

Inkjetting Hard Coats

Automotive Direct to Shape Applications

Phil Collins

Director – Advanced R&D



Vonlanthen

Automotive Events

AUTOMOTIVE

HMI, UX & Connectivity

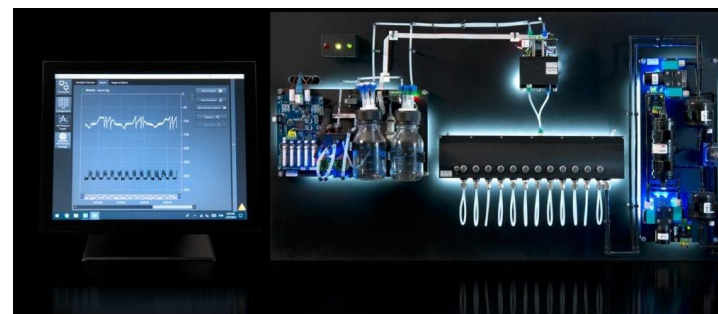
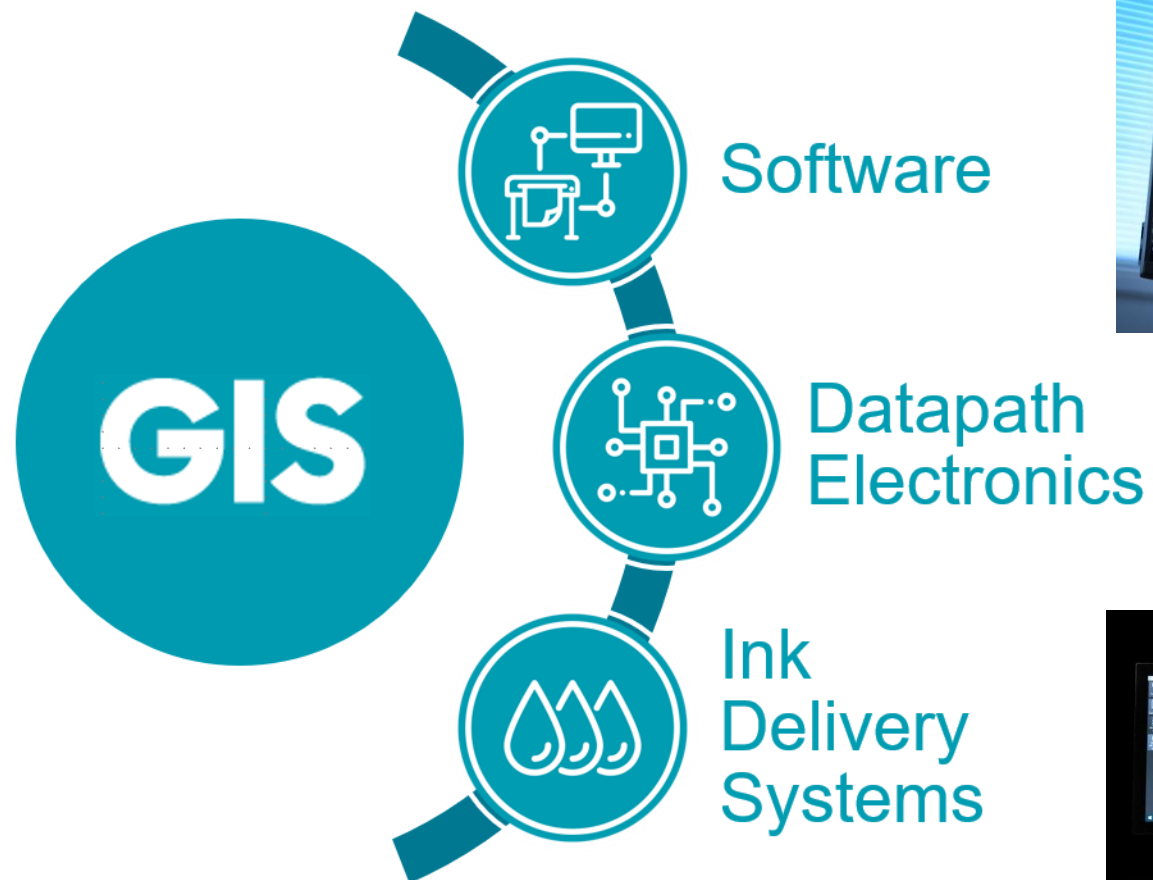
Plastics & Advanced Composites

Painting & Advanced Coatings



The GIS EcoSystem

Complete image management from pixel to drop



We work with customers from R&D, Prototype Development - through to Production

Phil Collins

- Engineer and mathematician
- Director – Advanced R&D
- 35 years experience in graphics and printing

