S3 – Screw Simulation Software
Advanced Process Simulation for Single-Screw Plasticizing Units in Injection Molding

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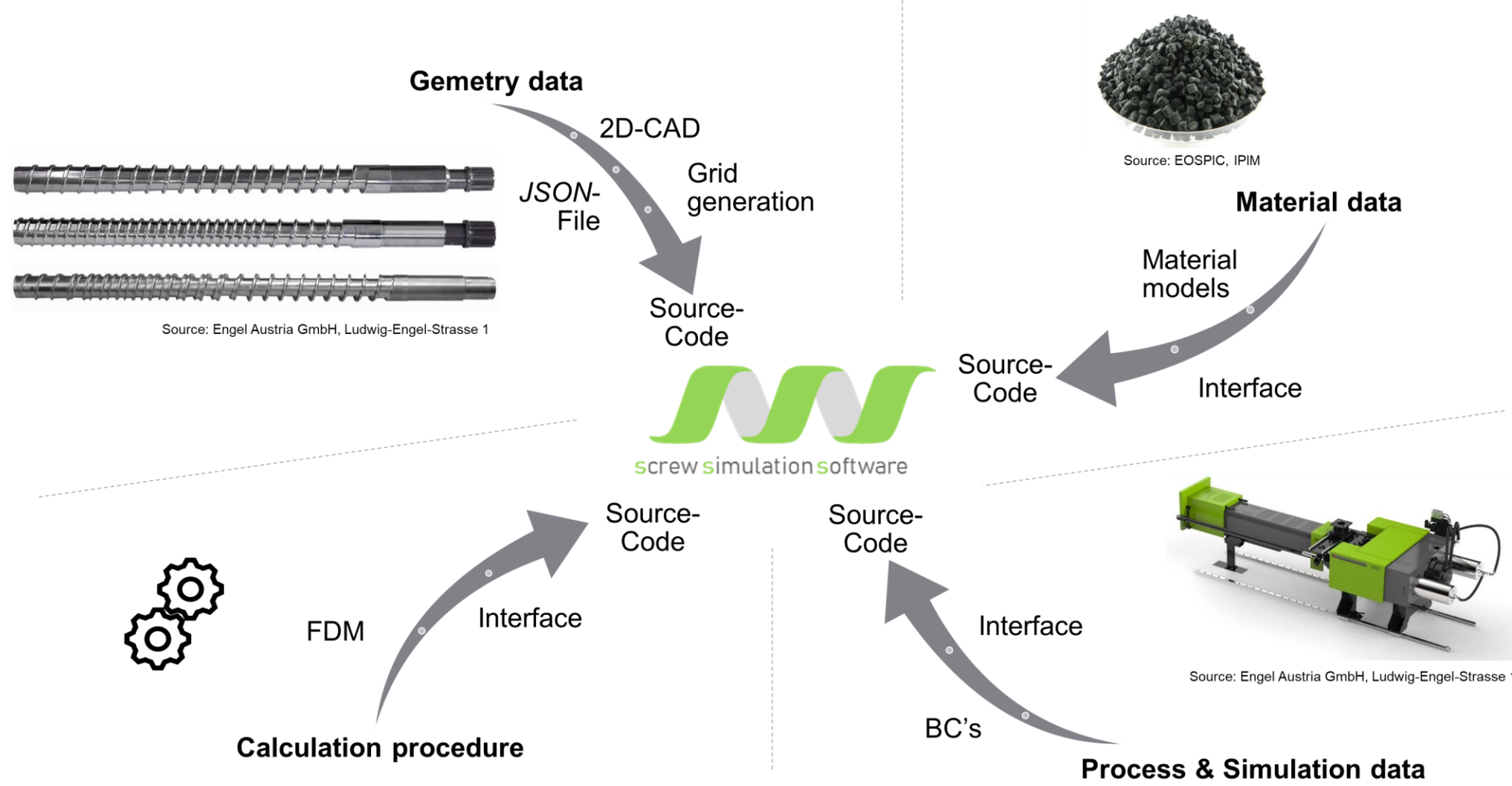
SCAN ME

Motivation and Objectives

In polymer processing, the **single-screw plasticizing** is the most crucial technology. This process starts with the conveying of solid granulate or powder from a hopper and ends with a melt conveying flow into a shaping tool. The complexity of simultaneous conveying and melting means, that good process simulation is still the subject of intensive research today. Due to the wide variety of thermoplastics processed and the screws used in a wide diameter range of typically 15 - 260 mm, there is often a lack of available data and the corresponding empirical values. Besides, short cycle times in the injection molding process due to fast and effective cooling of the molds extend the demands for novel screw concepts starting from double-flighted screws and leading to barrier screws with dispersive and distributive mixing elements.

