![S2R2 Technologies logo]

White Paper

TRACEABILITY + PREDICTIVE MAINTENANCE: THE MISSING LINK IN PROFIT-CENTRIC MANUFACTURING

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1. Executive Summary

In Tier-2 and mid-sized factories, profit erosion often goes untracked—not because of lack of effort, but due to lack of integration between two critical systems: traceability and predictive maintenance.

You know the scenario: a batch fails QA, a component breaks unexpectedly, delivery timelines slip—and each department defends its position. Quality blames process gaps, production points to overloaded tools, and maintenance says they were never alerted. The result? Rework, lost margins, and frustration.

In over 11 Indian factory audits conducted by S2R2, it was found that 68% of defects and unplanned downtimes could have been anticipated—if machine behavior and product trace logs had been analyzed together.

This white paper lays out how converging traceability and machine health monitoring leads to:

- Real-time visibility into "who worked on what—and how the machine behaved"
- Reduction of QA rejections by up to 32%, as proven in Pune-based CNC units
- 41% fewer tool breakdowns when trace data was aligned with vibration alerts
- Accountability across departments—backed by data, not speculation
- ₹2–3 lakhs per month in recoverable losses (scrap, penalties, downtime) for typical Tier-2 units

Most importantly, this is not a software-overhaul solution. S2R2's deployment model uses modular sensors, simple dashboards, and mobile alerts, integrated in under 10 days, without relying on ERPs or MES platforms.

For Tier-2 manufacturers operating under tight margins and tighter manpower, this convergence is a practical, scalable step toward smart profitability.

- Most factories today are data-rich but insight-poor.
- They trace every part: operator ID, shift time, machine number, recipe code
- They track some machines: vibration alerts, thermal warnings, overloads
- But when something fails, these two datasets sit in different places—and no one connects the dots

The result?

- QA finds 150 rejected parts, but can't say if the machine was misbehaving
- Maintenance swaps out a bearing, but doesn't know if it affected yesterday's batch
- Production logs look clean, but performance still dips
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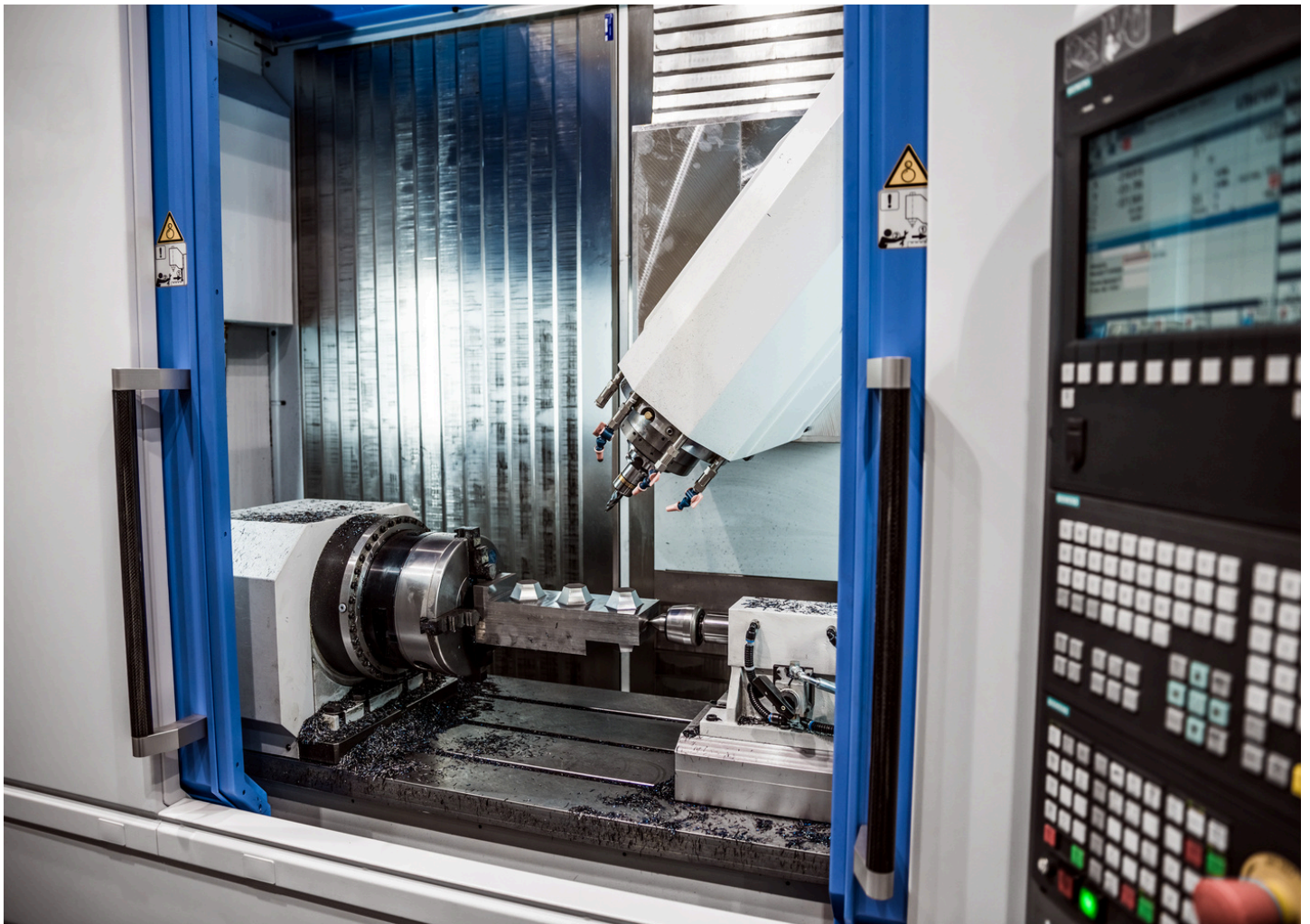
In one S2R2-supported CNC setup, 2,000 shafts were produced over three days. 300 failed precision checks. Trace logs pointed to a specific shift and machine. Machine health logs revealed a rising vibration curve. The cause? Early bearing wear. Without convergence, all 3 departments would've made the wrong fix.
The hidden cost isn't the defect. It's the delay in discovering its true cause.

