

## GLOBAL-LOCAL ORDER DRESSING: HOW STEEL PRODUCERS CAN USE PRODUCT CONFIGURATION AND RULE-BASED ENGINES TO GENERATE PRODUCTION ORDERS

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*Quality specifications are crucial for the metals industry to ensure consistent quality and safety. Integrating these specifications into the manufacturing execution system (MES) is essential for maintaining expected quality levels, minimizing errors, and enhancing efficiency, thereby meeting regulatory requirements and customer expectations. However, metals producers with geographically distributed locations face challenges in ensuring compliance with international quality standards, such as inconsistent data representation across different systems and varying completeness levels. Addressing these challenges requires a robust strategy that includes effective communication, standardized processes, and advanced technology integration. This paper details how Global-Local Order Dressing serves as a central knowledge base for the steel industry, enabling producers to leverage a unified quality repository with local download capabilities. As part of the digital transformation journey which is required for process optimization, the solution provides instant access to centralized industry specifications, reducing time-consuming and error-prone data entry at each local instance, allowing quality assurance teams to focus on core tasks and enhance productivity. We will further show how regardless of the location, the solution ensures that all teams adhere to the same best practices, resulting in consistent and high-quality outputs.*

**KEYWORDS:** ORDER DRESSING; QUALITY; GLOBAL; LOCAL; EFFICIENCY; KNOWLEDGE; GOVERNANCE; IAI;

### INTRODUCTION: THE ORDER DRESSING DIRECTIVE IN MODERN METALS PRODUCTION

In the metals industry, the transformation of commercial sales orders into detailed manufacturing instructions—commonly known as Order Dressing—is an indispensable yet traditionally manual and error-prone process.

This task demands the reconciliation of several complex dimensions:

- **Quality Specifications:** Encompassing chemical, mechanical, and dimensional requirements derived from international and customer-specific standards.
- **Manufacturing Rules:** Including process sequences, setup parameters, equipment capabilities, and energy/material inputs.
- **Multi-Site Variability:** Different plants often have unique configurations, legacy practices, and locally interpreted standards.

The traditional approach relies heavily on fixed catalogs and spreadsheets that require manual cross-referencing and expert intervention. This creates bottlenecks in engineering offices, introduces variability into production, and limits scalability. Yet the ultimate challenge lies in balancing global standardization with local adaptability—ensuring consistency without undermining site-specific operational realities.

The Global-Local Order Dressing platform from offers a modern alternative that simplifies the rigid legacy systems by providing a centralized, rule-driven knowledge base with download capabilities and an inference engine that automates technical elaboration to generate production orders with comprehensive quality and manufacturing details. This paper will explain the details of this dual Global-Local platform for end users.

## KNOWLEDGE-BASED ORDER DRESSING ARCHITECTURE

At the heart of the platform is a multi-layered knowledge base encoding expert industrial know-how. This digital foundation is structured into three interdependent models, including Quality Data Model, Manufacturing Data Model, and Governance Model:

### Quality Data Model

- Encodes normative standards (e.g., ASTM, EN, ISO, API), customer-specific specifications, and internal criteria –a.k.a internal qualities.
- Defines required tests (e.g., tensile, hardness, charpy, ultrasonic), sampling instructions, and acceptance limits.
- Captures relationships between product attributes (e.g., yield strength vs. heat treatment, melt grade chemistry and properties vs heat treatment practices).

### Manufacturing Data Model

- Formalizes process routes (e.g., Rolling → Pickling → Finishing → Inspection → Shipping).
- Contains algorithmic formulations for material usage and transformation per process step.
- Embeds equipment-level parameters, such as rolling speeds, furnace cycles, or coating compositions.

### Governance Model

- Allocates domain responsibility across engineering functions:
- Quality engineers maintain test logic.
- Process engineers govern routing and setup rules.
- Supply chain manages labeling, packaging and shipping instructions.
- Ensures traceable cross-domain dependencies (e.g., chemical tolerances affecting downstream cooling rates).

