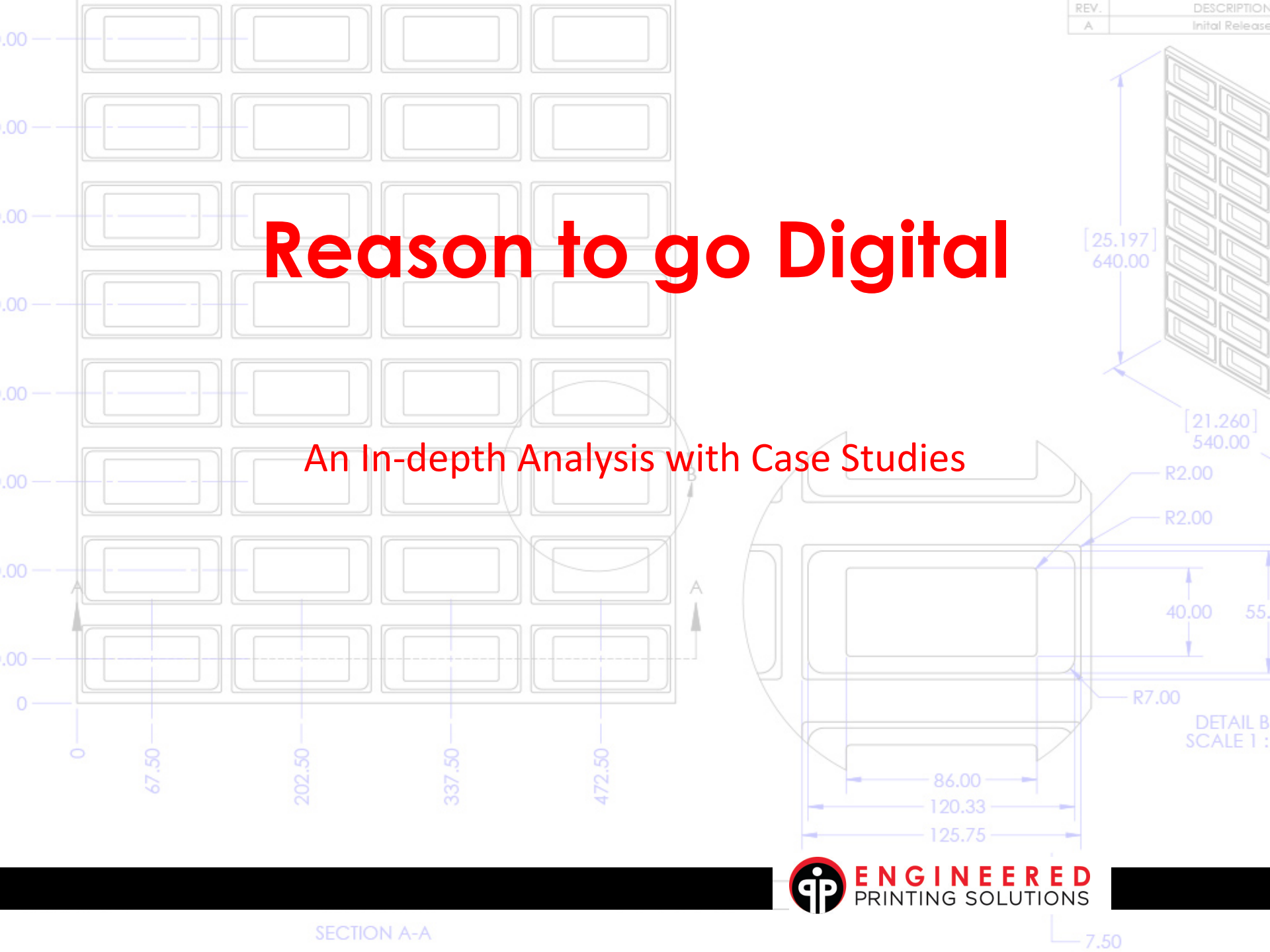


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# Reason to go Digital

An In-depth Analysis with Case Studies



SECTION A-A

# History of Engineered Printing Solutions

Engineered Printing Solutions (EPS) was founded in 1985 under the name of Pad Print Machinery, with the goal of providing our customers solutions to there printing needs. In 2003 we moved into a new building that was built out to support our growing manufacturing needs. In 2015 we added 10,000 square feet to our building so that we can continue to manufacture and engineer larger and more sophisticated printing solutions.

In 2016 Xaar plc acquired EPS as we had become an industry leader in direct to product digital print systems.

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# BIO

Julian Joffe is an industry veteran and has been in the printing and decorating industry for over 30 years. His experience is with pad printing, single pass inkjet, industrial inkjet, and automation of printing processes.

Ken Tyler has been in the inkjet industry for more than 10 years. During that time he has worked in fine art reproduction; technical service for industrial inkjet equipment and sales for direct to object printing.



# What is Analog Printing

- All analog printing can be defined as contact printing.
- For example. The pad in pad printing, the screen in screen printing, the cylinders in Gravure, the plates in Flexo and Lithography, the dies in hot stamping.
- There are many differences between each type of analog printing such as inks, pigment loads, speeds, skills required, imaging apparatus, etc...

# What is Analog Printing Setups

- Analog also is very labor intensive in setting up the printing process. For example in Pad printing:
  - Print the film
  - Photo expose the film to the cliché creating the etched - print image.
  - Wash, Dry, 2<sup>nd</sup> exposure
  - Attach ink cup and setup cliché(s) on the machine
  - Do a test print to make sure it is printing correctly
  - Adjustments
  - Start Printing
  - Repeat for every individual color you want to print.

