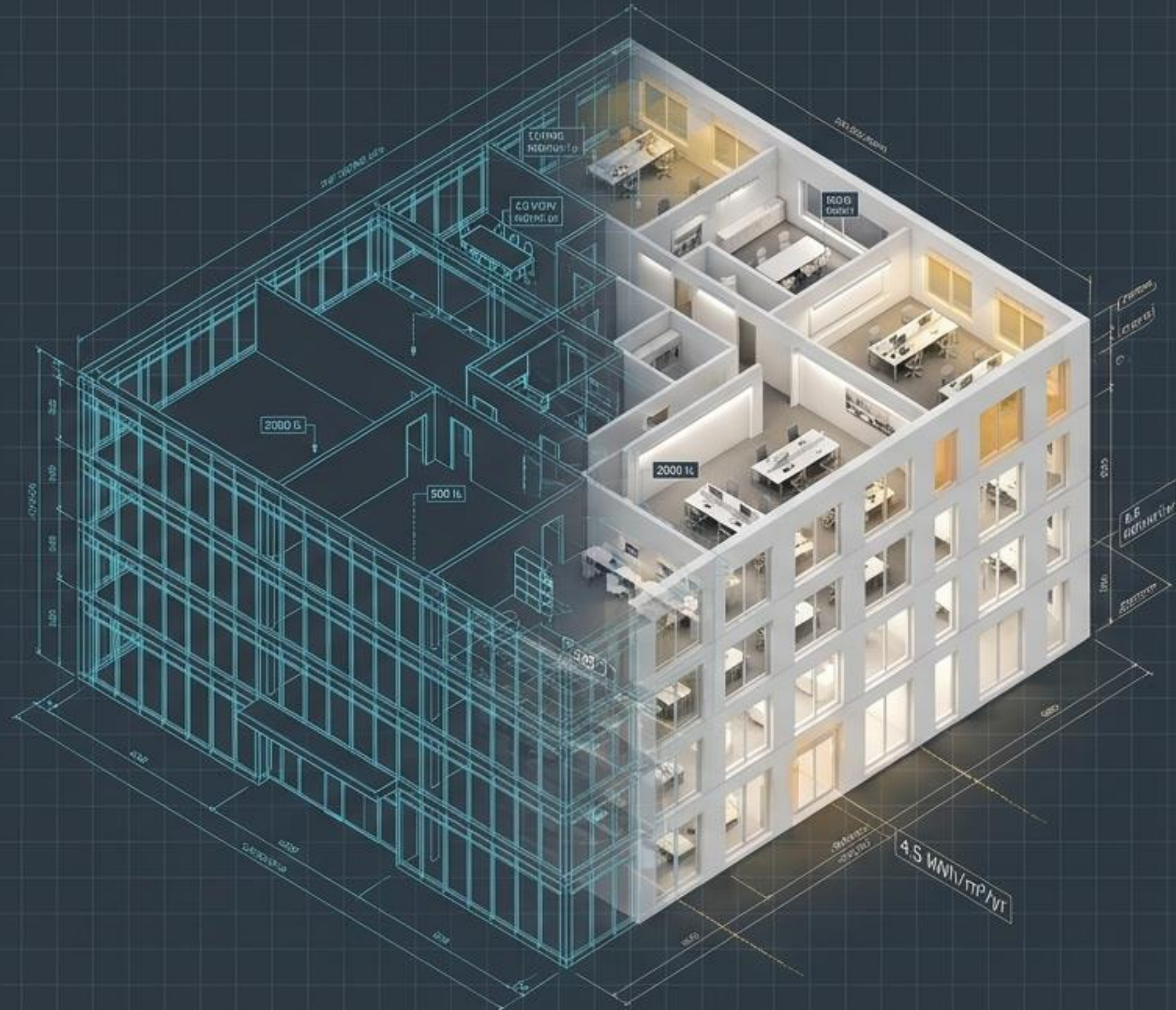


Intelligent Buildings Through Data-Driven Illumination

A methodology for BIM-based
lighting analysis and energy
optimization.

Roots BIM LLC



Lighting is a major energy liability hiding in plain sight

15-30%

of a commercial building's total energy consumption comes from lighting.

The Context: In data centers, healthcare, education, airports, and commercial developments, inefficient lighting creates significant, compounding operational expenditures over the building's lifecycle.