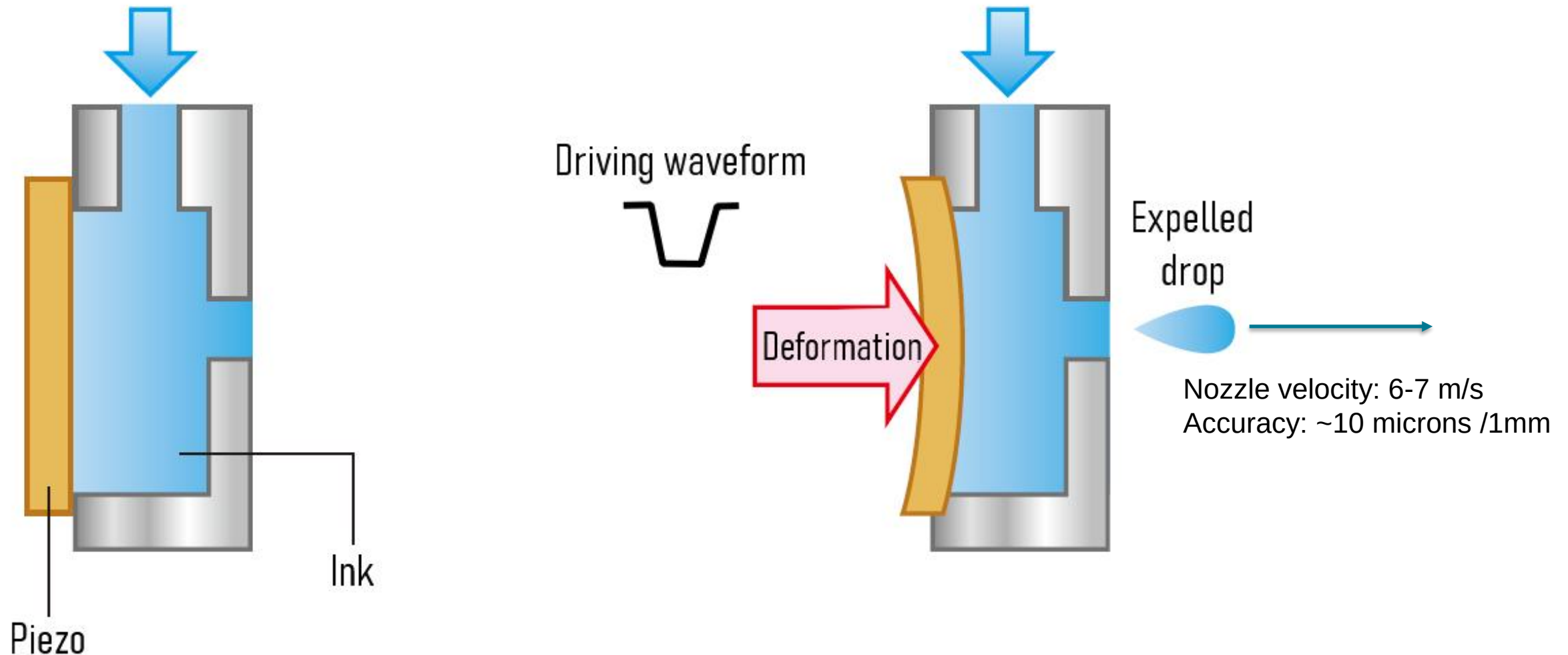


Agenda

- Inkjet Technology Background
- Inkjet in Industry
- Technology Update
- Coating & Decorating a Real Product

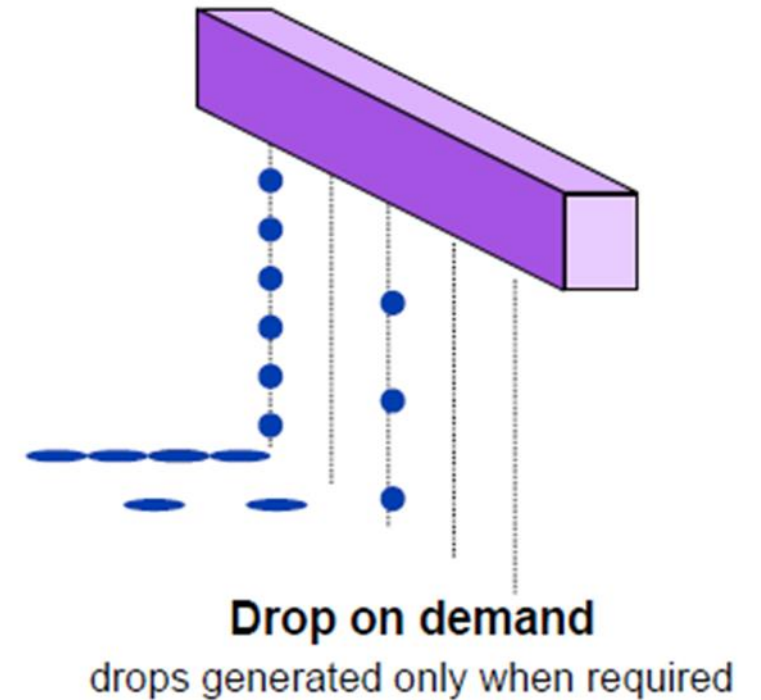
Inkjet Technology: Piezo-electric nozzle

The dominant technology in industrial inkjet is piezo-electric drop on demand

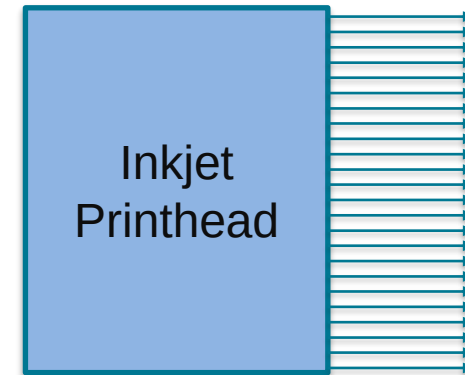
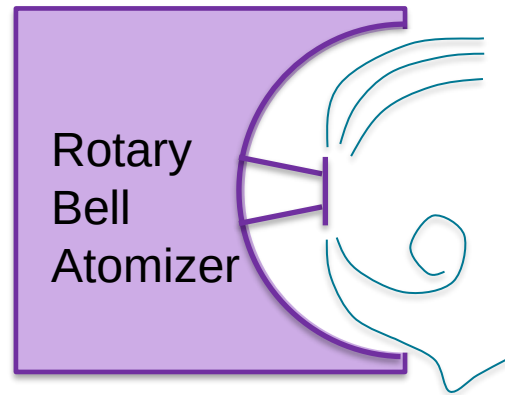


Inkjet Technology: Printheads

- **Industrial inkjet printheads**
 - Drop sizes: 2 – 200 picoLitres
 - Firing rates: 10 – 220kHz
 - Highly integrated: 1000's of nozzles per head
 - Modular and scalable
 - Long operating life: $\sim 10^{10}$ operations
 - Printheads and variants for many applications



Inkjet Technology: Comparison With Spray



- Inkjet and Spray use fundamentally different drop formation methods
- Typical concerns for spray painting systems:
 - Transfer efficiency – how much of the fluid gets to the target surface
 - How to deal with the fluid that doesn't get there – cost & environmental
- Typical concerns for inkjet systems:
 - Jettability of the fluid – viscosity and particulates
 - Complexity of digital control – every droplet counts, and there are lots of them

Inkjet Technology: Key Benefits



Precise drop formation



Accurate non-contact deposition



All under digital control

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Inkjet in Industry: Big Presses



Disclaimer

Global Inkjet Systems supplies inkjet technology and components to 150+ original equipment manufacturers world-wide. As a matter of policy, we do not disclose our customer relationships.

These slides contain images chosen to illustrate the range of inkjet print systems which is available in the market. The presence, or absence, of any manufacturer's products in these images does not in any way imply a commercial relationship between that manufacturer and GIS.