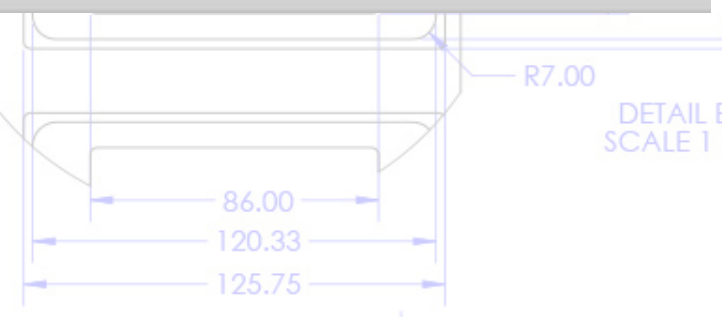
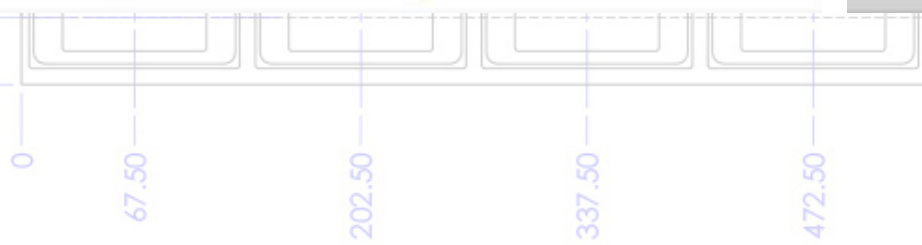
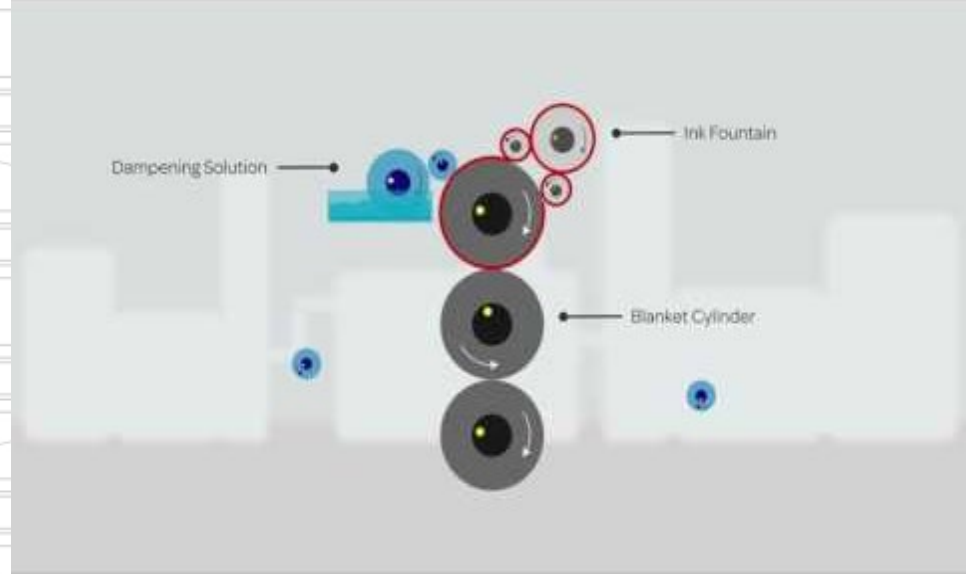
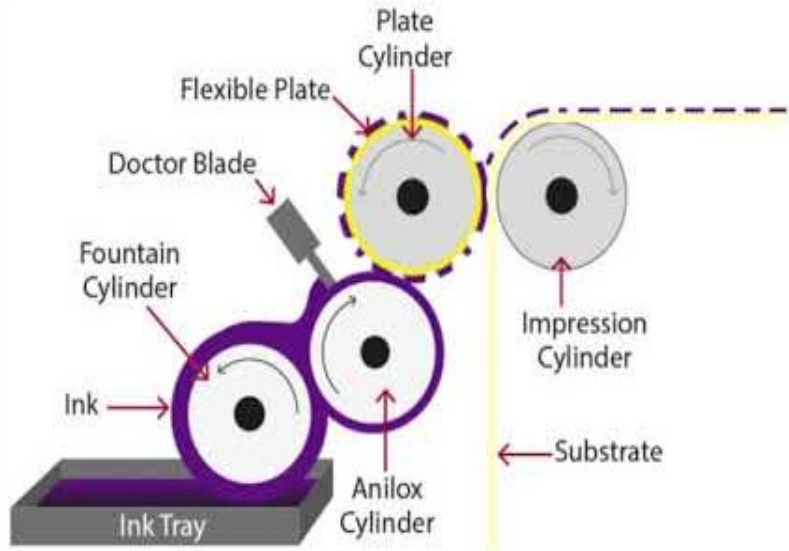


# What is Analog Printing Advantages

- Once setup Analog printing technologies are great for long run printing jobs.
- Where the image does not change.
- Fast Output.
- Once Setup require few adjustments
- Analog can be relatively inexpensive per piece compared to digital, because of the amount of output and material costs.

