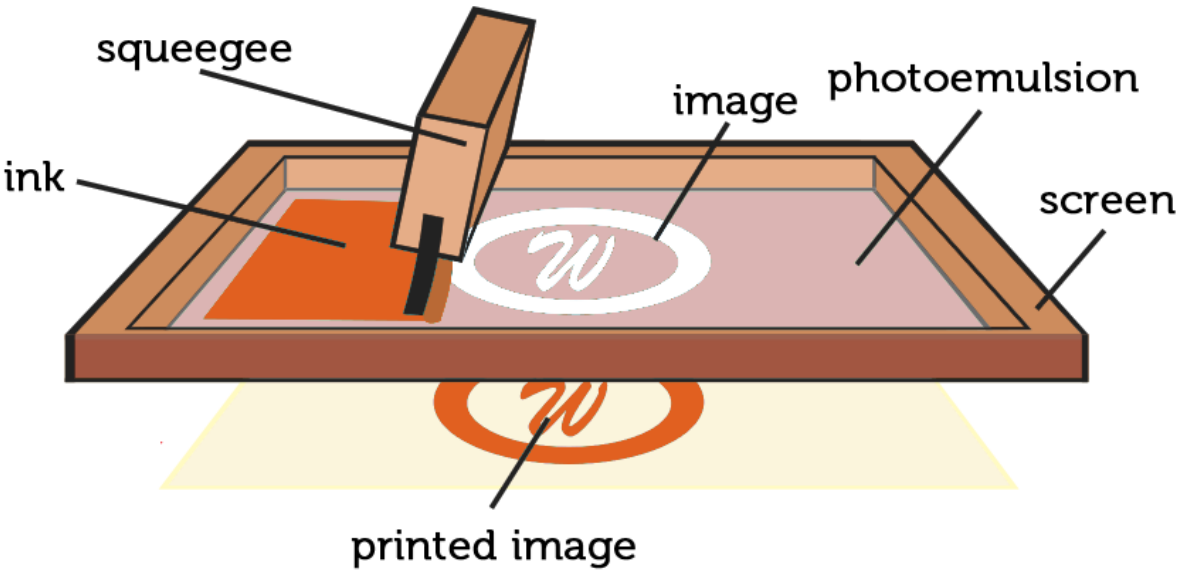
Screen Printing

Instrumental Technique
Group Meeting (07-07-18)

