Integration of Micro and Macro Prototyping into the production process
Let me introduce myself:

my name is Wim Janssen
I am the Managing Director of
Mareco Kunststoffen B.V.
and
Mareco Prototyping B.V.

both companies are located in
Venlo, the Netherlands, on the
Rijnaakkade
Integration of Micro and Macro Prototyping into the production process
definitions of Macro and Micro Prototyping
■ costs of changes
■ prototyping, a necessary step
■ choosing the type of prototyping
■ Micro Prototyping
■ Macro Prototyping
■ integration of Micro into Macro
■ summary
DEFINITIONS OF MICRO AND MACRO PROTOTYPING

MICRO Prototyping:
products that are very small and/or contain very small elements and that are also still functional with those dimensions. For the time being, by *small* I mean dimensions of approximately $0.15 \text{ [mm]}$ to $10 \text{ [mm]}$.

MACRO Prototyping:
products that are larger than the products that qualify for micro prototyping and that, in principle, can have unlimited dimensions.
COSTS OF CHANGES

80% of the cost price of the product is determined during the development phase.
Why integrate prototyping?

- Minimising design errors
  - cost savings
- Creating a “tangible” product
  - a milestone in the design process
  - for presentations (marketing, customer, trade fairs)
- Shorten the time-to-market
Available techniques:

- **MICRO PROTOTYPING**
  - photopolymerisation

- **MACRO PROTOTYPING**
  - SLS (Selective Laser Sintering)
  - Mechanical (CNC milling etc.)
  - PU casting (using silicone moulds)
  - Injection moulding (using an injection moulding tool)
Characteristics of Micro Prototyping:
- very high resolutions (from 16 µm)
- immediately usable functionally
- sophisticated materials

Production process:
- Photopolymerisation
Very fine details:

- resolutions of 16 µm and better
- layer thicknesses 0.016 to 0.10 mm
Biocompatible, transparent, nano-cured materials

SCREEN:
holes 0.30 x 0.30 [mm]
Available materials:

- Ceramic Nano Cured RCP 130
- Plastic-like R11
- ABS-like SI1300
- Bio- Compatible E200
- Transparant E300
- Rubber-Like E500

Tables of materials available on: www.mareco-prototyping.com

<table>
<thead>
<tr>
<th>Properties</th>
<th>Units</th>
<th>Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>[g / cm^3]</td>
<td>DIN ISO 1183-1</td>
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</tr>
<tr>
<td>Tensile Strength</td>
<td>[MPa]</td>
<td>DIN EN ISO 527-1</td>
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<tr>
<td>Elongation at Break</td>
<td>%</td>
<td>DIN EN ISO 527-1</td>
<td>2.5</td>
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<td>Flexural Strength</td>
<td>[MPa]</td>
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<td>Heat Deflection Temp. (HDT)</td>
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<td>ASTM D 648</td>
<td>102</td>
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</table>
Dimensions achievable using R11 and RCP30 materials

The highest resolution can be achieved by using R11 and RCP30. The maximum product dimensions are then 40 x 30 mm and the theoretical construction height is 230 mm.
## Micro Prototyping: Technology Matrix

**Tabel 1**: Micro-Prototyping met DLP/DMD

<table>
<thead>
<tr>
<th>belangrijkste gewenste eigenschap</th>
<th>factoren</th>
<th>RCP-130</th>
<th>R-11</th>
<th>SI-300</th>
<th>E-200</th>
<th>E-300</th>
<th>E-500</th>
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<tbody>
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<td>Snap-Fit onderdelen</td>
<td>functie</td>
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<td>-</td>
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<td>prijs</td>
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<tr>
<td>Temperatuur-bestendigheid</td>
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</tbody>
</table>

*The full technology matrix is available on our website*

[www.mareco-prototyping.com](http://www.mareco-prototyping.com)
Characteristics of Macro Prototyping:
- unlimited product dimensions
- accurate
- immediately usable functionally
- series productions are also possible
  (Direct Manufacturing using SLS)

Production process:
- SLS (Selective Laser Sintering)
- mechanical prototyping
- casting in a silicone mould
- injection moulding
Available materials:

- SLS: Nylon 12
- Mechanical Prototyping: all semi-manufactures
- Casting: several types of polyurethane
- Injection moulding: all available injection moulding polymers

Tables of materials available on: www.mareco-prototyping.com
SLS Nylon-12: detailed technical components
SLS Nylon-12: functional model with a film hinge
MACRO PROTOTYPING

SLS Nylon-12: painted, functional models

plasticproto.com
MACRO PROTOTYPING

SLS Nylon-12: also series production (Direct Manufacturing)
MACRO PROTOTYPING

Mechanical Prototyping: all semi-manufactures, including metal
MACRO PROTOTYPING

Casting in polyurethane

plasticproto.com
Injection moulding: example of a product made of PBT-GF30 using an aluminium injection moulding tool
## MACRO PROTOTYPING: TECHNOLOGY MATRIX

<table>
<thead>
<tr>
<th>Factoren</th>
<th>SLS PA12</th>
<th>Mechanisch</th>
<th>Spuitgieten</th>
<th>Afgieten in PU</th>
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<tr>
<td>belangrijkste gewenste eigenschap</td>
<td>Selective Laser Sintering</td>
<td>CNC-frezen draaien verlijmen</td>
<td>Spuitgieten van prototypes</td>
<td>Afgieten in PU a.d.h.v. oermodel</td>
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<td></td>
<td>RP + DM</td>
<td>P</td>
<td>P</td>
<td>RP + DM</td>
</tr>
<tr>
<td>factoren beïnvloed door afmetingen</td>
<td>factoren beïnvloed door CAM en Set-Up</td>
<td>factoren bij prototype spuitgieten sterk beïnvloed door aanmaak hulpmatris</td>
<td>factoren sterk beïnvloed door SLA-model + Sil. matris</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Hoe meer plusjes, hoe beter</th>
<th>function</th>
<th>prijs</th>
<th>levertijd</th>
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</tr>
<tr>
<td>Transparantie</td>
<td>-</td>
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<td>+</td>
<td>+++</td>
</tr>
</tbody>
</table>

**the full technology matrix is available on our website**
**www.mareco-prototyping.com**
Integrating MICRO components into MACRO components by means of insertion
SUMMARY

- Prototyping is a necessary step
- Both Micro and Macro Prototyping can be used
- Unlimited dimensions with the highest levels of detailing
- Short leadtimes
- Sophisticated materials
- Series production is also possible by using SLS
- MICRO components can be integrated into MACRO components by means of insertion
Mareco Prototyping B.V.
Rijnaakkade 20
5928 PT Venlo, the Netherlands

P.O. Box 3196
5902 RD Venlo, the Netherlands

Sales:
+31 (0)77 – 323 01 20 (direct)
+31 (0)6 – 504 599 25 (direct)
+31 (0)77 – 351 50 50 (switchboard)
+31 (0)77 – 351 38 38 (fax)

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