The compounding costs of traditional lighting guesswork

“Root Cause & BIM Solution” Diagnostic Matrix

Symptom	Root Cause	The BIM Solution
Over-illumination & Wasted Energy	Designing for peak capacity without granular occupancy data.	Simulation identifies exact spatial needs before construction.
Glare & Poor Daylight Utilization	Static 2D layouts cannot account for dynamic seasonal sun paths.	3D solar modeling balances natural light with thermal comfort.
Increased HVAC Loads	Lighting heat gains are calculated in a silo away from mechanical systems.	Integrated energy models account for cross-system thermal impacts.

Moving from static design to lighting intelligence

Traditional Lighting Design

Data Source

2D Assumptions

Testing Phase

Post-Construction Retrofits

System Interaction

Siloed Lighting Design

Operational
Lifecycle

Static Fixtures



BIM-Based Lighting Intelligence

Data Source

3D Geometric & Material Data

Testing Phase

Virtual Prototyping

System
Interaction

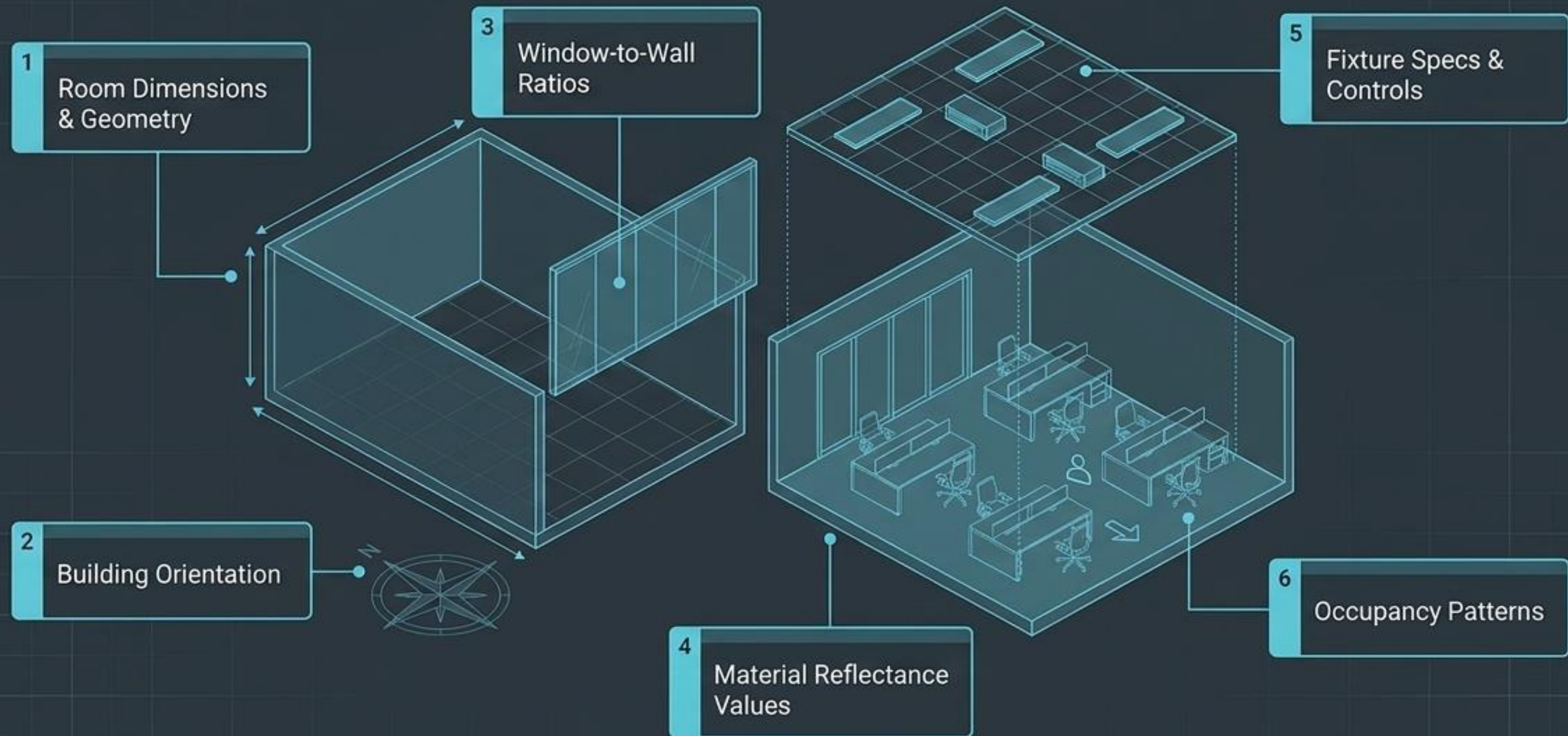
Holistic HVAC & Energy
Integration

Operational
Lifecycle

Continuously Monitored
Digital Twin

Building the data foundation for performance analysis

A BIM model acts as a centralized repository of architectural and MEP information, replacing assumptions with measurable performance metrics.



Pillar 1: Harnessing natural light to shape building geometry

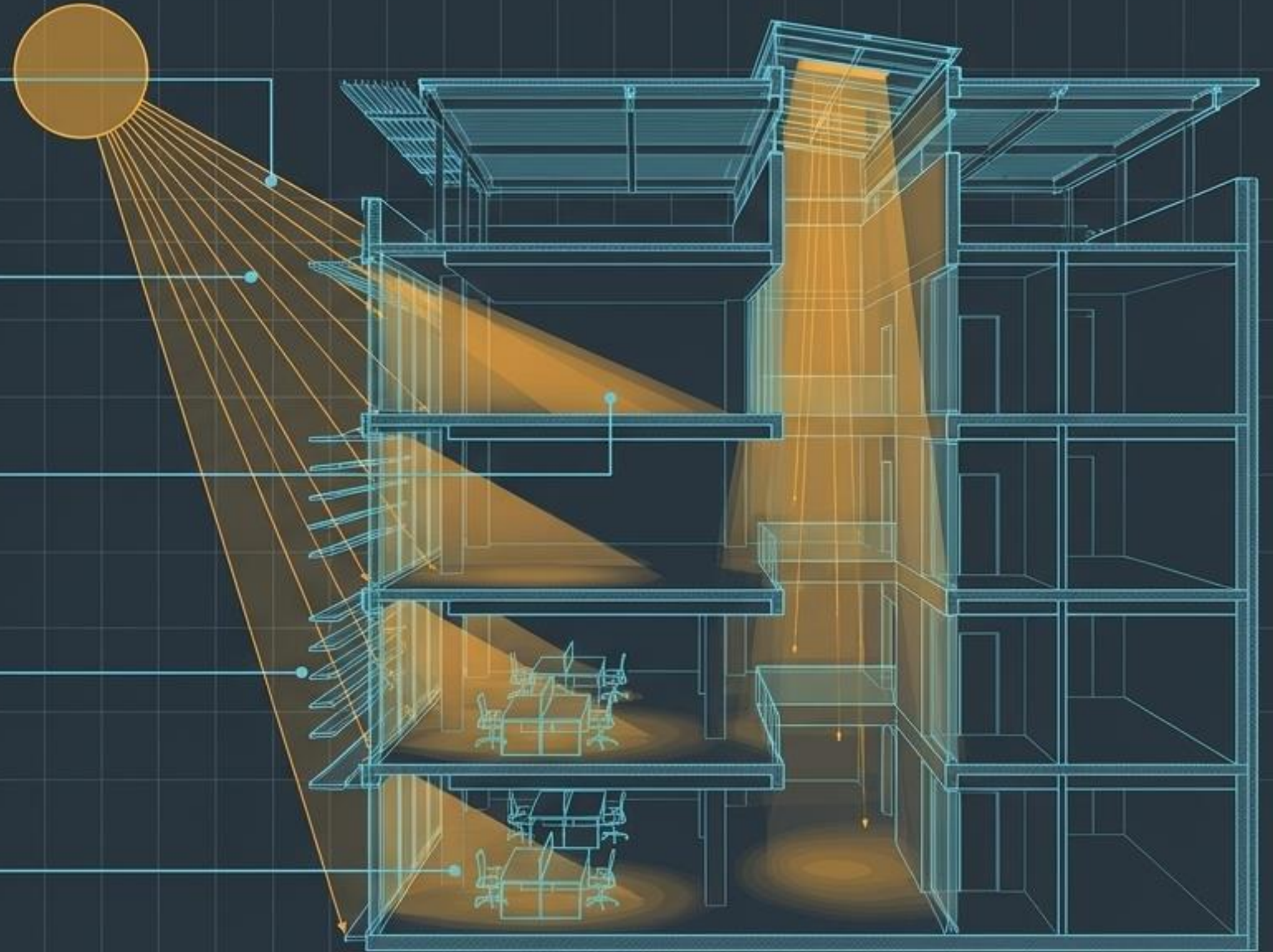
Window Placement: Pinpointing ideal locations for deep daylight penetration.

