

The Living Library

**How EON Universal builds industrial
3D knowledge that scales to reality**

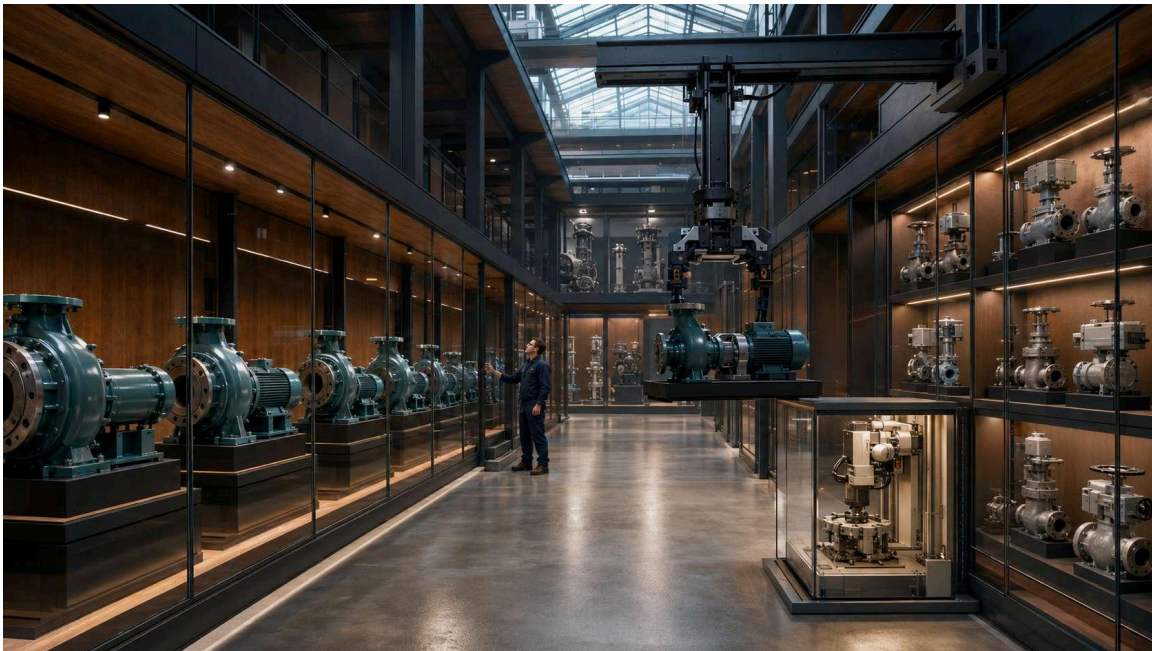


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Executive summary

Every industrial training and digital-twin effort collides with the same wall: the world contains effectively infinite equipment variants, and no library can pre-build them all. EON Universal resolves this with a two-part architecture. First, a **Living Library of ~50 equipment families per industry** — photorealistic, correctly scaled, functionally labeled archetypes that teach each **class** of equipment. Second, an **encounter-driven flavor pipeline**: when EON Universal Recognition meets a specific make and model in a real facility that the library does not hold, the system generates that exact variant from photographs in minutes, gates it behind a single human approval, and registers it into the library the same day. We build the bounded thing; reality supplies the unbounded thing. The library is not a catalog — it is a living system that grows precisely where the real world demands it.

1. The problem: you cannot pre-build reality

Industrial sites are assembled from recognizable classes of equipment — pumps, valves, ventilators, turbofans, excavators — but almost never from identical units. Each class exists in dozens of makes, hundreds of models, and thousands of size and option configurations. The combinatorics are unbounded.

The evidence is not theoretical. On EON's own instrumented training rig ("the Beast"), photo recognition verified that **11 of 12 inspected parts differed from the generic library model** — same class, different flavor. A library strategy based on enumeration fails twice: it never finishes, and what it ships rarely matches the unit in front of the worker.

2. The insight: training is taught by class; twins are mirrored by encounter

The variant problem dissolves once two different jobs are separated:

- **Teach the class.** "What is a syringe infusion pump? How does it work? What are its universal controls and hazards?" This is what training curricula actually teach — by class, not by serial number. For this job, a well-made archetype is not a compromise; it is pedagogically **preferable**, because it teaches what transfers across brands.