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# What is Analog Printing



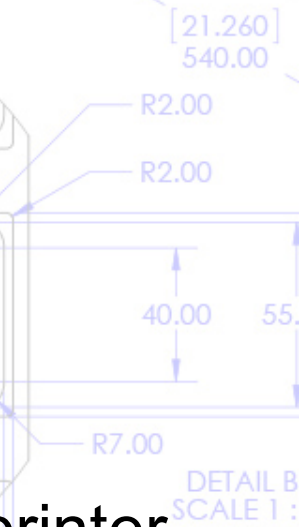
SECTION A-A

# What is Digital Printing

## Direct to Object UV Industrial Inkjet

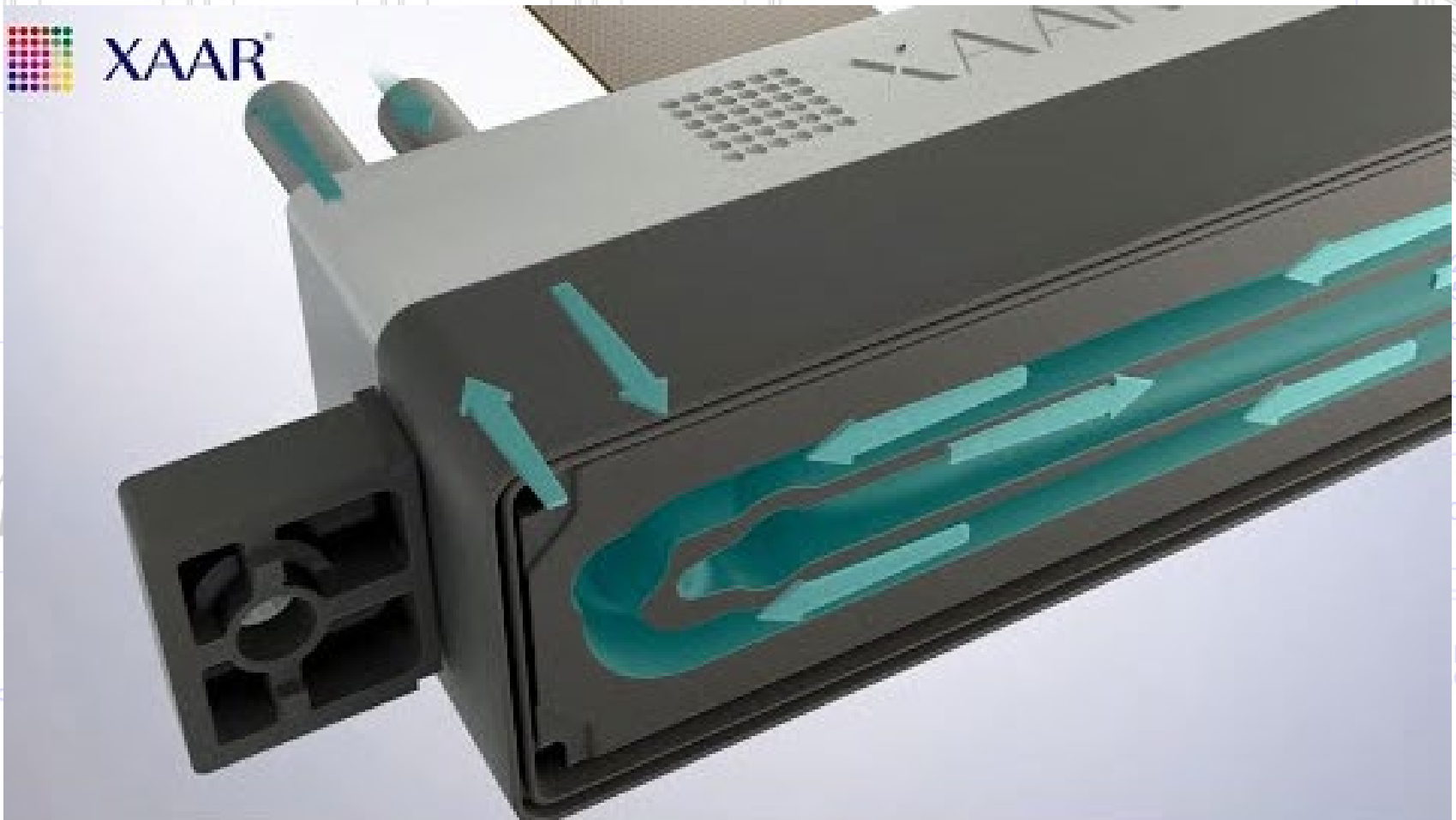
- Digital printing is using inkjet technology to print without contact to a substrate.
- The key advantages of inkjet are;
- Non contact printing
- Personalized and variable data
- Ability to print on demand
- Cost effective for short and mid range runs
- Fast Turnaround and quick changes
- Less operator handling and maintenance of the printer

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# How does a printhead work?



