WHITE PAPER

YVision

The Sovereign Operating System for Nature, Sports, and Health

A Multiscale Causal World-Model Platform for Ecological Intelligence, Simulation-Driven Decision Making, and Sovereign IP Architecture

António Câmara
YVision
February 2026

Executive Summary

YVision is a patented, sovereign, hybrid intelligence operating system that constructs and manipulates Multimodal Multiscale Causal World Models (M^3C-WM) of natural, physical, and social environments. It integrates simulation, structured perturbation, and agentic orchestration into a unified platform — enabling organizations to model reality, simulate interventions before execution, and deploy validated actions through a closed-loop feedback architecture.

YVision is not a prediction tool or a data platform. It is an operating system — the computational substrate through which complex environments become measurable, simulatable, governable, and transformable.

Core Value Proposition

- Builds hypergraph-based world models from sensor data, satellite imagery, video, and natural language
- Simulates counterfactual interventions before real-world execution (IDEAS engine)
- Applies structured perturbations via Surprise Calculus to test resilience and discover novel capabilities
- Deploys agentic orchestration with human governance gates across complex pipelines
- Provides sovereign validation and auditable output for carbon/biodiversity markets
- Generates an IP cascade over Nature Capabilities — creating new industries from ecological intelligence

The initial beachhead is the Internet of Nature (IoN), developed in partnership with the Portugal Natural Capital Corporation (PNCC). This positions Portugal as the first country deploying a sovereign ecological operating system — with measurable impact on GNP, employment, EU climate compliance, and global export potential.

The same architecture applies — without modification to the kernel — to Sports, Health, and Education, creating a platform strategy with deep defensibility and multi-vertical revenue expansion.

YVision is built on 25 years of deployed spatial computing heritage from YDreams, extending a proven lineage into a modern sovereign AI infrastructure. It is raising a Seed/Pre-Series A of €/$6–10M to deliver three lighthouse deployments and SDK v1, followed by a Series A of €/$15–25M to scale US enterprise go-to-market.

1. The Problem: Fragmented Intelligence for Complex Systems

Modern science, industry, and governance face a structural gap. The tools available for understanding and managing complex systems — natural ecosystems, sports tactics, surgical environments, urban infrastructure — fall into isolated categories:

- Statistical analytics that predict but cannot simulate causality
- Simulation engines that are domain-specific and manually parameterized
- Digital twins that reconstruct scenes but cannot be reliably manipulated or stress-tested
- AI models (including LLMs) that encode knowledge but lack grounded, spatial, and multiscale reasoning
- GIS and geospatial platforms that are descriptive, not causal

None of these systems provides what complex decision-making actually requires:

What is Missing

1. A unified representation of entities and relationships across scales (micro to macro)
2. Multimodal integration of sensor data, imagery, text, and numerical streams
3. Causal intervention semantics — not just prediction, but 'what if'
4. Structured perturbation — systematic exploration of surprising and resilience-testing scenarios
5. Agentic orchestration — autonomous pipeline execution with human approval thresholds
6. Sovereign validation — auditable, non-outsourceable certification of ecological and physical models

1.1 The Sovereignty Gap

For nations and institutions relying on natural capital — forests, soils, coastlines, biodiversity corridors — the risk is existential. If validation logic, digital twin infrastructure, and counterfactual simulation depend on foreign platforms, the nation becomes a data supplier rather than a platform owner. The highest-value layer is not raw data; it is the model kernel, the validation logic, and the intervention semantics.

This is precisely the vulnerability PNCC's 'Knowledge Sovereignty Doctrine' is designed to address — and precisely the gap that YVision fills.

2. The YVision Architecture

YVision is organized as a seven-layer sovereign operating system. Each layer is modular and domain-agnostic; together they form a closed-loop intelligence stack.

Layer	Function	Key Components
Sensing & Actuation	Physical data collection and deployment	IoT, drones, robotics, satellite, edge compute
Data & Knowledge	Alignment, uncertainty, knowledge synthesis	Data lake, RAG KB, ontologies, LLM routing
World Model Kernel (M³C)	Structured causal representation	Hypergraph, scale morphisms, causal operators
Simulation Layer (IDEAS)	Digital twin construction + scenario generation	Video→twin, counterfactuals, VR rendering
Perturbation Layer (Surprise)	Structured resilience testing	Transformation operators, Surprise Index
Orchestration & Governance	Agentic pipeline + human oversight	DAG planning, approval gates, audit logs
Experience Layer	Interfaces for humans and systems	AR/VR, dashboards, APIs, companion apps

2.1 The World Model Kernel: M³C-WM

The core mathematical object in YVision is the Multimodal Multiscale Causal World Model (M³C-WM), formally defined as a tuple:

Formal Definition

$\mathcal{W}$ = (H, M, S, D, C)

H — Hypergraph Core: entities (nodes) and arbitrary multi-entity relationships (hyperedges)
M — Modal Structure: typing function assigning modalities (symbolic, visual, numerical, sensory)
S — Scale Structure: partially ordered scale set with projection morphisms (micro ↔ macro)
D — Dynamics: state transition operator encoding temporal evolution
C — Causal Structure: structural causal model enabling do-calculus interventions

This formalism unifies frameworks that previously existed only in isolation. AI world models typically cover only (H, D). Causal inference covers (H, C). Climate models cover (H, D, S). Human cognition appears to operate across the full tuple. YVision is the first system to provide an operational implementation of the complete (H, M, S, D, C) architecture.

2.2 IDEAS: The Simulation Engine

IDEAS is the dynamic operator on world models. It provides the pipeline by which video streams, sensor inputs, natural language specifications, and domain knowledge are compiled into the M³C kernel. Formally:

IDEAS Pipeline

IDEAS: Video $\rightarrow \mathcal{W}$ (world model construction)
IDEAS: ($\mathcal{W}$, intervention) $\rightarrow \mathcal{W}'$ (counterfactual simulation)

Capabilities: Digital twin construction • Physics and behavior modeling
Counterfactual scenario generation • KPI computation
VR rendering • Risk projection (fire, flood, collapse)

2.3 Surprise Calculus: The Perturbation Engine

Surprise Calculus provides the grammar of structured transformations on world models. A surprise operator Ω acts on the world model:

$\Omega : \mathcal{W} \rightarrow \mathcal{W}^*$ where deviation increases, coherence is preserved, and causal viability is tested.

Core operators include: Inversion, Deletion, Scale Shift, Role Reversal, Boundary Change, and Counterfactual Branching. Each perturbation is scored by a Surprise Index measuring deviation magnitude, coherence preservation, and feasibility constraints.

