

EON Universal

Facility-Agnostic Training & Field Intelligence for Mining

A composable equipment ontology for surface & underground mining.

For surface & underground mining — fixed plant and mobile fleet.

Genesis shows the steps. EON Universal understands the work.

Understand the Work. Compose Any Device.



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Executive summary

EON Universal is a facility-agnostic field-intelligence layer for mining and mineral processing. It understands mining equipment at the level of process intelligence — not just the steps of a procedure — and uses that understanding to turn any worker into the equivalent of a multi-year expert, in the training center and in the field.

The industry has spent a decade building bespoke simulators one site at a time. That model never closes economically, because it treats the work as an infinite list of mines to memorise. EON Universal inverts the problem. It learns a bounded library of mining equipment — about fifty classes in mining — and composes any mine, pit or plant from them. Because the system understands the components, it can recognise them on sight, compose the correct procedure, branch a procedure on live conditions, inject faults, generate unlimited valid configurations, and certify a worker against a standard.

EON Universal is distinct from — and complementary to — **Genesis**, EON's engine for converting SOPs and photographs into simulations. The relationship is captured in a single line: **Genesis shows the steps; EON Universal understands the work.** Authored once, that understanding is delivered everywhere — on a phone or AR glasses, on a tablet on the real machine, and inside an immersive CAVE. It is built on ISO 14224 taxonomy principles, so its output speaks the customer's own data language, and it is a library the enterprise owns rather than a per-site cost that recurs forever.

The thesis in one paragraph. Don't model five hundred mines; model the fifty component classes they are built from. Give each class a six-layer competence record so the machine truly knows it. Then let the system recognise, guide, and escalate — turning hard-won field expertise into an owned, compounding asset that no general-purpose AI can replicate, because that knowledge has never left your sites.

SECTION 1 · THE PROBLEM

The expertise cliff

In open pits, underground mines, and processing plants, the people who hold thirty years of judgment are retiring, and remote fly-in/fly-out sites make them scarce. The knowledge that matters — how this shovel behaves when it stalls, why a conveyor must be restrained before work, what 'normal' sounds and looks like — lives in a shrinking number of heads and almost nowhere in the company's systems.

The standard response has been content: bespoke simulators, each modelling one specific site, each expensive to produce and obsolete the moment the plant or fleet changes. The unit economics never close, because every new site is a new modelling effort and the permutations are effectively infinite.

EON Universal begins from the worker's reality instead. A competent system should let someone walk up to a machine they have never seen and still do the job correctly. It should **recognise** the component on sight, **guide** the worker through the correct procedure step by

step, and **escalate** — stop and hand off to a human — the instant it is unsure. The worker is green; the guidance is not.

SECTION 2 · THE CORE INSIGHT

Composition, not enumeration

A mine is not a monolith to be memorised. It is a graph assembled from a finite library of known equipment — the same shovels, haul trucks, crushers, mills, conveyors and pumps, connected differently from one site to the next. The decisive move is to model the vocabulary, not the locations.

Think of learning a language. You could try to memorise every full sentence you will ever need — an endless, hopeless task. Or you can learn the words and the grammar, and then build any sentence on demand. Enumeration memorises sentences; composition learns words. EON Universal learns the components and composes any mine, pit or plant from them.

Two cost curves

Enumeration — model every site. Effort scales with the number of mines, so it is unbounded; every new site is a fresh modelling project, and the combinatorics are hopeless. It is a cost that recurs forever.

Composition — model the vocabulary. Effort scales with a bounded set of component classes — about fifty to start. The system recognises nodes, infers topology, and composes the rest. Every job performed makes the shared library smarter. It is an asset that compounds.

You don't model every mine. You model the equipment every mine is built from.

SECTION 3 · THE BOUNDED LIBRARY

Fifty classes, not five hundred mine sites

In mining, roughly 50 equipment classes cover the overwhelming majority of frontline work. About 15 classes carry most of the daily value, and together the core library accounts for more than 80% of real field interactions. This is what makes the problem tractable: a bounded, knowable set rather than an open-ended catalogue of sites.

Built on ISO 14224 taxonomy principles — the de-facto cross-industry equipment standard — tailored to the mine's asset hierarchy under ISO 55000. When EON Universal recognises a component, its output maps straight into the mine's CMMS / EAM reliability data. It speaks their data language on day one.

| Tier | Scale | What it covers |
|--------|-------------|--|
| Tier 1 | ~50 classes | Core fleet & plant a crew touches — 80%+ of interactions |
| Tier 2 | ~300 types | Variants & subtypes — rarely surprised |

| Tier | Scale | What it covers |
|--------|-------------|--|
| Tier 3 | 1,000–2,000 | Maintainable items: liners, GET, bearings, seals |

The tiers describe depth, not breadth of effort. Tier 1 is where the value concentrates; Tiers 2 and 3 extend the same records into variants and maintainable items so the system is rarely surprised in the field.