SECTION A-A

# How does this work in a printer?



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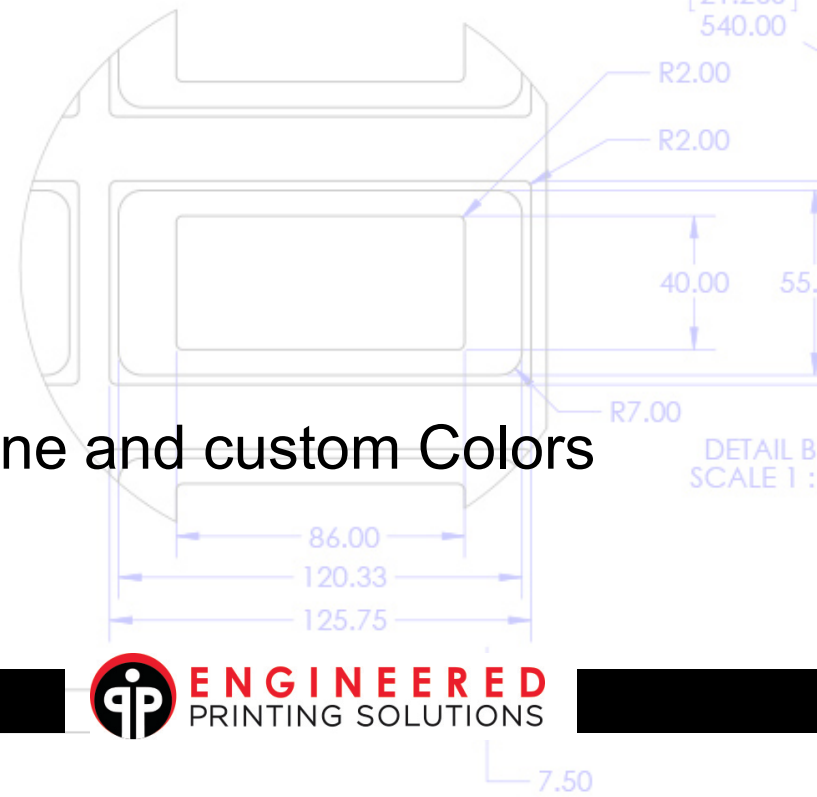


# Why would you switch to digital

- Multiple image changes to the same product/substrate.
- Customers asking for shorter run.
- Customers asking for variable data/personalization.
- Customers are constantly changing artwork for every production cycle.
- Need to print a pressure sensitive product.
- Printing to a wide variety of substrates.
- Printing to products that are dimensional.

# What dictates if Digital is a good option

- Substrate Shape
- Substrate Material/Color
- Ink Requirements – Food Grade, Medical, Prop65
- Production Rates
- Image Sizes
- Image Detail – Resolution
- Frequency of Variable Data
- Frequency of Product Changes
- Number of colors needed – Pantone and custom Colors
- Image Appearance



# Substrate Shape

What is the substrate shape?

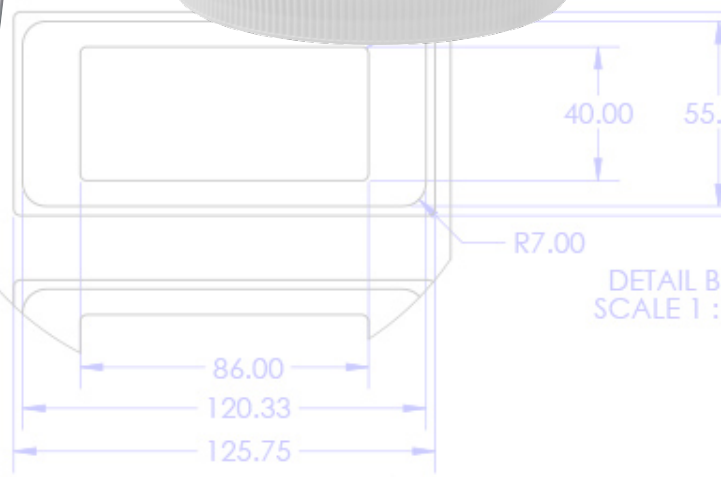
Digital is great for flat, symmetrical or very low angle objects. As you saw in the printhead video, printhead nozzle plates are straight. This means printing to a curved surface can cause distortion of the image and over spray.

This does not mean all curved substrates can not be printed but means that we have to take a new approach to dimensional printing. Example is to rotate the part correctly to print under the printhead as close to flat as possible.



# Substrate Shape

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# Substrate Shape



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# Substrate Material

- The substrate material plays a huge role in whether or not inkjet is possible.
- Some materials are not possible to be printed with inkjet currently.
- Some materials that used to be impossible are now able to be printed with great results.
- All materials should be tested and printed before purchasing a printer.
- There can be great difference in substrates from different manufacturers.
- The material dictates the dyne level or surface energy of the product.

# What Challenges do Substrates Present



Does the ink need modifying or can I pretreat the substrate and how





# Substrate Material

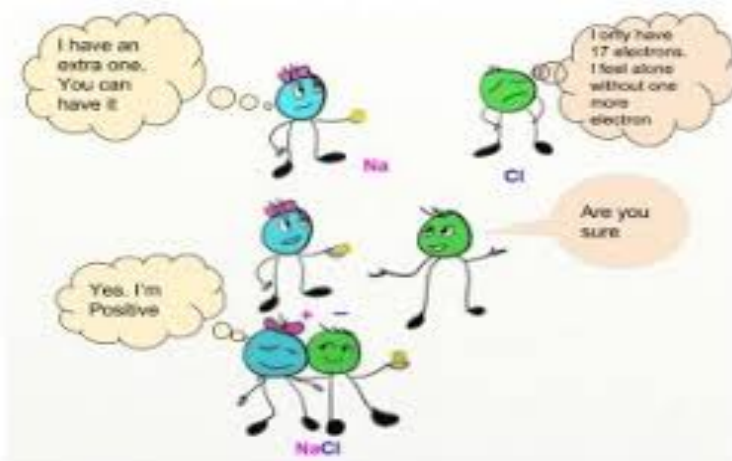
- The substrate material dictates the surface energy of the material.
- Surface energy is measured in Dynes.
- Low surface energy can cause adhesion issues or lack of adhesion
- Primers or pre-treatment must be used to raise the Dyne level to an acceptable level for inkjet inks.
- Surface energy affect the Dot Gain of a drop which affect appearance of the image.
- Low surface energy can cause ink to not form correctly leaving orange peel (pin holes).



