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Cloud-Based Scalability in Quality Management Systems: A Case Study on the Global Problem Solving System (GPSS) Migration

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Abstract: Quality management systems in globally distributed manufacturing organizations increasingly strain against the limitations of on-premise infrastructure, where data silos and geographic latency slow the resolution of manufacturing nonconformances and erode cross-site visibility into corrective action status. This article presents a case study on the migration of the Global Problem Solving System (GPSS), an enterprise platform for tracking quality incidents and eight-discipline (8D) problem-solving. The migration moved GPSS from an on-premise architecture to a cloud-based environment within a global semiconductor manufacturing organization. This migration, conducted under an Agile SCRUM framework, required bridging information technology development teams and business stakeholders, translating operational requirements into user stories and managing a sprint backlog against an explicit definition of done. Process re-engineering accompanied the technical migration, mapping the data flow from failure notification through root cause analysis to permanent corrective action and standardizing workflows that had previously varied across manufacturing sites. A central innovation was the introduction of automated eight-discipline scoring, which checked structural elements such as the presence of a five-whys analysis and the identification of an escape point before engineers submitted records for final approval. Phase one deployment produced a productivity gain of approximately eighty hours per cycle for quality teams, attributed to reduced latency, automated documentation, and centralized tracking. The case study offers a practitioner framework for organizations weighing similar cloud migrations of quality-critical systems.

Keywords: *Cloud Migration; Quality Management Systems; Agile SCRUM; 8D Problem Solving; Process Re-Engineering*

1. Introduction

Manufacturing organizations operating across multiple continents depend on quality management systems to capture nonconformances, drive root cause investigation, and close corrective actions before defects propagate to customers. Deming's articulation of continuous improvement as a management responsibility, rather than a downstream inspection function, established the expectation that quality systems should surface problems quickly enough for action [1]. Juran extended this logic by framing quality planning as an organization-wide discipline requiring clear ownership and measurable feedback loops [2]. The ISO 9001:2015 standard formalized these expectations into a certifiable framework, requiring documented processes for nonconformity and corrective action that most global manufacturers now treat as a baseline obligation rather than a competitive differentiator [3]. Recent scholarship on the evolution of quality management describes a shift from inspection-based control toward integrated, digitally enabled quality practices sometimes labeled Quality 4.0 [4]. That shift appears to assume an underlying information infrastructure capable of supporting real-time visibility across dispersed operations [5].

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That assumption frequently fails in practice. Many quality management platforms were built and deployed as on-premise systems tied to a single data center or regional server. That architecture made sense when manufacturing sites operated with a degree of independence, but it struggles under the interconnected, multi-site production networks common in semiconductor and electronics manufacturing today. Engineers at one site may lack timely access to problem records generated at another, corrective action documentation accumulates in formats that vary by location, and status updates travel through manual reporting rather than a shared system of record. Adoption of digitally enabled quality practice remains uneven across the industry: many organizations continue to run legacy platforms alongside newer digital initiatives rather than replacing them outright. That pattern can leave latency and data silo problems unresolved even as broader digital transformation efforts proceed elsewhere in the same organization. What results is a set of data silos and geographic latency problems that slow the very corrective action cycles quality management systems exist to accelerate, a tension that becomes more acute as organizations scale their manufacturing footprint globally.

Comparatively little practitioner-level documentation addresses the gap between the quality management ambitions described in standards and literature and the infrastructure many organizations actually operate on, particularly for platforms supporting structured problem-solving methods such as eight-discipline analysis. This article examines that gap through the migration of the Global Problem Solving System, a quality incident and 8D tracking platform, from on-premises infrastructure to a cloud-based environment within a global semiconductor manufacturing organization. It explains how an Agile SCRUM delivery approach, paired with deliberate process re-engineering and an automated 8D scoring capability, produced measurable productivity gains while addressing long-standing data silo and latency problems. It also draws out considerations relevant to practitioners evaluating similar migrations of quality-critical systems.