### Technical Elaboration

The rule engine automates the technical elaboration through a sequenced six-step process:

1. **Commercial Setup:** Gets customer order attributes (e.g., material type: seamless stainless steel tube, diameter: 50 mm, specifications (e.g. EN 10216-5, ASTM A312).
2. **Quality Data Model:** Resolves all applicable standards, identifies necessary inspections, and derives tolerance ranges.
3. **Route Composition:** Assembles the required process flow from applicable operations, filtered by site capabilities and production constraints.
4. **Material Transformation and Demand Calculation:** Computes input materials and dimensions (e.g., billet weight for a target tube length).
5. **Setup Parameter Generation:** Translates high-level routing into executable machine instructions (e.g., annealing at 950°C ±10°C, line speed 3.5 m/s).
6. **Costing and Standardization:** Assigns cycle times and estimated cost per process, enabling close collaboration and integration with ERP and MES systems.

### Production Order Details

The final output is a comprehensive, executable production order including:

- Inspection protocols with sampling frequencies and sample specifications.
- Line-specific machine instructions.
- Documented compliance against governing standards (EN, ISO, API, ASTM).
- Embedded digital traceability for audit purposes (versioning, change logs).

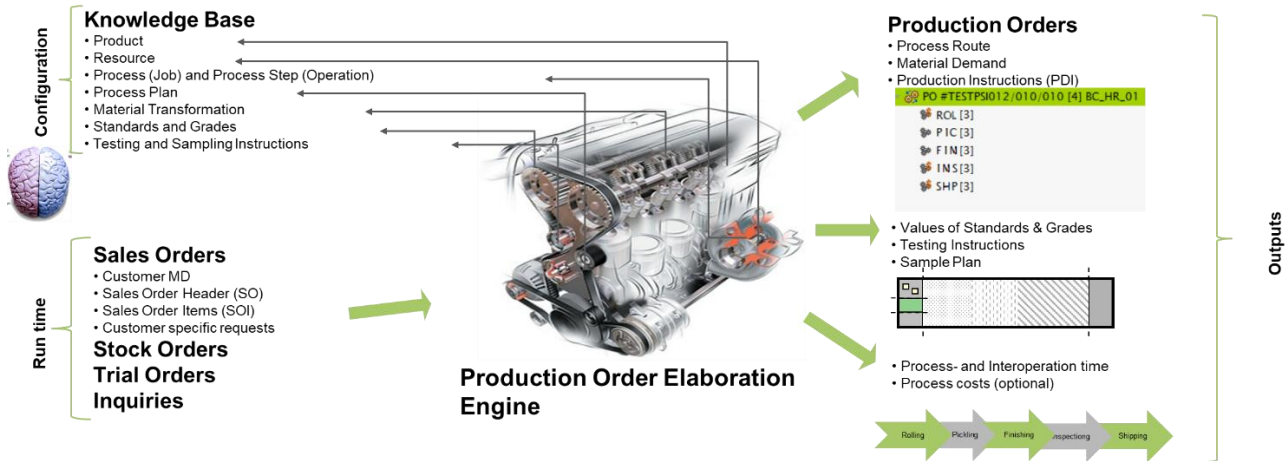


Fig.1 – Knowledge Based Order Dressing Architecture

## MULTI-SITE COMPLEXITY: THE CHALLENGE OF FRAGMENTED QUALITY AND PROCESSES

Multi-plant operations, though offering flexibility and proximity to markets, present significant operational and governance challenges.

### Quality Inconsistencies

- Variations in standard interpretation (e.g., one plant allows 0.30% max carbon for heat chemistry, another restricts it to 0.25%).
- Divergent test procedures and acceptance thresholds.
- Inconsistent documentation and traceability practices.

### Process Heterogeneity

- Rolling mills with different capabilities require customized leadtime schedules.
- Differing heat-treatment cycles due to furnace limitations or historical practices.
- Varying material handling and logistics configurations.

### Organizational Silos

- Local engineers with different backgrounds and expertise levels maintaining isolated rule sets.
- Redundancy in rule creation and difficulty aligning updates across plants.
- Limited knowledge transfer between facilities.

These inconsistencies lead to:

- Customer dissatisfaction due to variability in product performance
- Operational waste from rework and scrap.
- Exposure to compliance risk under ISO, API, or local regulations.
- Inefficient resource utilization and extended lead times.

