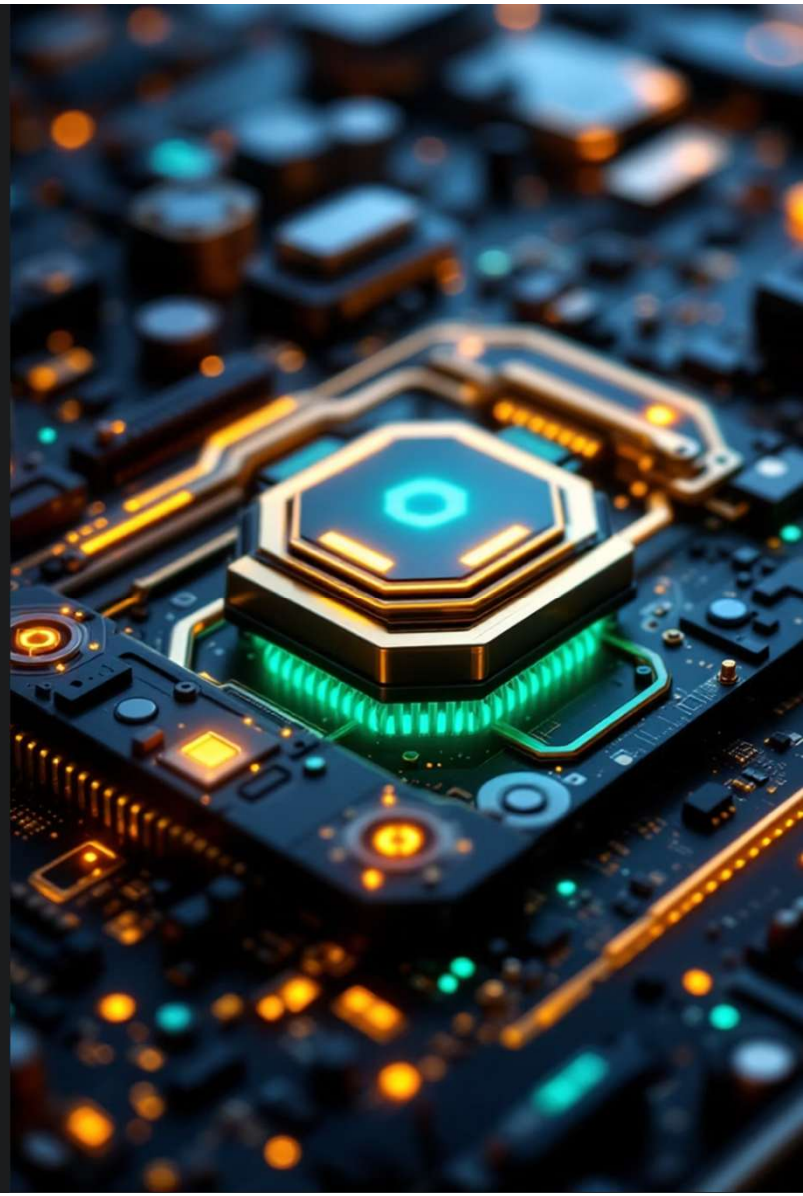
Lighting Up Design Blind Spots: Event-Driven Observability for ECAD-MCAD Collaboration

Conf42 Observability 2025

Bridging the gap between electrical and mechanical design through real-time visibility