This is not random generation. It is an algorithmic algebra of structured, legally-viable transformations — making YVision the first system to formalize resilience testing through causal perturbation.

2.4 The Full Operational Loop

The complete YVision operational cycle closes as follows:

YVision Closed Loop

Step 1: IoN / sensors build the $\mathcal{W}$(Nature) world model in real-time
Step 2: IDEAS constructs manipulable digital twin from video + telemetry
Step 3: Surprise Calculus generates structured perturbations (thinning strategies, species redistribution)
Step 4: IDEAS simulates outcomes (biodiversity, carbon, fire risk, water cycle)
Step 5: Agentic orchestration selects validated intervention (human gate if risk threshold exceeded)
Step 6: Robotics / field operations execute validated action
Step 7: Feedback from sensors updates $\mathcal{W}$ — the model learns

3. Internet of Nature (IoN) and PNCC: The Sovereign Deployment

YVision's primary and founding deployment is through the Internet of Nature (IoN), the operational sensing and actuation layer of Portugal's natural capital infrastructure, governed by the Portugal Natural Capital Corporation (PNCC).

3.1 Internet of Nature as Planetary World Model

IoN is reinterpreted through the M³C framework not merely as a sensor network but as a distributed, real-time, planetary-scale M³C World Model of Nature. Each element maps directly to the formal tuple:

IoN Component	M³C Mapping	Example
Forest / Ecosystem	Sub-hypergraph H_forest	Species nodes, nutrient hyperedges
Satellite, drone, IoT	Multimodal layer M	Imagery, temperature, acoustic data
Soil → tree → watershed → region	Scale morphisms S	Leaf → stand → forest → basin
Climate cycles, migration	Dynamics D	Seasonal fire risk, flood cycles
Policy interventions	Causal layer C	do(fishing quota reduction)

3.2 PNCC: Governance, Finance, and Sovereign IP

PNCC provides the institutional architecture within which YVision operates:

- Natural Assets (PNCC) → Computational Representation (YVision) → Simulation & Validation (IDEAS) → Perturbation & Resilience (Surprise) → Operational Deployment (IoN)

A critical structural feature is the IP separation principle: Portugal owns nature datasets and territory-specific digital twins. YVision owns the multiscale modeling engine, the Surprise Calculus engine, the orchestration OS, and the simulation compiler. This protects both national sovereignty and innovation incentives.

3.3 Carbon and Biodiversity Markets: Sovereign Validation

The offset economy requires Measurement, Reporting, and Verification (MRV) — and this is where YVision creates decisive strategic value. Without YVision, validation is outsourced to foreign platforms, making Portugal a credit seller dependent on external certification. With YVision, Portugal becomes a validation authority.

Market Requirement	YVision Capability
Measurement of ecosystem state	Multiscale hypergraph ecological model
Counterfactual baselines	Causal intervention + IDEAS simulation
Verification of additionality	Perturbation testing + scenario comparison
Audit trail	Agentic orchestration log + governance records
Independent repeatability	Sovereign kernel — not outsourced

This shifts Portugal from credit seller to validation authority — geopolitically significant in the context of EU Green Deal, Article 6 Paris Agreement implementation, and emerging biodiversity markets.

4. IP Architecture and the Nature Capabilities Cascade

YVision does not seek to own natural assets. PNCC governs those. Instead, YVision owns the computational engine that transforms natural capital into measurable, simulatable, and governable intelligence — and from that transformation, a cascade of downstream IP emerges.

4.1 The Three-Layer IP Architecture

IP Cascade Model

Layer 1 — Sovereign Natural Capital (PNCC Governance)
Forests, soils, watersheds, Atlantic EEZ, biodiversity corridors — publicly governed, non-transferable

Layer 2 — YVision (Computational Umbrella Layer)
Multiscale ecological modeling kernel • Hypergraph representation
Multimodal ingestion • IDEAS simulation engine • Perturbation engine • Agentic OS
→ YVision turns Nature into: measurable, simulatable, validatable, perturbable, governable

Layer 3 — Nature Capabilities → Industry IP Cascade
Validated functional potentials of ecosystems extracted through modeling and simulation
→ New industries, new products, new financial instruments, new software verticals

4.2 Five Worked Examples of the Cascade

Example 1: Forest Microclimate Optimization

YVISION discovers through multiscale simulation that specific thinning geometries reduce wildfire propagation by 37% and that certain species arrangements increase soil moisture retention. The Nature Capability identified: 'Microclimate Modulation Through Species Topology.'

Downstream IP cascade: Forest Layout Optimization SaaS (algorithmic topology engine) → Autonomous Reforestation Robotics (precision planting pattern methods) → Fire Risk Derivative Contracts (actuarial simulation frameworks). YVision owns the modeling engine; industry IP forms downstream.

Example 2: Marine Biodiversity Signal Extraction

Hypergraph modeling combined with drone video and acoustic sensing of seagrass beds reveals that specific acoustic biodiversity signatures predict ecosystem collapse six months in advance. Capability: 'Acoustic Early-Warning Biodiversity Index.'

Cascade: Biodiversity Risk Analytics Platform (acoustic-to-collapse predictive mapping) → Marine Carbon Verification Standard (multiscale MRV methods) → Ocean Health Bonds (financial instruments backed by YVision validation).

Example 3: Soil Regeneration Capability

Simulation shows that certain rotational polycultures improve microbial diversity, increase yield stability, and reduce fertilizer dependency. Cascade: Regenerative Agriculture SaaS → Soil Microbiome Monitoring Hardware → Nutrient Optimization Algorithms → Seed-rotation licensing protocols.

Example 4: Biomaterial Discovery

Material resilience patterns derived from structural hypergraph modeling of Portuguese cork and marine biomaterials reveals cross-domain analogies with marine exoskeleton microstructures. Cascade: Packaging biomaterials → Shock-resistant composites → Biodegradable architectural materials.

Example 5: Nature Digital Twins for Media and Tourism

High-fidelity ecosystem digital twins generated from YVision become licensable assets for gaming, film production, and immersive tourism pre-experience platforms — creating derivative digital IP without consuming or transferring the underlying natural asset.

4.3 The Economic Flywheel

Regenerative Innovation Loop

Natural Asset → YVision Modeling → Nature Capability Extraction
→ Industry Formation → New IP → Revenue
→ Reinvestment in Natural Capital → Improved Natural Asset

Better models → Better resilience → Higher asset value
→ More credible credits → Stronger exports → More investment → Stronger ecological base

The flywheel accelerates over time.