Building Orientation: Maximizing solar benefits while minimizing thermal heat gains.

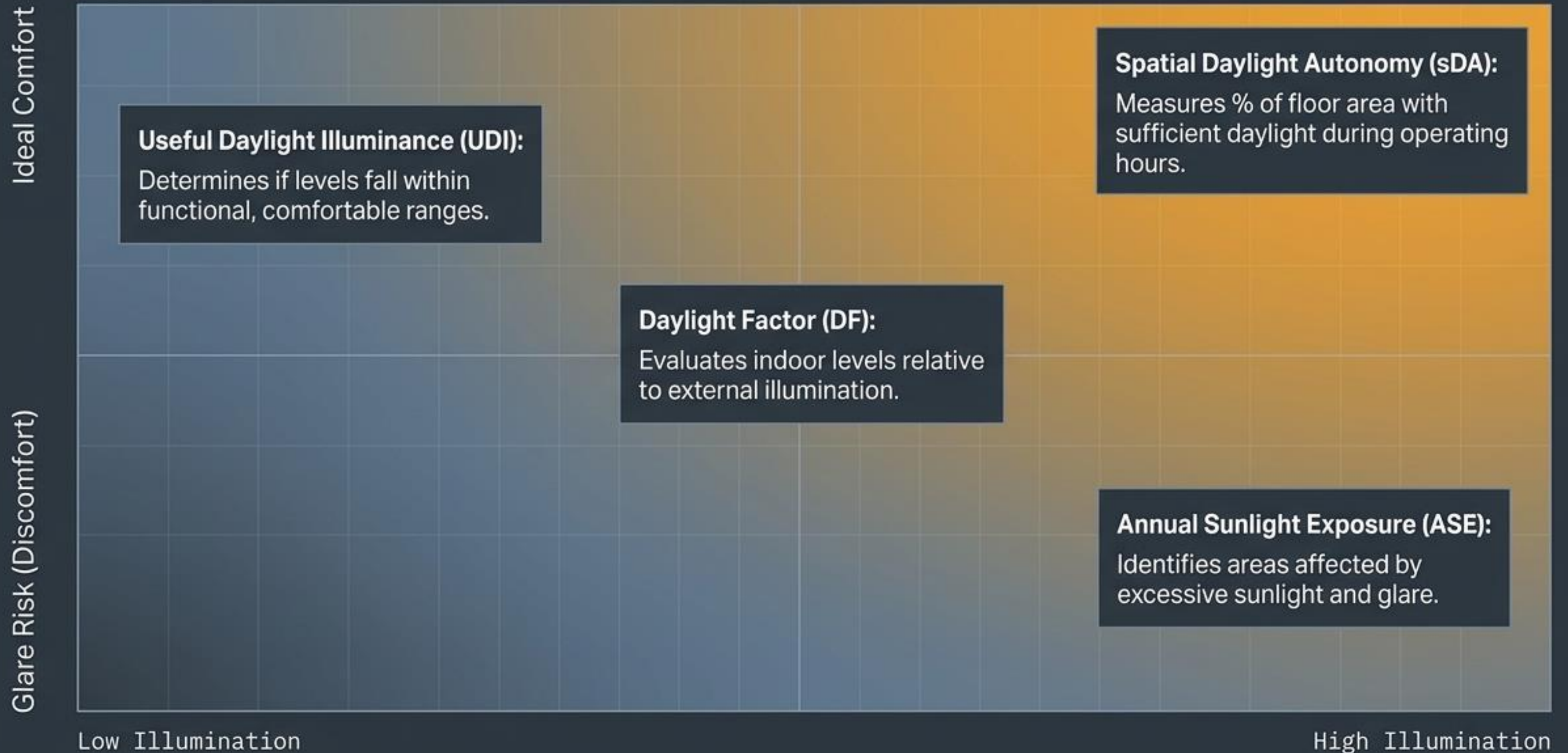
Skylight Design: Improving natural light distribution in deep, large-scale facilities.

