

Inside Every Machine

**How AI finds and builds 3D models that come apart,
for assembly and overhaul training**

Reading engineering drawings to build every internal part as a separate, named 3D object,
training-ready for EON Genesis 3.

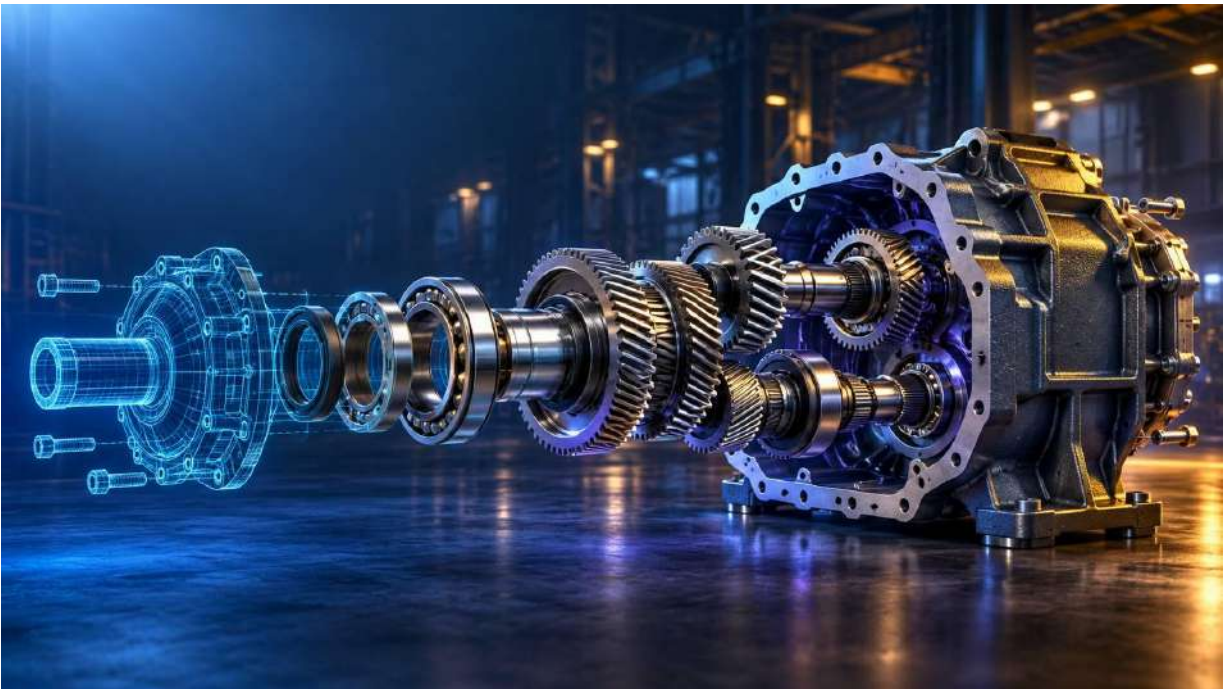


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Executive summary

Industrial training is moving into extended reality, but most 3D content stops at the surface. Assembly, disassembly and overhaul training needs the inside of a machine: the parts a technician actually removes, inspects and replaces.

- **The interior gap.** Libraries and AI image-to-3D tools produce hollow shells. Manufacturers publish the outside of their equipment for installation and keep the inside in 2D drawings and service manuals.
- **The cost of closing it by hand.** A commissioned 3D assembly of a mid-sized machine typically costs thousands of dollars and takes weeks.
- **The approach.** EON Model Inside looks for an existing model first. If none exists, an AI modelling agent builds one from the drawings in Blender, checks that every part fits and comes apart, and delivers one light model into EON Genesis 3.
- **The principle.** Training needs exact structure, not manufacturing precision. Parts must be separate, named and fitted. Sizes can be approximate.
- **The beta.** Model Inside enters beta measuring one headline result: the share of each machine's parts the AI builds by itself.

1 The interior gap

An overhaul is a sequence of physical decisions. Isolate the machine. Remove the cover. Take out the parts in the right order. Inspect the ones that wear. Replace the consumables. Put everything back and prove it works. A 3D training model supports that only if each of those parts exists as its own object.

Most 3D models do not meet that bar. They are built to be looked at, not taken apart. A typical asset is a single welded surface, or a set of pieces with generic names such as Object_047. Cut it open and there is nothing inside.

