

RootSolve by PHRED Solutions Inc.

Executive Summary

Typically, plant floor problem solving knowledge is locked in the heads of operators and engineers or scattered across spreadsheets, emails, word docs, QMS systems and other unconnected repositories.

AI systems built for industrial problem solving are only as good as the structured, granular data they are trained on; that data does not exist in ERP systems or machine sensors. It is generated in real time by people working through a structured problem solving process.

RootSolve by PHRED Solutions is the system that captures that process. For 35 years, it has been the mechanism by which manufacturing teams describe problems precisely, diagnose root cause, assign corrective actions, and verify that fixes hold.

RootSolve provides the missing layer in Factory 4.0 architectures; without the structured record of human problem solving, the data is incomplete.

Our Experience in Plant Floor Problem Solving Software

From 1991 to 2004, PHRED Solutions, the company behind RootSolve, was engaged by some of the world's leading manufacturers to design reasoning and diagnosis software around catastrophic failure and structured problem solving. Clients during this period included HP, Shell, and Kaiser Permanente.

The most consequential of these early engagements was a multi-year project with Toyota Motor Manufacturing, from 1997 to 2001, to help design what became Toyota's Practical Problem Solving (PPS) methodology and to build shop-floor prototypes tested directly in production cells. This is why RootSolve is engineered for usability by the people doing the work. It is not a reporting layer bolted on after the fact.

In 2005, PHRED launched its first commercial web-based problem solving system for Coca-Cola Bottling. Intel selected PHRED for its Systems Manufacturing Divisions in 2007, work that led to development of RootSolve's web-based problem solving capability for suppliers. In the years since, clients including JELD-WEN, Avnet, and Hella have driven forward features such as data integration and interactive analytics, while engagements with Schlumberger and Graphic Packaging accelerated cloud security and service maturity.

This iterative process, refined against the demands of sophisticated industrial clients, and built to compete directly with SAP, Salesforce, and other established players, has produced a platform that is rigorous enough for the most complex environments and simple enough to be adopted broadly.

Today's customer base spans semiconductor manufacturing at Marvell to packaging at Ball Corporation; global multinationals such as Mondi to mid-sized operations like Nippon Electric

Glass and smaller manufacturers such as AdelWiggins; and industries ranging from automotive at Grote to electronics at Trimble Navigation.

RootSolve users are sitting on decades of structured, plant-floor-originated problem data that makes a credible AI deployment possible.

The Problem Solving Gap in Modern Manufacturing

The Human Skill That Drives Quality

Problem solving has always been a core competency on the plant floor. When something goes wrong (a customer or internal complaint, a line stoppage, a supplier non-conformance), a manufacturer's ability to diagnose true cause, coordinate a cross-functional response, and prevent recurrence determines whether that problem becomes chronic.

This is a human skill: the ability to describe a problem precisely, ask the right questions, work through structured methodologies like 8D and 5 Why, assign accountability across departments and supply chains, and close the loop with preventive action. Done well, it protects customers, reduces costs, and builds institutional knowledge. Done poorly, problems recur, customers churn, and quality costs compound.

The Decline of Structured Problem Solving

Despite its importance, structured problem solving is under pressure across manufacturing. As organizations race toward digital transformation, the disciplines that underpin it — like Six Sigma, Lean, A3 thinking, 8D and formal root cause analysis — are receiving less attention and investment. Speed to solution is prioritized over rigor of diagnosis. Institutional knowledge walks out the door with retiring operators and engineers.

This is when structured, high-quality problem data matters the most. The AI systems being evaluated and deployed can only be as good as the data they are trained on and informed by.

What Factory 4.0 Needs and What It's Missing

The Factory 4.0 Promise

As we understand it, Factory 4.0 envisions a manufacturing environment where data flows freely across machines, systems, and enterprise platforms. At its core is the Unified Namespace (UNS), consolidating information from every node in the factory: PLCs, SCADA systems, ERP, MES, CRM, and more. AI sits on top of this architecture, analyzing patterns, predicting failures, and accelerating decision-making.