Inkjet in Industry: Ceramics



Image Source: System Italy

Inkjet now dominates
ceramic tile production



That floor looks like stone
- but it isn't

Inkjet in Industry: Textiles



Image Source: SPG

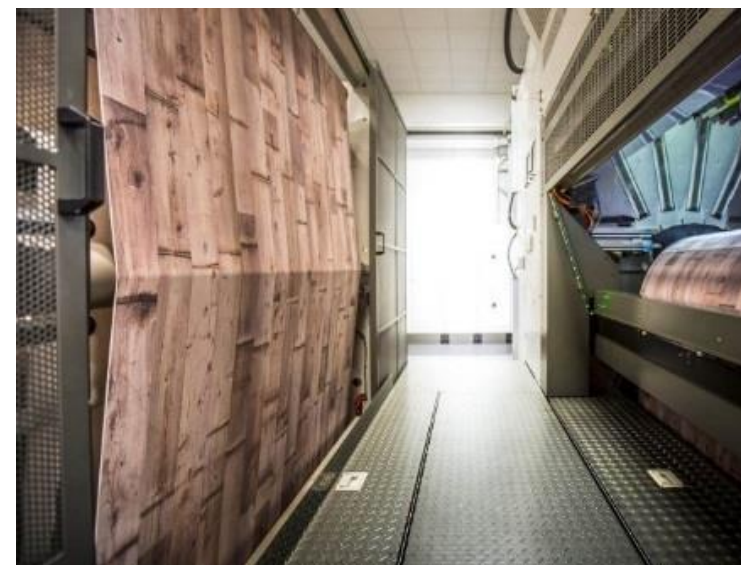
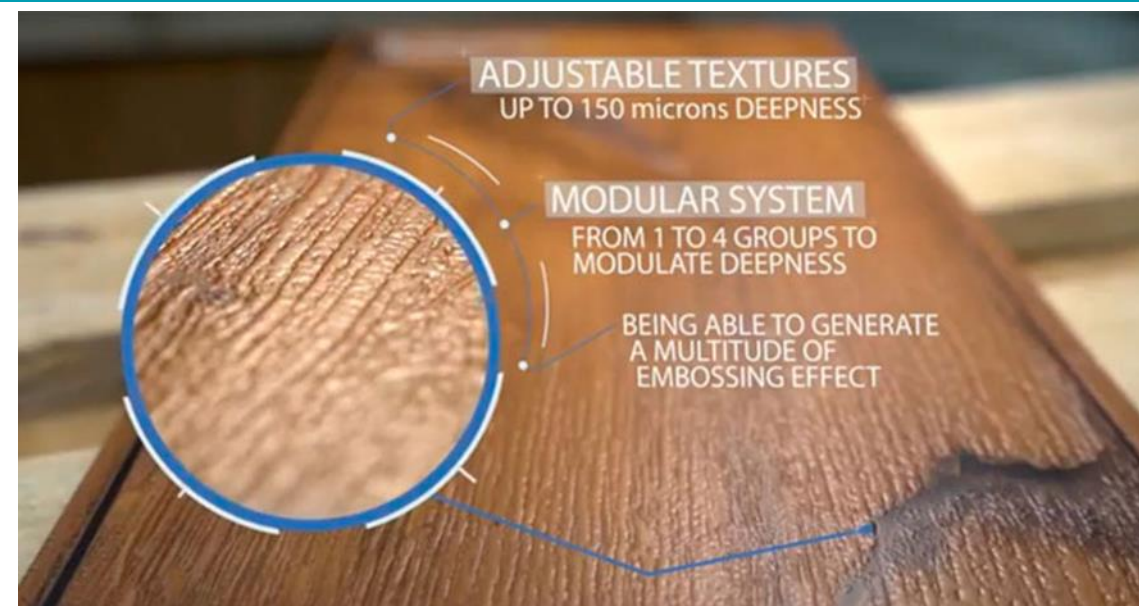
Digital print for textiles has reduced minimum viable print run lengths and shortened turnaround times



Image Source: Seiko Epson Corporation

Inkjet in Industry: Décor

Graphics and textures for all kinds of decorative products: wall coverings, edge banding, flooring, doors, window frames, furniture...



Inkjet in Industry: Automotive

- Decoration and protective coatings
- Mostly partial coverage so far
- Still some way from mainstream product

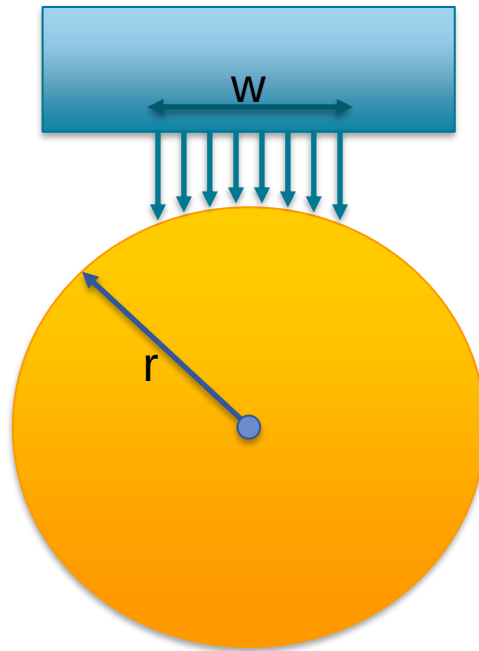


Agenda

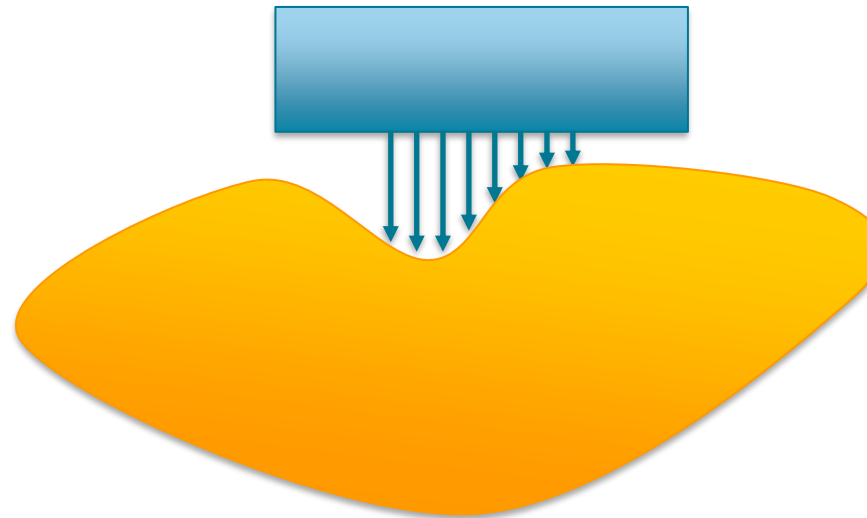
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Technology Update: Throw Distance

Inkjet is usually associated with throw distances of 0.5 – 4 mm.
Surface curvature creates a requirement to jet further