2. Infrastructure Modernization: The Case for Cloud Integration

On-premise quality management infrastructure typically ties system performance and availability to a fixed set of physical servers located at or near a single manufacturing site. Capacity planning under this model requires organizations to provision hardware for anticipated peak load. In a global quality system, that means sizing infrastructure for the combined demand of every site and shift rather than the demand any single location generates on a given day. Manufacturing volume can grow, a new site can come online, or a customer audit can drive a temporary spike in report generation. In each case, the fixed infrastructure either absorbs the load poorly or requires a capital procurement cycle that can lag the operational need by months. GPSS, prior to migration, exhibited these constraints directly. Engineers connecting from sites geographically distant from the hosting data center experienced longer page load times and slower record retrieval, and the platform's centralized but singly located database created a bottleneck during periods of concurrent multi-site access.

Cloud computing addresses this class of problem through what Armbrust and colleagues describe as the illusion of infinite computing resources available on demand, paired with the ability to pay only for the capacity actually consumed [6]. The NIST definition of cloud computing formalizes this through five characteristics, among them on-demand self-service and rapid elasticity [7]. These characteristics mean that computing resources can expand or contract in response to workload without a corresponding change in the underlying physical hardware managed by the organization. For a quality system supporting a large, multi-site user base spread across time zones, elasticity of this kind matters directly. It allows the platform to accommodate a shift change in one region and a quarterly audit push in another without either event degrading performance for the other. Distributed computing architecture spreads workloads and data across multiple physical or virtual nodes rather than concentrating them in a single facility. This further reduces the latency global users experience by locating processing closer to the point of use rather than routing every request back to one origin server.

A direct contrast separates this model from the legacy environment it replaced. Provisioning additional on-premise capacity for GPSS required a capital request, a procurement cycle, and physical installation lead time, whereas a cloud-based environment allowed capacity to be adjusted through configuration rather than through a hardware acquisition project. That difference reshaped how the organization approached future growth, since extending GPSS to additional sites or user populations no longer required anticipating that growth years in advance through a fixed hardware budget cycle.

Systematic reviews of cloud migration practice describe the transition as more than a lift and shift of existing applications onto rented infrastructure [8]. Migrations succeed or fail based on how well the organization re-architects data access patterns, integration points, and operational responsibilities for the new environment. This distinction mattered for the GPSS migration, where the objective was not simply to relocate the existing on-premise database. The migration also had to restructure how quality data moved between sites, how records synchronized across the network, and how the platform scaled to meet demand that had previously been constrained by hardware limits rather than actual business need. Comparable transitions in enterprise resource planning contexts have been associated with performance gains attributed to the shared infrastructure model, in which computing resources serve many tenants rather than sitting idle in a single organization's data center [9]. The magnitude of such gains, however, depends heavily on workload characteristics and should not be generalized without qualification [10].

Cloud infrastructure is not without its resource considerations. Recalibrated estimates of energy consumption in global data centers indicate that the aggregate computing demand of cloud and colocation facilities has grown even as efficiency per unit of compute has improved [11]. That pattern is a reminder that elasticity shifts resource management responsibility rather than eliminating it. For an organization migrating a quality-critical system, the practical case for cloud integration relies more on the operational alignment between a geographically distributed workforce and the distributed, elastic infrastructure than on any single efficiency metric. Adoption research across manufacturing and enterprise contexts links cloud migration decisions to this alignment fairly consistently, framing the technology choice as a response to organizational structure rather than a pursuit of infrastructure novelty for its own sake [12]. The GPSS migration proceeded from this premise, treating cloud adoption as the infrastructure correction needed to match a quality system to the global, multi-site organization it was meant to serve.