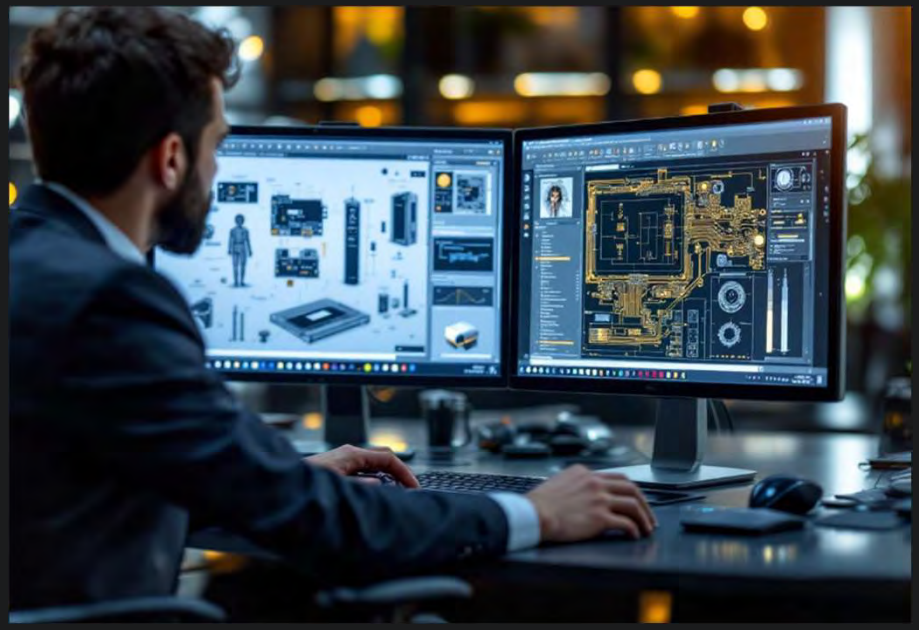
by Pradeep Karanam



Agenda

- Problem: ECAD-MCAD blind spots
- Vision: Event-driven observability
- Three building blocks: Schema • Audit • Library Sync
- Reference architecture & event flow
- Pilot metrics & lessons
- Roadmap and Q&A

ECAD-MCAD Blind Spots



- File-based exchanges only at design milestones
- Avg. >10 snapshots per board spin; issues found late (internal study, n=8)
- Re-work typically adds 8-10 % cost and 4–6 weeks slip (IPC-2581 white-paper)

Late Discovery Example

Chassis rib added by mechanical team

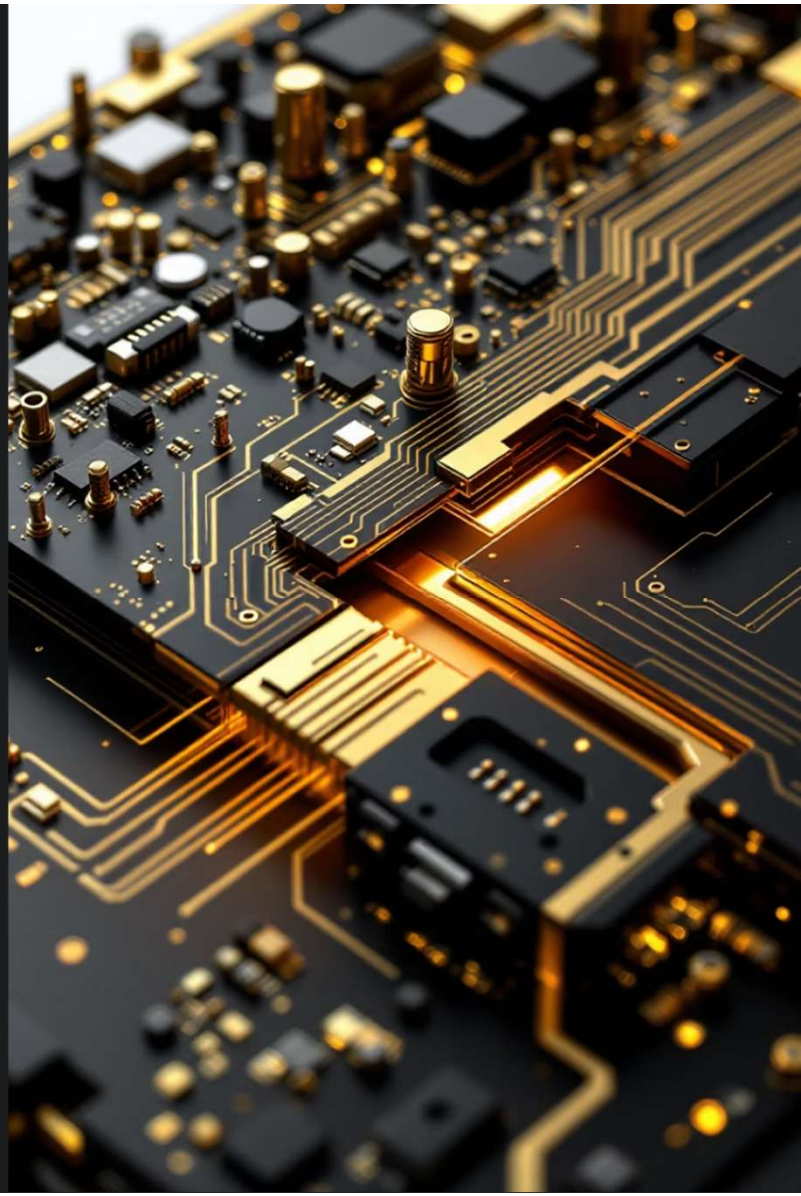
Mechanical engineers modify the chassis design by adding structural support