The Missing Data Type: Structured Problem Knowledge

Machine data tells you what happened. It cannot tell you why it happened, what the team decided to do about it, whether the fix worked, or how to prevent the next occurrence. The human diagnostic layer of reasoning cannot be captured by sensors, PLCs, or ERP systems.

For AI to be genuinely useful for plant floor problem solving, it needs structured problem descriptions, documented root causes, categorized corrective actions, and longitudinal tracking of whether those actions fixed the problem. Without it, even the most sophisticated AI system is pattern-matching with incomplete information. RootSolve is purpose-built to supply the structured, semantically rich problem solving data the UNS needs but cannot generate on its own.

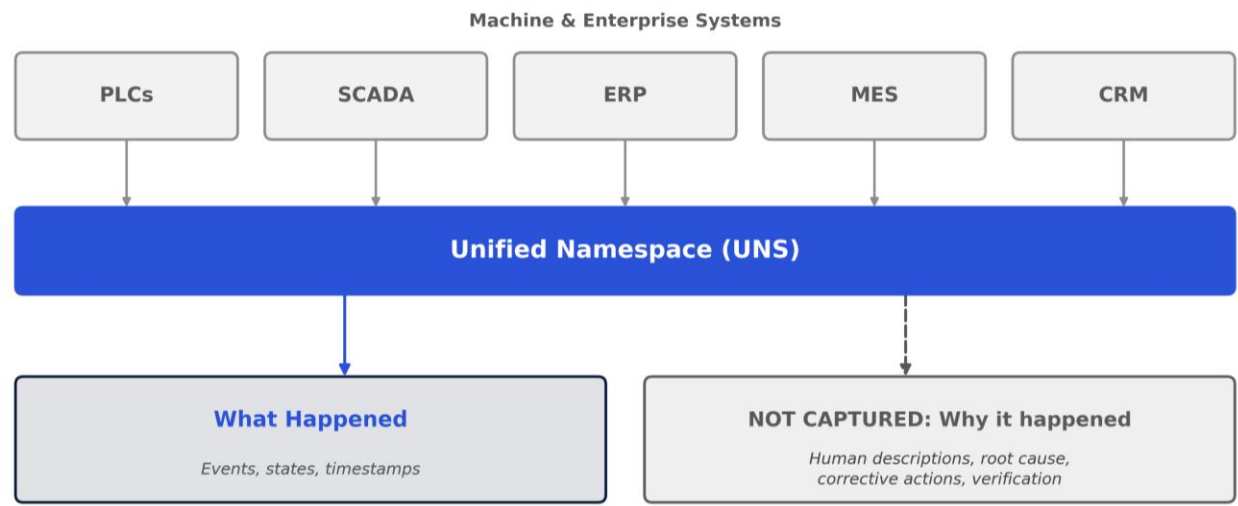


Figure 1. Machine and enterprise systems capture what happened; RootSolve captures why, and what was done about it.

How RootSolve Captures Operational Knowledge

What RootSolve Captures

RootSolve is a structured, team-based problem solving platform used real-time on plant floors, primarily on repetitive, high-volume work processes, by quality, operations, engineering, and customer/supplier complaint teams. It captures:

- Precise, structured problem descriptions on who, what, where, when, and how much
- Root causes identified through methodologies including 8D, 5 Why, 3x5 Whys, and fishbone analysis, depending on the complexity of the problem
- Corrective and preventive actions with owners, due dates, and completion reminders
- Categorization by product line, customer, supplier, plant, department, and work cell (and whatever other descriptors are needed)
- Repeat problem tracking to identify if an issue has occurred before, what steps were taken, and whether prior fixes held
- Customer and supplier complaint information sent to the relevant departments and systems, i.e. scorecards
- Cost data is identified, enabling prioritization by financial impact

This is not reporting data created after the fact. Problem-by-problem and day-by-day, this creates an ever growing library of knowledge is built. Our customers use these libraries to improve. It is operational data created while problem solving in real-time.

