Reverse Engineering

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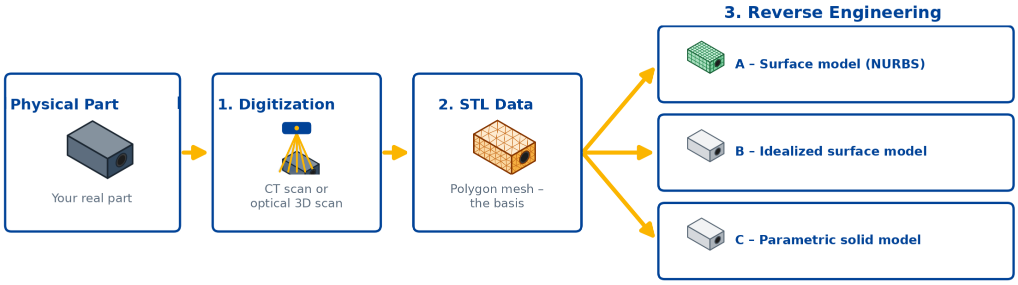
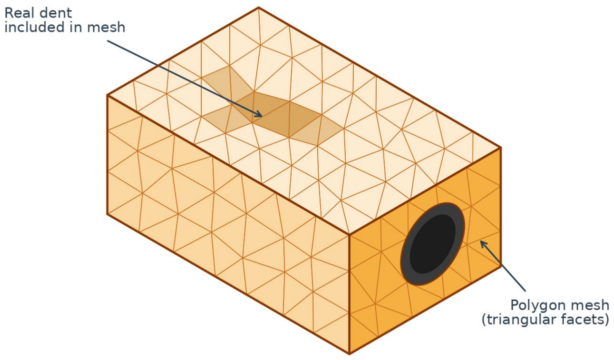
From physical part to CAD model – the variants at a glance

There's more than one kind of reverse engineering: depending on the intended use, the effort, data format and properties of the result differ considerably. This document presents the three common variants and helps you choose the right solution for your application.

The Process

The starting point is always **digitization**: your part is captured as completely as possible using **computed tomography (CT)** or **optical 3D scanning**, creating a digital twin. From this, the part surface is extracted as **STL data** (a polygon mesh of triangular facets). STL data always forms the basis for reverse engineering. One advantage of computed tomography: internal, non-visible geometries are also captured in full.





The STL data: a polygon mesh of triangular facets = the digital twin of your part

From here, your intended use determines which of the following three variants is right for you.

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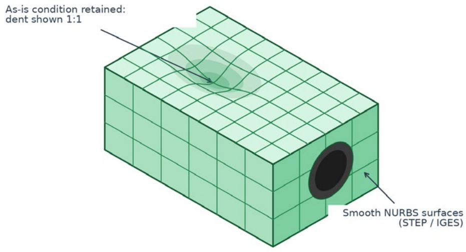
A The surface model (NURBS)

The triangular facets of the STL data are approximated into smooth **NURBS surfaces**. The result corresponds almost exactly to the real part – shape deviations such as dents or warping are therefore retained in the model. The process is semi-automated, making it the fastest and most cost-effective variant.

- **Output:** STEP / IGES format, readable in any CAD system
- **Representation:** As-is condition of the part, including deviations
- **Editability:** barely – no regular geometries, so it cannot easily be adjusted in CAD; generally not a closed (watertight) model



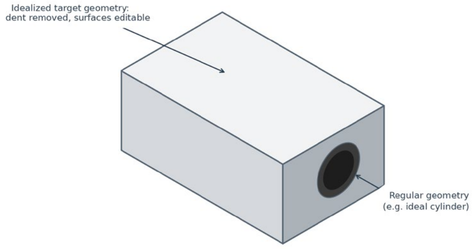
Typical applications: As-is documentation and archiving, installation and collision checks, reproduction via 3D printing, connecting designs to existing parts.

We carry out this variant ourselves directly at MessX AG.
Effort: low.

B The idealized surface model (based on regular geometries)

Based on the STL data or the NURBS surface model, all surfaces are remodeled as **regular geometries** (planes, cylinders, cones, etc.) and **freeform surfaces**. Deviations in the real part are idealized in the process – a dent disappears, a slightly oval hole becomes an ideal cylinder.

- **Output:** STEP / IGES format, compact file size
- **Representation:** idealized target geometry
- **Editability:** surfaces are editable in the CAD system; without additional processing, the model is not necessarily closed (watertight)

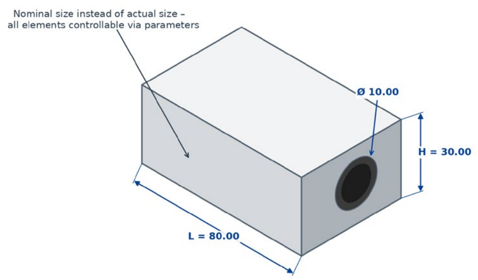


Typical applications: Further processing in CAD, manufacturing (e.g. milling), basis for simulations, design adjustments.

We carry out this variant together with a qualified partner – we supply the STL data and advise you.
Effort: medium.

C The parametric solid model

Every geometric element is rebuilt as an ideal element controlled via **parameters** – as in a new design.
One example: if a real hole has an actual diameter of 10.15 mm but, due to its function, should have a diameter of Ø 10.00 mm, it is constructed in the model using the original nominal dimension of Ø 10.00 mm – if needed, based on an existing drawing or after consultation.
This requires close coordination with development/design to ensure the part's function is maintained.



- **Output:** fully closed (watertight) solid model in native CAD format (e.g. Parasolid, CATIA, SolidWorks)
- **Representation:** idealized target geometry with nominal dimensions, including internal structures; mass, density and material properties can be stored
- **Editability:** complete – every element can easily be adjusted later via parameters

Important: For the parametrization to be preserved, the reconstruction must be carried out in the CAD system, or version, in which you intend to work later. In addition, we coordinate with you in detail beforehand on which properties the solid model should represent.

Typical applications: New designs and design modifications, tool making (e.g. new injection mold), series production, complete technical documentation.

We carry out this variant together with a qualified partner – we supply the STL data and advise you.

Effort: high.

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Decision guide – comparing the variants

	A – Surface model (NURBS)	B – Idealized surface model	C – Parametric solid model
Representation	As-is condition 1:1, including all shape deviations (e.g. dents, warping)	Idealized target geometry made of regular and freeform surfaces	Idealized target geometry with nominal dimensions, fully parametric
Data format	STEP / IGES	STEP / IGES	Native CAD format (e.g. Parasolid, CATIA, SolidWorks), STEP also possible
Editable in CAD	Barely (no regular geometries)	Yes, surfaces editable	Yes, fully controllable via parameters
Closed (watertight)	Generally no	Not necessarily, without additional processing	Yes, fully defined volume
Typical applications	As-is documentation, installation/collision check, reproduction via 3D printing, archiving	Further processing in CAD, manufacturing (e.g. milling), basis for simulation	New designs, tool making (e.g. injection molding), series production, design modifications
Effort / cost (relative)	low (semi-automated)	medium	high (close to a new design)
Execution	Directly by MessX AG	With a qualified partner, consulting and STL data provided by MessX AG	With a qualified partner, consulting and STL data provided by MessX AG

Not sure which variant suits your application?

That's exactly what we're here for: tell us what you plan to do with the data – we'll recommend the right variant and be happy to prepare a quote for you.

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