- **Mirror the facility.** "This exact unit, on this exact skid, with these exact connections." This is the digital-twin job, and it genuinely requires the specific make and model — the *flavor*.

Fidelity must match the training task:

Training job	Example	Required fidelity
Recognize the class	"That is a syringe pump"	Archetype suffices
Understand function	Fluid path, mechanism, cutaway	Archetype + cutaway suffices
Operate the controls	"Press bolus, set the rate"	Specific flavor
Perform procedures	Isolate, service, make safe	Specific flavor

EON archetypes are deliberately **functionally correct, not bland**: each family ships with the standard control set of its class — buttons, screens, and labels that every real unit of that class shares — without copying any single manufacturer. Where operate-level fidelity is needed, the specific flavor is generated on demand.

3. The vocabulary: five levels

WING (industry) Medical · Aerospace MRO · Mining · Oil & Gas — never mixed

FAMILY GROUP e.g. "Infusion & Fluid Delivery" — 10-12 shelves per wing

FAMILY (class) BUILD e.g. "Syringe Infusion Pump" — ~50 per wing; what we BUILD

FLAVOR (variant) e.g. "B. Braun Perfusor Space" — generated ON DEMAND, same day

PART (L2) drive screw · syringe clamp · display — named and labeled

Families are the bounded build. Flavors are the unbounded reality, captured by encounter. Parts carry the labels, hotspots, and procedures that make a model teachable.

Where the intelligence lives: the six-layer intelligence record — what it is · how it works · anatomy · operate · make-safe · faults & procedures — lives at the **family** level, and **flavors inherit all of it, instantly**. When Recognition captures your specific machine, it is not a dumb 3-D scan — it is born already knowing everything

its family knows. This is implemented today in the flavor promotion pipeline, not aspirational.

4. Four wings, one museum

Each industry is a separate library — its own folder, its own manifest, its own build list — sharing one intelligence schema:

- **Medical** (50 families in 10 groups): infusion, respiratory and anesthesia, patient monitoring, diagnostic imaging, cardiac and resuscitation, renal, surgical, sterilization, laboratory, facility biomed.
- **Aerospace MRO** (50 families in 12 groups, organized by ATA chapter): powerplant, landing gear, hydraulics, flight controls, avionics, fuel, pneumatics, APU, electrical power, ice and fire protection.
- **Mining** (50 families in 10 groups): excavation and loading, haulage, crushing and comminution, conveying, separation, slurry pumping, drilling and ground support, fixed plant.
- **Oil & Gas** (343 components): the founding wing — rotating equipment, valves, vessels, instruments, piping, safety systems, and the Permian onshore surface set.

The separation is architectural, not cosmetic: a component cannot leak between wings, because each wing is a distinct library with a `segment` marker on every record. The shared schema — six-layer intelligence records, port anchors, placement, real dimensions — means every wing inherits the viewer, procedure engine, and competency system for free. A ventilator never sits next to a dragline, yet both are equally smart.

Native safety language per wing: the schema is shared, but each wing speaks its own industry's language — make-safe is a LOTO isolation chain in oil & gas; electrical isolation, medical gas supply and infection control in a hospital; ATA-chapter task cards in an MRO hangar; isolation and permit-to-work in mining terms. The buyer's question "do you understand my industry?" is answered in the data model itself.

5. The five hands: who does what

System	Role
EON Living Library	Builds the families — geometry, real scale, cutaways, connection anchors
EON Smart Components	Makes them smart — the six-layer intelligence, labels, procedures
EON Universal Recognition	Captures reality — identifies equipment in the field, spawns flavors
EON Universal Configurator	Assembles facilities — places components, routes the piping
EON Universal Competency	Trains and scores people — courses, assessments, records

Five specialized systems, one contract between them: each hand does its job and passes a richer object to the next.

6. The build method

Each family is built by an automated pipeline with two human gates:

1. **Specification.** The wing's BuildPack defines all ~50 classes, each with identity description and seven named sub-parts. Nothing is invented ad hoc.
2. **Reference views.** AI image generation paints clean, photorealistic front and side views from the specification — the same object across all angles, on a neutral background.
3. **3D reconstruction.** Multiview generative reconstruction produces the mesh, which is then segmented into its constituent parts.
4. **True scale.** An automated catalog lookup finds the class's real-world dimensions (sourced, in metres) and the model is baked to them. Every record carries `dimensions_m`; the application scales from the record. A 0.3 m pump and a 2.0 m MRI scanner are proportioned correctly by construction — scale is data, not guesswork.
5. **High-definition surfaces.** Textures are generated at high resolution and finished by a viewer-side detail layer, eliminating the "plastic" look of naive generative 3D.
6. **Cutaway.** Where seeing inside teaches something, a half-section variant is generated so training can open the machine.