SECTION 4 · WHAT “KNOWING A COMPONENT” MEANS

The six-layer competence record

A class name is a label. Understanding is a structure. EON Universal carries a six-layer competence record for every class, and each layer earns its place:

1. **Identity** — the ISO class, common aliases, and the equipment tag pattern. This is how the system names what it sees.
2. **Geometry** — a 3D model and multi-angle imagery, so the component can be recognised and rendered from any viewpoint.
3. **Anatomy** — subcomponents and the boundary of the asset: what is part of it, and where it ends.
4. **Function** — what the component does and its operating envelope: the normal conditions under which it works.
5. **Behavior** — how it responds to upsets and abnormal conditions. This is the layer that makes guidance safe.
6. **Procedure** — how to operate, inspect, isolate, and fix it, expressed as composable steps rather than a single fixed script.

Recognition keys on layers 1–2. Guidance composes from layers 3–6. A simulator that only stores geometry can show a part; a system that also stores function and behavior can reason about it. That is the difference between a recording and an understanding.

SECTION 5 · THE DIFFERENCE

Genesis shows the steps. EON Universal understands the work.

EON Universal does not replace **Genesis**. Genesis is EON’s production-ready core engine: it converts standard operating procedures and ordinary photographs into interactive, hands-on simulators, compressing what used to take hours of authoring into minutes. Genesis is the on-ramp — it captures how a task is done and renders it as a simulation a worker can practice today.

EON Universal is the **understanding layer** that sits on top. It brings the component library, the configurator, and live recognition, and it knows *why* each step exists. Because it understands

the equipment, it can do things a scripted simulator structurally cannot. The boundary between the two products is exact:

| GENESIS — the core engine | EON UNIVERSAL — intelligence + library |
|---|--|
| Needs 3D models supplied to it | Brings the component library and the configurator |
| Runs sequential SOPs only — not conditional | Authors conditional SOPs that branch on live conditions |
| Knows what to show, but not why | Explains why each step matters |
| Cannot configure different capabilities | Generalises to skids it has never seen |
| Does not recognise equipment in real life | Recognises equipment on sight — feeds FieldIQ + Holodeck |

This is the step nobody has taken — not even a simulator. Genesis gives you a faithful recording of a procedure; EON Universal gives you a system that understands the equipment well enough to adapt the procedure, generalise it to new sites, and recognise the real thing in the field. That understanding is the entire product.

SECTION 6 · IN THE TRAINING CENTER

What EON Universal makes possible

Understanding the equipment unlocks a class of capabilities that scripted content cannot reach:

- **Talking components.** Every part can explain what it is and how it works, and let the worker try it — turning a static model into an explorable teacher.
- **Conditional procedures.** Branching SOPs with safety gates — restrain stored energy before removing a guard — rather than a single straight line of steps.
- **Fault diagnosis.** Inject a fault and require the trainee to recognise and respond, building judgment instead of rote sequence memory.
- **Generative configurations.** Produce unlimited, engineering-valid plant and fleet configurations from one component library.
- **Certification.** Generate defensible, scored evidence that a worker is ready, measured against the relevant standard.
- **Compounding.** Every session improves the shared library, so the next worker starts from a smarter system.

SECTION 7 · THE SEVEN TRAINING USE CASES

From exploration to certification

The first library ships with seven training use cases that move a worker from first contact to certified competence:

1. **Talking components** — free exploration: tap any part to learn it and try it.
2. **Guided & scored SOP** — step-by-step execution with live scoring and feedback.
3. **Conditional SOPs** — procedures that branch on live conditions, with safety gates.
4. **Fault injection** — recognise and respond to an introduced abnormality.
5. **Generative configurations** — unlimited valid layouts for varied practice.
6. **AR-only practice** — 1:1 rehearsal with no physical hardware.
7. **Certification** — scored, defensible evidence of readiness against the standard.

The proof: a conditional SOP that branches

A fixed SOP is a straight line. A conditional SOP is a decision tree with safety gates, where the next action depends on a live condition. Take isolating a hydraulic excavator: shut down and lock out, lower the implements, then ask — is stored hydraulic energy still present? If yes, bleed the accumulators and re-check, looping until safe; if no, proceed to work. Anything abnormal stops the job and escalates to a human (Verdict).

Why this is the proof. The 'stored energy still present?' branch only exists because EON Universal knows, from the component's behavior layer, that a shovel's hydraulic accumulators hold pressure after shutdown and a raised boom stores gravitational energy. Genesis has no concept of stored energy, so it cannot branch on it. A conditional, safe procedure is something only a system that understands the equipment can author.