# Substrate Color

- Inkjet ink is transparent, due to viscosity.
  - Pigment loads are much less than analog printing.
- White backgrounds allow the CMYK to look brilliant.
- Anything that is not white will affect how you see the color.
- On colors that are not white, you should print a white base layer.
  - This give the print the correct colors.
- Color also affect curing
  - White backgrounds will reflect the wavelengths thru the ink.
  - Dark backgrounds will absorb the wavelengths causing slightly less curing

# Methods of pretreating substrates -WHY



LOW SURFACE ENERGY MATERIAL  
LIQUID DOES NOT "WET" THE SURFACE



HIGH SURFACE ENERGY MATERIAL  
LIQUID "WETS" THE SURFACE

# Ink Requirements

- Digital inks are relatively young compared to analog printing inks.
- Because of viscosity restrictions due to the printheads the inks are limited to a smaller group of usable chemicals.
  - Think water vs molasses.
- What properties does your ink need?
  - Adhesion, mechanical attachment to the product.
  - Abrasion, Tabor testing.
  - Scratch resistance.
  - Chemical durability.
  - Water/Humidity resistance.
  - Class VI Medical grade
  - Something else??

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# Ink Requirements

- Right now there is a big push for compliance in printing inks.
- Inkjet Ink companies are working on ways to develop inks that are compliant with...
  - FDA Standards, Medical Classes, Food Grade Packaging inks, Direct Food Contact, Prop65, CPSIA, EN-71, REACH, RoHS, and also Restricted Substance Lists (RSL's)
  - RSL's are list created but companies that limit what suppliers can put in to the products they buy. Started by Nestle and has been adopted by every major corp.
- One of the reasons that the compliance issues are a big matter is Migration of chemicals thru packaging, specifically plastics.
- The inkjet ink industry has also been proactive in trying to keep heavy metals out of pigments.
- They have also developed inks that are BPP compliant or BPP free.
- There are a number of UV and LED inks that are safe for indirect food packaging on the market currently.

# Production Rates

- Inkjet can be slower than analog printing but it can also go faster in some case.
  - Printheads and Integrators are coming up with novel ways to increase print speeds.
- Inkjet printers are more efficient as down time is virtually non existent.
- To switch art work or designs we do not need to stop the printer.
- Inkjet can easily print as speed of 250 feet a minute.
- If designed to fit multiple products down time for printing can be just a few minutes.