5. Market Context and Competitive Positioning

5.1 Global World-Model Investment Landscape

World models are transitioning from research concept to investable platform layer. Three forces have converged: multimodal foundation models can now infer structure from rich observation; simulation and digital twins are becoming operational across robots, factories, cities; and agentic AI turns world models into control systems. Capital is moving beyond LLMs toward spatial intelligence, physical AI, and industrial twins.

Platform	Funding	Capability	Signal for YVision
World Labs (Fei-Fei Li)	~$1B	Spatial intelligence; 3D world modeling	World models are becoming a foundation-model category
Runway	$315M Series E	World simulation / generative environments	Simulation is being productized for real-world use
Wayve	$1.05B Series C	Embodied AI for automated driving	World models + agents as real-world control systems
Siemens + NVIDIA Omniverse	Strategic	Industrial digital twin stack	Platform lock-in risk for nations relying on foreign stacks
OpenAI (Sora + multimodal)	$6.6B at $157B	Video-native generative modeling	Confirms multimodal AI scaling; sovereign layers needed
Google DeepMind Genie	Internal R&D	World generation from video/text	Foundation labs are prioritizing environment simulation

5.2 YVision Competitive Differentiation

Competitors are strong in parts of the stack. YVision competes by unifying the stack around a usable sovereign world model:

Category	Key Players	YVision Differentiation
Industrial digital twins	Siemens, Dassault, NVIDIA Omniverse	Sovereign hypergraph kernel; not dependent on foreign simulation OS
Infrastructure twins	Bentley iTwin, Autodesk Tandem	Explicit causal operators; Surprise Calculus; agentic governance
Geospatial twins	Esri / GIS-centric systems	Multiscale morphisms; dynamic causal layer; not just descriptive
Real-time 3D engines	Unity, Unreal Engine	Semantic hypergraph + agents that act inside the world model
VPS / AR Maps	Niantic, Matterport	Full pipeline from capture to counterfactual simulation to actuation

5.3 Sovereignty and Differentiation for Portugal / EU

The most important differentiation is not technical — it is structural. Portugal faces a choice: become a data supplier to foreign world-model platforms, or deploy a sovereign kernel. YVision provides the second option. The strategic implications:

- Validation capture is prevented: carbon/biodiversity 'truth' is defined domestically
- Lock-in is avoided: no single-vendor dependency for national digital twins
- Export capacity is enabled: Portugal can export a validated Nature OS
- Patent moat is established: YVision architecture is legally defensible against Big Tech replication

6. Use Cases: Nature, Sports, Health, Education

6.1 Nature: Ecological Intelligence at Scale

Nature is the founding vertical and the strategic anchor for YVision's sovereign architecture. The platform enables:

- Forest ecosystem modeling with multiscale simulation from leaf to watershed
- Wildfire risk prediction and topology optimization
- Coastal and marine ecosystem digital twins
- Soil microbiome dynamics and regenerative agriculture optimization
- Carbon MRV and biodiversity credit verification
- Counterfactual policy simulation: 'What if temperature increases 1.5°C over 10 years?'

Real-world operational loop: Drone footage of a forest → multiscale twin construction → Surprise engine tests thinning strategies → simulation evaluates fire risk → agent selects intervention → robot executes → feedback updates twin. This full loop is patent-protected.

6.2 Sports: Tactical Intelligence Through World Models

YVision models sports environments as entities (players, ball, zones), hyperedges (pressing clusters, attacking triangles), multiscale structures (player → formation → strategy), and causal interventions (substitution, tempo change, formation shift).

Capabilities include tactical counterfactual simulation ('What if we press higher?'), formation perturbation testing, injury risk modeling, training scenario generation, and digital twin coaching environments. Revenue streams: professional club subscriptions, national federation systems, immersive VR tactical training, and esports derivatives.

6.3 Health: Pre-Surgical Simulation and Counterfactual Planning

YVision models anatomical entities (organs, vessels, tools), functional relationships (flow, pressure, metabolism), scale morphisms (cell → tissue → organ → patient system), and intervention operators (incision variation, clamp placement, dosage change).

Capabilities: pre-surgical counterfactual testing, risk simulation under different procedures, immersive VR training with real-world data, and adaptive recovery modeling. Revenue streams: surgical planning platforms, hospital digital twin systems, medical device simulation integration, and health-risk analytics services.

6.4 Education: Immersive World-Based Learning

YVision enables students to interact with causal models of climate systems, biological systems, economic simulations, and historical reconstructions. Learning becomes experiential, causal, interactive, and adaptive. Revenue streams: national immersive curriculum platforms, exportable educational digital twins, VR simulation licenses, and university research infrastructure.

Layer	Nature	Sports	Health	Education
World Model Kernel	Ecosystems	Game systems	Anatomical systems	Knowledge systems
Simulation	Climate/fire/biodiversity	Tactical scenarios	Surgical planning	Interactive learning
Perturbation	Resilience testing	Strategy testing	Procedure testing	Hypothesis testing
Agentic Orchestration	Field operations	Training adaptation	Clinical workflow	Adaptive curriculum

7. Business Model and Financial Projections

7.1 Four Revenue Layers

YVision's revenue architecture is structured across four layers, each reinforcing the others:

Layer 1: SaaS Platform Subscriptions

Enterprise platform licenses (annual subscription per deployment/site/twin domain), including core engine, world DB, governance, and monitoring. Vertical modules for Nature, Sports, and Health. Targeted at professional clubs, public sector bodies, healthcare systems, and educational institutions.

Layer 2: Validation-as-a-Service

Carbon MRV validation fees, biodiversity credit verification, counterfactual baselines for carbon markets, EU compliance contracts, international certification services. This layer captures the highest-margin revenue by positioning YVision as the MRV authority.

Layer 3: Platform Licensing and IP Royalties

YVision SDK licensing to other sovereigns and companies. Industry vertical packs (sports, health). Equity participation in spin-offs. Nature Capability licensing. Export of the sovereign ecological OS to Lusophone and EU partner countries.

Layer 4: Usage-Based Compute

Simulation runs, rendering, neural reconstruction, agent operations. Margin expansion through pipeline optimization and standardized compute.