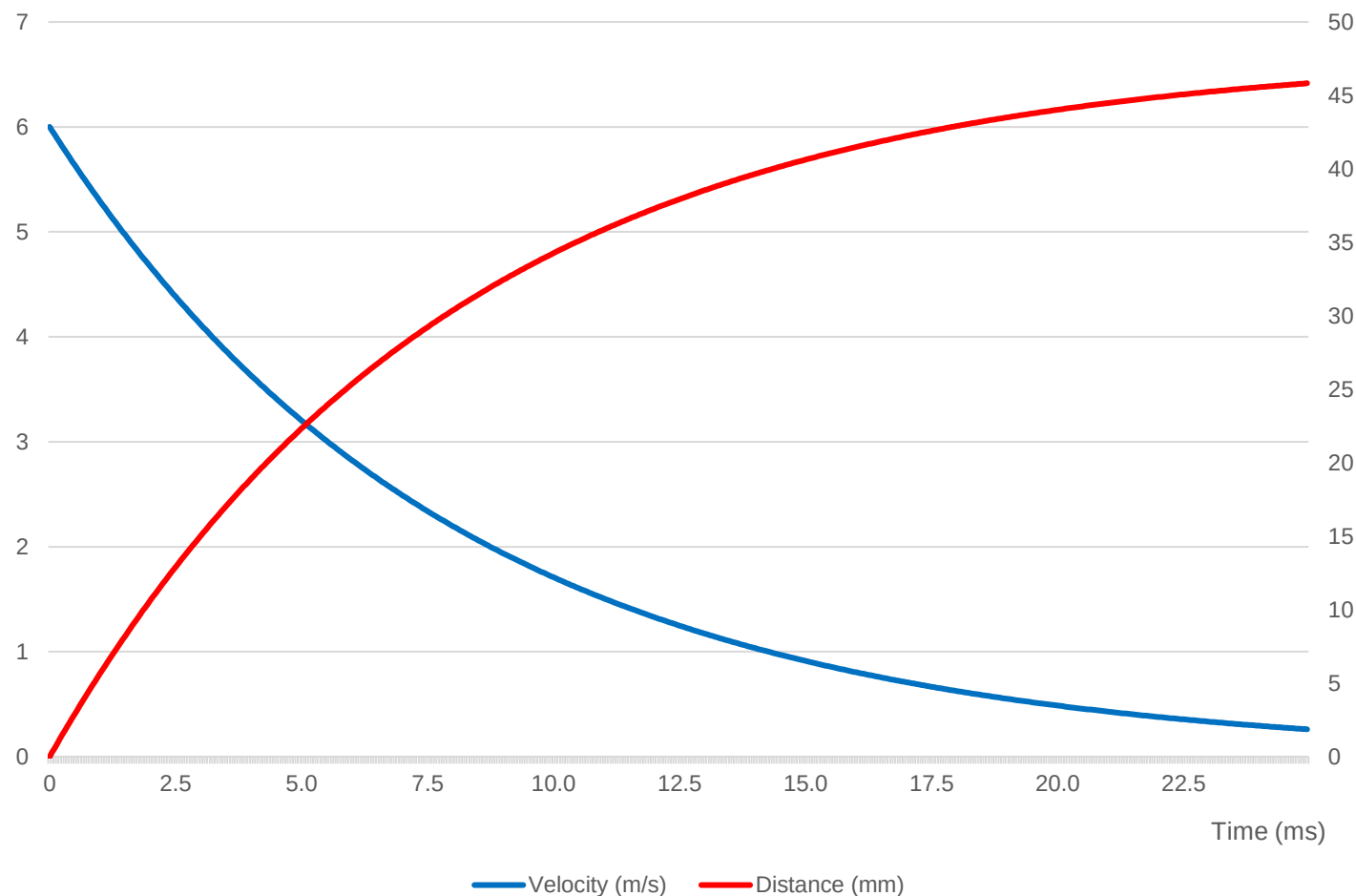
Convex
 $r \gg w$



Near-convex
 $h < h_{\max}$

Technology Update: Throw Distance

Flight of Droplet - Stokes' Law Model



This is a droplet drag model for

- 70 picoLitre drop
- Nozzle velocity 6m/s
- Density ~1(000)

Although this is a theoretical model it seems to hold quite well in laboratory tests across a range of drop sizes and speeds

The drops lose their way once they slow down to below ~1m/s

A distance of 30-40mm is achievable for coating applications

For print and graphics, 5-10mm is more realistic

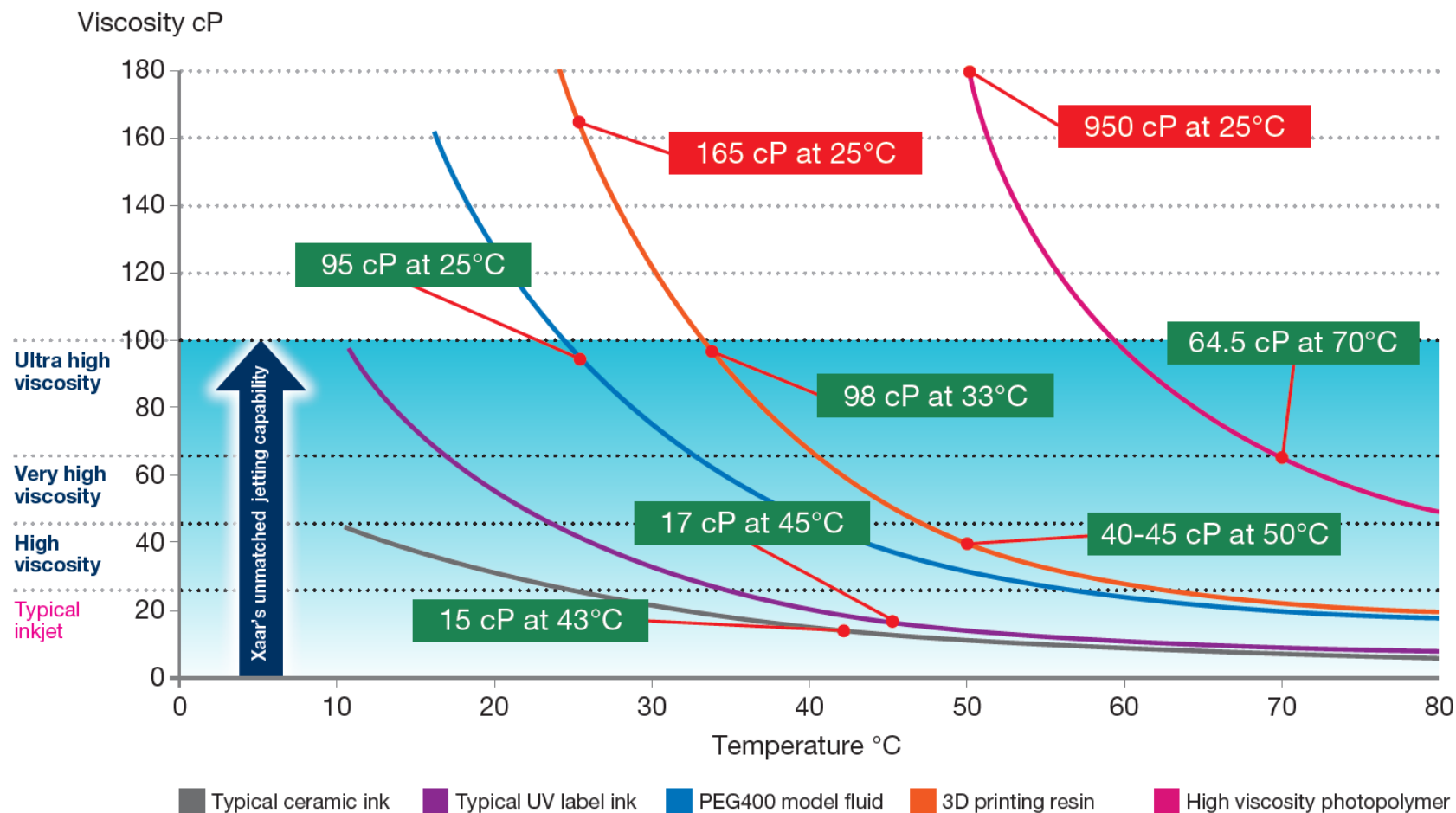
Technology Update: Viscosity Range



Xaar has released experimental data showing that their TF Technology® printheads are capable of jetting fluids at much higher viscosity than previously thought.

Ricoh has also disclosed information about jetting high viscosity fluids.

Not yet commercially available, but pointing the way towards inkjet application of all kinds of paints and coatings.