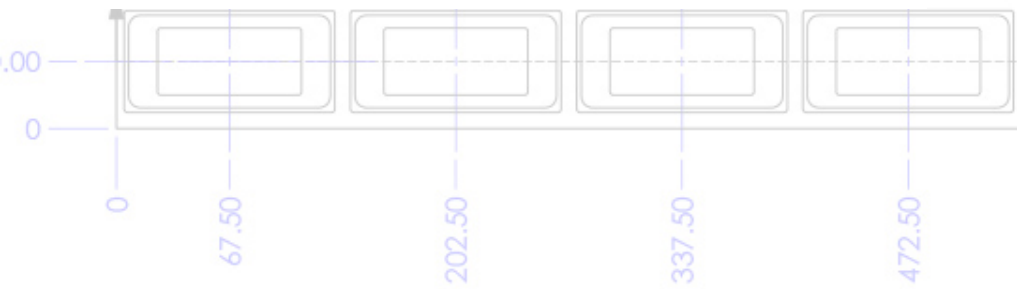
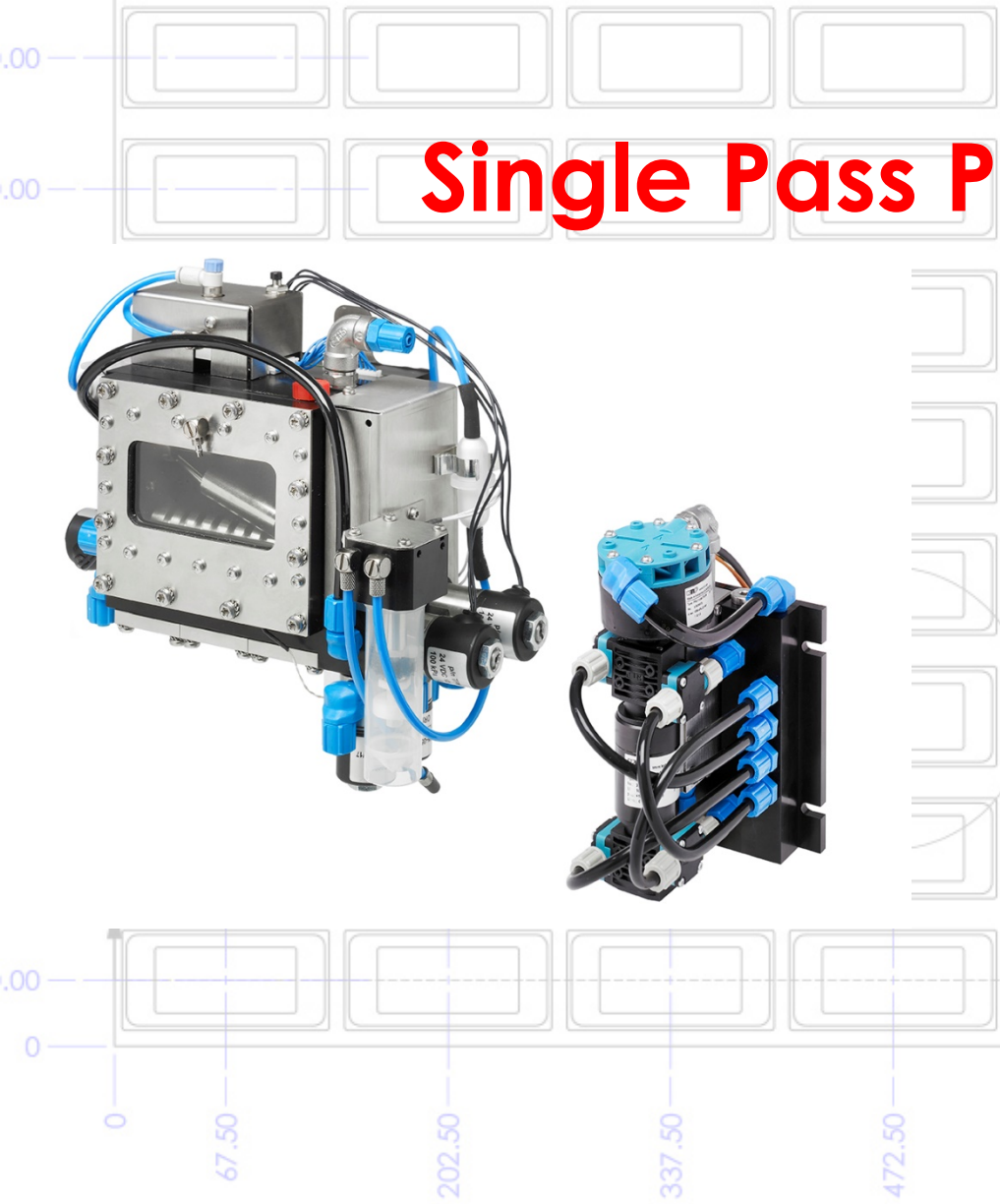
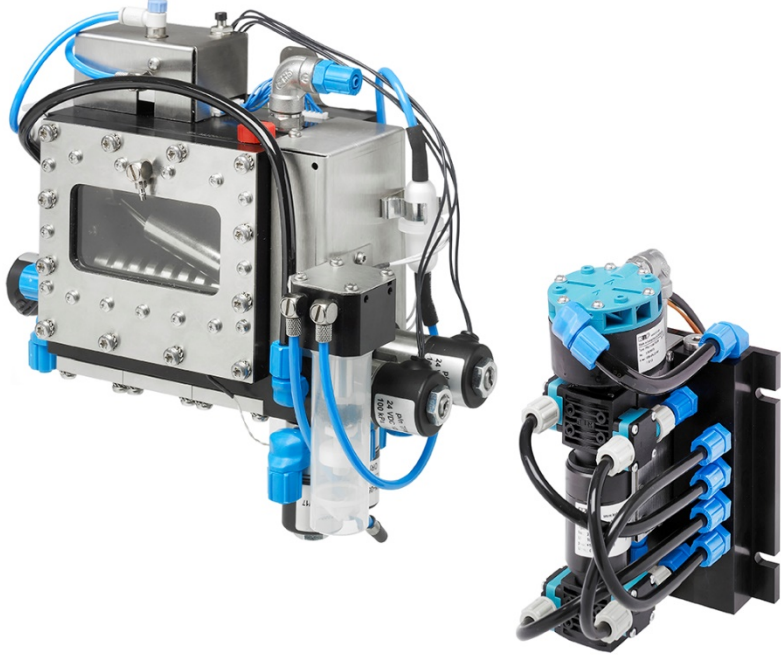


# Image Size

- Image size drives the cost of the printer.
- Image length is not an issue.
- Image width is limited to the width of the printhead.
- To go wider, you need to add more cost.
  - This adds cost to electronics, Ink Management System, more printheads, lamps/curing.
- Adding more printheads to make the print area wider is called “Stitching”
- There are “page wide” waterbased printheads available
  - Good for printing paper and coated rolls
- UV and LED Printheads are becoming modular in design
  - See the Xaar 5601

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# Single Pass Print Heads



SECTION A-A

7.50

# Image Details - Resolution

- Resolution in inkjet tends not to be a problem.
- Scanning printheads have the ability to travel and print over the same area, printing small amounts of ink with each pass.  
Building resolution
- Single pass has to apply the drops all at once, this give the print the native resolution of the printhead.
- Resolution is also affected by distance from the printhead to the substrate.
  - The further the printhead is from the substrate the likely the drops will go thru air turbulence and land in a different location than they were supposed to.
  - Larger drops can travel further distance than smaller drops, but that decreases the resolution.
  - Air Mitigation can be used to make the drop fly further with higher accuracy. Replacing the air around the printhead and substrate with a gas with a lower coefficient of drag.

# Frequency of Variable Data

- Inkjet Thrives in this area.
- You can setup multiple jobs at once and print them all without stopping.
- With an ERP system, you wont have to even look at or have some touch an image, it can go directly to the printer.
- Short and even one off prints can be printed quickly and efficiently.
- Imagine being able to print 20, 40, 100 different small jobs a day, all at higher margin with limited interaction.
- Analog systems would not be able to do this cost effectively.
- Customers would be able to print what they need when they need it, at a higher price point while holding less inventory.