7.2 Five-Year Revenue Projections (Illustrative)

Revenue Stream	2026	2027	2028	2029	2030
Enterprise Licenses	$1.5M	$4.5M	$10M	$22M	$40M
Usage-Based Compute	$0.4M	$1.5M	$4M	$9M	$16M
Vertical Modules	$0.6M	$2.0M	$6M	$14M	$24M
Services / Partners	$0.3M	$0.8M	$1.5M	$2.5M	$3.5M
TOTAL	$2.8M	$8.8M	$21.5M	$47.5M	$83.5M

Assumptions: 5–8 enterprise deployments by 2027; 25–40 by 2030; expansion via partners and SDK ecosystem. Validated EV scenarios at 2028 ARR of $20M suggest a range of $120–240M; at 2030 ARR of $80M, the range is $480–960M at 6–12× multiples.

7.3 Portugal–US Dual Company Structure

Corporate Architecture

IP HoldCo (licensing entity)

YVision Portugal (EU Sovereign Core) YVision USA (Delaware)

- Nature vertical & public sector
- EU grants + sovereign deployments
- Reference projects + datasets
- Local talent & R&D expansion
- Sports + enterprise GTM
- Strategic partnerships (cloud/sensors)
- US capital markets access
- Path to global scaling and exits

Portugal anchors sovereign EU deployments and public funding pathways (including EU Green Deal, Horizon Europe, and PNCC institutional contracts). The US entity optimizes access to enterprise buyers, capital markets, and strategic exits.

8. Investment Case and Strategic Roadmap

8.1 The Core Moat

YVision's defensibility rests on four interlocking foundations:

- Patent protection covering the multiscale hypergraph world modeling kernel + structured perturbation algebra + agentic orchestration + closed-loop execution
- 25 years of deployed heritage from YDreams — not a hypothesis, but an industrial-scale evolution
- Sovereign institutional anchor (PNCC/IoN) creating structural lock-in at the national level
- IP cascade architecture: every nature capability extracted generates downstream IP that reinforces the platform's value without requiring YVision to own the underlying assets

Competitors may build LLMs, digital twins, or simulation engines in isolation. What they cannot legally replicate is the integrated architecture combining multiscale hypergraph kernels + structured perturbation + agentic orchestration + real-world execution. That is the moat.

8.2 Investment Requirements

Round	Amount	Milestones	Use of Funds
Seed / Pre-Series A	€/$6–10M	3 lighthouse deployments + SDK v1 + reference pipeline	45% R&D, 35% GTM, 15% cloud/ops, 5% legal/IP
Series A	€/$15–25M	$10–20M ARR; US enterprise scale; partner ecosystem	Engine hardening, US GTM, multi-tenant cloud

8.3 18-Month Roadmap

Phase	Timeline	Key Deliverables
Foundation	0–6 months	Finalize world DB + coherence engine; Pilot #1 (Nature); Pilot #2 (Sports); security & deployment tooling
SDK + Commercialization	6–12 months	SDK v1 + partner integration kits; Pilot #3 (Health/Education); paid conversions + reference cases
Scale	12–18 months	Multi-tenant cloud + usage billing; US expansion (5–10 pilots via partners); plugins & templates library

8.4 Strategic Exit Paths

Potential acquirers include: climate infrastructure funds, sovereign digital infrastructure players, defense and resilience technology firms, and large cloud providers seeking ecological sovereignty layers. However, the preferred long-term path is platform independence with sovereign partnerships — particularly as PNCC's institutional anchoring creates structural alignment with national interest.

8.5 Why Now

Four global trends converge at this precise moment to make YVision's timing optimal:

- Explosion of sensor data: satellite, drone, IoT infrastructure has reached planetary coverage at economically viable cost
- AI model maturity: multimodal foundation models can now infer world structure from heterogeneous inputs
- Regulatory pressure for ecological accountability: EU Green Deal, CSRD, Article 6 Paris Agreement all require MRV at scale
- Capital shift to nature-based solutions: biodiversity and carbon credit markets are expanding rapidly, with institutional capital seeking validated, auditable instruments

9. Economic and Sovereign Impact for Portugal

9.1 From Extraction Economy to Ecological Intelligence Economy

Portugal possesses one of the largest Exclusive Economic Zones in Europe and a diversified terrestrial ecological base. Historically, natural capital contributed to GDP primarily through first-order extraction: agriculture, forestry, fisheries, and tourism. YVision + IoN + PNCC enable the transition to an Ecological Intelligence economy — multiplying value per hectare without increasing extraction.

9.2 GNP Contribution Channels

- Higher value-added per hectare through intelligent optimization and precision management
- Retention of validation revenues domestically instead of outsourcing MRV to foreign platforms
- Export of YVision modules, standards, and sovereign OS to Lusophone and EU partner countries
- Reduced disaster-related economic losses through fire risk modeling and flood simulation
- New industry formation: agri-tech, marine analytics, biomaterials, climate fintech, robotics for ecology

9.3 Employment Generation

YVision + IoN + PNCC create employment across five tiers, from high-skill AI and robotics engineers to field operations, financial services, and downstream industry formation. The profile is knowledge-intensive — precisely aligned with Portugal's strategic objective of talent retention and export value.

9.4 Sovereignty Assurance

YVision guarantees national control of ecological baselines, sovereign carbon and biodiversity validation, independence from foreign simulation platforms, export capacity without data leakage, and control of Nature-derived intellectual property. This aligns with EU digital sovereignty objectives, strategic autonomy frameworks, Green Deal compliance, and Atlantic maritime security doctrine.

Portugal's Strategic Position

- First country with a sovereign ecological operating system
- Reference model for Lusophone countries
- European leader in nature-based AI infrastructure
- Exporter of validated nature services
- Standard setter for ecological digital twins
- First-mover in the ecological intelligence economy

10. Historical Continuity: 25 Years of YVision Heritage

YVision is not a speculative construct. It is the formal evolution of a spatial computing and world-model architecture first developed at YDreams in the early 2000s — constituting one of Europe's earliest large-scale deployments of spatial computing platforms.

10.1 YDreams Heritage

The original YVision platform at YDreams integrated data-driven engines, AR/VR, AI and embodied interaction, interactive digital twins, and was deployed in hundreds of projects across 50+ Fortune 500 companies. YDreams delivered over 2000 projects in 30+ countries, commercialized over 40 products globally, and developed a patent portfolio including spatial interaction and indoor positioning patents (one later sold to Uber).