Keep-out area shrinks but ECAD unaware

Available space for circuit board components is reduced without notification

Violation caught during DRC

Design Rule Check catches the issue too late, requiring costly redesign



Why Event-Driven Observability?

Design tools publish fine-grained changes as events

Real-time notifications when changes occur

Supports analytics on decision speed & complexity

Data-driven insights for process improvement

Cross-domain checks run continuously

Automated validation across ECAD and MCAD

Issues surface within minutes—not days

Immediate feedback on potential conflicts

Building Block 1 — Canonical Schema

EDADesign.xsd → ECAD_CHANGE, MCAD_UPDATE events

XML schema definition for standardized event formats

Mandatory fields: itemId, revId, geometryHash, user, timestamp

Core data elements required for every event

Optional CCAVariant for BOM variants & alt footprints

Support for design variations and alternatives

Strict validation stops malformed events at source

Ensures data quality and consistency

Building Block 2 — Audit Logging

Log Type	Purpose	Key Fields
General	Basic system events	LoggedDate, EventType
Workflow	Process transitions	User, EventType
Structure	Design changes	ChangeID, ItemID
Security	Access control	User, Action
File-Access	File operations	FilePath, Operation

Immutable logs per event via Audit Manager

Fields like LoggedDate, EventType, User, ChangeID customizable

Export to Excel/CSV for compliance & RCA

Building Block 3 — Library Sync

ExportLibrary

Extract component data from source system

SyncLibrary

Reconcile differences between systems

CheckIn/OutLibrary

Version control for library elements

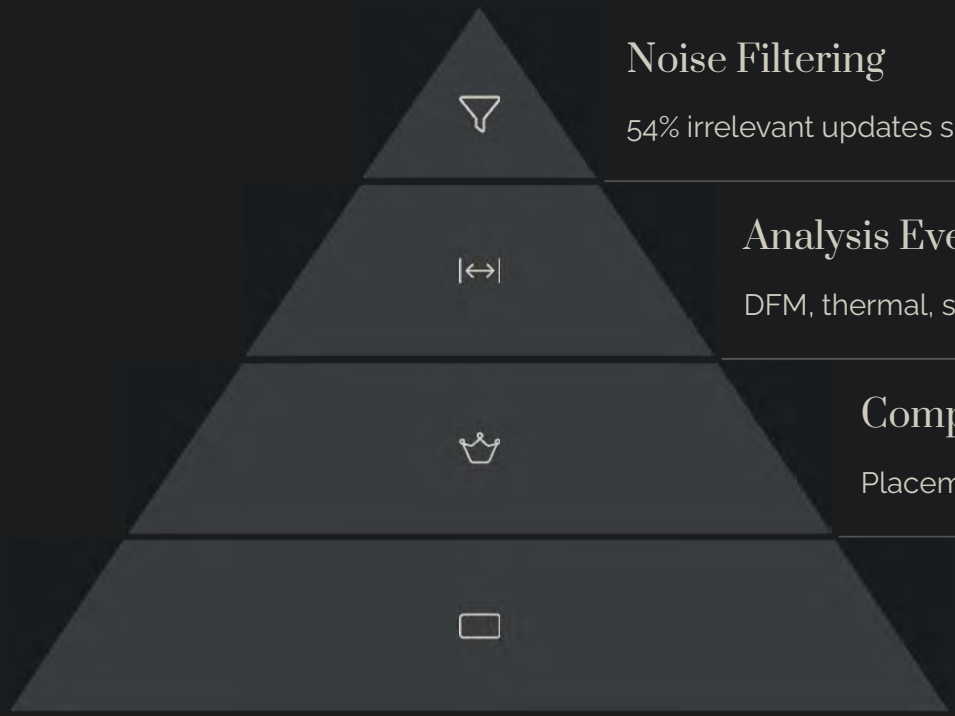
Status Verification

Returns

EDALib.xml powers part & footprint sync

Multi-revision support (MultipleRevision="true")

Design-Event Taxonomy & Noise Filtering



Noise Filtering

54% irrelevant updates suppressed (internal pilot, 5 projects)