## GLOBAL-LOCAL ORDER DRESSING PLATFORM: GOVERNANCE WITH FLEXIBILITY

Addressing these challenges requires a robust strategy that includes effective communication, standardized processes, and advanced technology integration. Our Global-Local Order Dressing serves as a central knowledge base for the steel industry, enabling producers to leverage a unified quality repository with local download capabilities. As part of the digital transformation journey, which is required for process optimization, the solution provides instant access to centralized industry specifications, reducing time-consuming and error-prone data entry at each local instance, allowing quality assurance teams to focus on core tasks and enhance productivity.

### Dual Repository Architecture

The platform enforces standardization through a two-tiered repository model:

- Global Repository
  - Central hub maintained by corporate teams.
  - Contains core standards, tests, and production rules.
- Local Repositories
  - Plant-specific overlays mapped to the global layer.
  - Allow for operational customization (e.g., plant-specific test adaptations, specific tolerances).

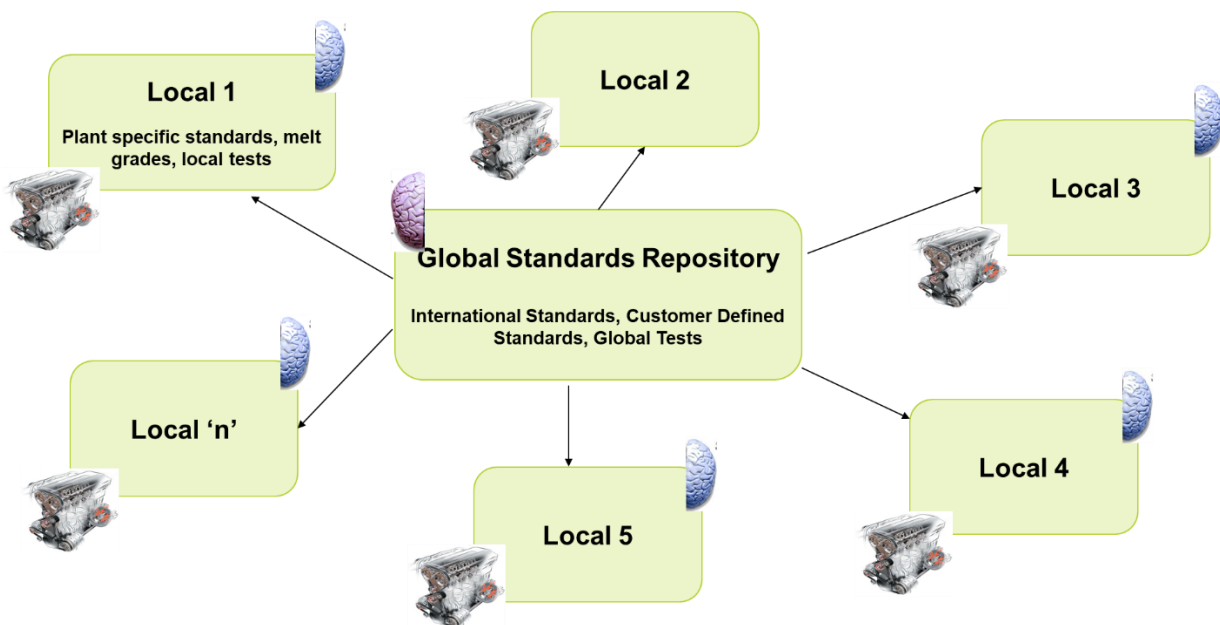


Fig.2 – Global-Local Order Dressing – Dual Repository

### Governance and Role Responsibilities

- Global Role (Corporate Engineering)
  - Maintains master standards (ASTM, ISO, etc.).
  - Assigns applicable rules to plants through a controlled release mechanism.

