3 Levers That Manufacturing CIOs Must Pull to Improve and Sustain Data Quality

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Initiatives: Manufacturing General IT Initiatives

Despite increased investment by manufacturers in data analytics and business intelligence solutions, poor data quality continues to drag down the value generated from these initiatives. CIOs must empower people, establish processes and adopt technologies that accelerate data quality improvement.

Overview

Key Findings

- Data in manufacturing organizations is often stored and maintained in silos/multiple systems with significant overlaps, gaps or inconsistency. This makes it difficult to establish or scale the value of data in their organizations.

- While high-quality and trustworthy data is prerequisite to achieving success in any digital initiative, manufacturers struggle to take a pragmatic approach toward data quality (DQ) improvement.

- Majority of manufacturers adopt a technology-centric approach to DQ improvement, with little focus on organizational culture, people and processes, and hence, fail to generate expected results.

Recommendations

Manufacturing CIOs seeking to improve data quality in their organizations must:

- Engage people and empower data stewards through data governance initiatives to drive a culture of data quality by fostering a dedicated data quality management team. This team is responsible for defining data stewardship and continuous skills development.

- Define a process that outlines standards, data governance policies and guidelines to ensure adherence to data quality guidelines by creating business rules and standardized key performance indicators for managing workflows and progression.

- Leverage data quality tools for profiling data, identifying data anomalies or issues, and taking corrective actions to improve data quality.

Strategic Planning Assumption

By 2025, at least 40% of manufacturers will adopt modern DQ solutions to better support their digital business initiatives.

Introduction

Manufacturers generate vast amounts of data from information technology (IT), operational technology (OT) and engineering technology (ET) systems across their value chain and activities. As products, processes and customer journeys become increasingly complex, they need validated, trusted and high-quality data to make reliable decisions and improve probability of success in their digital initiatives. However, they rate inconsistency in data stored across sources as the most challenging DQ problem according to the 2022 Gartner Digital Decision Making Survey. If they are not connected, data standardization becomes much harder. This research highlights three key levers, people, process and technology, that when pulled together will improve data quality (see Figure 1).

Figure 1: Three Levers to Improve and Sustain Data Quality in Manufacturing

Three Levers to Improve and Sustain Data Quality in Manufacturing
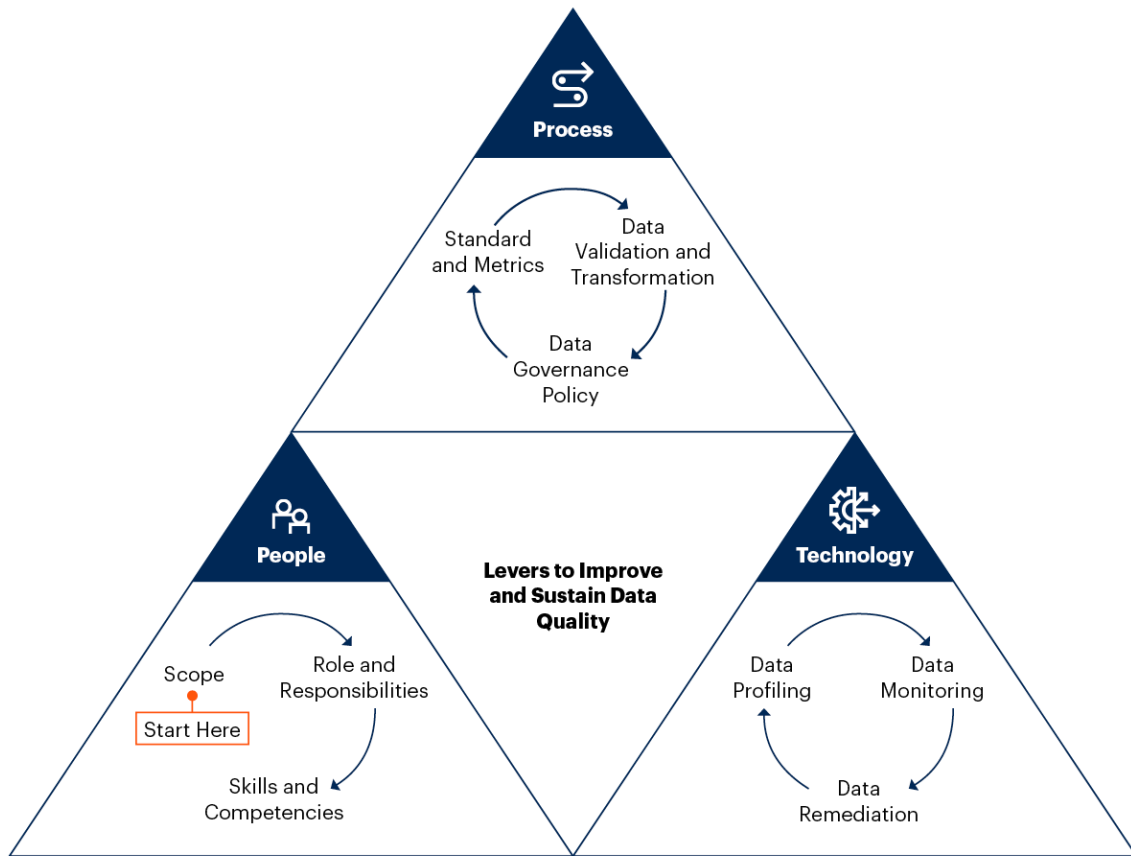
Source: Gartner
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However, it is important to understand that data quality improvement is not a big-bang implementation approach, but rather a continuous process that involves measuring and monitoring the improvements. Therefore, people, process and technology need to be fine-tuned to varying degrees in a continuous loop to sustain data quality improvements. To learn more about challenges and implications related to data quality, please refer to Navigate the Maze of Data Quality Challenges in Manufacturing (Presentation Materials).