Based on this background, the *Institute of Polymer Injection Molding and Process Automation* (JKU, Linz) in cooperation with *Kompetenzzentrum Holz GmbH* (*Wood K plus*) and the company partner *ENGEL Austria GmbH* is developing a novel software, called **S3** ("Screw Simulation Software") for the detailed modeling and simulation of the process procedures. In addition, we would like to express our special thanks to *uni software plus GmbH* for their support in software development.
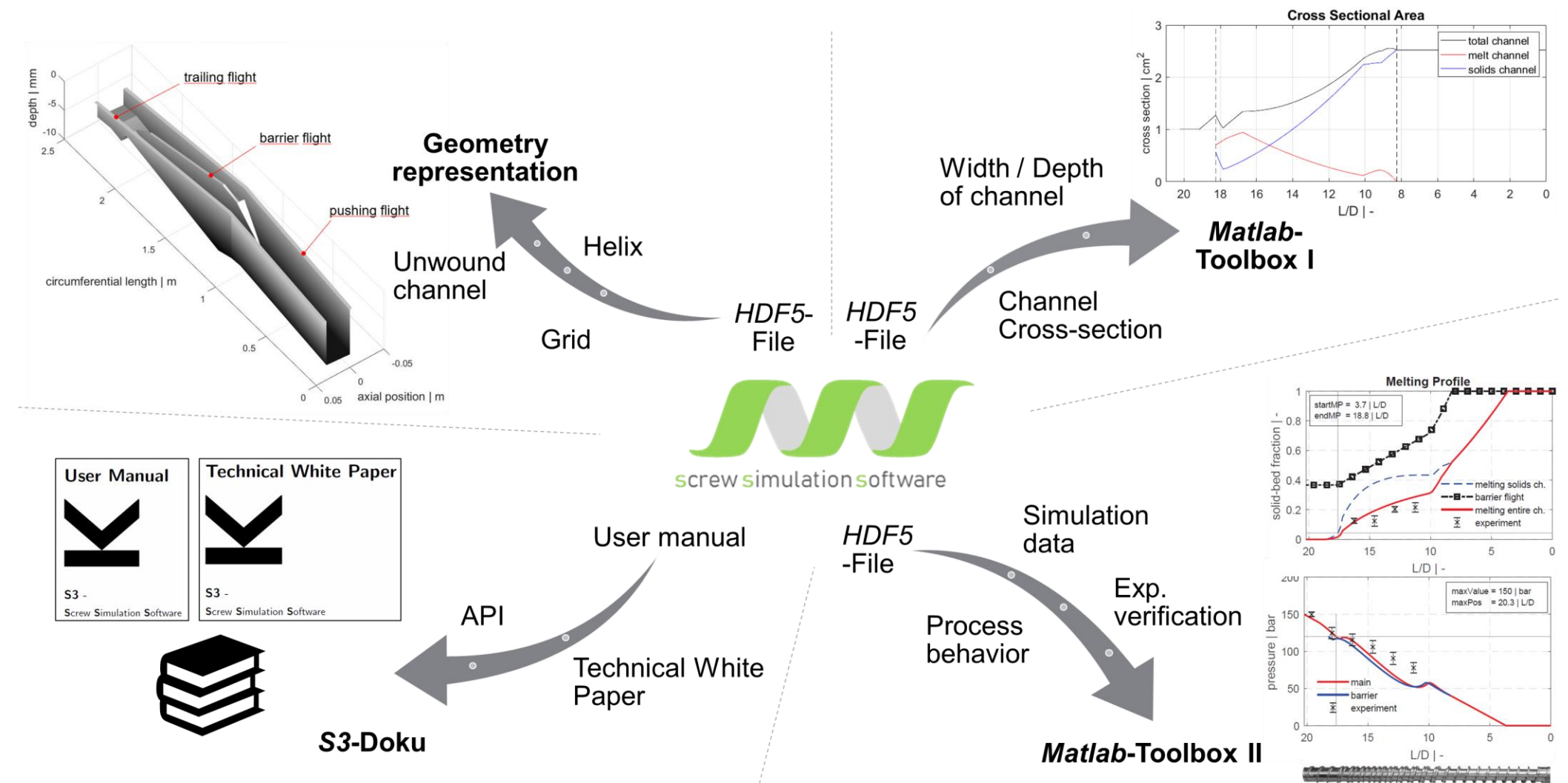
S3 – Input
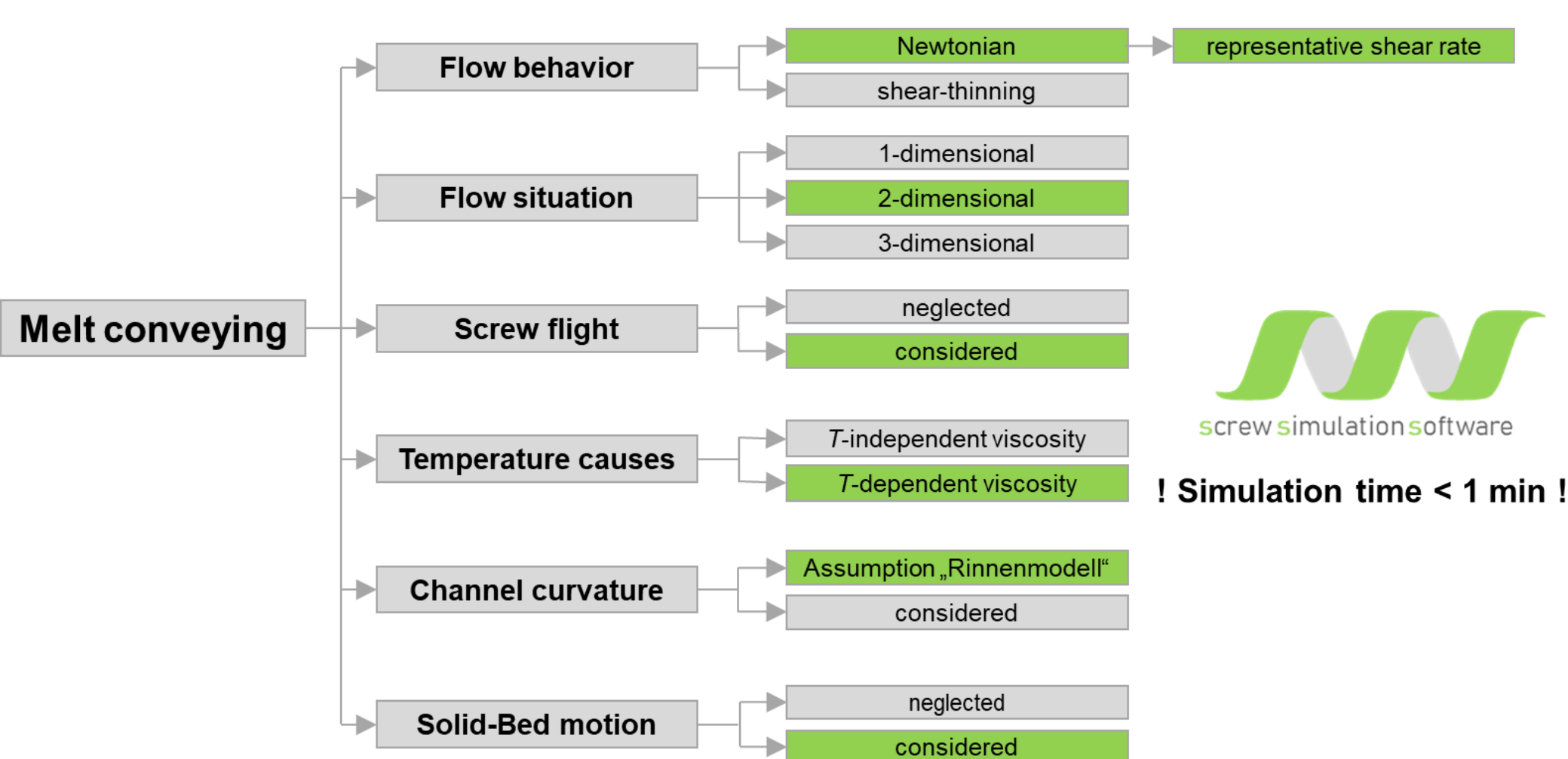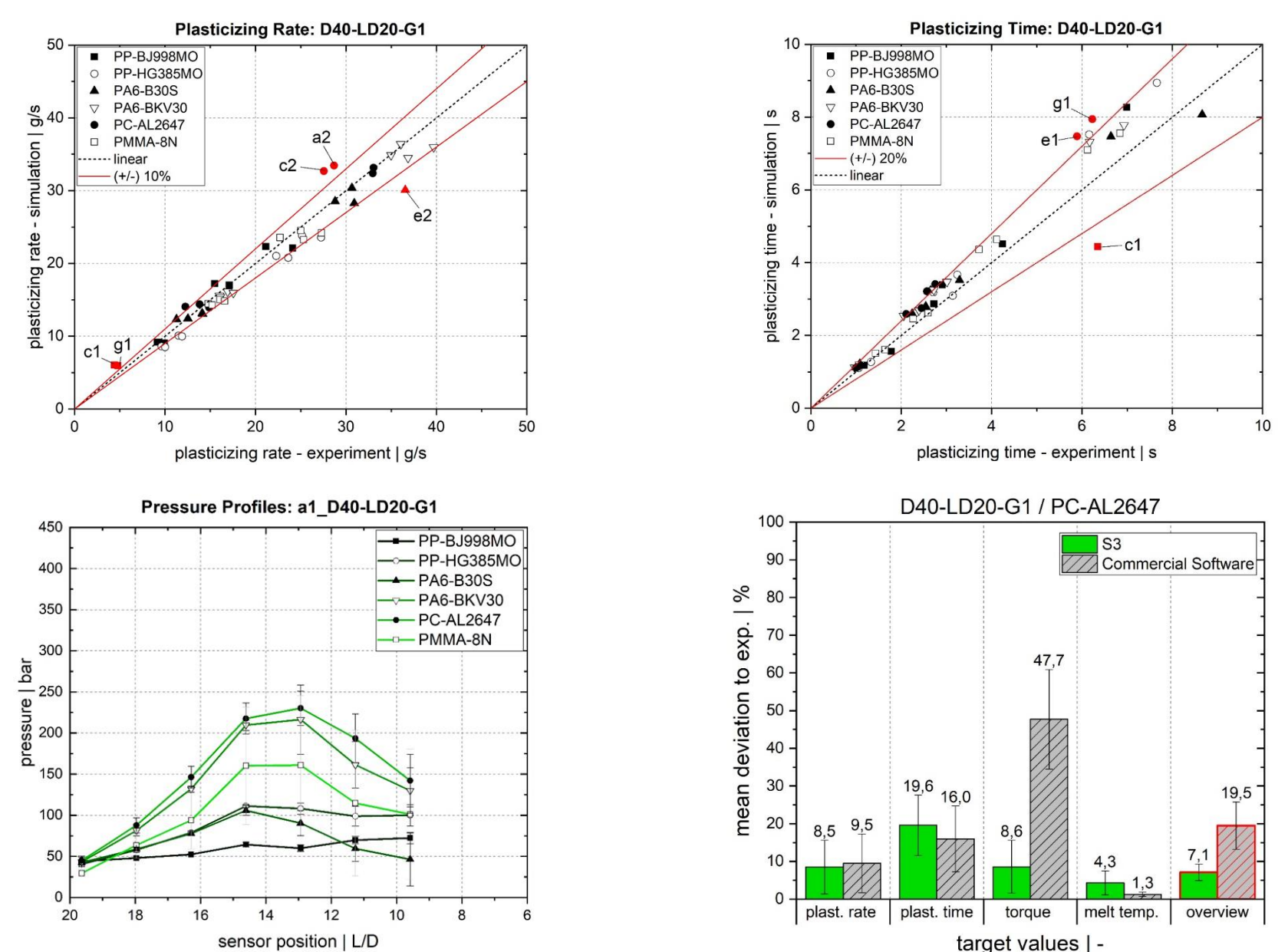
What effort do you have to put into it?