Tier-2 factories operate in a high-pressure reality:

- Thin margins
- Quick turnarounds
- High output with low tolerance for scrap

You don't have time for 3-day root cause investigations. You need answers in 30 minutes, not 30 hours.

Convergence makes that possible:

- Predictive maintenance tells you what's going wrong
- Traceability tells you what was impacte

Together, they tell you what to do—immediately

In an S2R2-enabled lathe unit, surface finish issues kept recurring. QA blamed operator technique. Once health data was layered in, it showed a subtle vibration spike during shift change—caused by delayed tool recalibration. Training, not machine replacement, was the fix.

The right insight leads to the right intervention. Fast.

You don't need a data scientist or a cloud engineer. You need 4 basic components:

1. Sensors

Install non-invasive devices that capture:

- Vibration trends
- Thermal rise
- Electrical current anomalies
- Cycle time fluctuations

Setup time? Often less than 60 minutes per machine.

2. Logs

Install non-invasive devices that capture:

- Barcode scans
- RFID logs
- Job cards or operator sheets
- Timestamps from control panels

3. Overlay Tools

Use Excel, Power BI, or a basic reporting tool. Match:

- When did vibration cross safe thresholds?
- What batch was running at that time?

No complex dashboards needed.

4. Alerts

Configure simple rules:

- If tool vibration > limit AND high-precision job running → send SMS to supervisor
- If batch rejection > threshold AND no machine alert → escalate QA review

S2R2 deployments use pre-configured templates for alerts. No coding. No custom apps.

It's not about tech—it's about visibility you can act on.

Convergence isn't an expense. It's an upgrade in operational intelligence.

Here's what factories achieved:

- **Quality Loss Reduction:** Instead of scraping entire batches, only flagged parts were isolated

- **Smarter Maintenance:** No more over-servicing healthy machines

- **Recall Scope Reduced:** In one plant, an issue that would've affected 3 days of production was narrowed to 3 hours

- **Maintenance Budget Efficiency:** Spindle replacement cycles extended by 60%, saving ₹5.3 lakh/year

In a Kolhapur-based S2R2 pilot, ₹20K worth of sensor deployment led to ₹2.8 lakh in saved costs in the first quarter alone.