# Frequency of Product Changes

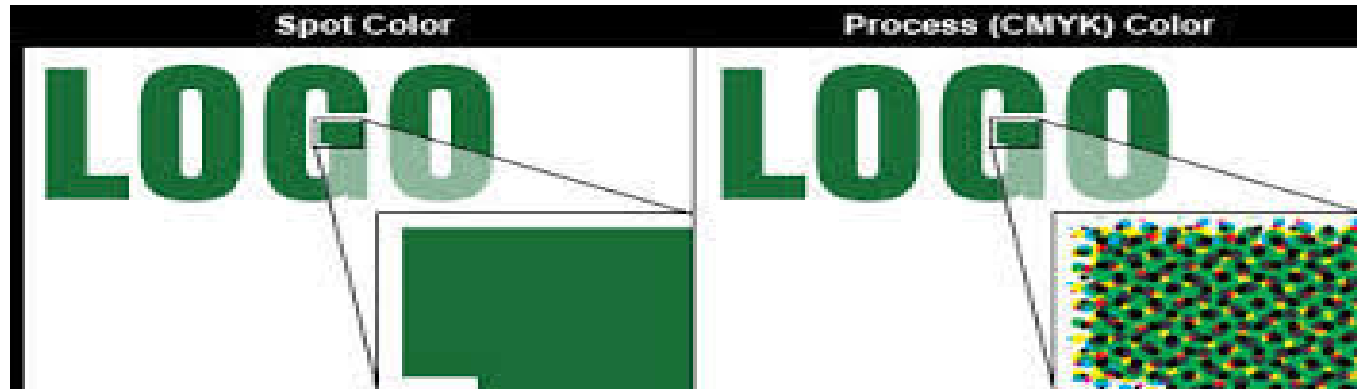
- Typically changing to a new product with analog can be time consuming and expensive.
- With inkjet printing changing to a new product can be quite easy.
- As long as the product fits under the printheads and is stable when being printed it should work.
- LED flatbeds can move up to 6" in height and print on tall objects.
- Lifts can be added to an LED Flatbed printer to move the printable height from 6" to 12" or higher custom heights.
- Single pass systems can be built to accommodate a tall printable substrate.



# Number of Colors

- Unlike analog inkjet's inks are limited in Colors
  - Color are also limited by lower pigment loads compared to analog
- Primary colors are Cyan, Magenta, Yellow and Black
- White and Varnish are also very popular but not needed on every printer
- Secondary color are Light Cyan and Light Magenta
- After that you get into specialty colors such as Light Black, Violet, Green, Red, and Orange.
- Spot colors are available but most ink companies charge a fee to develop and have MOQ's.
- Color Gamut of CMYK is smaller than analog prints, but with OGV you can increase the color.

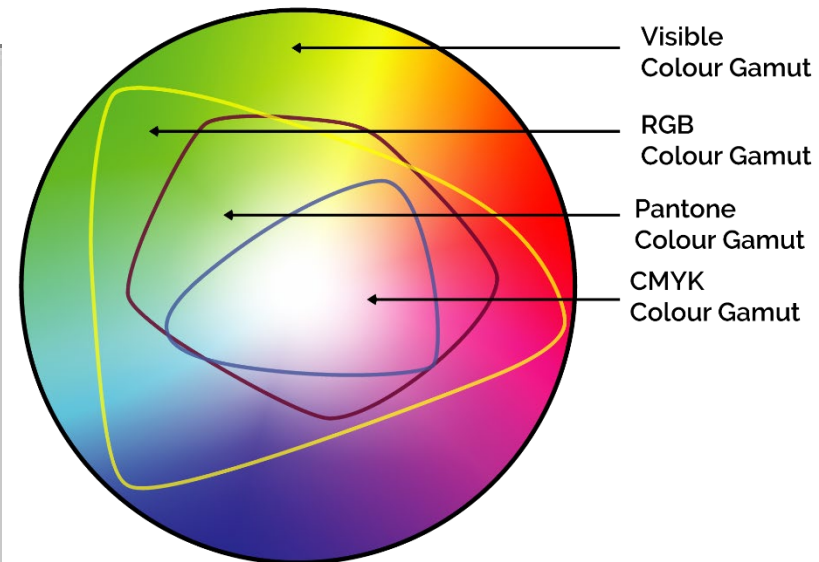
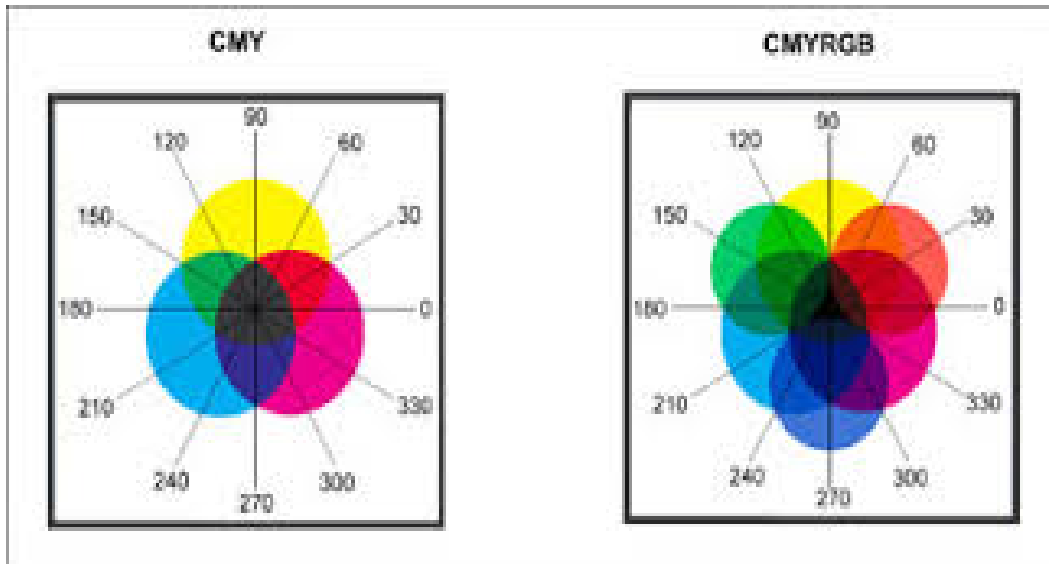
# Visual Differences –Analog verses Ink Jet