Analysis

Foster Shared Data Quality Ownership Among Stakeholders

Manufacturing is a people business and data quality is a team sport where everyone plays a part (see Table 1). However, a lack of proper ownership means that it is everyone's job and nobody's responsibility. While DQ improvement is an IT-led effort, it needs collaborative efforts from business stakeholders. Therefore, make people, from lines of business as well as IT, care about data quality. Distinguish their role based on formal and content-related data quality, for example, data formats and integrity rules are more formal (usually IT organization), while validation rules of certain attributes are content related (line of business functions). However, even with defined roadmap and policies, CIOs often struggle with the challenge of operationalizing them. They must identify a team of data stewards/champions who have strong functional knowledge (often subject matter experts [SMEs]), can identify data-related challenges, enforce policies, and act as a bridge between functional leaders and corporate teams. See Note 1 for more detail on the role of a data steward.

Table 1: Lever 1: People

(Enlarged table in Appendix)

Action required	How to do it	Benefit
Define scope and business value of data	■ Engage business stakeholders to define, agree and prioritize expected business outcomes. For example, organizations could start with data related to product innovation, customer experience or cost optimization. Or start with metrics that maybe impact new technology implementation like IoT or generative AI (GenAI). ■ Develop the boundaries of the program, project or product and its method of implementation in agreement with stakeholders.	■ Specification of decision rights and an accountability framework to ensure the appropriate behavior in the valuation, creation, consumption and control of data.
Define roles and responsibilities	Use Toolkit: Create a RACI Matrix for the Data and Analytics Governance Office to benchmark current state against the desired future state. ■ Assign data custodians (within each business function) and accountability responsibility for selected data quality dimensions to focus on. ■ Establish a systematic DQ monitoring process. Schedule periodic DQ checks, and define the responsibilities of individuals or teams involved in the monitoring process.	■ Map stakeholders based on their role and designated accountability. ■ Improve communication, identification of issues and issue resolution.
Foster skills and competencies	■ Foster an in-house data literacy program to establish a common culture and data language across business functions. ■ Spot and incentivize internal "local" data stewards through periodic knowledge assessments (see Toolkit: Data and Analytics Governance Role Descriptions). ■ Establish a feedback loop where data stewards coach their local teams and report common barriers to be addressed to IT (see A Day in the Life of a Data and Analytics Steward).	■ Reduce burden on central data and analytics teams by developing analytics talent across organizations. ■ Sensitize all stakeholders and not only those who have technical or D&A skills.

Source: Gartner (August 2023)

Colgate-Palmolive, a global consumer goods manufacturer, started with people and has created:

- **Analytics Enablement Team** that executed a talent strategy by combining executive engagement (periodic newsletter, expert session and talk shows) and community outreach (nearly 680 active community participants), training (starting with 300 senior leaders, expanding to 1,000, and 90% completion rate) and ongoing user support.