Shading Strategies: External louvers positioned to block direct glare.

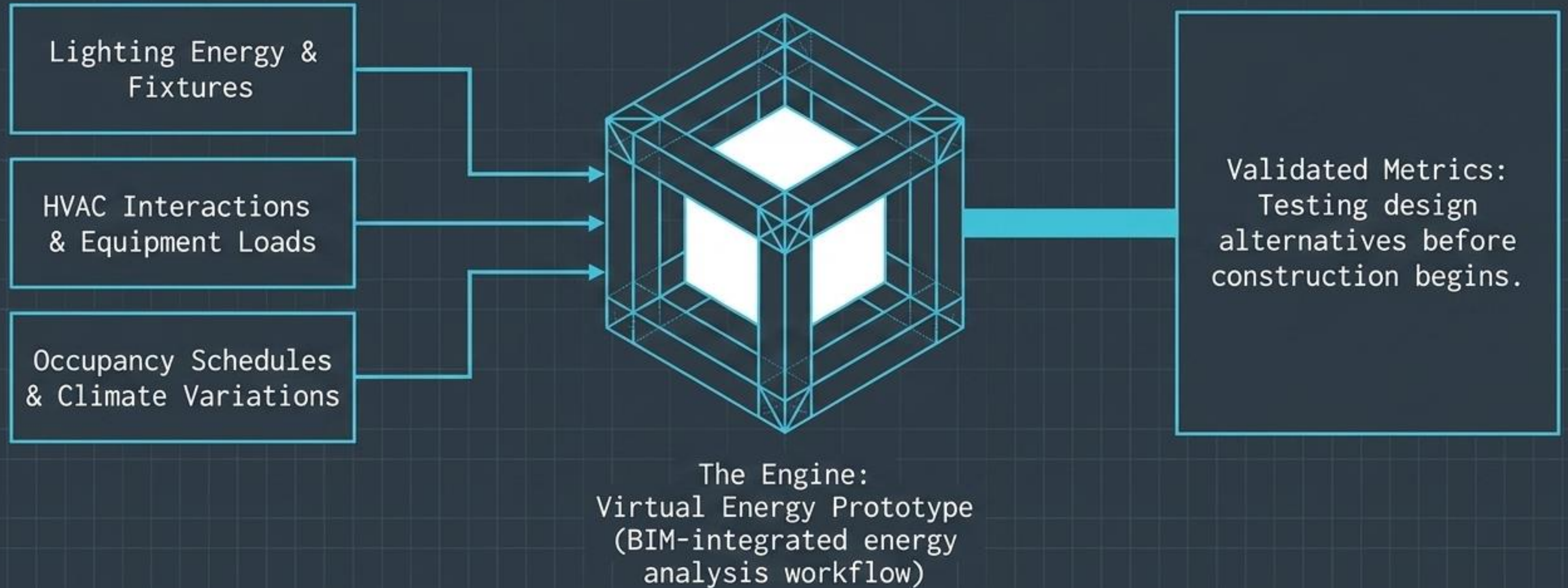
Interior Layout Planning: Workstations positioned strategically in naturally illuminated, glare-free zones.



The delicate balance of illumination and comfort



Pillar 2: Constructing the virtual energy prototype



Quantifying performance to drive down energy consumption

LED Fixture Optimization

Balancing efficiency with required lumen output.



LPD Reduction

Lowering Lighting Power Density to exceed energy codes.



Occupancy-Based Controls

Eliminating usage in vacant zones.



Daylight Harvesting

Dimming artificial lights dynamically as natural daylight increases.