Gemetry data
2D-CAD
JSON-File
Grid generation
Source: Engel Austria GmbH, Ludwig-Engel-Strasse 1
Source-Code
Source-Code
Source-Code
Source-Code
FDM
Interface
Calculation procedure
Material data
Source: EOSPIC, IPIM
Material models
Interface
Interface
BC's
Process & Simulation data
Source: Engel Austria GmbH, Ludwig-Engel-Strasse 1

S3 – Output

What do you get for it?

trailing flight
barrier flight
pushing flight
Geometry representation
Helix
Unwound channel
Grid
HDF5-File
HDF5-File
Width / Depth of channel
Channel Cross-section
Cross Sectional Area
Matlab-Toolbox I
User Manual
Technical White Paper
User manual
API
Technical White Paper
S3-Doku
Simulation data
Process behavior
Exp. verification
Melting Profile
Matlab-Toolbox II

Simulation Procedure

The basic computational methods for *S3* simulations are highlighted here:

Melt conveying
- Flow behavior → Newtonian / shear-thinning → representative shear rate
- Flow situation → 1-dimensional / 2-dimensional / 3-dimensional
- Screw flight → neglected / considered
- Temperature causes → T-independent viscosity / T-dependent viscosity
- Channel curvature → Assumption „Rinnenmodell" / considered
- Solid-Bed motion → neglected / considered

! Simulation time < 1 min !

Results and Experimental Verification

The pressure and throughput behavior as well as certain process parameters such as melt temperature, torque, residence time and more, can now be evaluated and compared with experiments.

Plasticizing Rate: D40-LD20-G1
Plasticizing Time: D40-LD20-G1
Pressure Profiles: a1_D40-LD20-G1
D40-LD20-G1 / PC-AL2647

Conclusion

Development of a new software → Why?
- Better understanding of the IM plasticizing process
- Machine selection and/or screw design
- Optimization of process settings for special use cases
- Linking of different work areas: part, material, IM ↔ screw

Highlights:
- **S3 architecture** forms a very good basis for further development
- Good balance of **accuracy & simulation time**
- Quick generation of an extensive **simulation database**
- Determination of **process settings** for the IM plasticizing unit