The information needed to build the inside usually exists. It sits in the manufacturer's section views, exploded drawings and parts lists, where every component has an item number and a place in the assembly order. What has been missing is a fast, repeatable way to turn those drawings into a 3D model.

2 What a training-ready model needs

A model that can teach an overhaul has five properties. Each one fails in a visible way when it is missing.

Property	What it means	What fails without it
Separate parts	Every part the procedure touches is its own object	The part cannot be removed at all
Real names	Each part carries its manual item number and description	Every step must be named by hand
Fit	Parts touch their neighbours without gaps or overlaps	Parts float, or pass through each other
Removal path	Each part has a pivot and a direction it comes out	Removal animations look wrong
Light enough	One compressed file within headset budgets	The model will not run on a headset

EON grades models on a readiness scale, so nobody starts building a course on a model that cannot support it.

Level	What the model has
0	One welded mesh. No separation of any kind.
1	Separate pieces, but not yet named, grouped or given removal axes.
2	Separate, named, grouped parts with sensible pivots.
3	Level 2, plus removal axes, collision volumes, fastener data, interior geometry and consumable flags. The target for overhaul training.

TRAINING IS NOT MANUFACTURING

Engineering CAD exists to make parts, so it records exact surfaces and tolerances. A trainee needs to recognise a part, remove it in the right order and see how it fits. Approximate dimensions serve that purpose, provided the parts fit together. That single decision makes AI modelling practical.

3 Nine ways to get the inside of a machine

There are nine realistic sources for interior geometry. They differ sharply in what they deliver, what they cost and how long they take.

Method	Real interior	Separate parts	Typical cost and time
AI modelling agent in Blender	Built from drawings	Yes, named	Compute only; hours to days per machine
Download existing CAD or models	Mostly outside only	Varies	Free; hours
Request CAD from the manufacturer	Exact, when released	Yes	Free; days to weeks, often declined
Standard-part generators	Exact catalogue parts	Yes	Free; minutes, for bolts, bearings, rings
AI-written CAD code	Simple parts only	Yes	Compute only; weak on gears and springs
AI image-to-3D	None; the inside is invented	Surface cuts only	Minutes; outside look only
Teardown, measure and scan	Real	Yes	Free phone apps to scanner kits near \$38,000; days to weeks
Industrial CT scan	Real, without opening	Split by hand	From about \$285 a scan for small parts; days [2]
Commissioned CAD modeller	Good	Yes, named	About \$2,500 to \$15,000; three to five weeks [1]

Only a few of these produce real, separate, named interior parts, and the reliable ones are slow or expensive. The opportunity is to make the fastest one, AI modelling from drawings, reliable enough to be the default.

4 Look first: libraries and manufacturer CAD

The cheapest model is one that already exists, so Model Inside searches before it builds. Two findings shape how much that search can deliver.

Libraries hold outsides

General 3D libraries are built for visual assets. Community CAD sites sometimes hold full assemblies, but quality and structure are inconsistent, and not every source can be searched automatically. Search is therefore partly automated and partly assisted by a person.

Manufacturers publish the outside, not the inside

Catalogue platforms that distribute manufacturer CAD publish simplified models designed for installation, and state that they do not show internal design [3]. EON's own evaluation confirmed the pattern. A downloadable CAD model of a metering pump models the outside accurately, down to the head bolts. Cut open, its entire drive mechanism is a single empty housing, with no worm, wheel or eccentric inside.

That outside model is still valuable. It gives real overall dimensions and the true outer shape, which is exactly the frame an AI agent needs when it builds the inside.

5 Build: an AI modelling agent in Blender

When no usable model exists, Model Inside builds one. An AI modelling agent reads the machine's drawings and builds each part as a short program in Blender, the open-source 3D suite.

Why Blender rather than engineering CAD

- **Triangles are fine.** Real-time engines draw triangles. Exact engineering surfaces add nothing a trainee can see.
- **Hard shapes are easy.** Worms, gears, springs and threads are simple to build in Blender. AI-written CAD code tends to drop the sweeps and lofts they need [4].
- **Named parts come out directly.** Blender exports each part as its own named object in a single GLB file.
- **It runs on servers.** Blender can run without a screen, so an agent can build, render and check in a repeatable pipeline.