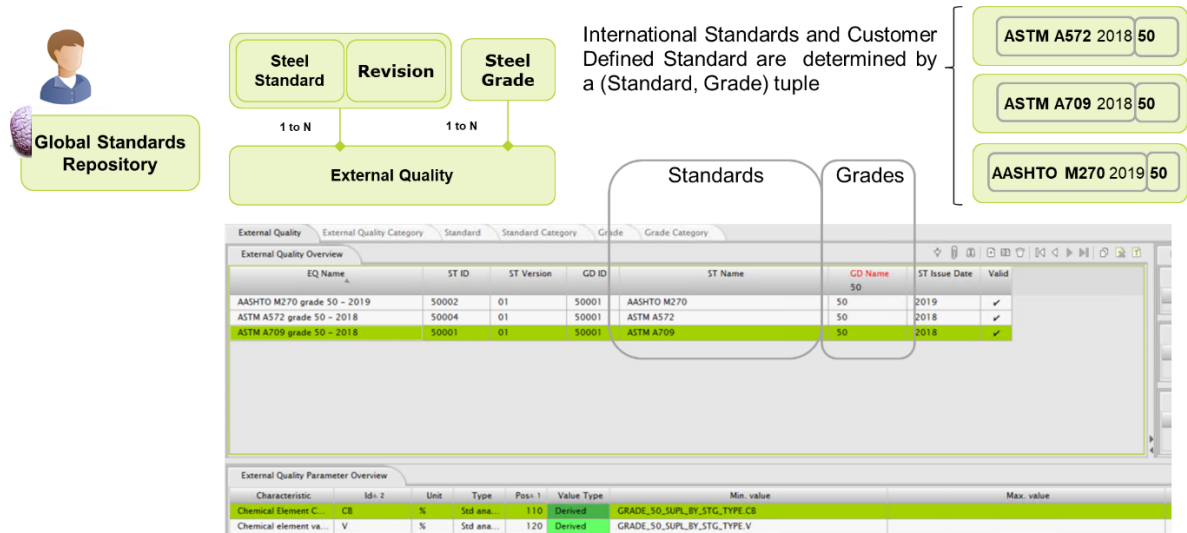


Fig.3 – Global-Local Order Dressing – Global Repository

- Local Role (Plant Engineering)
  - Maps global rules to site-specific entities (e.g., API 5L X70 specification is mapped to melt grade 'ABC123' at plant 'A' whereas the same specification is mapped to melt grade 'XYZ987' at the plant 'B').
  - Creates extensions only where allowed (e.g., local inspection procedures).
  - Operates under restricted permissions—cannot modify core global rules.

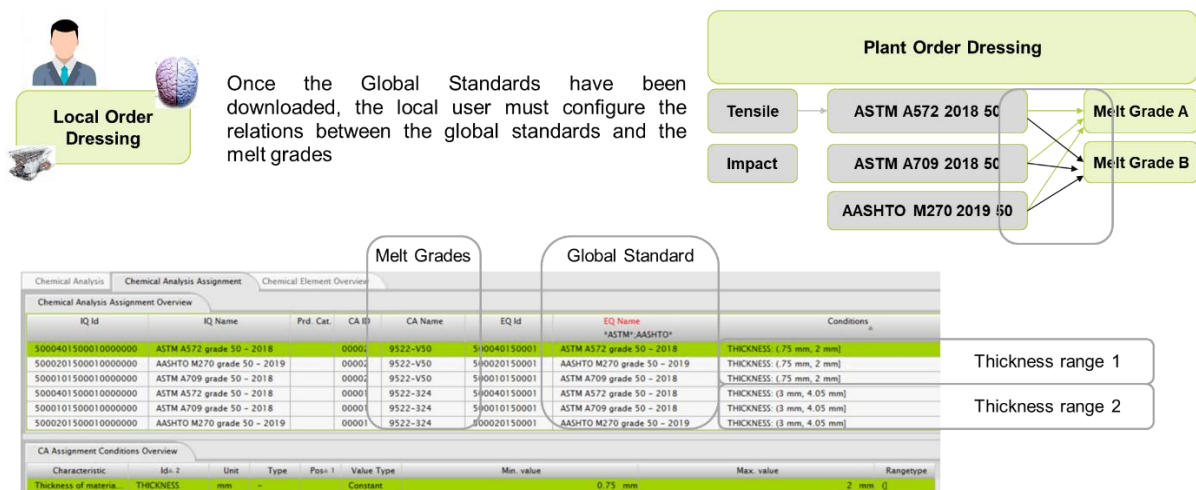


Fig.4 – Global-Local Order Dressing – Local Repository

## Conflict Mitigation and Harmonization

- Baseline Enforcement
  - Global rules enforce the minimum required compliance (e.g., minimum elongation for tensile tests).
- Permitted Extensions
  - Local engineers can add constraints (e.g., smaller coil weight for overhead crane limits).
- Synchronization Engine
  - Periodically syncs updates.
  - Blocks conflicting overrides.