3. Agile-Driven Deployment: The SCRUM Framework in System Migration

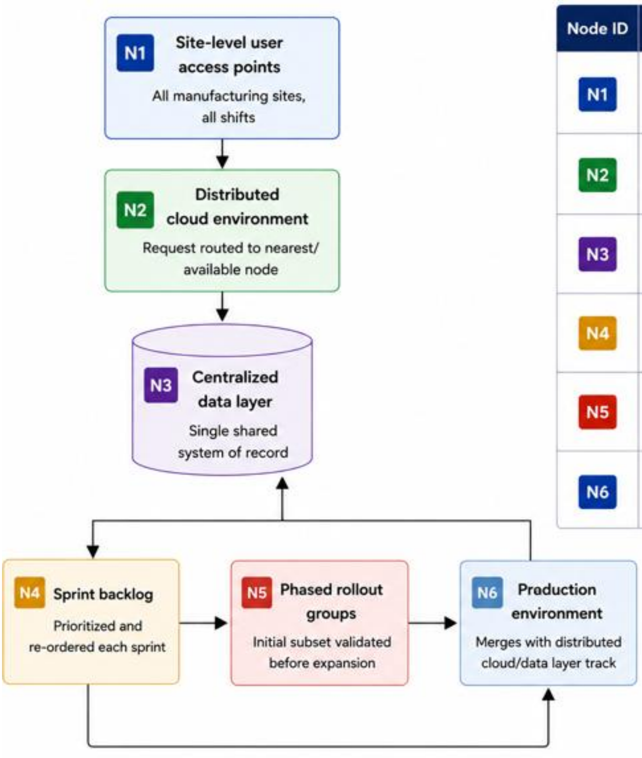
Migrating a quality-critical system used by engineers across every manufacturing site as a single large release would carry unacceptable risk. Any defect in the new platform would interrupt the corrective action process the organization depends on to contain manufacturing nonconformances. The GPSS migration instead followed the Scrum framework, an iterative approach to product delivery organized around fixed-length sprints, a prioritized backlog, and defined roles for coordinating work between a development team and the stakeholders who depend on its output [13]. Serving as SCRUM Master for the initiative, the author held responsibility for facilitating sprint ceremonies, removing impediments reported by the development team, and maintaining the discipline of the framework, rather than writing the underlying application code. That division of labor reflects Scrum's separation of process facilitation from technical implementation.

Translating between two groups that described the same system in different vocabularies was a recurring challenge throughout the migration. Business stakeholders, including quality engineers and site leaders, articulated their needs in terms of workflow outcomes, such as faster access to open corrective actions or clearer visibility into overdue eight-discipline records. The information technology development team, in turn, required these needs expressed as discrete, testable units of work. Much of the author's role centered on converting stakeholder input into user stories, each specifying a user role, a desired capability, and the reason that capability mattered. These stories were then prioritized in a sprint backlog reviewed and reordered at the start of every sprint. Research on how Scrum is adapted in practice observes that this translation function often falls informally to whoever bridges technical and business perspectives, even when that person's formal title does not include product ownership responsibilities [14]. That pattern mirrors how the GPSS migration operated.

Every user story carried a definition of done, an explicit checklist establishing when a piece of work qualified as complete rather than merely coded. For GPSS, the definition of "done" extended beyond functional correctness to include criteria such as successful data migration validation, user acceptance testing sign-off from a representative stakeholder, and documentation updates. A story could not be marked complete until it met the standards required by the business side of the migration. Analyses of Scrum team effectiveness link this kind of shared, explicit completion criteria to reduced rework and clearer accountability between technical and business participants, particularly on initiatives where the two groups have historically operated with different definitions of success [15].

Sprint reviews held at the close of each cycle gave stakeholders a recurring opportunity to inspect completed work and redirect priorities before further development effort was committed. Sprint retrospectives, in turn, gave the development team a structured forum for identifying process friction internal to the team itself. Sustaining this cadence across a migration spanning several years required consistent facilitation, since teams under delivery pressure often let ceremonies lapse first, which would have removed the feedback loops the framework depends on to keep stakeholder priorities and development capacity aligned.