10.2 Illustrative Historical Deployments

Project	Year	Description	Relevance to Modern YVision
Santander Financial City	2010	3D city model + AR overlays + autonomous robotic guides	Early institutional digital twin; prototype of sovereign modeling
EDP Picote Dam	2010s	Infrastructure digital twin for operational decision support	Predecessor to PNCC infrastructure twins
Barreiro Public Participation	2005–2016	VR-based civic spatial modeling and participation	Early operational civic world model
Cisco 'Hear the City' (Rio Olympics)	2016	Real-time urban spatial data interaction	Real-time multiscale urban world model
Ziphius Aquatic Drone	2013	Autonomous aquatic drone for sensing	Physical actuation layer — now core to IoN
YScope Medical Imaging	Various	Gesture-based natural interface for medical data	Predecessor to YVision Health vertical

10.3 The Structural Transformation

Dimension	Original YVision (YDreams)	New YVision (Sovereign OS)
Knowledge layer	Domain scripts + databases	Multimodal foundation models + RAG + LLM routing
Representation	3D scene models	Multiscale hypergraph M³C-WM
Simulation	Physics engine + scripted agents	IDEAS: video→twin + counterfactual generation
Perturbation	Manual scenario variation	Surprise Calculus formal algebra
Governance	Client-driven	Sovereign agentic orchestration + audit log
Scale	Project/installation level	National + planetary
Revenue	B2B project delivery	SaaS + MRV-as-a-Service + IP licensing

11. Patent Strategy and IP Architecture

11.1 Provisional Patent Scope

The YVision patent is structured to protect the integrated architecture — not individual components. The core claim anchors novelty in the combination of elements that no prior art provides jointly:

Core Patent Claim (Provisional)

A computer-implemented operating system comprising:
- A multiscale multimodal hypergraph world model kernel
- An automated compiler from heterogeneous inputs into said kernel
- A structured perturbation algebra operating over said kernel
- A simulation engine generating counterfactual scenarios
- An agentic orchestration layer governing execution and safety
- A feedback mechanism integrating real-world sensed data

11.2 Strategic Patent Portfolio

The patent strategy employs three interlocking provisional filings to create a moat of mutually reinforcing claims:

- Provisional 1: Core YVISION architecture + world model kernel + orchestration
- Provisional 2: Surprise perturbation algebra + scoring method
- Provisional 3: Video-to-causal-world compilation (IDEAS integration)

11.3 Strategic Consequences of the Patent

The patent does five powerful strategic things for the YVision + PNCC + IoN ecosystem:

- Makes Explora the Core Asset: Explora becomes the first implementation of YVISION in the nature domain — not just a platform, but a patented sovereign ecological OS
- Enables the Export Model: Portugal can export the Nature Stack governance model + YVISION platform license + Nature Capability pipelines globally
- Protects Against Big Tech Capture: Ownership of the multiscale hypergraph + structured perturbation calculus + agentic orchestration of the nature stack prevents replication by large technology platforms
- Makes Nature a High-Tech Sector: Formalizes Nature as a computational object, simulatable asset, causally manipulable system, and governable infrastructure — transforming green policy into deep tech national capability

- Anchors the Nature Industries Foundry: The engine that algorithmically generates, simulates, and validates Nature Capabilities — turning conceptual capabilities into industrial reality

12. Conclusion: The Computational Infrastructure of the Ecological Economy

YVision stands at the convergence of four global trends: the maturation of world-model AI, the platformization of digital twins, the structural demand for ecological accountability, and the emergence of sovereign digital infrastructure as a national strategic asset.

It is not a prediction tool, a green tech startup, or a niche simulation engine. It is the operating system layer through which natural capital, athletic systems, human physiology, and knowledge environments become computationally accessible, causally manipulable, and sovereignly governable.

The Unified Thesis

Internet of Nature builds planetary world models.
IDEAS turns them into manipulable digital twins.
Surprise Calculus generates structured deviations.
The M³C framework provides the mathematical backbone.
PNCC provides the institutional and financial architecture.
YVision binds it all into a sovereign, patented, exportable operating system.

The strategic narrative is clear: Portugal is not starting from zero. It possesses 25 years of deployed spatial computing heritage, a documented platform lineage, international deployment experience, hardware and robotics integration capability, and intellectual property foundations. YVision formalizes this lineage into a sovereign architecture aligned with global world-model investment trends — and positions Portugal as the first country with a patented ecological operating system.

Investors are not funding software. They are funding the technological infrastructure of the ecological economy — a new sovereign operating system for the world's most valuable and most neglected computational domain: the living planet.

YVision — Confidential Working Document — February 2026

Appendix F — World Models Developed by YVision

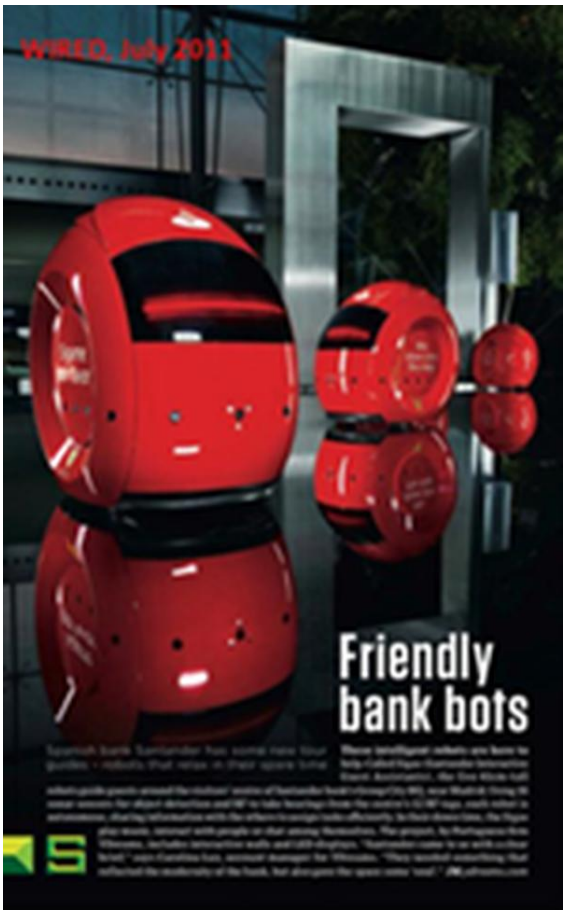
YDreams / YVision · 2010–2026

This appendix documents the lineage of world models built and deployed by YDreams and YVision between 2010 and 2026.

Each project is described as a formal M³C World Model instance — demonstrating that YVision's theoretical frameworkis grounded in decades of real-world deployment across cities, infrastructure, health, sport, ecology, and immersive media.

F.1 Santander Financial City — Robots + 3D Model + AR

DOMAIN	Urban / Corporate Digital Twin · Spatial Computing · Embodied AI · Augmented Reality



Santander Financial City: intelligent robot guides navigating within an AR-enhanced 3D physical model.