- Tracks deviations and flags for audit or escalation.
- Monitors synchronization status:
  - Green = Up to date.
  - Yellow = Updates available, ready for download.
  - Orange = Global update released, local implementation lagging.



Global Standards  
Repository

Global user identifies  
which Plants (plants) the  
External Quality is  
appropriate for

- Green: EQ is up-to-date at this plant
- Yellow: EQ has been changed in the mean-time (between last download time and now), is not up-to-date
- Orange: EQ is released for download to the plant, but is not yet downloaded (the plant does not yet know this EQ)

| Global Identification Overview |                             |       |            |       |                     |            |               |       |    |    |                  |  |  |  |  |  |
|--------------------------------|-----------------------------|-------|------------|-------|---------------------|------------|---------------|-------|----|----|------------------|--|--|--|--|--|
| EQ Id                          | EQ Name                     | ST ID | ST Version | GD ID | ST Name             | GD Name    | ST Issue Date | Valid | P1 | P2 | Update Date      |  |  |  |  |  |
| 000020100049                   | AASHTO M 270 GR 50 -20      | 00002 | 01         | 00049 | AASHTO M 270M/M 270 | 50         | -20           | ✓     | ✓  | ✓  | 4/15/21 7:27 PM  |  |  |  |  |  |
| 000440100113                   | ASTM A709 GR 50S -18        | 00044 | 01         | 00113 | ASTM A709/A709M     | 50S        | -18           | ✓     | ✓  | ✓  | 4/15/21 7:27 PM  |  |  |  |  |  |
| 000380100000                   | ASTM A588 -19               | 00038 | 01         | 00000 | ASTM A588/A588M     | Default    | -19           | ✓     | ✓  | ✓  | 4/6/21 7:56 PM   |  |  |  |  |  |
| 000130100054                   | ASME SA-516 GR 55 2019      | 00013 | 01         | 00054 | ASME SA-516/SA-516M | 55         | 2017          | ✓     | ✓  | ✓  | 4/6/21 7:56 PM   |  |  |  |  |  |
| 500260150177                   | ASTM A653M HSLAS GR 380 -20 | 50026 | 01         | 50177 | ASTM A653/A653M     | HSLAS 380  | -20           | ✓     | ✓  | ✓  | 2/23/21 10:29 PM |  |  |  |  |  |
| 500260150179                   | ASTM A653M HSLAS GR 410 -20 | 50026 | 01         | 50179 | ASTM A653/A653M     | HSLAS 410  | -20           | ✓     | ✓  | ✓  | 2/23/21 10:29 PM |  |  |  |  |  |
| 500260150182                   | ASTM A653M HSLAS GR 480 -20 | 50026 | 01         | 50182 | ASTM A653/A653M     | HSLAS 480  | -20           | ✓     | ✓  | ✓  | 2/23/21 10:29 PM |  |  |  |  |  |
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| 500260150193                   | ASTM A653 HSLAS-F GR 40 -20 | 50026 | 01         | 50193 | ASTM A653/A653M     | HSLAS-F 40 | -20           | ✓     | ✓  | ✓  | 2/23/21 10:29 PM |  |  |  |  |  |

Last Update

Fig.5 – Global-Local Order Dressing Platform – Conflict Mitigation and Harmonization

## OUTSTANDING BENEFITS

The global-local platform delivers measurable efficiency gains by automating error-prone manual tasks, reducing order-dressing time from weeks to hours and cutting data-entry mistakes. Quality consistency improves as all plants enforce identical international standards (e.g., ASTM, EN), while local adaptations for site-specific constraints (e.g., furnace capabilities) maintain operational flexibility. This harmonization directly reduces quality-related scrap, frees engineering bandwidth for innovation, and ensures audit-ready compliance across sites—turning standardization into tangible cost savings and competitive advantage.

It is also the starting point for a successful implementation of the so-called 'Digital Twin' and the creation of the first steps integrating Industrial Artificial Intelligence (IAI) models based on the usage of existing knowledge in its digital format.