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Case Study: Wing Mirror Cover

- Based on commercial work
- Objective: to apply an approved automotive hard coat by inkjet over the exterior surface
- Using a generic after-market product with no commercial confidentiality restrictions



Case Study: Automotive Hard-Coats

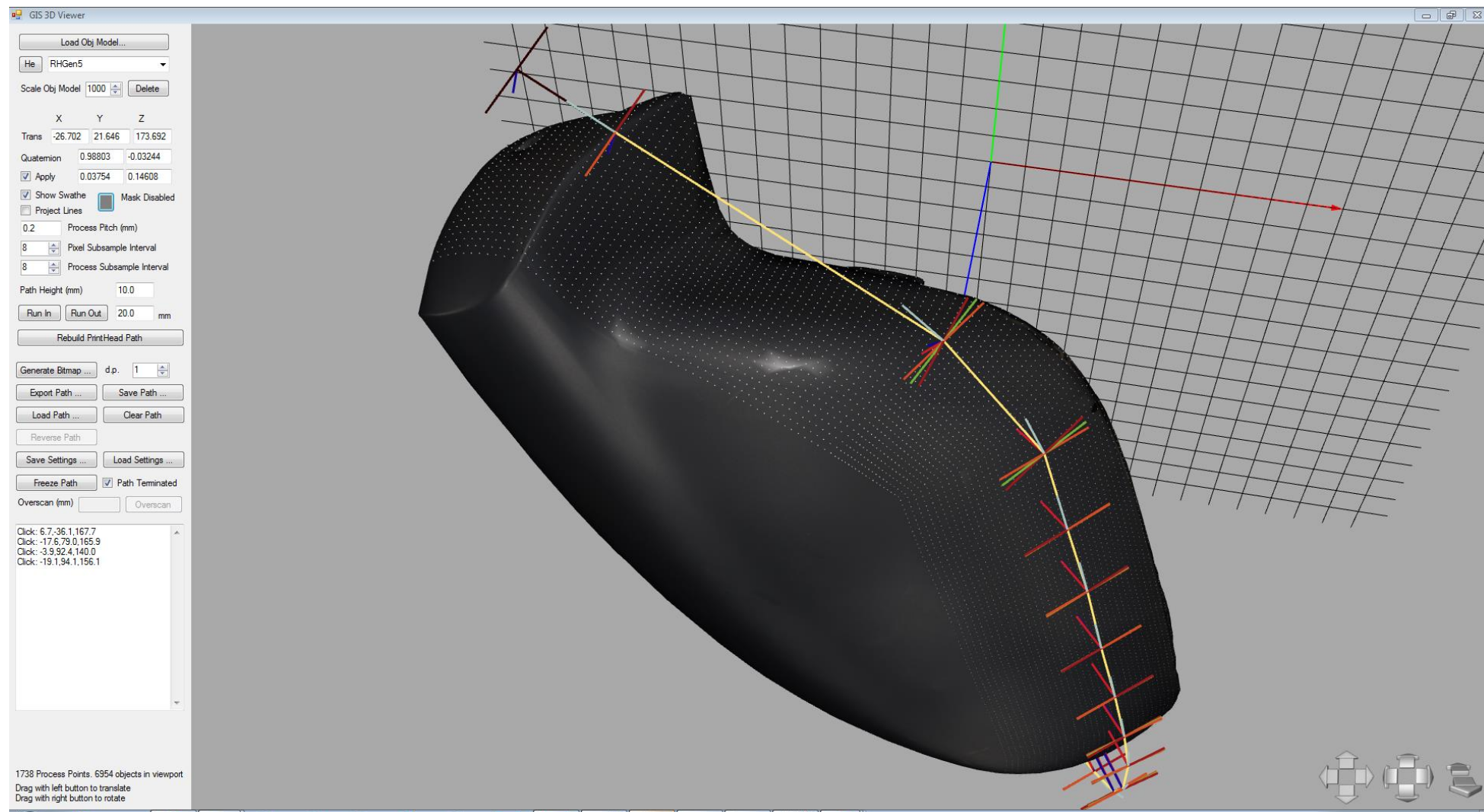
Hard-coats are an early market opportunity for inkjet

- Some are already available in inkjettable formulations
 - notably Momenive's SilFORT range
- There are many new requirements for coating plastic components
- Significant cost savings are possible
 - Materials savings
 - Process efficiencies
 - Environmental controls