The build loop

- **Read.** Take the part from its drawing, with its item number, neighbours and removal direction.
- **Block out.** Rough the part in simple shapes, scaled from the outside model and the parts it mates with.
- **Refine.** Add the holes, flats, threads and teeth a trainee can see.
- **Render and compare.** Render the part at the drawing's own angle and list every difference.
- **Fix.** Correct and repeat, up to a fixed number of rounds.
- **Finish.** Apply the name, pivot, part class and removal axis, then export.

What the research shows

Independent research published in 2026 explains both why this approach is now viable and where it needs guarding.

Study	Finding	How Model Inside responds
3DCodeBench [5]	Across twelve AI models, feeding errors back raised working Blender scripts from 70 to 97 percent. Floating and disconnected parts remained the main failure.	A self-correcting loop, plus automatic fit checks
3DHarnessBench [6]	Agents with full 3D access in Blender, including measuring and rendering, rebuilt objects best. Results varied widely between agents.	The agent measures and renders its own work
BlenderRAG [7]	Showing good example scripts first raised working scripts from 40.8 to 70.0 percent.	The agent starts from proven part scripts
Thinking in Blender [8]	Building in stages beat building everything at once.	One part at a time, shape before detail
BenchCAD [4]	AI-written CAD code recovers outer shape but drops sweeps and lofts.	Hard shapes are built in Blender, not CAD code

6 Check: proving the parts fit

A model that looks right can still fail as training. Model Inside therefore tests every assembly, and reports every pair of parts it tested, so a pass is evidence rather than a claim.

Check	Passes when
Gap	Mating faces sit within tolerance. No part floats.
Overlap	No part passes through another beyond tolerance.
Removal path	Each part slides free along its removal axis once the parts before it are removed.
Structure	Parts sit inside the sub-assembly the drawing shows, in the manual's order.

Because sizes are approximate by design, tolerance is relative to each part: small gaps and overlaps compared with the part's own size pass. What never passes is a part that floats, hides inside another, or cannot come out.

7 When the AI gets stuck: mixed methods

No single method builds every part of every machine. Model Inside moves a part down a ladder of methods after two failed attempts, and records which method finally produced it.

Method	Best for
AI modelling agent in Blender	Every part, by default
Standard-part generators	Bolts, washers, balls, bearings, O-rings and gears
AI-written CAD code	Simple turned and square parts
AI image-to-3D	Outside shells and castings the trainee sees but never measures
Existing CAD	The true outside shape and overall scale
Expert modeller	Anything every other method failed on

The record of which method built each part is itself a product: it shows, machine by machine, where AI modelling is already reliable and where human expertise still matters.

8 From model to training

Formats

Everything becomes GLB, the compact open format real-time engines load. STEP files are exact 3D CAD and convert cleanly. Blender, FBX and OBJ files convert directly. Conversion keeps what disassembly needs, namely part names, the part tree and positions, and discards manufacturing detail it does not need.

Weight

Meta's guidance for Quest 3 is 1.3 to 1.8 million triangles for an entire frame [9]. Training runs in the headset browser alongside other content, so Model Inside targets far less for a single machine: under 300,000 triangles and under 20 MB as a compressed file. Only the parts a procedure touches stay separate; fasteners nobody removes are shared or merged.

Look

Shape comes first and the look is a separate pass. Materials are assigned by part class, such as machined steel, cast iron, PTFE or rubber. Material variants let one model show a

part clean, worn or corroded for inspection training. Texturing never changes a part's shape or size.

Delivery

Finished models load into EON Genesis 3, where learners take the machine apart and put it back together on the web, on tablets and in headsets.

9 The beta

What is available

Model Inside enters beta as the engine that finds or builds training-ready interior models and delivers them into EON Genesis 3 for assembly, disassembly and overhaul training.

What we measure

The beta measures one headline result: the share of each machine's parts the AI builds by itself, before any expert modelling is needed. Every model also reports the checks it passed and the method that produced each part.

Limitations

AI modelling is already reliable for many parts and still hands the hardest ones to an expert. Sizes are approximate by design, and procedures remain drafts until a qualified engineer approves them.

How to join

Organisations with overhaul and maintenance training needs can nominate a machine from its drawings and service manual, and follow it through the pipeline into EON Genesis 3.

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