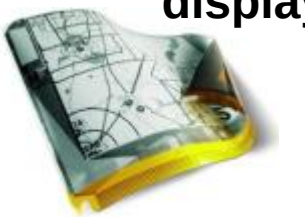


- Ankit Nagar

Printing: Emerging Applications

touch screens

flexible displays



flexible solar cells

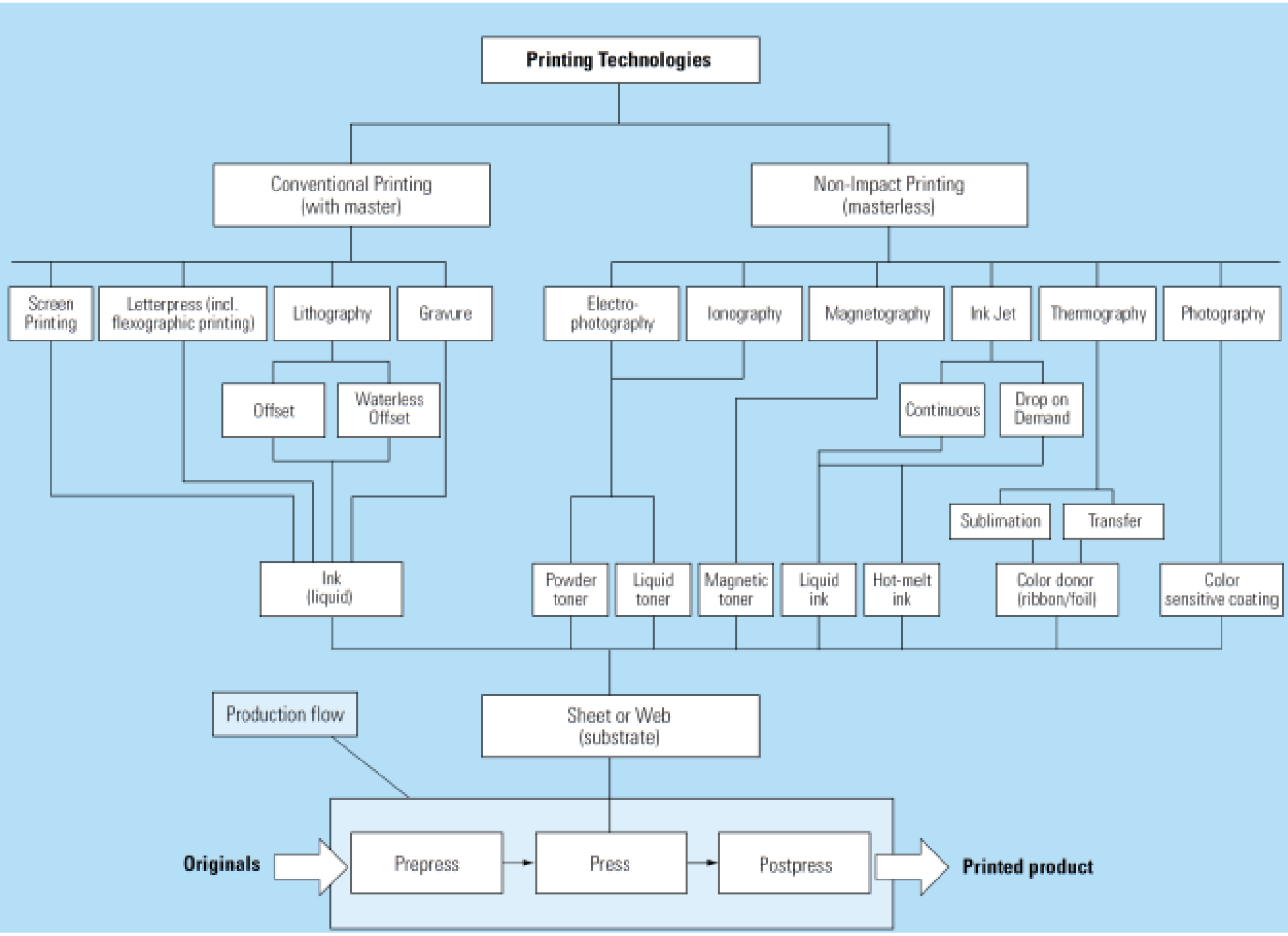
Characteristics…	Benefit…
• made on plastic foils (+metal) • size > tens of cm^2 • thickness < 200 µm	• flexible: easy to handle • flexible: easy to integrate in other products • Flexible = unbreakable

food and medicine monitoring sensors

health patches

flexible light emitting devices (OLEDs)

Source: FlexE, IITK


Printing Technologies
Conventional Printing (with master)
Non-Impact Printing (masterless)
Screen Printing
Letterpress (incl. flexographic printing)
Lithography
Gravure
Offset
Waterless Offset
Electro-photography
Ionography
Magnetography
Ink Jet
Thermography
Photography
Continuous
Drop on Demand
Sublimation
Transfer
Ink (liquid)
Powder toner
Liquid toner
Magnetic toner
Liquid ink
Hot-melt ink
Color donor (ribbon/foil)
Color sensitive coating
Production flow
Sheet or Web (substrate)
Originals
Prepress
Press
Postpress
Printed product

Plenty of Choices?

Limitations by available inks and substrates!

❑ **Surface Parameters**

- Material
- Surface Energy
- Roughness
- Temperature performance
- Thickness
- Transparency

❑ **Processing Parameters**

- Processing Temperature
- Shrinkage/ Deformation

❑ **Pretreatments necessary?**

- R2R compatible
- Costs

❑ **Ink Parameters**

- Surface Tension
- Concentration
- Solvent
- Viscosity/ Rheology

❑ **Ink Formulation**

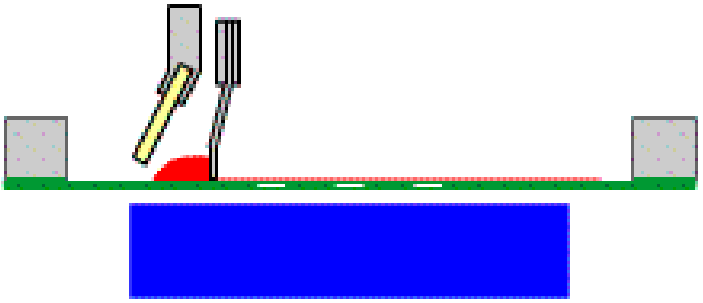
- Solubility
- Printability (Viscosity and surface tension)
- Environmental and safety issues