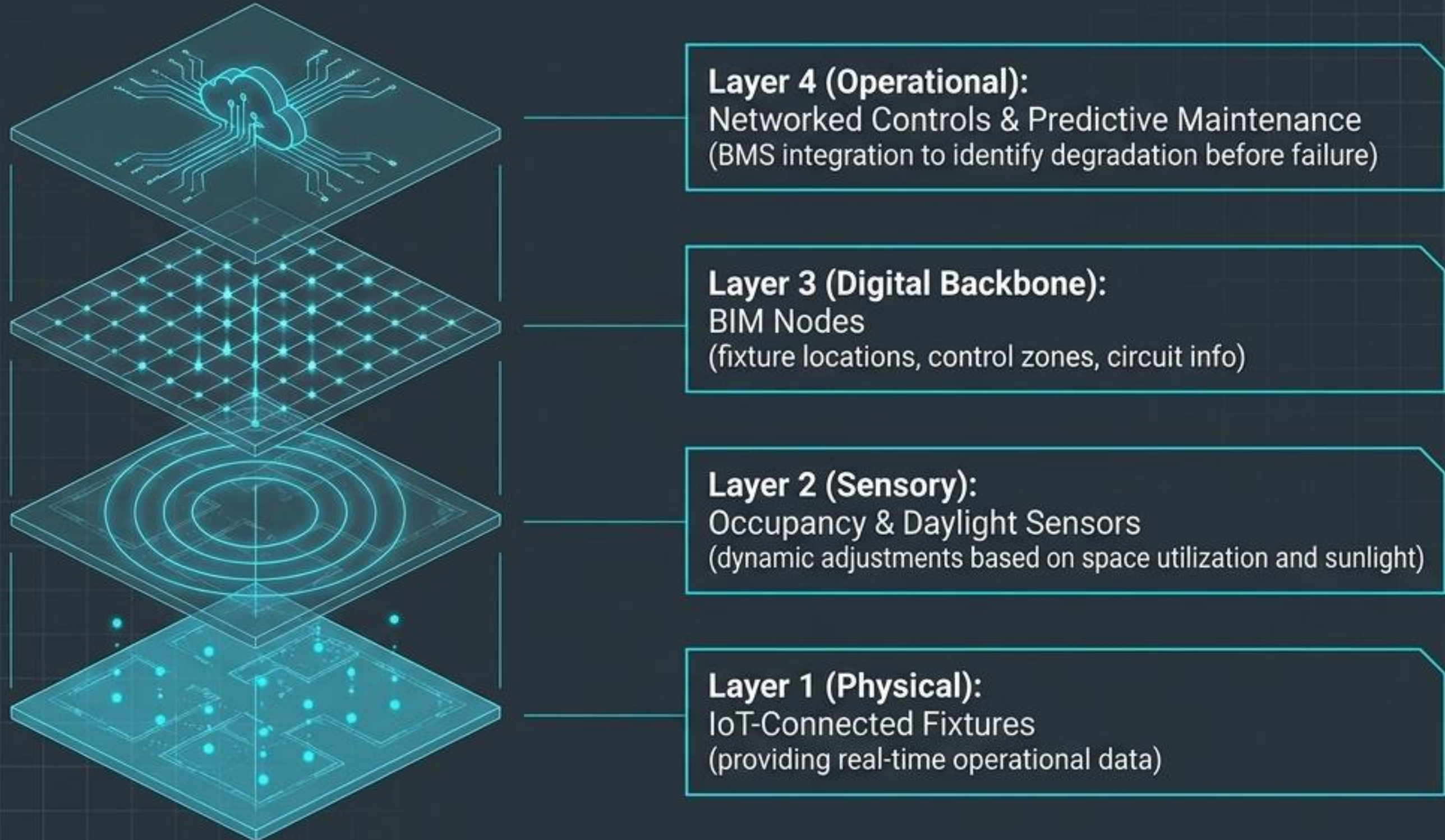


Demand Response

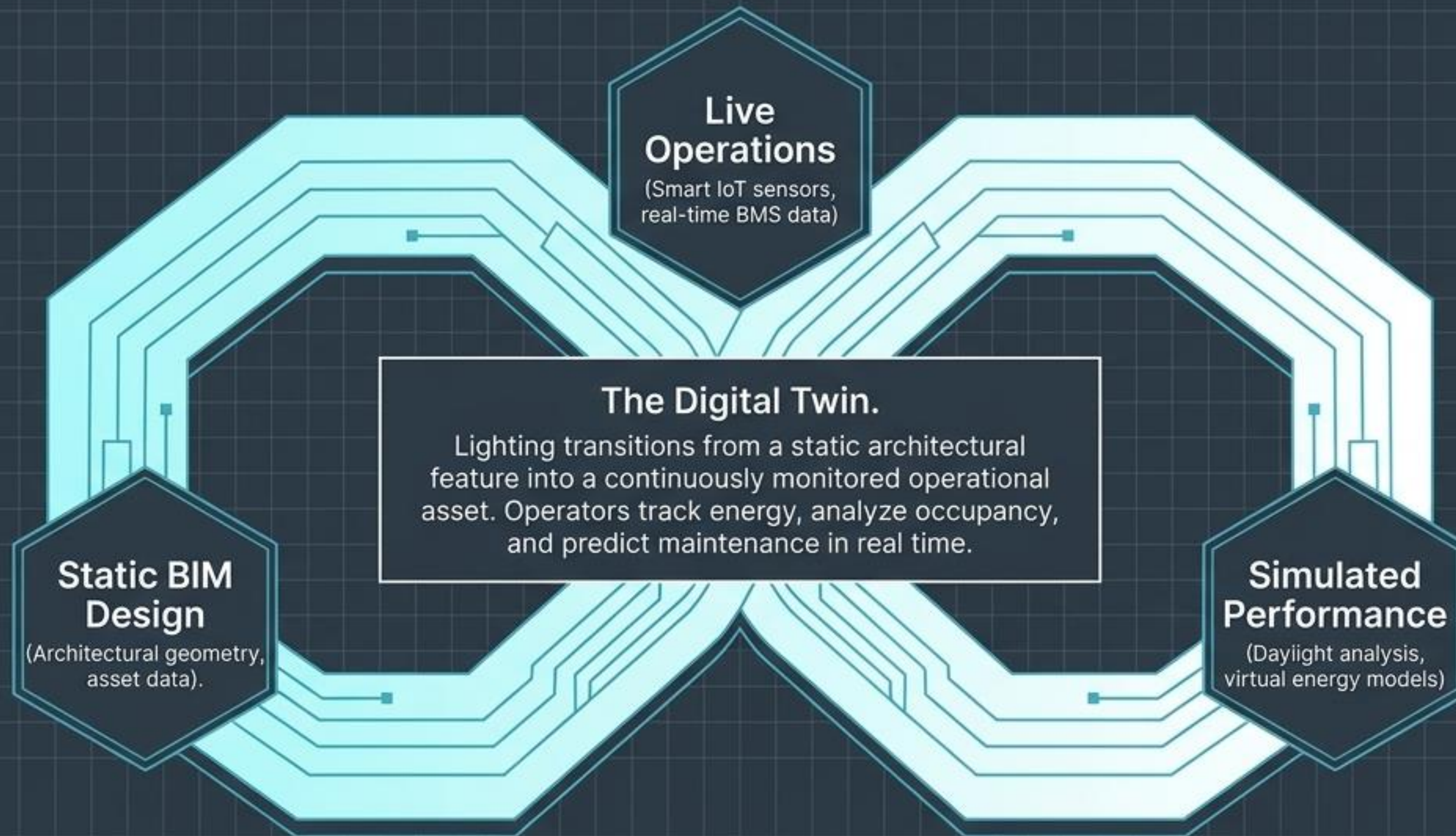
Shedding energy loads during peak utility pricing periods.



Pillar 3: Integrating lighting as an active intelligent network



The Digital Twin Ecosystem



Precision lighting applications across critical industries



Commercial Offices

Enhanced workplace wellness, employee productivity, reduced utility costs.



Healthcare Facilities

Circadian lighting strategies, patient comfort, lowered operational expenditures.



Educational Institutions

Improved learning environments, maximized daylight utilization.



Airports & Transit

Large-scale coordination, passenger experience enhancement, operational efficiency.



Data Centers

Intelligent maintenance lighting, energy-efficient support spaces.

The compounding returns of lighting optimization



Reduced total
energy
consumption



Maximized natural
daylight utilization



Enhanced
occupant
comfort &
productivity



Lower long-term
operational costs



Compliance with
sustainability
certifications



Advanced facility
management
capabilities



Improved Return
on Investment
(ROI)



Long-term
energy resilience

Illuminating opportunities for efficiency and sustainability.

Lighting is no longer simply an architectural feature—it is a strategic asset. By combining BIM-based daylight simulation, energy modeling, and smart lighting integration, we create buildings that are not only visually striking but operationally intelligent.



Roots BIM LLC | Engineering Intelligence Through BIM, Digital Twins, and Building Performance Optimization.

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