What Was Built

- A 3D physical scale model of Santander Financial City
- Augmented Reality overlays tied to model components
- Intelligent robots guiding visitors and explaining spatial elements
- Dynamic display explanations updated in real time

Why This is a True World Model

The physical terrain model was linked to live databases. Each spatial object — buildings, trees, infrastructure components — was data-bound, making the model semantically alive. AR overlays updated meaning in real time as visitors interacted. Robots navigated and interacted within that mapped spatial representation, demonstrating autonomous agency within a structured world model.

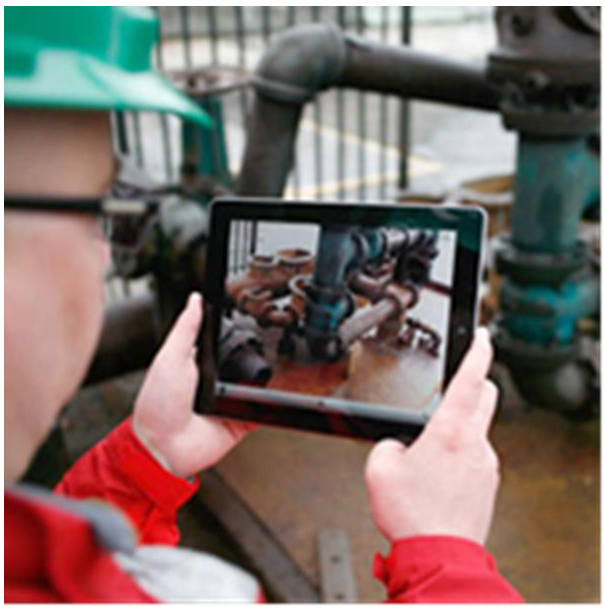
> M³C Classification: A structured spatial hypergraph of a real city, connected to semantic and operational data layers.
>
> Scale morphisms operational from building component → district → city-wide strategy.
>
> Robots acted as agents executing decisions within the world model — an early closed-loop execution prototype.

M³C Component	Mapping in this World Model
H (Hypergraph)	Buildings, infrastructure, roads, trees as nodes; operational and spatial relationships as hyperedges
M (Multimodal)	Physical model + AR overlays + robot speech + database readouts
S (Scale)	Component → building → campus → city district
D (Dynamics)	Live database updates; robot navigation state transitions
C (Causal)	Visitor interaction triggering AR content; robot routing decisions

Project videos: Project video | Making-of video

F.2 EDP Picote Dam — Operational Decision Theater

DOMAIN	Infrastructure Digital Twin · Project Management · Decision Support · Risk Visualization



EDP Picote Dam: AR-enhanced operational view showing real-time project status and construction state.

What Was Built

- 3D representations of a dam — external and internal operational views
- Data-driven status indicators ("traffic lights") for construction schedule
- Real-time project management data integrated spatially
- Visual simulation of progress, risk status, and construction milestones

Why This is a World Model

This was an operational digital twin for infrastructure management. The 3D terrain and infrastructure representation served as a persistent spatial substrate onto which real-time project management data was layered. Decision-support logic operated over the model, enabling managers to understand at a glance the state of complex, multi-phase construction — a direct predecessor to what YVision now formalises as the Dynamics (D) and Causal (C) layers of the M³C kernel.

> M³C Classification: Infrastructure operational digital twin — explicitly demonstrates decision-support logic
>
> operating over a real-time updated spatial world model.

M³C Component	Mapping in this World Model
H (Hypergraph)	Dam structures, turbines, pipes, construction phases as nodes; dependencies as hyperedges
M (Multimodal)	3D model + numerical status indicators + traffic light overlays + textual annotations
S (Scale)	Component → structural section → full dam → project portfolio
D (Dynamics)	Real-time construction progress data; schedule vs. actuals tracking
C (Causal)	Decision logic: which delays trigger which risks; intervention triggers

F.3 Olympic Park Rio — VR Exploration of Future Territory

DOMAIN Urban Planning · Predictive World Modeling · VR · Stakeholder Communication

Olympic Park Rio: virtual reality model of a future urban territory, enabling spatial reasoning and stakeholder planning before construction.

What Was Built

- A full virtual reality model of a yet-to-be-constructed Olympic Park
- Exploration and navigation tools within the simulated future configuration
- Future-state spatial simulation for stakeholder communication and planning

This project demonstrates predictive world modeling at urban scale — the construction of a M³C World Model not of what exists, but of what will exist. The model supported spatial reasoning and stakeholder communication across scales from individual venue to site-wide transport flows. It was a counterfactual world model: a causal representation of a future configuration whose interventions — construction sequences, venue placement — could be explored before commitment.

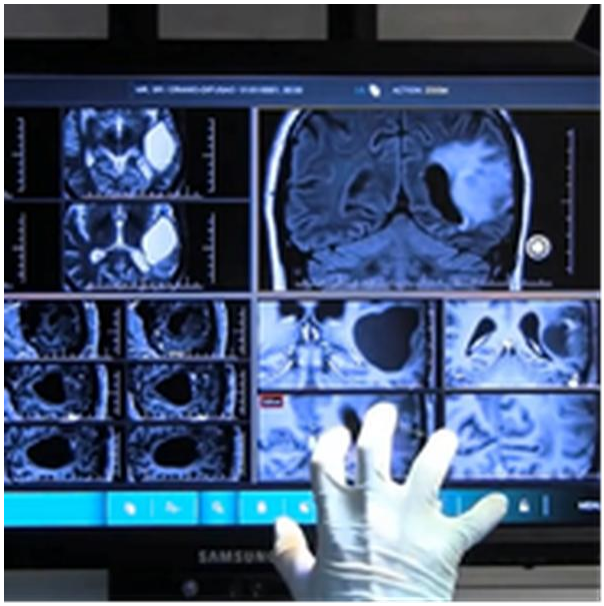
> M³C Classification: Predictive / counterfactual world model. Demonstrates the C-layer (causal intervention)
>
> applied to urban planning: 'What if we place the velodrome here instead of there?'