- **Analytics Catalyst Team** composed of individuals residing in divisions or regions, who are committing part of their time (approx. 20% of their time) to coach and support their organization's specific analytics needs.

This resulted in improved productivity in obsolete inventory management, generated proactive alerts and workflows to manage supply chain disruption due to weather, and reduced unplanned downtimes due to manual errors in product transition. For more details, see Case Study: A 360-Degree Approach to Develop Talent and Accelerate Analytics Culture.

Establish a Sustainable Process

This is essentially the business context in which decisions are to be taken (see Table 2). What are the dependencies? For example, data related to product innovation in a digital product life cycle management (PLM) ecosystem is not only generated and shared across multiple connected applications, but also with external stakeholders. Therefore, it is imperative to learn and control where it is generated, harmonized, retained, used and by whom.

Table 2: Lever 2: Process

(Enlarged table in Appendix)

Action required	How to do it	Benefit
Define a current state data architecture	- Engage the enterprise architecture and external partner to create a process and data map of all the enterprise systems. - Define or prescribe what is the leading system for what type of data and in which additional system(s) data can be updated, referenced or used. Also include an authorization concept that should define what role is allowed to create, update, enhance or view certain types of data. - Use data maps to identify critical data assets that have a direct linkage to organizational digital initiatives and priorities. You can also compare yourself to industry standards (see Infographic: IT Score for D&A Benchmarks for Manufacturing).	- Establish a mutually agreed baseline for measurements. - Assist in data validation and transformation rules discussed later.
Establish standard and metrics	- Organize a list of existing DQ standards (where they exist), including information about how they are used and by whom. - Identify gaps in these standards by applying regulatory/compliance requirements and business priorities/objectives. Establish a definition of "what good looks like" or required levels of "fitness." - Set thresholds (or acceptable ranges) and targets (or benchmarks) for each DQ metric. While thresholds define acceptance level, targets drive continuous improvement.	- Establish a picture of success and enable consistent measurement and reporting. - Common language understood by all stakeholders.
Establish data validation and transformation rules	- Design, create and deploy business rules for specific data values. For example, how similar data (like customer information) from multiple systems (like CRM, ERP, supply chain management [SCM] applications, etc.) would be combined and validated. - Build flexibility in data architecture to accommodate new data sources and changes in requirements related to data ingestion, processing and storage. For example, when industrial IoT or other sensors are added to existing assets or regulatory requirements change like General Data Protection Regulation (GDPR). Or add a quick reference guide (QRG) that details the process of creating and modifying certain records, for example, workflow for new SKU creation or existing SKU modification.	- Traceability of raw data source and its guardian throughout its life cycle. This makes it easier to relate data models and derived values back to origins in case of data loss, change of business context or addition of new data. - Quicker root cause analysis and resolution of DQ issues.
Focus on governance	- Identify regulatory/compliance standards, privacy/security and required workflows impacting your organization. - Set a priority list based on the business outcomes and risk severity for each of the critical data assets identified earlier. Decide which policy types must be applied to those assets. - Publish periodic reports on DQ metrics, Conduct and publish periodic audits reports and performance reports on DQ metrics. Use Tool: Playbook for Effective Data Governance to kick-start/boost effectiveness in your data governance program.	- Measurement of organizations' digital dexterity, data literacy and overall data maturity. - Refine DQ improvement roadmap based on the output. - Hierarchy or relationships between the DQ dimensions to establish a framework for organizing and contextualizing the data.

Source: Gartner (August 2023)

Roche, applied findable, accessible, interoperable and reusable (FAIR) data principles to define the data requirement and make data easily understandable, measurable and applicable to different process owners across the business. These principles allowed Roche to standardize data requirements, consolidate data across the function and easily evaluate whether the data is analysis ready. For more details, see Case Study: Future-Focused Quality Data Management.

Deploy Technology That Augments People and Automate Processes

Manufacturers manage a complex web of IT, OT and ET technologies and other sources (equipment, sensors, processes and transactions) that often have siloed data in multiple formats and structure (often unstructured or semistructured) (see Table 3). This complexity for one makes manual processes insufficient to handle vast amounts of data and, secondly, limits an organization's ability to scale their approach in any meaningful way. According to the 2022 Gartner Data and Analytics for Digital Transformation Survey, integrating multiple data sources is the biggest challenge (39%) manufacturers face in data and analytics transformation projects. This is followed by finding the right technology architecture (37%) and scaling initiatives beyond project stages (21%). For more details, see What Manufacturing CIOs Must Do to Overcome D&A Challenges. DQ tools help automate improvements and must be preferred over manual methods.