Deploying the migrated system network-wide in a single event was never seriously considered; instead, the team executed a phased rollout, validating stability and gathering feedback from a limited subset of users before extending access to the full global user base. This iterative deployment pattern allowed defects and usability issues to surface and be corrected while the operational impact of any single issue remained contained to a small group rather than the entire quality organization. Comparative studies of Agile Scrum adoption report associations between this kind of incremental delivery discipline and improvements in both team productivity and client or stakeholder satisfaction [16]. That pattern is broadly consistent with the rationale for phasing the GPSS rollout rather than attempting a single cutover.



Node ID	Label	Shape	Connects To	Branch Condition
N1	Site-level user access points	Rectangle (terminal/input)	N2	All manufacturing sites, all shifts
N2	Distributed cloud environment	Rectangle (process)	N3	Request routed to nearest/available node
N3	Centralized data layer	Cylinder (data store)	–	Single shared system of record
N4	Sprint backlog	Rectangle (process)	N5	Prioritized and re-ordered each sprint
N5	Phased rollout groups	Rectangle (process)	N6	Initial subset validated before expansion
N6	Production environment	Rectangle (terminal/output)	N3	Merges with distributed cloud/data layer track

Figure 1: Conceptual GPSS Cloud Architecture and Agile Delivery Pathway

A conceptual diagram would appear here, showing user access points at each site connecting through a distributed cloud environment to a centralized data layer, alongside a parallel track depicting the Scrum delivery cycle, the sprint backlog, and the phased rollout groups feeding into the production environment. The figure is intended to show how the SCRUM delivery process and the underlying distributed infrastructure functioned as complementary tracks throughout the migration.

4. Process Engineering and Integrated 8D Workflow Design

The eight-discipline methodology structures problem resolution into a defined sequence of steps, beginning with problem description and containment and proceeding through root cause analysis to permanent corrective action and process closure. It remains one of the most widely used structured problem-solving frameworks in automation and manufacturing organizations [17]. Migrating GPSS to the cloud created an opening to examine how well the platform's existing workflow reflected this sequence in practice. A technical migration that simply reproduced an inconsistent process would have left the underlying quality problems in place, regardless of the infrastructure supporting them. The author led a process re-engineering exercise that mapped the complete data flow from initial failure notification through root cause analysis to permanent corrective action, documenting where each site's actual practice diverged from the intended eight-discipline sequence.

This mapping exercise required direct engagement with process owners at multiple sites rather than reliance on existing documentation alone, since written procedures did not always reflect the workaround practices engineers had adopted to compensate for gaps in the legacy platform. Site-level interviews and workflow walkthroughs surfaced these informal practices, letting the redesigned workflow account for behavior actually occurring on the shop floor rather than only the behavior described in existing standard operating procedures.

Meaningful variation emerged across manufacturing sites in how engineers navigated the platform, how thoroughly they documented root cause findings, and how consistently they scored the quality of a completed 8D record before closing it. Some sites had developed local conventions for structuring corrective action narratives that made sense locally but complicated comparison or aggregation of quality data at the organizational level. Standardizing these workflows into a single, platform-enforced sequence reflected what this article treats as a Quality-by-Design approach, in which the system itself, rather than site-specific training or supervisory review, becomes the primary mechanism for ensuring every record follows a consistent structure. Frameworks describing knowledge creation within organizations distinguish between tacit knowledge, held informally by individuals or local teams, and explicit knowledge, codified in a form that can be transferred and reused across the organization [18]. The standardization effort appears to function as a mechanism for converting site-specific tacit practice into explicit, platform-enforced workflow.

Requirements gathering for the redesigned workflow combined two sources of input that did not always point toward the same solution. Internal process engineers wanted a system that reduced navigation friction and eliminated redundant data entry across the stages of an 8D record. Much of their frustration with the legacy platform stemmed from having to re-enter information already captured earlier in the same record. Customers receiving quality reports from the organization, by contrast, expected a level of documentation completeness and consistency that internal users sometimes viewed as additional overhead layered onto their existing workload. Stakeholder interviews conducted during the requirements phase surfaced three recurring pain points with the legacy system. These included difficult navigation between related records, an absence of automated reporting that forced engineers to compile status updates manually, and inconsistent scoring of 8D quality that made it difficult to compare records across sites or over time. Research on digitalization platforms for quality management in multi-stage manufacturing systems identifies data flow mapping and stakeholder-driven requirements as prerequisite steps for a platform that supports cross-site standardization, rather than treating them as optional groundwork ahead of the technical build [19].