M³C Component	Mapping in this World Model
H (Hypergraph)	Future venues, transport nodes, public spaces, infrastructure as nodes; flow relationships as hyperedges
M (Multimodal)	3D geometry + symbolic labelling + spatial data overlays + VR immersion
S (Scale)	Individual venue → cluster → Olympic park → city transport network
D (Dynamics)	Construction phase sequencing; crowd flow simulation
C (Causal)	Design choice interventions: venue placement, access routes, capacity allocations

Project video: Olympic Park Rio VR

F.4 YScope — Surgical AR World Model

DOMAIN Medical Digital Twin · Surgical AR · Anatomy Modeling · Real-Time Interaction



YScope: gesture-controlled AR interface for real-time interaction with patient imaging in operative contexts.

What Was Built

- Augmented Reality representations of patient medical imaging (CT, MRI)
- Gesture-based natural interface for navigation and manipulation
- Real-time interaction in operating room contexts
- Multi-layer exploration combining imaging modalities with surgical context

Why This is a World Model

YScope is a medical digital twin operating in real time. It builds a 3D reconstruction of anatomy from imaging data, binds that representation to physical spatial coordinates, and enables natural interface manipulation — precisely the multimodal, multiscale structure the M³C kernel formalises. The gesture interface acts as the agentic layer: the surgeon interacts with the world model to inform surgical decision-making. This project anticipates the YVision Health vertical by over a decade.

M³C Classification: Medical digital twin — a real-time operational world model of a patient's anatomy.

Demonstrates the M-layer (multimodal: MRI + spatial coordinates + gesture interface) and the S-layer (cell → tissue → organ).

M³C Component	Mapping in this World Model
H (Hypergraph)	Organs, vessels, tissue planes as nodes; proximity and flow dependencies as hyperedges
M (Multimodal)	CT/MRI imaging + 3D reconstruction + gesture input + visual overlay
S (Scale)	Cellular → tissue → organ → patient system
D (Dynamics)	Real-time imaging update; intraoperative anatomy changes
C (Causal)	Surgeon interventions: do(incise at position x); consequence modelling

Project video: YScope demonstration

F.5 RealSim — Virtual Car Racing Against Real Cars

DOMAIN Mixed Reality · Sports Simulation · Scene Modeling · Geometric Alignment

RealSim: virtual racing cars inserted into live race footage with real-time geometric alignment and collision logic.

What Was Built

- Real-time insertion of virtual racing cars into live race footage
- Geometric alignment of virtual objects with real-world perspective
- Collision logic for virtual-only interactions within real scenes
- Dynamic tracking of real cars to maintain spatial consistency

Why This is a World Model

RealSim required constructing a live world model of a real racing environment from video — extracting scene geometry, perspective, lighting, and object trajectories in real time, then inserting virtual objects that obeyed the same spatial laws. This is mixed reality world synchronisation: maintaining coherence between a real physical world and a virtual one by operating on a shared world model representation. It directly prefigures the IDEAS video-to-world-model pipeline.

> M³C Classification: Mixed-reality world model with real-time scene modeling and virtual-physical coherence.
>
> Directly anticipates the IDEAS engine: video → scene graph → entity tracking → causal interaction.

M³C Component	Mapping in this World Model
H (Hypergraph)	Real cars, virtual cars, track, spatial zones as nodes; proximity and overtaking relationships
M (Multimodal)	Video stream + geometric model + physics engine + symbolic race state
S (Scale)	Vehicle position → track sector → full circuit → race strategy
D (Dynamics)	Real-time car trajectory tracking; virtual car physics simulation
C (Causal)	Virtual car placement decisions; collision avoidance logic

Project videos: Video 1 | Video 2 | Video 3

F.6 Environmental Installations — Ecosystem Micro-World Models

DOMAIN Ecological Simulation · Interactive Environments · Sensor Integration · Artificial Life

Left: LEGO Aquarium — interactive ecosystem with simulated fish behaviour and sensor integration. Right: Oceanarium Sea Monsters — AR creature exploration with encyclopaedic overlays.

What Was Built

- Modelled artificial ecosystems with simulated organism behaviour
- Artificial fish and sea creature agents responding to visitor interaction
- Interaction zones mapped and sensor-connected to virtual representations
- Encyclopaedic content layered over physical creature displays

Why These Are World Models

These installations were micro-world models: domain-specific, spatially grounded representations of ecological systems with dynamic, agent-driven behaviour. The LEGO Aquarium modelled an underwater ecosystem in which artificial agents exhibited behavioural rules responding to physical interaction. The Oceanarium Sea Monsters project layered semantic information over physical exhibits, creating a multimodal world model of a natural history collection. Both demonstrated that world models can integrate physical environments as part of the representational substrate — a key principle behind the Internet of Nature architecture.

> M³C Classification: Ecological micro-world models with embodied agents and sensor-physical integration.

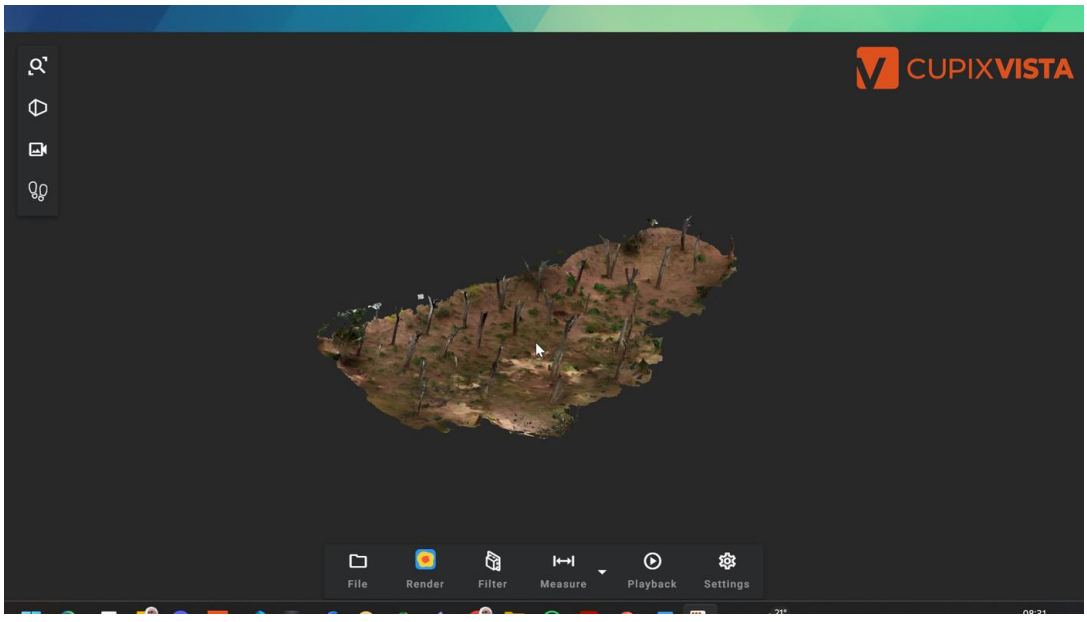
> Anticipates the Internet of Nature architecture: real-physical space + sensors + agent behaviour + semantic overlay.