## Colour Gamut Comparison

Our visible colour spectrum  
vs.  
RGB displays & print processes

Available color Gamut ?

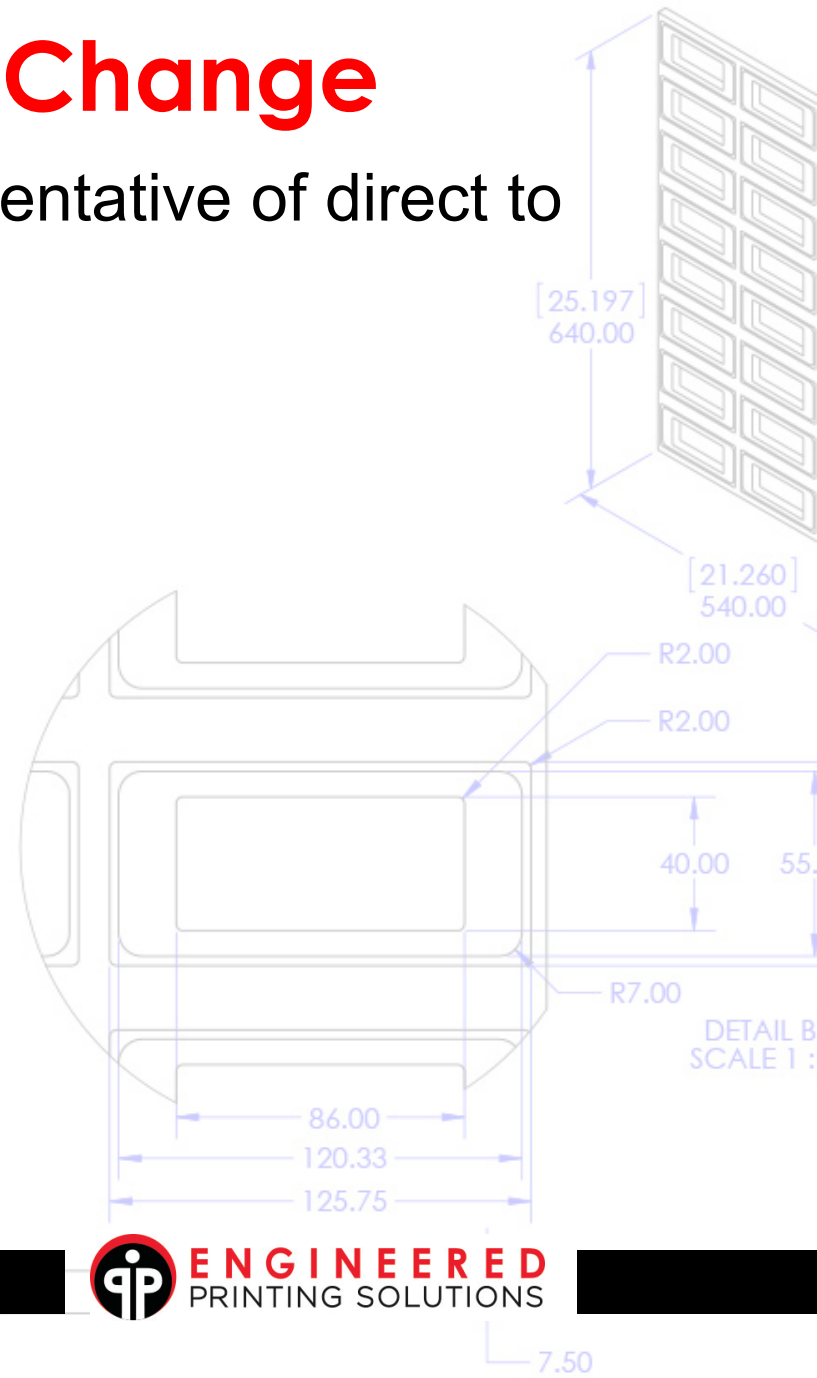


# Why convert from Analog

- Personalized and Variable Data is a must
- Less down time
- Non contact printing or pressure sensitive substrate
- Ability to print on demand – Hold less inventory
- Short and Mid production runs – Eliminate MOQ
- Fast Turnaround and quick changes – Same day shipping
- Less operator handling and maintenance of the printer
- Lower cost of entry
- Ability to have ERP handle incoming print files

# The Process to Change

- Discuss application with representative of direct to object integrator
- Establish clearly defined scope
- Send samples for print testing
  - Printed samples for evaluation
    - Adhesion
    - Print quality
    - Ink requirements/certifications
- Production system proposal
- Purchase of system
- Design & Acceptance
- Installation



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