WHITE PAPER

Organize Before You Optimize: The AI-Ready Data Foundation

Building a Connected, Contextual Data Backbone for AI-Driven Semiconductor Design

KEYSIGHT

Executive Summary

Artificial Intelligence (AI) is redefining what's possible in semiconductor design, from intelligent layout generation to predictive verification and generative IP reuse. Yet despite the growing promise, most design environments are not ready for AI.

The reason isn't a lack of models or computational power. It's the data.

AI-enhanced Electronic Design Automation (EDA) workflows depend on structured, contextualized, and verifiable data. Without it, AI cannot learn effectively, scale efficiently, or deliver reliable insights. Fragmented files, inconsistent metadata, and undocumented IP reuse all obscure the relationships that make design data meaningful.

The path to AI-driven innovation begins with data organization, not algorithm selection.

This whitepaper explores why semiconductor design teams must *organize before they optimize* — and how **Keysight SOS** provides the purpose-built foundation for AI-ready data management across the chip design lifecycle.

The AI Hype vs. Data Reality in Semiconductor Design

The semiconductor industry is awash with AI promises: generative layout, constraint prediction, adaptive verification, and even autonomous design assistants. But while a few are seeing measurable gains, many organizations remain stalled.

The reason is simple: AI models cannot function on unstructured data.

Most chip design environments are built around decades of accumulated data — repositories of schematic files, simulation logs, and IP blocks spread across multiple tools, file systems, and teams. Naming conventions are inconsistent. Metadata is missing. Version histories are unclear. In this kind of environment, AI cannot recognize meaningful patterns; it only amplifies the noise.

Common Condition	Resulting Problem for AI
Flat file storage without hierarchy	No visibility into design dependencies
Unstructured metadata	No context for reuse or validation
Manual version control	High error risk and lost lineage
Fragmented test data	Incomplete learning signals for models

Before optimization comes organization

An AI-ready design environment must ensure that data is structured, contextualized, verified, and accessible. That foundation transforms disconnected design data into actionable design intelligence.

From Files to Intelligence: The Evolution of Design Data

For decades, “design data management” meant storing, versioning, and archiving files. But today’s EDA complexity, combined with AI’s hunger for structured, data, demands a more sophisticated approach.

The Shift from Storage to Intelligence

Traditional systems treat design artifacts as static files. In contrast, an AI-ready data foundation treats them as linked entities within a living model of the design ecosystem.
Each file becomes a node enriched with:

- Contextual metadata (e.g., process node, PDK version, author, tool origin)
- Relationship mapping (dependencies between IP blocks, design revisions, and regressions)
- Verification lineage (test coverage, results, and historical performance)

This structure unlocks queryable intelligence.

Engineers, managers, and even AI models can now navigate not just what was built — but how and why it evolved:

- A layout engineer doesn’t search folders; they filter verified IP blocks by process and performance history.
- A verification engineer traces a failed regression back to the exact IP version and its prior test outcomes.
- An AI model proposing layout constraints draws on validated schematic-layout pairs, not arbitrary files.

The intelligence comes not from the AI alone — but from the *data structure* that gives AI something to learn from.

The Hidden Barriers: Why Most Teams Aren’t AI-Ready

Despite recognizing AI’s potential, most semiconductor design organizations still rely on generic software tools (e.g., Git, SVN, or custom scripts) for version control and collaboration.

These tools were never designed for semiconductor-scale complexity. They lack integrations with EDA workflows and an EDA-aware data model which captures meaningful aspects such as the hierarchy of the design objects. They also cannot efficiently handle gigabyte-scale binary data, and do not enforce metadata or traceability. The result is design data chaos that undermines both human productivity and AI reliability.

Typical failure points:

- **Flattened hierarchies:** IP dependencies are invisible to AI models.
- **Metadata inconsistency:** PDK, process, and verification attributes are lost or mislabeled.
- **Untracked reuse:** Engineers copy and modify IP without lineage tracking, risking silent errors.
- **Limited scalability:** Version control systems choke on large binary files, fragmenting projects.
- **Generic data management processes:** Requires the user to manually manage data operations outside their day-to-day workflow

When AI models ingest such data, they fail to generalize or generate misleading recommendations. In short:

Unstructured design data produces unreliable AI.

Building the AI-Ready Data Foundation

The AI revolution in EDA will not be won by algorithms alone — it will be won by organizations that invest in data readiness.