❑ **Layer Formation**

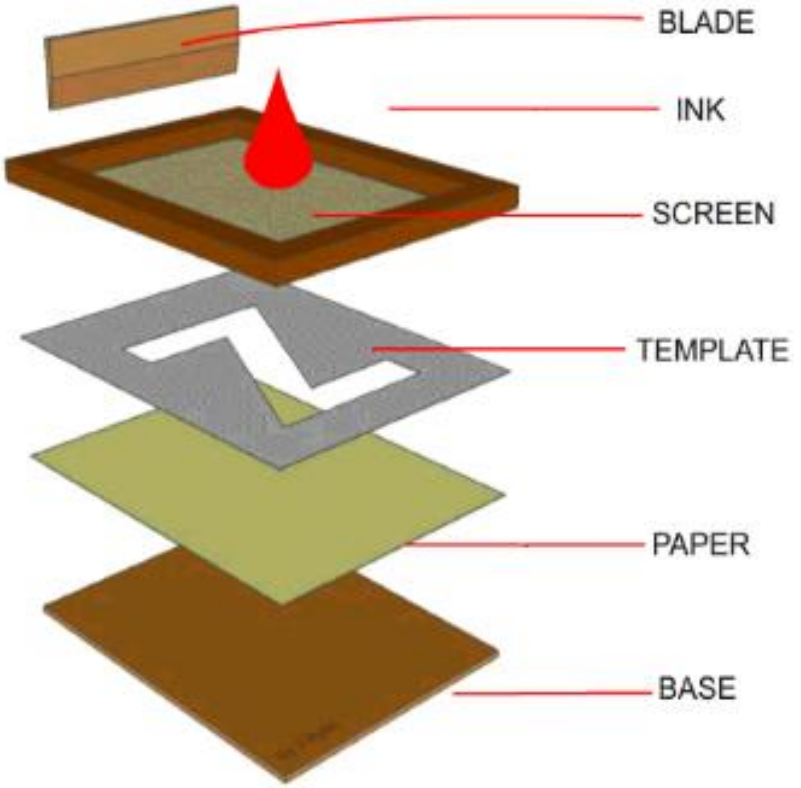
- Ink and substrate interaction (wetting and spreading)
- Levelling -> Uniform layer
- Morphology

Screen Printing

- Woven mesh supports ink blocking stencil
- Stencil forms open areas of mesh that transfer ink as image onto substrate
- Roller or squeegee is moved across the screen forcing ink past the threads of the woven mesh