Automatic root cause analysis research in manufacturing contexts emphasizes that structured, machine-readable RCA documentation is a precondition for downstream automation of quality analysis, since inconsistent or free-text root cause records cannot reliably be parsed, compared, or scored [20]. The workflow redesign undertaken for GPSS addressed this precondition directly, restructuring root cause and corrective action fields into a more consistent format that later supported the automated 8D scoring functionality described in the following section. Taken together, the process mapping, the Quality-by-Design standardization, and the dual-source requirements gathering formed the process engineering foundation on which the platform's cloud infrastructure and its new scoring capability were both built.

5. Automated 8D Scoring as a Technical Innovation

The standardized workflow described above made possible a scoring capability that had not existed in the legacy platform: an automated check of structural completeness applied to every eight-discipline record before an engineer could submit it for final approval. The scoring logic examined specific, rule-based criteria drawn directly from 8D methodology rather than from a statistical or machine-learned model of quality outcomes. Two checks illustrate the approach. The system verified that discipline four, the root cause analysis section, contained a documented five-whys chain rather than a single-level explanation. It also verified that the record identified an escape point, the specific process step where the defect should have been detected but were not. Both checks reflect requirements already embedded in 8D methodology [17]; the scoring functionality's contribution was to enforce them consistently and immediately rather than relying on a reviewer to catch their absence after submission.

Worth distinguishing here is how this rule-based approach differs from predictive quality methods built on machine learning and deep learning models, which have been applied elsewhere in manufacturing to forecast defect likelihood or classify failure modes from historical production data [21]. The GPSS scoring functionality made no such prediction and involved no model training; it checked for the presence and structural completeness of defined fields against criteria the organization had already established as necessary for an acceptable 8D record. It functioned, in other words, as an automated completeness and consistency check embedded in the workflow, giving engineers immediate feedback before final approval rather than after a downstream review identified a gap.

Feedback delivered before submission, rather than after a supervisor or customer reviewer identified the same gap, shifted the point of correction earlier in the record's lifecycle, when the engineer who authored the analysis still had the relevant context readily available. Correcting a missing escape point or an incomplete five-whys chain during initial entry required less effort than reconstructing that same analysis after the record had moved to a reviewer and been returned with comments. That reconstruction also required the original engineer to revisit a case that may no longer have been their primary focus.

Phase one deployment connected this feedback loop directly to a measurable productivity outcome. Quality teams using the migrated platform realized a productivity gain of approximately eighty hours per cycle, a figure attributed to three contributing factors rather than to the scoring functionality alone. Table 1 summarizes these factors and the mechanism through which each contributed to the observed gain.

Table 1: Contributing Factors to the Phase 1 Productivity Gain

Contributing Factor	Mechanism
Reduced latency	Distributed cloud access shortened page load and record retrieval times for geographically dispersed engineers.
Automated documentation and pre-populated templates	Previously captured record data carried forward automatically, cutting redundant manual re-entry.
Centralized tracking	A single shared system of record removed the need for manually compiled status updates.

Each factor addresses a different source of delay identified during the requirements and process mapping work described earlier, and the combined effect, rather than any single change in isolation, produced the observed cycle time reduction. The automated 8D scoring functionality complements these three factors indirectly. By catching structural gaps in a record before submission, it reduces the likelihood that a record requires rework after review, which could otherwise erode part of the time savings the other three factors created. Read together, the scoring capability and the three documented contributing factors describe a workflow in which time previously spent on latency, re-entry, and manual status compilation was returned to the quality teams responsible for closing corrective actions.