7. **Connection anchors.** Ports (inlet, outlet, suction, discharge) are located with position, axis, and bore, enabling automatic pipe routing in facility building.
8. **Intelligence.** EON Smart Components authors the six-layer record — identity, anatomy, function, operation, behavior, procedures — turning geometry into a teachable object. Safety templates adapt per wing: medical "make-safe" concerns electrical isolation, gas supply, and infection control, not industrial lockout-tagout.

Honesty is enforced structurally. Records carry a fidelity flag (*representative or verified*); part names come from the specification, never invented; a cutaway flag exists only when the cutaway file ships; and no generated content reaches any consumer until a human blesses it.

7. Growing by encounter

The flavor pipeline turns the infinite-variant problem into a routine, low-cost workflow:

1. **A worker photographs** equipment in a real facility.
2. **Recognition matches it** to a family and checks the library for the specific flavor.
3. **A no-match is flagged** as a demand signal — a human reviewer confirms "different flavor, generate it."
4. **The system generates the flavor** from the photographs, in minutes, into a quarantined staging area.
5. **One human blessing** promotes it: into the production library, through Smart Components enrichment, and into the requesting facility.

Real case: recognition on the Beast rig identified a Coriolis flow meter — a class variant the library lacked. It was generated from a single field photograph and delivered with parts, real dimensions, and connection anchors the same day. The library grew exactly where reality demanded, at negligible cost, under human control.

A whole facility typically needs 30–80 flavors beyond the family library — a bounded, predictable line item, not an open-ended modeling contract.

8. Economics

Item	Traditional approach	The Living Library
One industrial 3D asset	\$500–2,000, days of artist time	Under an hour, automated
A 50-class industry library	A multi-month modeling contract	Days
A specific field variant	Rarely economically viable	Minutes, same day
Mirroring a whole facility	Open-ended engagement	A bounded one-week line item

The pipeline does not merely reduce cost — it changes the category. An entire industry wing is built in days, and the marginal cost of capturing reality's variants is negligible. (Internal generation costs are held in the engineering specification; customer pricing is a commercial decision.)

9. Why these markets

- **Medical:** the highest-stakes operate-level training in the world, chronic equipment-familiarization gaps, and strong archetypes with high brand divergence in controls — the perfect family-plus-flavor market.
- **Aerospace MRO:** intensely type-specific (a CFM56 is not a Trent); the archetype teaches systems, and type flavors carry the tasks. ATA-chapter organization drops directly onto the wing structure.
- **Mining:** massive equipment, global skills shortage, and per-site brand standardization that makes site flavor sets small and high-value.
- **Oil & Gas:** the founding wing, already 343 components deep, proven with a major-operator training pilot.

10. The honesty system: governance, safety, and IP posture

- **Human blessing gate:** view approval before 3D spend; a single blessing before anything generated reaches any consumer — not the library, not a facility. Fresh AI output is a candidate, never automatically truth.
- **Fidelity marking:** every record declares itself representative (built from specification) or verified (checked against the real unit); SME review lists exist per wing; medical and aerospace part names are never fabricated.

- **Deterministic safety gate:** safety content is never statistically averaged — a make-safe step is either verified present and correct, or the record is flagged. A safety miss can never be averaged away. For regulated industries, this credibility story outsells photorealism.
- **IP posture:** archetypes shipped to all customers are brand-neutral composites of a class's universal features. Brand-specific flavors are generated per customer, for equipment that customer owns and photographed on their site — a digital twin of their own property.

11. Roadmap

1. **Now:** Medical wing — five-family pilot live (syringe pump, ventilator, patient monitor, defibrillator, MRI); the remaining 45 batch on blessing.
2. **Next:** Aerospace MRO wing (50 families by ATA chapter).
3. **Then:** formal separation of Mining and Oil & Gas into clean wings.
4. **Always:** every wing grows by encounter — one photograph, one encounter, one blessing at a time.

We built the museum. Reality fills it.