Every blind spot you remove pays for itself.
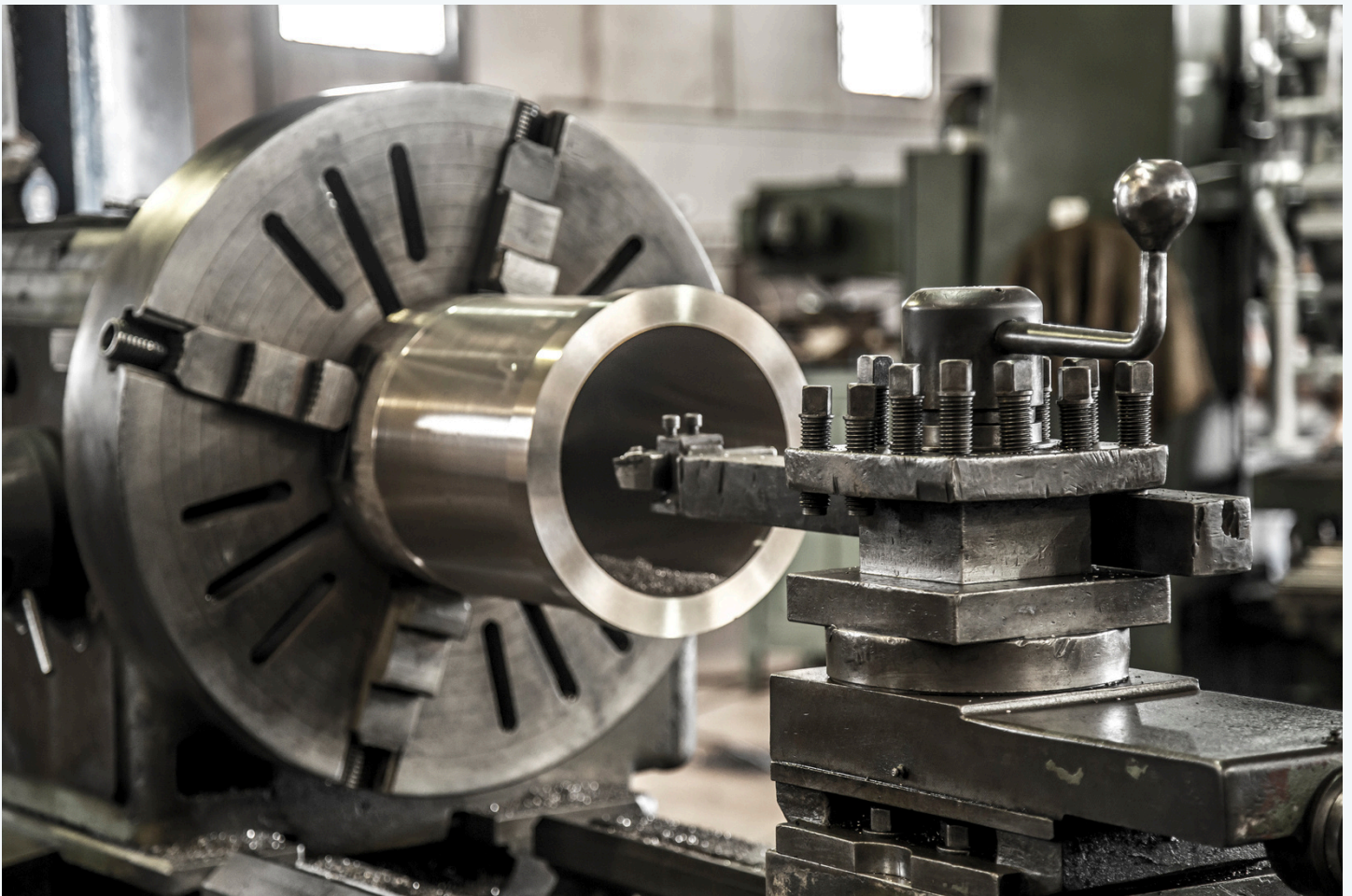
6. How to Start: No IT Team Required

- The best part? You can begin in 7 days or less.

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Step-by-Step:

- **Pick a product line:** Ideally one with high rejection rate
- **Identify a machine:** Especially one prone to wear or misalignment
- **Install sensors:** Non-invasive, plug-and-play
- **Pull trace logs:** Use your barcode/RFID or even manual logs
- **Overlay in Excel:** Match faults with machine events
- **Take one action:** Prevent or fix based on real correlation
- **Measure impact:** Downtime avoided, rework reduced, accuracy improved

S2R2 pilot teams generated reports within 10–14 days—no training sessions, no extra screens.
Start small. But think long.

7. Conclusion: This Isn't About Technology. It's About Clarity.

Manufacturing is becoming faster, leaner, and more unforgiving. You don't just need speed—you need insight before action.

When traceability and predictive maintenance converge:

- Quality teams find answers faster
- Maintenance teams prevent instead of repair
- Operators stop being blamed for invisible problems
- Clients gain confidence in your process

This is not "smart manufacturing." It's smart thinking—using tools you already have in ways you haven't yet tried.
The cost of staying disconnected is no longer technical—it's financial.

Still dealing with:

- Finger-pointing across departments?
- Sudden breakdowns followed by urgent batch recalls?
- Guesswork in your root cause analysis?

Then the question is simple:

"Can we see product data and machine behavior—side by side, in real time?"
If not, the problem isn't people. It's process blindness.

Take one shift, one machine, one product line.
Overlay data. See what your factory's been trying to tell you all along.

Book a no-cost, 30-minute convergence readiness session.

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The examples, results, and deployment models shared in this document are based on verified manufacturing use cases, including Indian Tier-2 and SME factories using the S2R2 platform. While these results are indicative of successful convergence strategy, actual outcomes may vary based on team engagement, machine age, operational discipline, and volume variability. This document is intended to educate and guide—not to promote or prescribe. All deployment examples are shared with permission and anonymized where required.