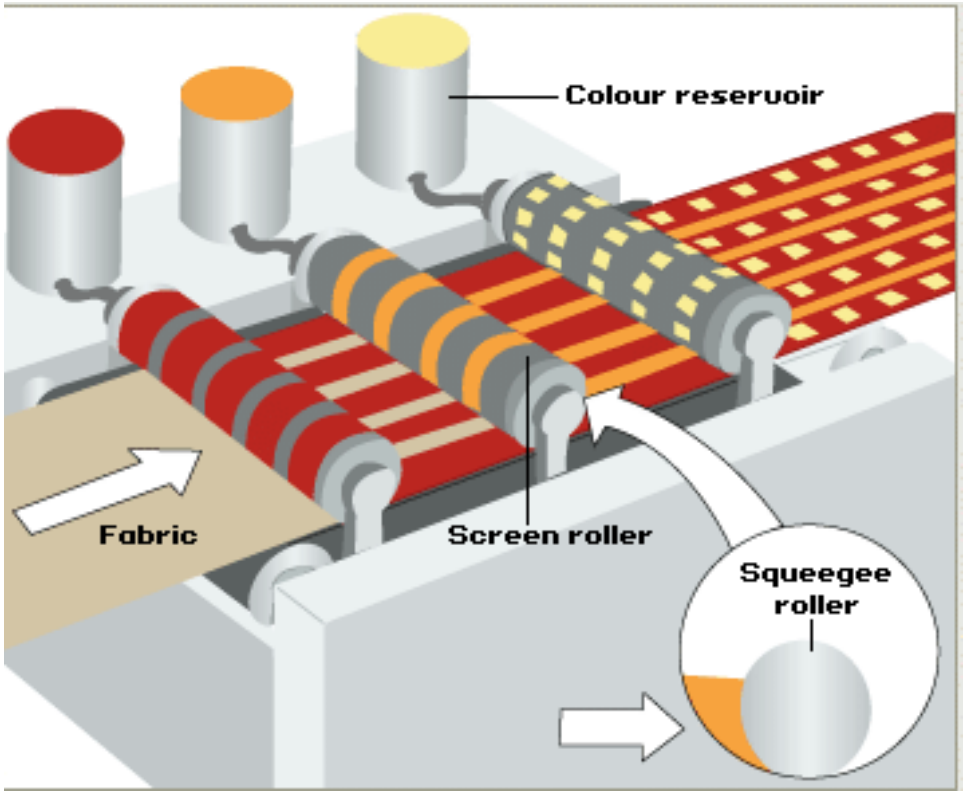


http://www.npt-print.co.jp/main/animation/SC-FLAT-main.gif



https://hanguppictures.com/blog-post/understanding-different-print-runs-ap-pp-hc-type

Rotary Screen Printing



smallest feature size (lab)	20 µm
smallest feature size (industrial scale)	80 µm
ink viscosity range	100 – 80,000 mPas
wet layer thickness	12 – 500 µm
dry layer thickness	500 – 50,000 nm
dry layer thickness accuracy	15 – 40 %
alignment/overlay accuracy	100 µm
linear line speed	>> 10 m/min, independent from resolution

Key Features

- Silk/polymer/steel mesh with photo resist
- Inks: Oil-resin base, UV, solvent based, Water based, 10-400 Pa.s
- Short to medium runs – posters, flyers, textiles, any rigid curved surface
- S2S speed 60 – 1500 sheets per hour.
- High definition screens: 500 mesh fabric, wire diameter 8 µm
- Challenges: material agglomeration, limits maximum particle size to 12 – 15 µm

Solution Processing → Ink

Ink parameters

- Surface Tension
- Concentration
- Solvent
- Viscosity/ Rheology

Ink formulation

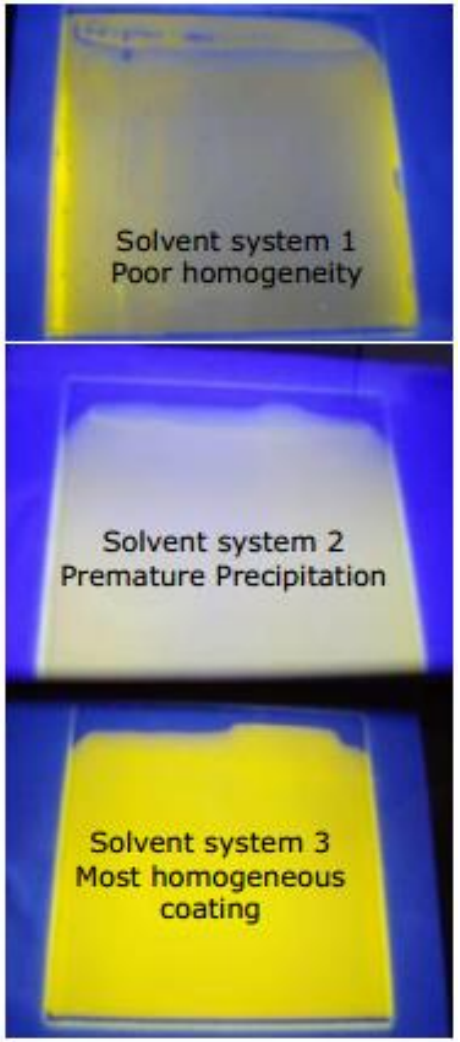
- Solubility
- Compatibility with active material
- Printability
- Environmental and safety issues
- Stability