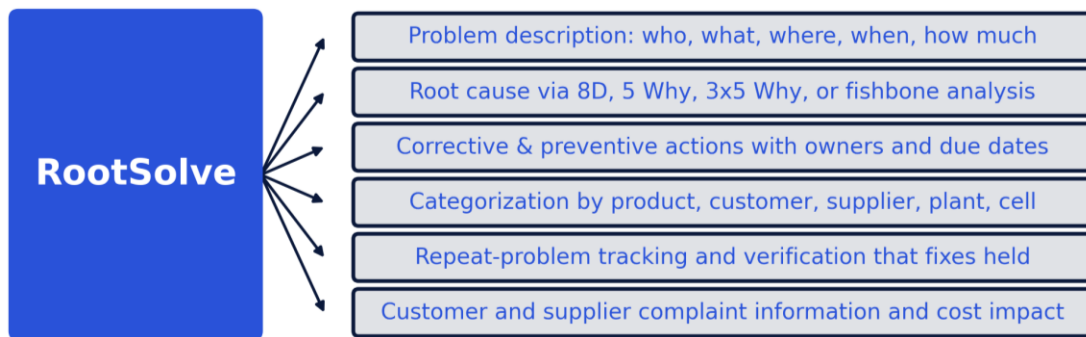


Figure 2. The structured elements of a RootSolve problem record.

The Critical Role of Problem Definition

One of the most important contributions RootSolve makes to AI-powered problem solving is that it enforces proper problem definition before analysis begins.

The most common failure mode in root cause analysis is a failure to describe the problem specifically enough for meaningful analysis. Teams jump to solutions. “Machine down” is not a problem description. “Bearing failure on Line 3 press at position 4, third occurrence this quarter, affecting SKU 77821” is.

RootSolve's structured workflow enforces this discipline. The result is that data entering the UNS from RootSolve is semantically rich. It is not just a timestamp and an error code, but a structured account of what happened, why, and what was done.

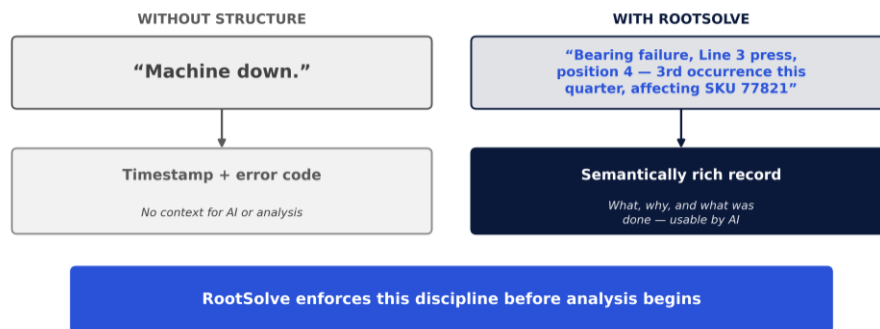


Figure 3. Structured problem definition versus an unstructured description.

How RootSolve Fits Into Factory 4.0 Architecture

The diagram below summarizes how RootSolve integrates end-to-end with a Unified Namespace architecture:

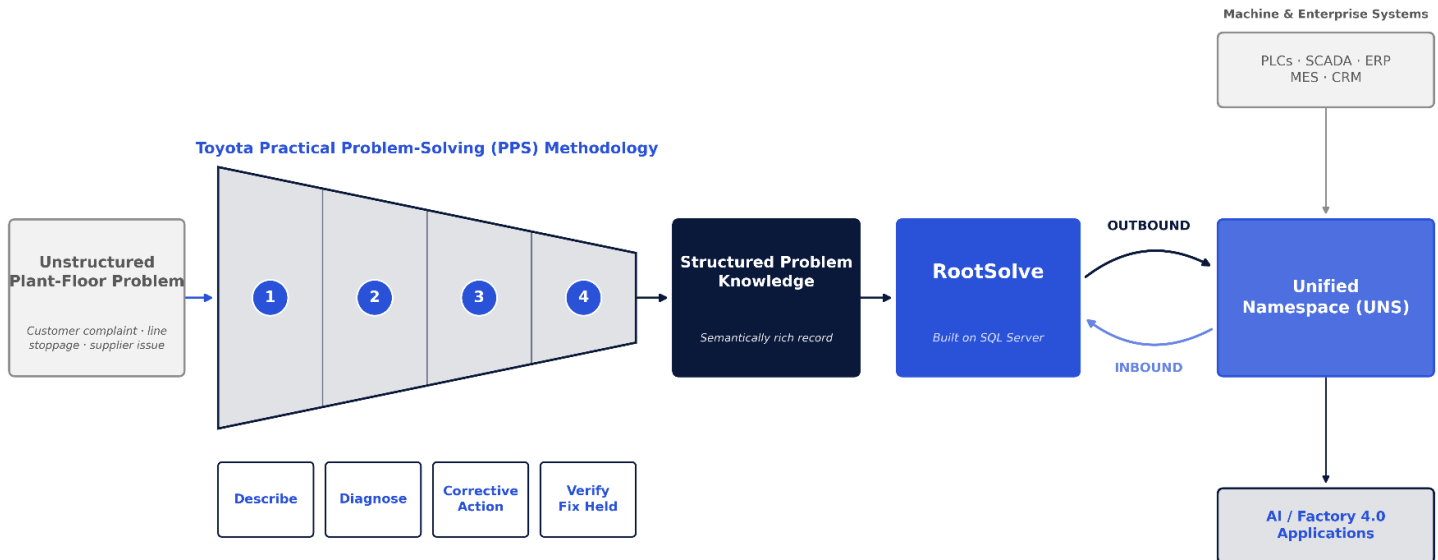


Figure 4. RootSolve's end-to-end architecture: the Toyota Practical Problem Solving (PPS) methodology converts an unstructured plant-floor problem into structured, semantically rich knowledge; RootSolve stores this as a structured problem record and integrates bidirectionally with the Unified Namespace, exchanging data with machine and enterprise systems (PLCs, SCADA, ERP, MES, CRM) and AI/Factory 4.0 applications, which return suggested causes and historical patterns as in-workflow suggestions.

UNS Integration to Support Human Judgement, Not Replace It

RootSolve operates as a node in a UNS architecture, contributing data to the central repository and receiving data from it. The integration is bidirectional and flexible:

- **Outbound:** RootSolve can send structured problem data, indexed to order numbers, part numbers, customers, suppliers, or any other relevant key, into the UNS in whatever format is required. CRM systems needing root cause outcomes, ERP systems monitoring quality costs, and AI platforms training on problem patterns can all pull from this feed.
- **Inbound:** When a problem is opened in RootSolve, relevant data from across the enterprise can be pulled into the problem record automatically. Rather than operators hunting through emails, spreadsheets, SAP, etc. for order quantities or failure history, that context can be populated.
- **AI augmentation:** At appropriate points in the problem solving workflow (after the problem is described and the 5-Why is structured), RootSolve can query the AI layer sitting on top of the UNS and return suggested causes, related historical problems, or patterns from across the enterprise.

Existing Data Integration and Experience

RootSolve is built on MS SQL Server and has a long track record of data exchange with external platforms. Clients currently receive data exports to multiple platforms, including Power BI, SAP, and third-party reporting environments. Connecting to a Unified Namespace is a natural extension of this capability.

The specific integration is determined by the client's architecture and business rules. RootSolve provides the structured problem data and the connection. The intelligence of when and how to use it is configured at the enterprise level, typically in collaboration with the systems integrator deploying the UNS.

Conclusion

The most important data type missing from most Factory 4.0 architectures is structured problem knowledge: the granular, semantically rich account of what goes wrong, why, and what is done about it. No ERP system captures this. No machine sensor produces it. It is created through disciplined, team-based problem solving, and it requires a purpose-built system to capture and structure it.

With 35 years of deployment, a proven methodology, and the flexibility to integrate bidirectionally with modern UNS and AI architectures, RootSolve supplements the data layer with structured, human-generated problem solving knowledge those models cannot otherwise capture.