6. Global Adoption and Stakeholder Alignment

A platform's value depends on whether engineers across every site actually adopt the new way of working, rather than reverting to informal habits developed under the legacy system. Technical migration and workflow redesign therefore address only part of what a global rollout requires. Organizational research on Industry 4.0 implementation identifies training and change management as recurring determinants of whether a digital initiative achieves its intended operational benefit, noting that technically sound systems can still underperform when the workforce lacks confidence in using them [22]. The GPSS migration treated adoption as a deliverable in its own right rather than as an afterthought following technical deployment.

Engineers, site quality leads, and occasional customer-facing users approached the system with different needs and different amounts of available time for training, which led the author to develop multimodal training materials tailored to these roles. Video tutorials addressed users who preferred a short, self-paced walkthrough of a specific task. Written guides served as reference material for users returning to a less frequently used feature.

Interactive sandboxes let engineers practice entering and scoring a sample 8D record in a nonproduction environment before working with live quality data. This reduced the risk that a user's first experience with the new scoring functionality would occur on a record with real consequences attached. Distributing training across these formats reflected the recognition that a single training format, however well produced, would not reach every user population effectively across a global organization operating in multiple time zones and languages.

Training delivery followed the same phased logic as the platform rollout itself, introducing materials to the initial subset of users before the network-wide expansion so that early adopters could raise clarifying questions while the content could still be revised. Feedback gathered from this early group shaped subsequent versions of the video tutorials and written guides. The materials reaching the full global population had therefore already been tested against real user confusion, rather than only against the author's assumptions about where users would struggle.

Balancing internal and external expectations was an ongoing task that shaped several of the platform's design decisions, extending well beyond training delivery. Internal information technology capacity constrained how quickly certain features could be built and tested, since the development team's capacity within any given sprint was finite regardless of how many capabilities stakeholders wished to prioritize simultaneously. External customers receiving quality documentation from the organization expected a consistent level of detail and timeliness that did not always align with what internal users considered the minimum necessary effort for a given record. Research on digital transformation success in Industry 4.0 contexts describes this kind of tension as a normal feature of implementation rather than a sign of planning failure [12]. That research also appears to associate successful outcomes with organizations that treat the balancing of internal capability and external expectation as an ongoing management task, rather than a problem solved once during initial design.

Conclusion

Migrating the Global Problem Solving System from on-premise infrastructure to a cloud-based environment shows how the technical work of relocating a quality platform's infrastructure and the organizational work of redesigning its workflow are inseparable in practice. Cloud elasticity addressed the latency and data silo problems that had constrained a globally distributed engineering workforce, but the productivity gain the organization realized depended equally on process re-engineering that mapped and standardized the eight-discipline sequence across every manufacturing site. An Agile SCRUM delivery approach supplied the structure needed to translate stakeholder requirements into deliverable increments and validate stability through a phased rollout. It also held every piece of work to an explicit definition of done before it reached the production environment used across the global organization. Automated 8D scoring, checking for structural elements such as a documented five-whys analysis and a clearly identified escape point, gave engineers a rule-based feedback mechanism before final approval rather than relying solely on downstream review to catch incomplete records. Combined with reduced latency, automated documentation, and centralized tracking, this functionality contributed to a phase one productivity gain of approximately eighty hours per cycle for quality teams. That gain is attributable to the combined effect of infrastructure, process, and scoring changes, rather than to any single intervention in isolation. Multimodal training materials and deliberate attention to balancing internal development capacity against external customer reporting expectations supported adoption of the redesigned system across a global user base. The GPSS case suggests, taken as a whole, that organizations pursuing similar migrations of quality-critical systems may benefit from treating infrastructure modernization, Agile delivery discipline, and workflow standardization as interdependent components of a single initiative rather than as sequential or separable projects. Documenting the sequence in which these components were introduced, and not only their end state, might help other practitioners anticipate where friction is likely to arise during a comparable initiative. The magnitude of any resulting productivity gain will depend on organization-specific factors, but the underlying framework, pairing GPSS-style cloud infrastructure with process re-engineering and algorithmic 8D scoring, offers a documented reference point for practitioners evaluating comparable initiatives in distributed manufacturing environments.

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