Drying

- Drying behavior and conditions
- Pre-drying step
- Hard baking
- Annealing

Layer formation

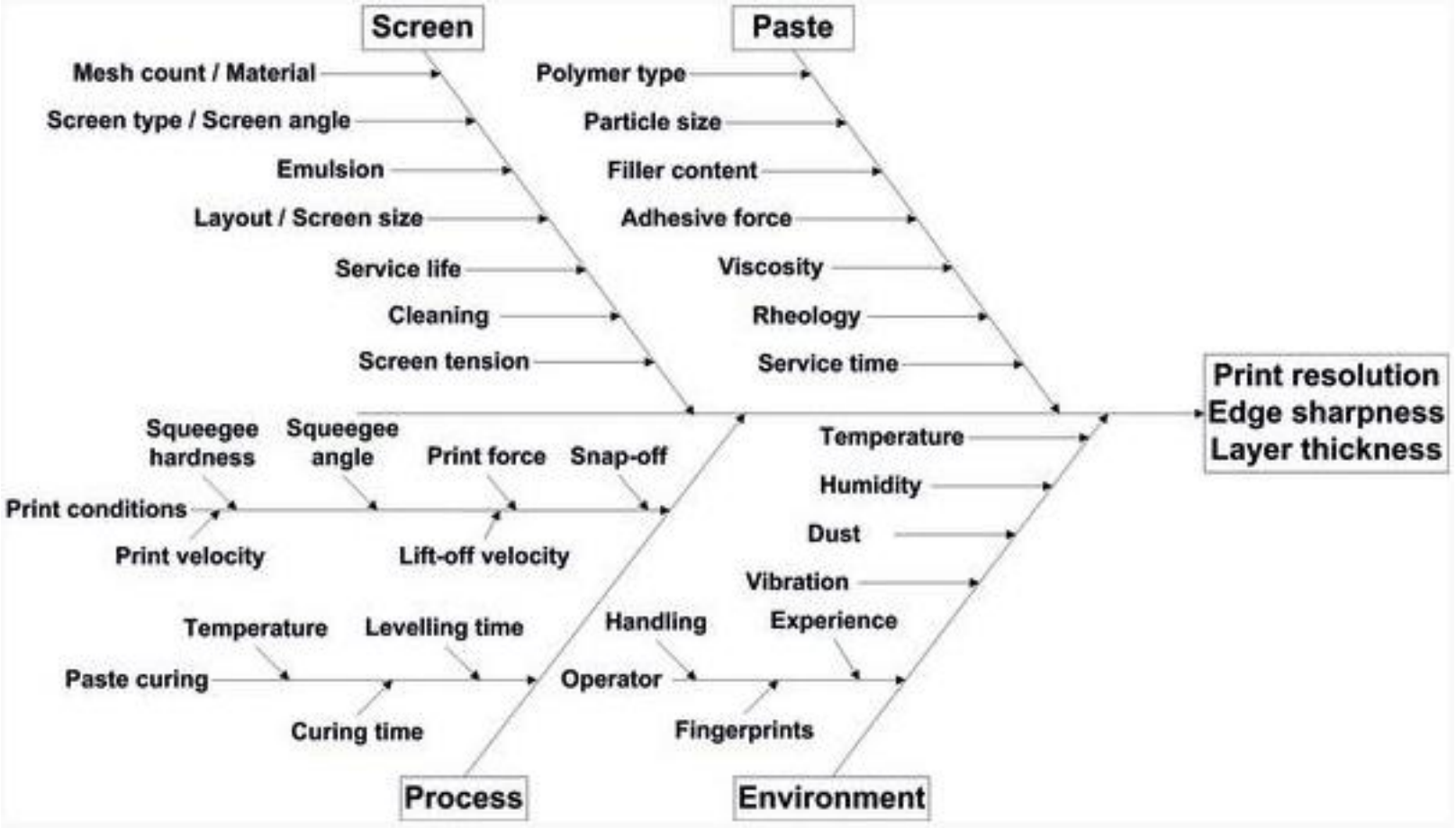
- Ink and substrate interaction (wetting and spreading)
- Levelling -> uniform layer
- Pinning
- Morphology



Devices

- Layer homogeneity
- Device performance and efficiency

Print Quality



https://epp-europe.industrie.de/technology/applications/process-for-highest-integration-density-on-wafer-level-dr-dr-andre-hanke-qimonda-dresden-gmbh-co-ohg-and-marco-luniak-dresden-university-of-technology-germany/#slider-intro-1

THANK YOU