SECTION 8 · ONE SYSTEM, THREE SURFACES

Author once — deliver everywhere

Because a single understanding drives delivery, content is authored once and meets the worker on whichever surface fits the moment:

- **Anywhere — phone or AR glasses.** AR-only practice at 1:1 scale, at camp or home, with no physical hardware at all.
- **On site — tablet or AR glasses on the machine.** LiDAR overlays the digital twin onto the real haul truck or crusher; every part is tappable.
- **Immersive — the CAVE (Holodeck).** LED walls and floor surround the trainee in a generated pit or plant at full scale — a modern, reborn iCube, and the premium tier.

The progression is natural: practice on a phone at camp, validate on a tablet against the real machine, and rehearse the highest-consequence scenarios immersively in the CAVE — all from the same library, with the same understanding underneath.

SECTION 9 · HOW IT IS BUILT

The Pyramid — layer by layer

EON Universal is built from the bottom up, and you cannot skip a level. Each layer is a prerequisite for the one above it:

1. **3D model** — an accurate model is the base of everything.
2. **Label** — every component identified and tagged.
3. **Function** — what each labelled component does.
4. **Foundational skills** — the must-know basics, especially safety.
5. **SOPs** — standard procedures applied on that foundation.
6. **Field** — using everything in the field: the eventual goal.

The lower layers are about understanding *components*, not mines — which is precisely the bridge to a universal, facility-agnostic solution. Get the foundation right, and the field outcome follows.

SECTION 10 · BEYOND MINING

The same engine, every heavy industry

Because EON Universal understands components rather than memorising mines, the method transfers to any industry built from a finite parts vocabulary. Mining shares the same composition logic proven first in oil and gas. Aerospace MRO and power and energy each present their own bounded vocabulary and follow the same approach. The investment in the method — recognition, the six-layer record, the configurator, conditional procedures — is reusable across verticals. Learn the parts once; help every site built from them.

SECTION 11 · THE ARCHITECTURE & THE VALUE

Own the work, not the weights

The architecture is intentionally legible. **Genesis** is the core engine — it models, labels, and runs step-by-step SOPs. **EON Universal** adds the intelligence: the library, the configurator, and recognition. **FieldIQ and the Holodeck** deliver it — field recognition, on-the-spot guidance, and immersive scenarios. Capture flows up the stack; delivery flows back down to the worker.

Why it compounds

- **Every job makes the system smarter.** Usage feeds the shared library; the asset improves with operation rather than depreciating.
- **It works on mines it has never seen.** Recognise, infer topology, compose — no per-site rebuild required.
- **It is a library you own.** A bounded asset on your balance sheet, not a per-site modelling cost that recurs forever.

Own the work, not the weights. General-purpose AI models are a commodity that everyone rents. How your mine actually runs is not on the public internet, so no foundation model can learn it. EON Universal turns that proprietary know-how into a structured, owned, compounding asset — the durable advantage as AI absorbs the commoditised work around it.

SECTION 12 · WHERE IT FITS

Work Intelligence and the Intelligence Flywheel

EON Universal is one engine inside a larger company architecture: **One System Human 2.0** is the vision, the **Intelligence Flywheel** is the engine, and **Work Intelligence** is the asset — the enterprise's missing system of record for how work is actually done. ERP holds your resources, CRM your customers, PLM your products; Work Intelligence holds your work. EON Universal is how that work becomes executable on the frontline: it converts the standard operating procedures captured by Genesis into living, adaptive guidance, and it carries that competence from the training center into the field through FieldIQ and the Holodeck.

SECTION 13 · ENGAGEMENT

Getting started

A typical engagement begins with a single high-value equipment family — a haul-truck or crusher fleet, say — and a defined set of procedures, proving the recognise–guide–escalate loop on the customer's own assets and data. From there, the library extends class by class along the bounded vocabulary, and delivery expands across phone, tablet-on-the-machine, and the CAVE. Because the records align with ISO 14224 principles, outputs integrate with existing reliability and maintenance systems from the start.

The composition method is proven first in oil and gas and applies directly to mining's bounded vocabulary. A companion presentation accompanies this paper, and the EON AI Ventures team is available to scope a first library against a target operation.

ABOUT EON AI VENTURES

EON AI Ventures is the company behind Work Intelligence — the enterprise's missing system of record, capturing how work is actually done and turning it into an owned, compounding digital asset. Built on One System Human 2.0 (the vision), the Intelligence Flywheel (the engine), and Work Intelligence (the asset), EON serves enterprises in safety-critical industries worldwide. Founded by the leadership behind EON Reality, with twenty-five years of experience in immersive learning, EON AI Ventures supports 4,400+ institutional customers across 80+ countries from its headquarters in Irvine, California. For more information, visit www.eonaiventures.com.

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