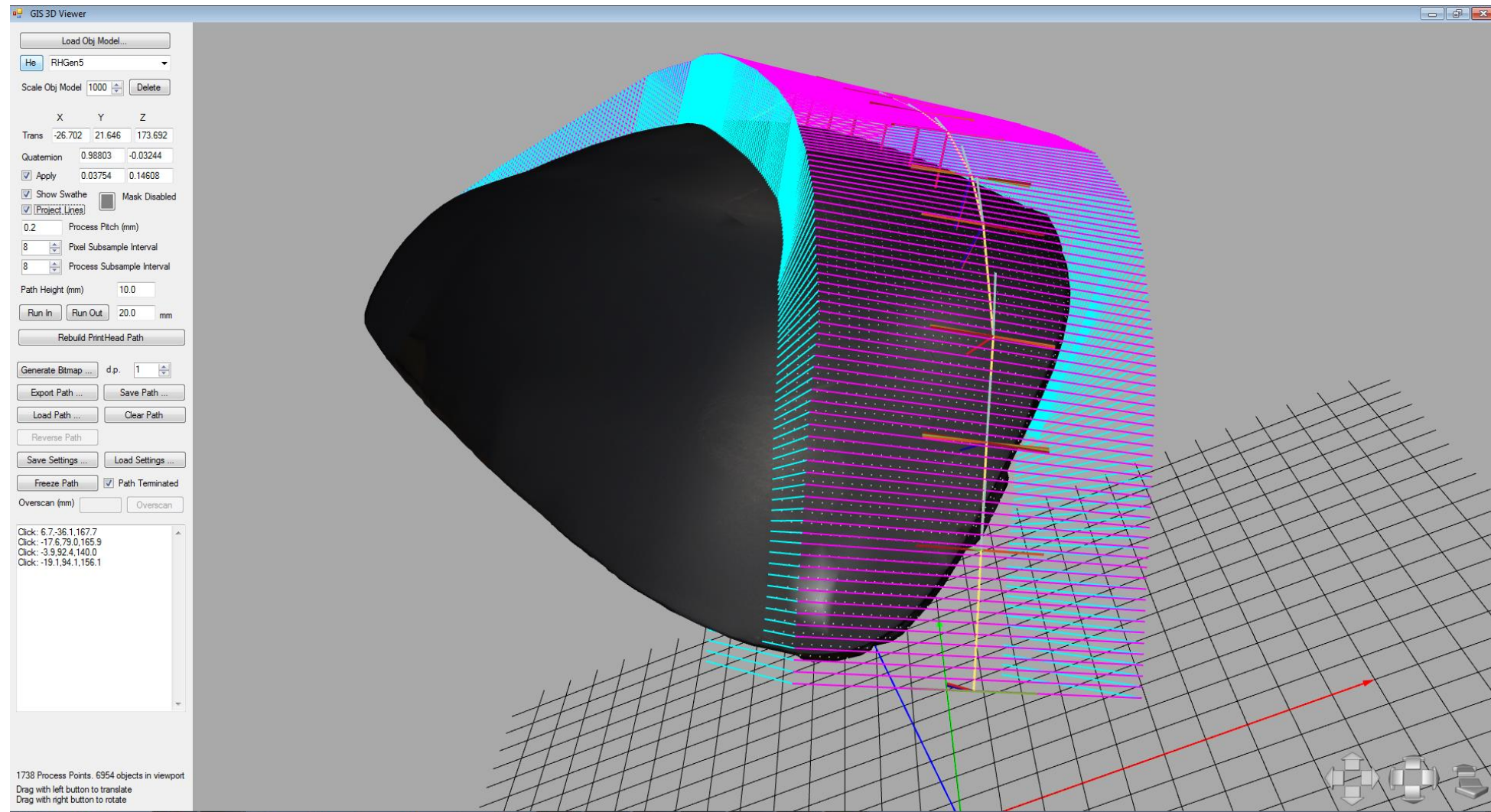


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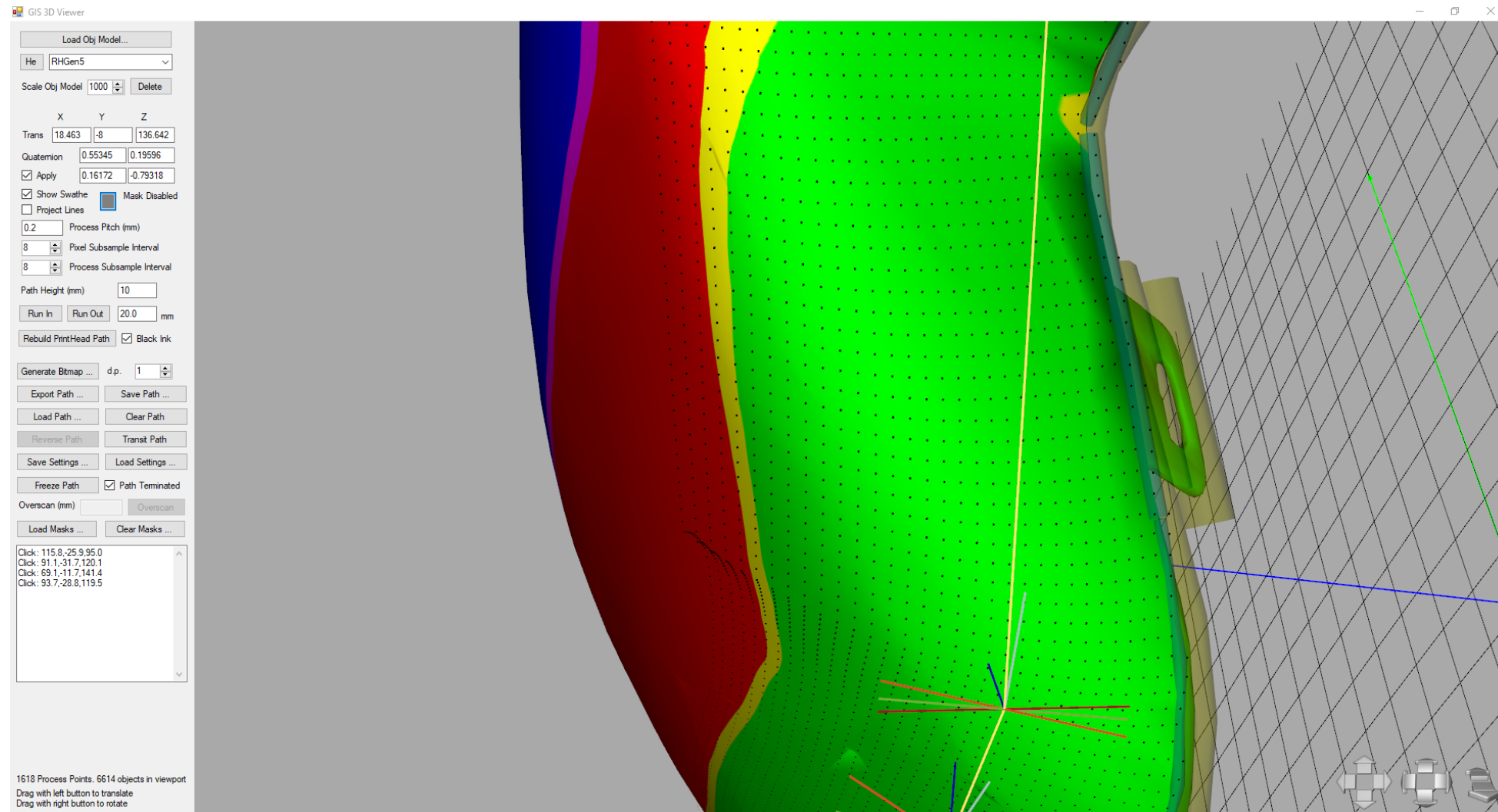
Case Study: GIS Print Path Designer