Analysis Events

DFM, thermal, structural findings

Component Events

Placement, part change, variant swap

Geometry Events

Board outline, keep-outs, mounting holes

Resilience Patterns for Design Streams

Back-pressure and replay

For long tool sessions

Compensating transactions

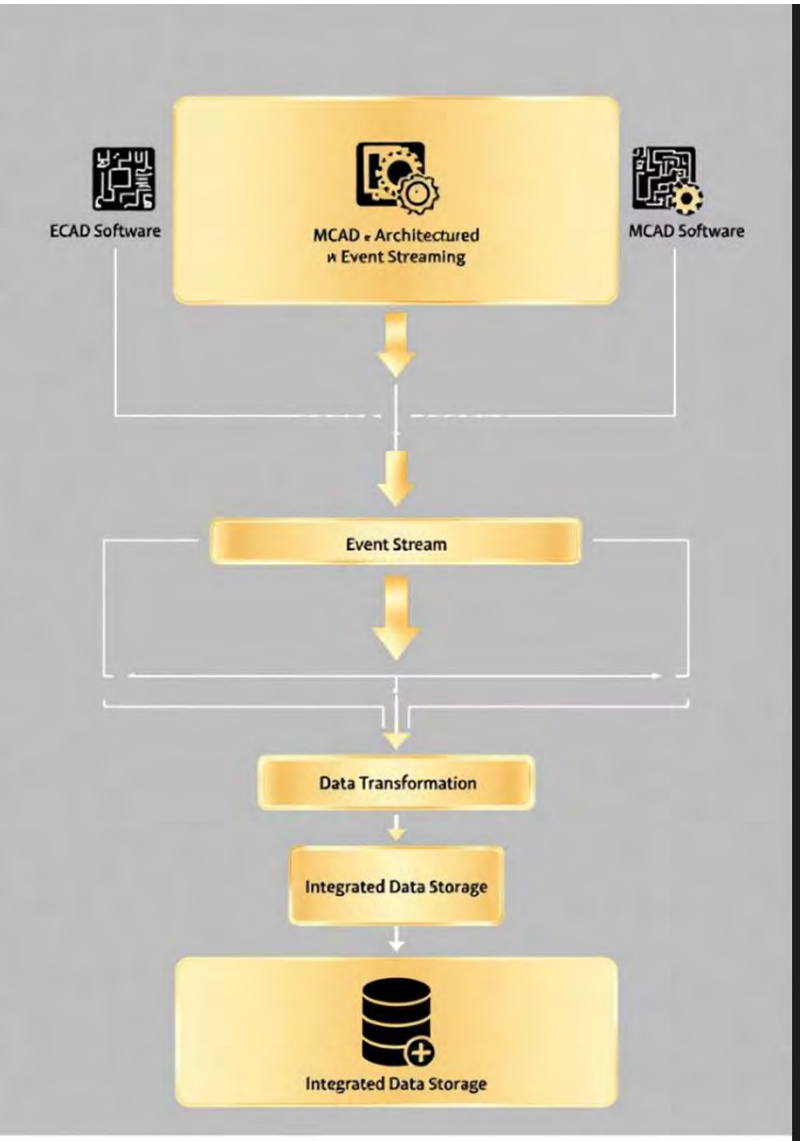
Roll back partial updates

Circuit breaker

Around PLM API avoids cascading failures

Checksum integrity verifier

Blocks corrupt payloads



Reference Architecture

1

ECAD Tool

OrCAD / Allegro

2

Event Broker

Kafka

3

Stream Processor

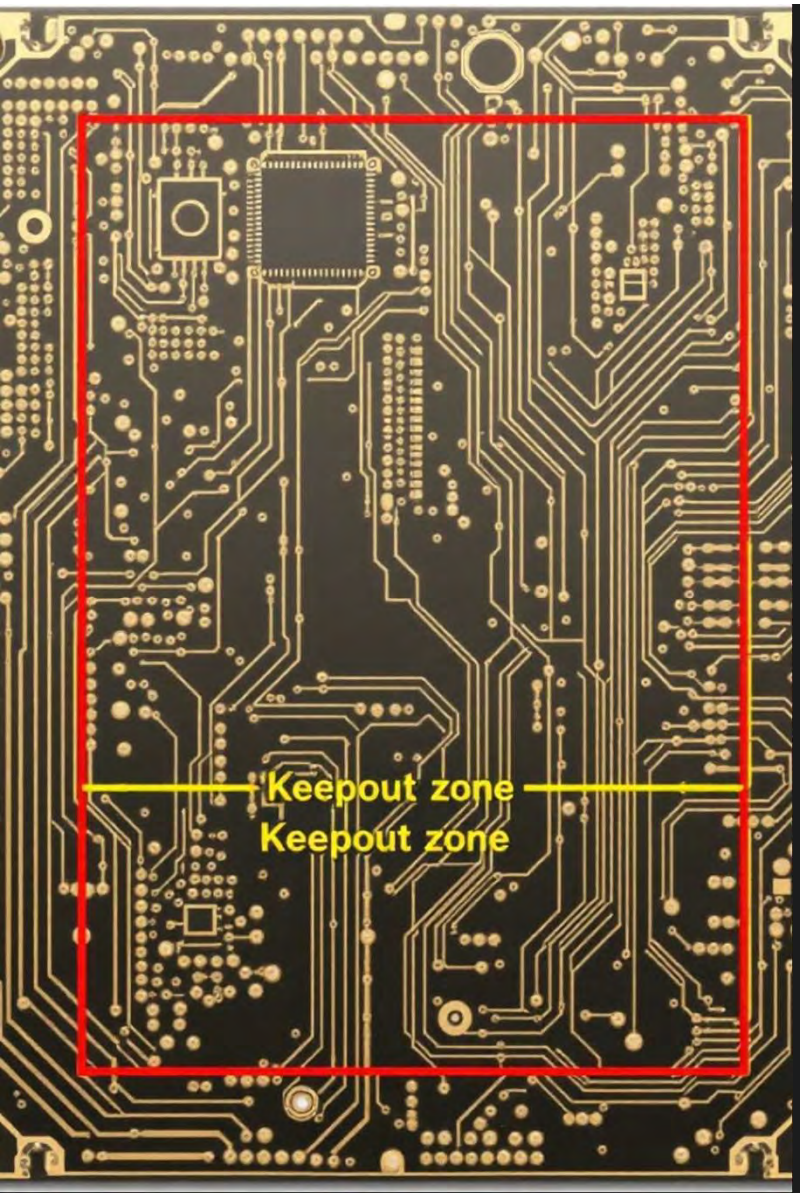
Flink / Spark

4

Dashboards

Grafana

MCAD tools (NX/Creo) and PLM/Audit Store complete the ecosystem



Event Flow - Board Outline Change