Keysight SOS provides a purpose-built platform for this transformation: a hierarchical, secure, and AI-ready data management solution designed specifically for semiconductor design workflows.

Core Principles of the AI-Ready Data Foundation

Principle	Description	Enabled Capabilities
Centralization	All design artifacts (schematics, layouts, test results) reside in one unified workspace	Global visibility, deduplication, and efficient collaboration
Structure	Hierarchical awareness links parent-child relationships between IPs, projects and versions	Accurate reuse, dependency tracking, impact analysis
Contextualization	Rich metadata embeds tool provenance, process context, and validation status	AI learns from verified patterns, not noise
Traceability	Every change, reuse, and result is versioned and auditable	Predictive verification, root cause analysis
Scalability	Handles terabyte-scale projects and global teams	Reliable performance and secure collaboration

By enforcing these principles, Keysight SOS converts chaotic repositories into AI-ready ecosystems.

From Organized to Optimized: Capabilities Unlocked

Once design data is clean, connected, and contextualized, new capabilities emerge — both human and AI-driven.

These include:

1. Intelligent IP reuse

Linked lineage and test history ensure that reused blocks are both current and verified. Engineers can see where each IP was deployed, how it performed, and what risks remain.

2. Predictive verification and debug

By correlating design changes with regression outcomes, AI can anticipate likely failure points before simulation completes — turning verification into a proactive rather than reactive process.

3. Context-rich design reviews

Keysight SOS makes design reviews data-driven and traceable. Reviewers can instantly visualize change propagation, confirm standard compliance, and identify hidden dependencies.

4. Enterprise design intelligence

With structured data, managers gain dashboards showing reuse rates, verification coverage, and risk exposure across sites — enabling smarter staffing, planning, and decision-making.

The result? Design teams move from reactive, manual workflows to flow states, focusing on innovation instead of file archaeology — while organized, cataloged, and contextualized data becomes the foundation for applications like co-pilots and agents, enabling context-aware, domain-specific automation.