Case Study: Swathe Visualisation



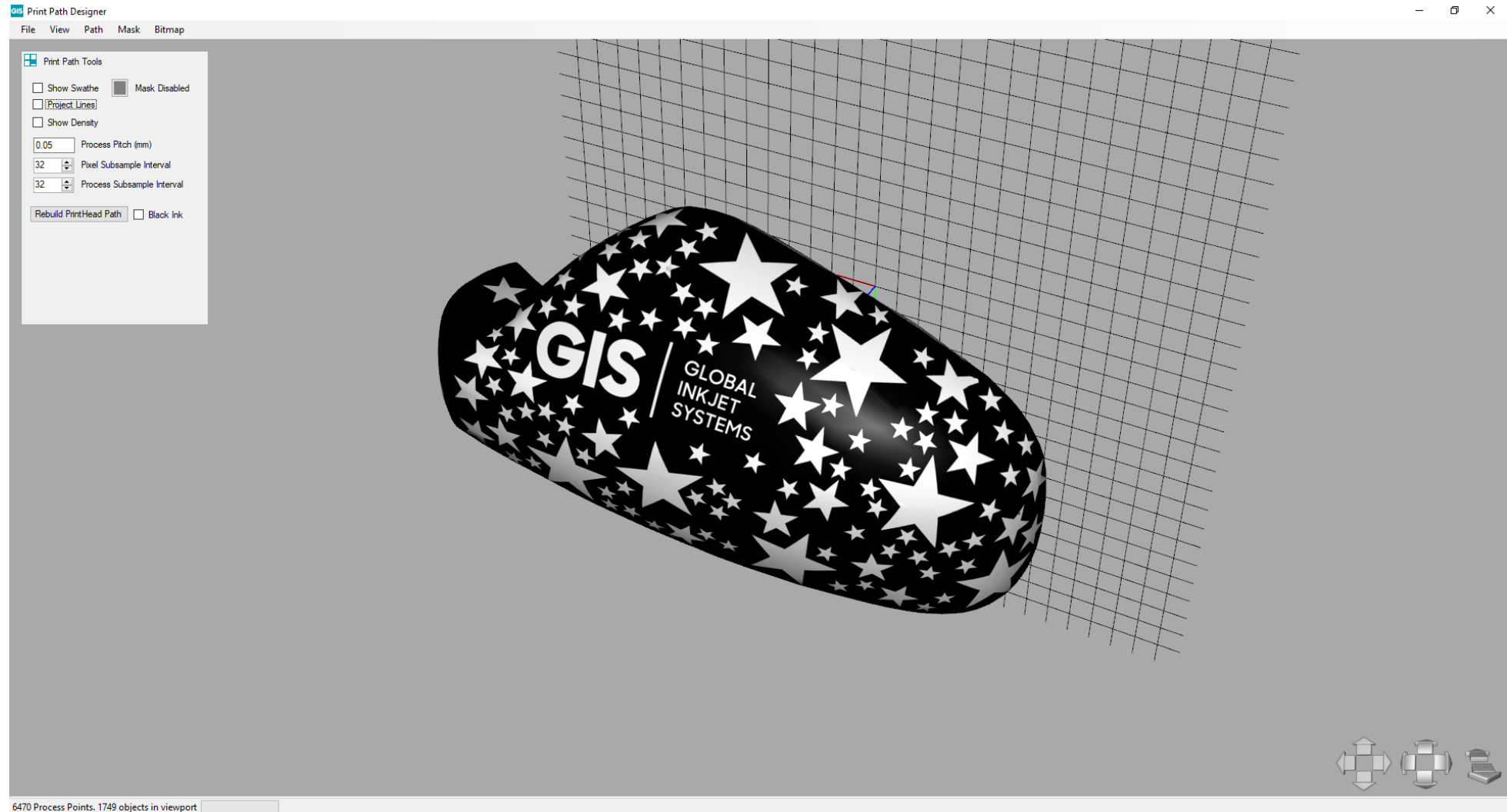
Case Study: Masking and Density



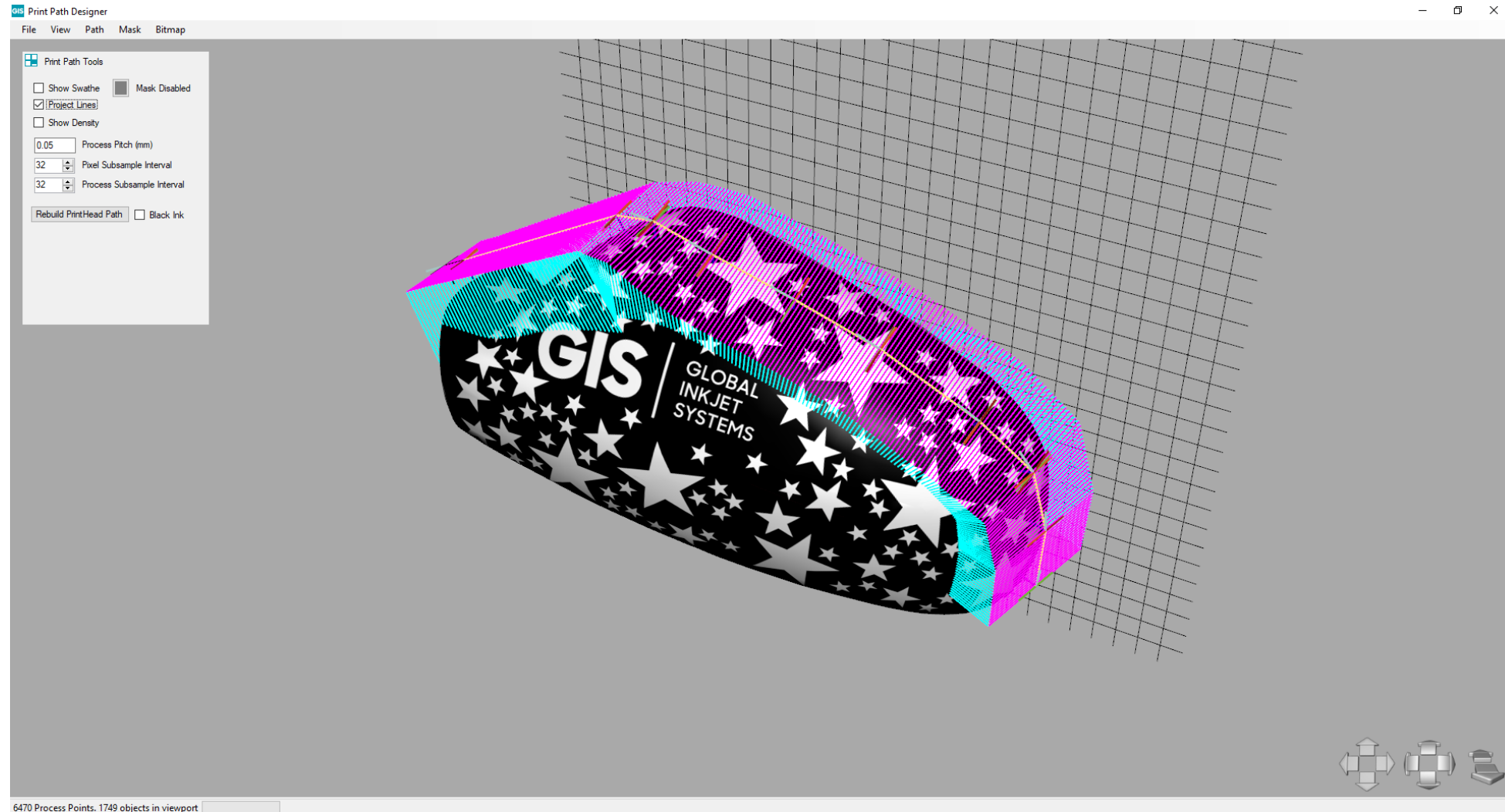
Case Study: The Movie



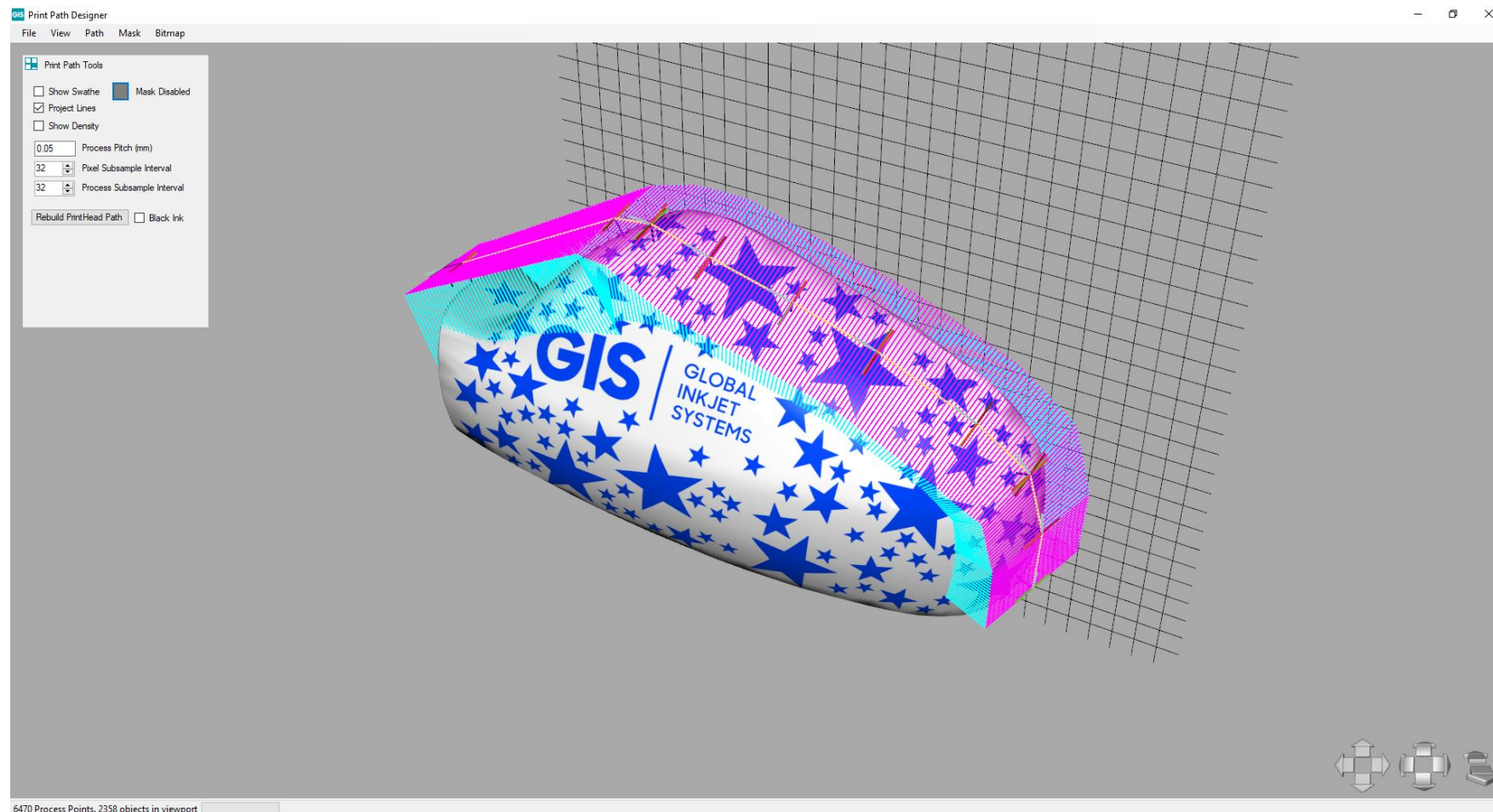
Case Study: Product Decoration 1



Case Study: Product Decoration 2



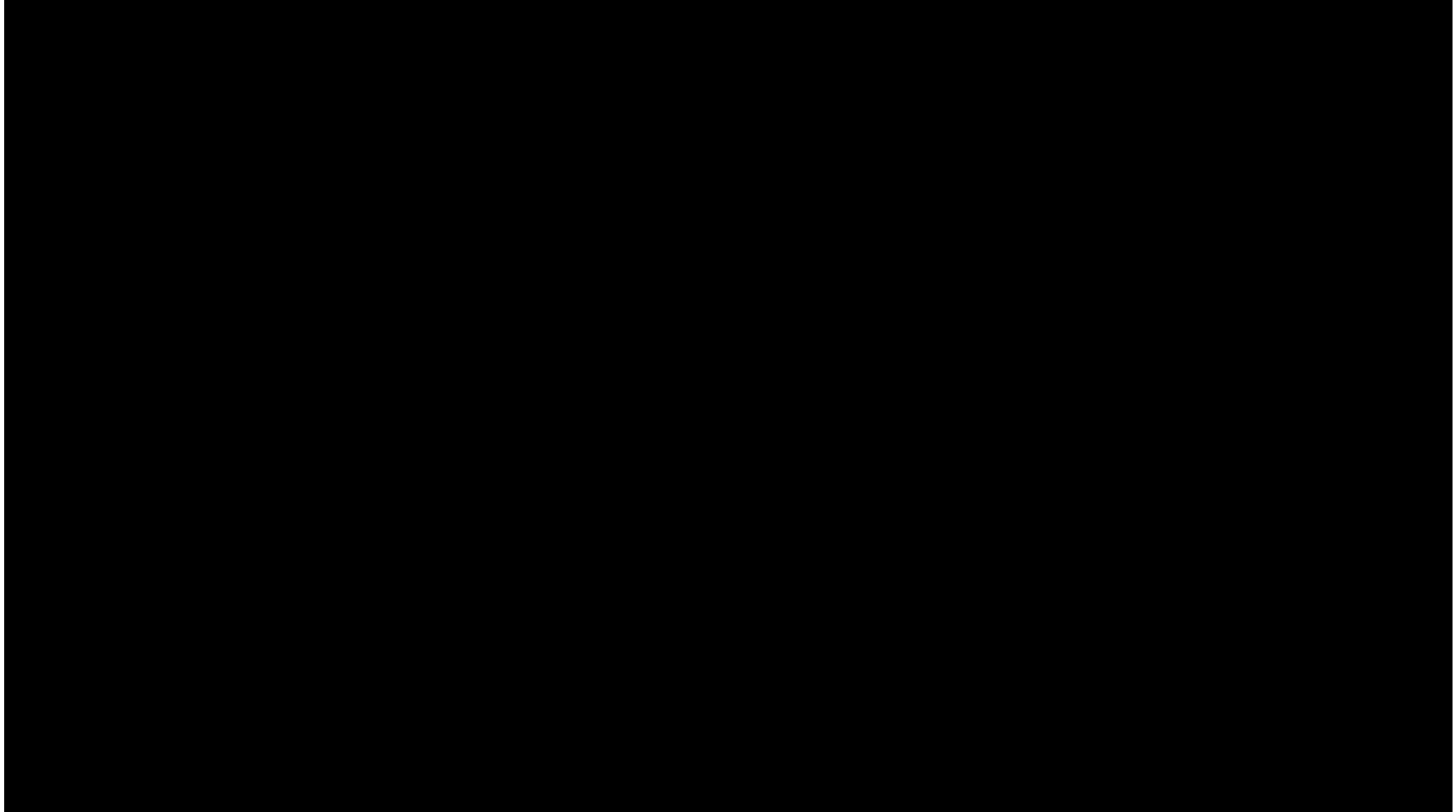
Case Study: Product Decoration 3



Printing a Marabu graphic UV curable inkjet ink
Additional coating may be required for durability



Case Study: The Movie 2



Summary

- Inkjet is a mature technology which has already brought benefits to many industries
- There are early market opportunities in automotive, for example with hard-coats
- And our ambition reaches much further

Any Questions?



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