MCAD Update

Publishes geometry event with rib addition

Hash Comparison

Processor detects outline geometry diff

Rule Violation

Engine flags keepout zone breach

Team Alert

Dashboard heatmap notifies both teams

Measured Benefits

Integration Cycles

Reduced from 3 weeks to 2 days

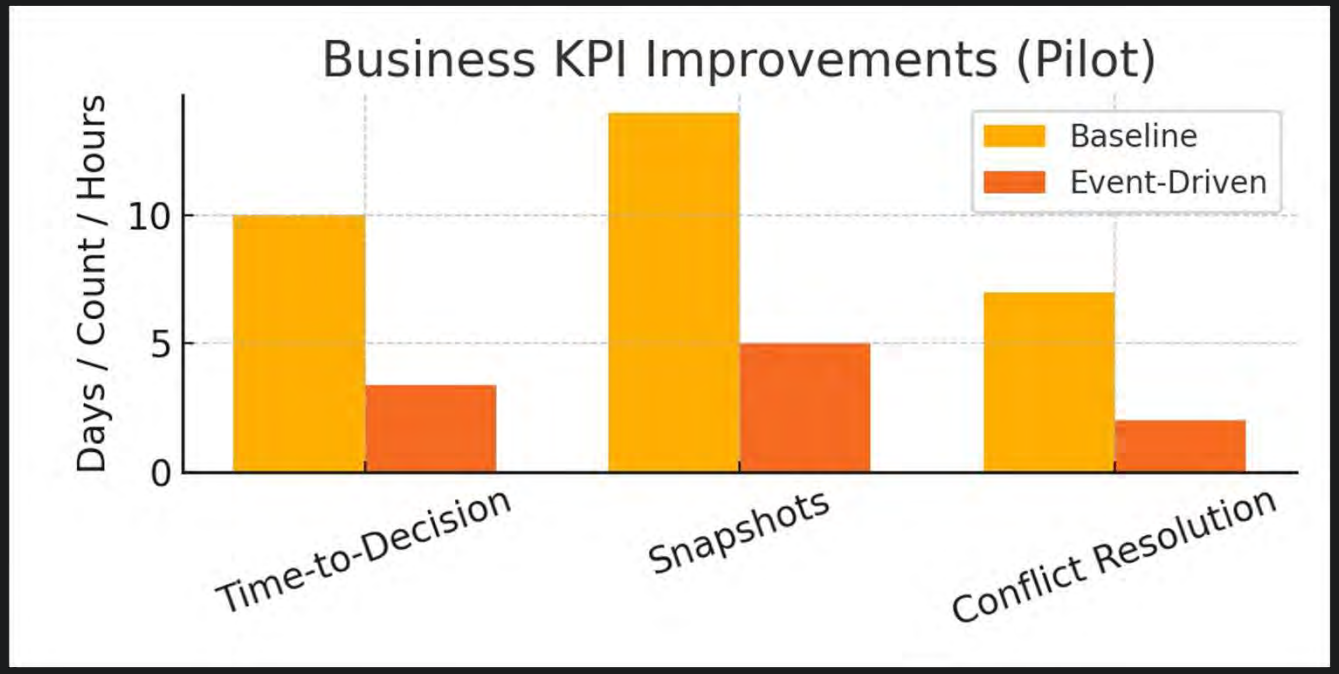
Error Detection

85% faster constraint violation discovery

Team Coordination

Real-time visibility eliminates blind spots

Business Impact Metrics



Cost Savings

Reduced prototype iterations

Lower manufacturing delays

Time to Market

Accelerated design cycles

Parallel workstream optimization

Quality Improvement

Proactive constraint checking

Design rule validation

Visualization & Monitoring Stack

Grafana Dashboards

Event volume and broker lag metrics

3D Heatmaps

Teamcenter workspace delta visualization

Log Analytics

Kibana cross-event audit search

Alert System

Database connection and deadlock monitoring

Phased Implementation Roadmap

Phase l: BOM & outline events

Weeks 0-4

Phase 2: Constraint & variant events

Weeks 5-10

Phase 3: Automated DFM & thermal

Quarter 2

Phase 4: Supplier & manufacturing

Quarter 3

Lessons Learned & Pitfalls

Signal Quality

Start with low-noise, high-value events

Avoid overwhelming teams with alerts

Schema Management

Govern version changes rigorously

Maintain backward compatibility

Observability Investment

Build broker monitoring early

Align naming conventions across domains

Thank You!