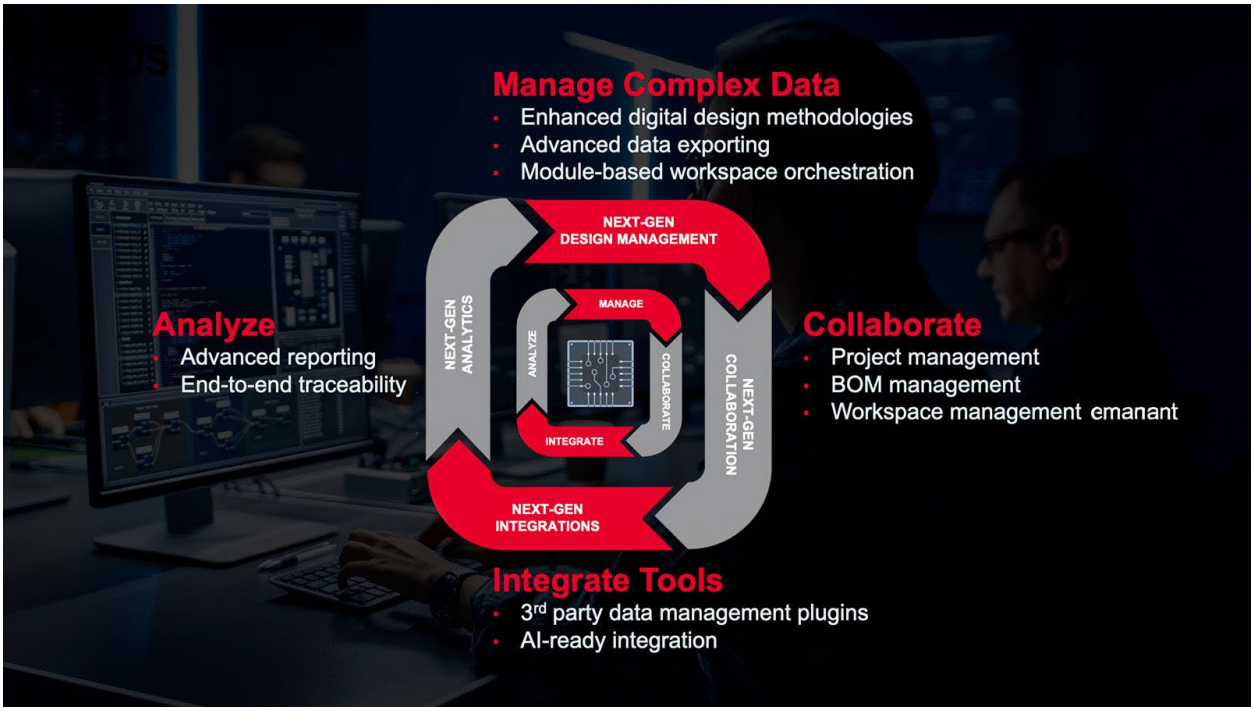

Figure 1. Smart design data unlocks a range of accelerated workflows — from layout automation to enterprise-level visibility.

Purpose-Built vs. Force-Fit

Many teams try to retrofit software versioning tools into semiconductor workflows. The result is friction, data loss, and limited scalability.

Approach	Limitation	SOS Advantage
Open-source version control tools (eg. Git/SVN)	Flat file storage; no awareness of design hierarchy	Hierarchy-aware, metadata-rich model
Manual re-use	Unverified IP, undocumented dependencies	Verified IP reuse with traceable lineage
In-house scripts	Brittle, non-scalable, hard to maintain	Enterprise-grade automation and API's
Generic PLM	Focused on BOMs, not design intelligence	Semiconductor-specific data structures

Keysight SOS is engineered for EDA reality — not adapted from software practices. It supports gigabyte-scale binary data, understands design hierarchies, and integrates natively with major design and verification tools.

Case Study: Allegro MicroSystems' Transformation

When Allegro MicroSystems deployed Keysight SOS across its business units, it achieved measurable improvements in both efficiency and reuse.

Key results:

- 55% of all IP is now reused from verified templates
- Design cycle times reduced by up to 50%
- 200+ IPs and 150 projects managed with consistent traceability

By converting legacy chaos into organized, contextualized design intelligence, Allegro didn't just accelerate workflows — it built a durable foundation for AI readiness.

A Practical Transition Plan to AI Readiness

Becoming AI-ready doesn't happen overnight, but with the right roadmap, teams can progress systematically:

Stage	Action	Outcome
Baseline	Centralize design data in Keysight SOS	Unified access, reduced duplication
Normalize	Enforce metadata standards, naming, and access controls	Reliable, searchable datasets
Automate	Link design, verification, and release workflows	Traceable, repeatable processes
Analyze	Enable reuse analytics and regression insights	Measurable performance improvements
Learn	Feed clean data into AI models or EDA plug-ins	Trustworthy AI training inputs
Optimize	Deploy AI-driven design and verification processes	Human-AI collaboration at scale

The first two stages — organization and normalization — are the most critical. They make every downstream optimization possible.

The Human Impact: AI That Amplifies Engineers

AI in EDA is acting as an enabler for engineers-when AI operates on structured, meaningful data, it accelerates debug, enhances layout decisions, and surfaces insights that inform, not override, human judgment.

Keysight SOS ensures engineers remain at the center of the process:

- AI provides recommendations with traceable context.
- Designers maintain creative control and technical authority.
- Workflows become proactive, intelligent, and scalable.

The result is a partnership between human expertise and machine intelligence built on a foundation of data integrity.

Conclusion: The Future Belongs to the Organized

As the semiconductor industry races toward AI-enhanced design, the winners won't be those with the flashiest models, but those with the smartest data.

AI success in EDA is not a question of if, but when — and for whom.
The deciding factor will be whether your organization has built an AI-ready data foundation.

Keysight SOS empowers semiconductor design teams to:

- Transform chaotic repositories into structured, queryable design intelligence
- Enable AI-guided workflows that accelerate innovation
- Maintain traceability, security, and collaboration across the enterprise

The message is simple and strategic:

Organize before you optimize.

Because without structured, contextualized data, there is no intelligent design flow.

Figure 2. Keysight SOS for hierarchical IC design data management.

About Keysight SOS

Keysight SOS is a purpose-built semiconductor design data management platform that delivers hierarchical awareness, secure scalability, and native integration with major EDA tools. It provides the structured, contextualized, and verified data foundation required for AI-enhanced design and enterprise-wide reuse.

Get in touch with Keysight's experts to request a demonstration or trial of Keysight SOS