M³C Component	Mapping in this World Model
H (Hypergraph)	Species, habitat zones, interaction points as nodes; predation and proximity as hyperedges
M (Multimodal)	Physical exhibits + AR overlays + sensor input + encyclopaedic text + visitor interaction
S (Scale)	Individual creature → species population → ecosystem → habitat zone
D (Dynamics)	Agent behaviour rules; visitor-triggered state changes
C (Causal)	Visitor interaction interventions; species interaction rules

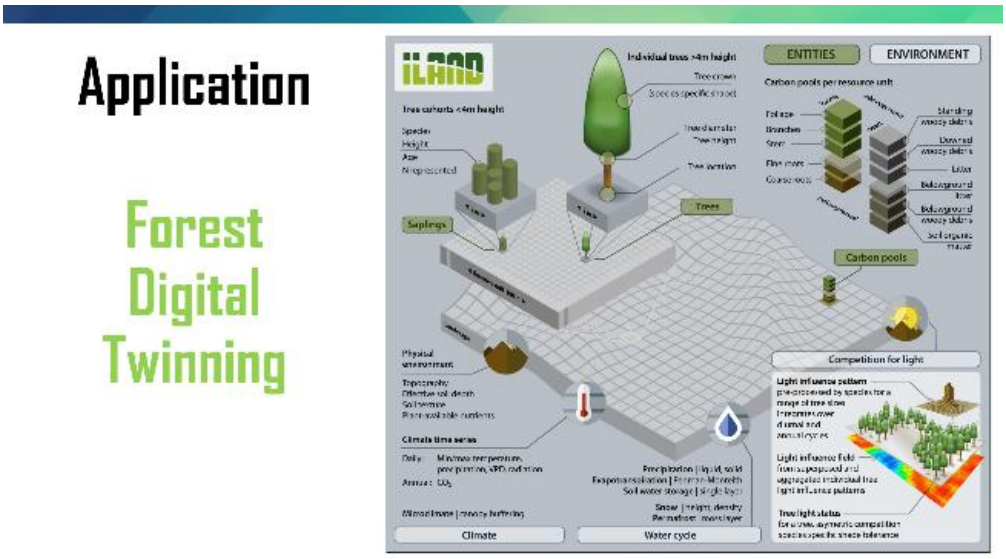
Project videos: LEGO Aquarium | Oceanarium Sea Monsters

F.7 Internet of Nature Worlds and Agents

DOMAIN Ecological AI · Forest Digital Twin · Nature Agents · IoN Operational Platform



Forest digital twin generated via CupixVista photogrammetry: a real post-fire forest reconstructed as a manipulable 3D world model.



iLand forest digital twinning application: multiscale forest model with individual tree entities, carbon pool tracking, climate dynamics, and species competition modelling.

What Is Being Built

The Internet of Nature Worlds and Agents represents the current frontier of YVision's world model programme — the evolution from deployed prototypes to a sovereign, planetary-scale ecological operating system. Two strands illustrate this:

Strand A: Photogrammetric Forest Twins

Using tools such as CupixVista and drone-based photogrammetry, real forest territories — including post-fire recovery zones in Portugal — are being reconstructed as high-resolution 3D world models. These twins capture individual tree positions, canopy structure, terrain morphology, and ground cover, providing the spatial hypergraph substrate (H) of the M³C kernel. This is the foundation of the Nature Capability extraction pipeline: from physical forest to measurable, simulatable digital representation.

Strand B: Agent-Based Ecological Simulation (iLand)

The iLand forest simulation framework demonstrates the full M³C architecture applied to ecological systems. Individual tree entities are modelled with species-specific attributes — height, crown, wood type, carbon pool — subject to climate dynamics, light competition rules, and water cycle coupling. This is a working M³C World Model instantiation: entities and hyperedges (H), multimodal data layers (M), scale morphisms from individual trees to carbon sequestration totals (S), seasonal dynamics (D), and causal intervention operators for thinning and species management (C).

> M³C Classification: Full M³C World Model implementation — the most complete instantiation in the YVision portfolio.

Demonstrates all five tuple components (H, M, S, D, C) operating simultaneously in an ecological domain.

Direct implementation target for the PNCC / Internet of Nature sovereign deployment.

M³C Component	Mapping in this World Model
H (Hypergraph)	Individual trees, species, soil patches, water bodies, climate cells as nodes; competition, nutrient flow, and predation as hyperedges
M (Multimodal)	Photogrammetric 3D models + satellite imagery + LiDAR + drone video + climate time series + acoustic sensors
S (Scale)	Individual tree → stand → forest → watershed → national carbon balance
D (Dynamics)	Growth cycles, succession dynamics, fire propagation, climate drift, species migration
C (Causal)	do(thinning_pattern) → fire risk; do(species_introduction) → biodiversity; do(irrigation) → soil moisture

Interactive model under development: [A Desirable Worlds and Agent List]

F.8 Synthesis: The YVision World Model Lineage

Taken together, the seven project classes documented in this appendix constitute a 25-year empirical record of world model construction across domains. Each deployment tested a different aspect of what the M³C formalism now unifies:

Project	Domain	H	M	S	D	C
Santander Financial City	Urban/Corporate	✓	✓	✓	✓	✓
EDP Picote Dam	Infrastructure	✓	✓	✓	✓	✓
Olympic Park Rio	Urban Planning	✓	✓	✓	✓	✓
YScope	Medical	✓	✓	✓	✓	✓
RealSim	Sports / MR	✓	✓	✓	✓	~
Environmental Installs	Ecology	✓	✓	✓	✓	~
IoN Worlds & Agents	Nature / IoN	✓	✓	✓	✓	✓

The consistent presence of all five M³C components — even in the earliest deployments — confirms that YVision was not building isolated applications, but iteratively constructing a world model operating system. The Internet of Nature Worlds and Agents initiative brings this lineage to its natural culmination: a sovereign, planetary-scale, causally manipulable world model of natural capital, built on 25 years of operational precedent.

> This appendix demonstrates that YVision is an evolution, not a hypothesis. Every claim in the white paper
>
> about M³C-WM architecture, agentic orchestration, multimodal integration, and closed-loop execution
>
> has a direct precedent in a real, deployed system documented here.