After three successful implementations of this innovative digital platform, here is a list of outstanding benefits confirmed by our customers:

### Error Elimination

- Reduces manual data entry errors by 60–80%.
- Eliminates standard interpretation discrepancies.
- Automatic validation of order completeness and feasibility.

### Cycle Time Compression

- Order dressing that once took 2 weeks can be completed in under 1-2 hours (sometimes it takes minutes).
- Reduced queue time in engineering departments.
- Faster response to customer inquiries and modifications.

### Resource Optimization

- Enables quality and engineering focus on process improvement and innovation.
- Reduces dependency on senior subject matter experts for routine tasks.

**Standardization Achievements**

- Uniform interpretation of EN, ASTM, and ISO across all sites.
- Consistent application of customer-specific requirements.
- Standardized documentation and reporting formats.

**Audit Readiness**

- Full traceability for internal and external inspections.
- Automated compliance verification against multiple standards (multi-quality requests).
- Reduced audit preparation time.

**Non-Conformance Reduction**

- Outdated rule usage is automatically prevented.
- Real-time validation of production parameters.
- Proactive identification of potential quality issues.

**Market Responsiveness**

- Rapid deployment of new product specifications across global sites.
- Faster time-to-market for new product variants.
- Enhanced ability to respond to regulatory changes.

**Scalability Benefits**

- Onboarding new plants with consistent rule application in 2-3 months instead of years.
- Reduced training requirements for new engineering staff.
- Standardized processes enable easier technology transfer.

**Cost Control**

- Scrap and rework costs reduced through consistent production logic.
- Reduced engineering overhead through automation.
- Improved yield through optimized process parameters.

The transformation from fragmented, manual processes to unified, intelligent systems is not merely a technological upgrade—it represents a fundamental shift in how manufacturing knowledge is captured, shared, and applied across global operations. The future belongs to organizations that can effectively harness their collective expertise through intelligent platforms that enable both global consistency and local adaptability.

**IMPLEMENTATION AND DEPLOYMENT STRATEGY**

Deployment begins by migrating core standards and process rules into the global repository, curated by corporate experts. Plants are subscribed to the global repository and then create their concrete instance by linking the global standards (e.g., API 5L) to local melt grades and adding site-specific parameters (e.g., max coil weight, sample taking details). A sequence of recommended actions for a successful deployment strategy are:

- Data consolidation and Harmonization
- Pilot implementation
- Multi-site rollout
- Optimization and Continuous improvement

Governance is critical: corporate controls global objects, plants own local extensions, and automated sync alerts (Green/Yellow/Orange statuses) enforce update discipline. Bi-weekly global releases and compliance audits sustain the system, transforming fragmented sites into a synchronized production network within 6-9 months.

Finally yet importantly, Change Management is key for a successful implementation of the digital platform, since it requires discipline through visibility and accountability from top management and core business areas (Quality, Engineering, Processes, and Supply Chain) ensuring organizational and technical readiness, subject matter experts involvement, comprehensive training and user adoption.

## CONCLUSION

The global metals industry stands at a critical juncture where traditional approaches to order processing and quality management are no longer sufficient to meet the demands of modern manufacturing. The Global-Local Order Dressing platform represents a paradigm shift from reactive, manual processes to proactive, intelligent systems that leverage decades of accumulated expertise.

### Key Strategic Advantages:

- Operational Excellence: Dramatic reduction in processing time and error rates while improving resource utilization
- Quality Assurance: Consistent application of standards and requirements across global operations
- Regulatory Compliance: Automated validation and documentation for audit readiness
- Strategic Agility: Rapid response to market changes and new product requirements
- Scalable Growth: Framework for efficient expansion and knowledge transfer

### Implementation Success Factors:

- Strong executive sponsorship and clear strategic vision
- Comprehensive change management and user adoption strategies
- Phased deployment with pilot validation and continuous improvement
- Integration with existing systems and processes
- Long-term commitment to platform evolution and optimization

The companies that successfully implement manufacturing intelligence platforms will establish sustainable competitive advantages in efficiency, quality, and time-to-market responsiveness. Those that continue to rely on traditional approaches will find themselves increasingly disadvantaged in a rapidly evolving global marketplace.

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