Table 3: Lever 3: Technology

(Enlarged table in Appendix)

Action required	How to do it	Benefit

Data profiling	• Select a relevant data profiling tool that augments/automates your capability to:
	  • Data discovery and cataloging based on data maps created earlier.
	  • Determine data characteristics and variability based on attributes like types, ranges and distribution
	  • Evaluate data structure/schema by using data dictionaries/documentation and data relationships.
	  • Detect potential data issues/anomalies by identifying outliers, duplicates or inconsistencies.
	• Effectively collect, discover or import metadata for data curation. Use capability to match, link and merge related data entries within or across diverse datasets.
		• Automated insights on DQ for improved data cleansing, standardization and its transformation before integration.
		• Formulate effective strategies for DQ enhancement and governance.
		• Improves data observability — an extension of augmented data management combining features from augmented data quality, active metadata and DataOps. For more details, see Data and Analytics Essentials: Data Observability.

Continuous DQ monitoring	• Configure automated DQ checks based on preconfigured, custom-made monitoring rules, or adaptive rules, and alert violations. Previously defined targets and thresholds, prepopulated fields with default values, and workflows that dynamically fill certain fields based on certain business context will be used for this purpose. • Define and deploy business-context-specific rules for specific data values and overall data validation. These rules can be embedded either in DQ monitoring tools or in third-party applications. • Automate reporting and review results to identify trends, patterns or anomalies that provide key insights on data health. Maintain these monitoring dashboard, log files or audit trail for compliance requirements.	• Rapidly identify, quarantine, assign, escalate and resolve DQ issues within specific contexts. For more details, see The State of Data Quality Solutions: Augment, Automate and Simplify. • Improves communication, transparency, pervasive monitoring and effective case management (see Magic Quadrant for Data Quality Solutions).
Data remediation	• Prioritize root cause analysis of DQ issues, reported earlier, based on severity of its impact on business outcomes. • Start from data origin, collection process, transformation/integration processes or data entry methods to identify the sources of errors or data inconsistencies and course of action. This may involve tools and rules related to data cleansing, data standardization, data enrichment or data integration processes. If required, correct the data maps. • Document the entire process and monitor the impact of changes for a selected time duration to avoid recurrence or take swift actions in case similar issues are identified elsewhere.	• Easily rectify DQ problems. • Bring the data into compliance with predefined DQ standards or business requirements.

Source: Gartner (August 2023)

Evidence

2022 Gartner Data and Analytics for Digital Transformation Survey: This survey sought to provide industry-level insight and to find out how organizations use data and analytics and how they relate to digital success. The research was conducted online from 2 September through 13 October 2022. In total, 311 respondents were interviewed across six industries — banking, insurance, healthcare, manufacturing, telecom and transportation. Respondents were required to be primary decision makers or have a high level of influence on their organizations' or business units' data and analytics investments. Disclaimer: Results of this survey do not represent global findings or the market as a whole, but reflect the sentiments of the respondents and companies surveyed.

2022 Gartner Digital Decision Making Survey: This survey was conducted online between November through December 2022, with 287 completed responses from strategy leaders and business partners detailing their perceptions on emerging technologies used in strategy function. This research focused on different technologies, their future value and adoption stage used by strategy function. Data and background were pulled from secondary literature review as well as primary research among heads of strategy and their teams. Disclaimer: Results of this survey do not represent global findings or the market as a whole, but reflect the sentiments of the respondents and companies surveyed.

Note 1: Data Stewards

The data (or information) steward role is focused on the enforcement of data and analytics governance policies created by the data and analytics governance board. In effect, the steward is responsible for implementing data and analytics governance policies and monitoring information assets and people against those policies. When deviations from policy are detected and not resolved through automated means, the steward is the focal point for issue resolution.

Data stewards are the power users in the business — the visible, action-oriented engine of a data and analytics governance effort. Data stewardship is ideally a business role and is the primary point of responsibility, accountability and activity for the assessment, improvement and ongoing fitness for purpose and overall conformance with our critical data asset policies.

Recommended by the Author

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Data and Analytics Essentials: Data Quality

Case Study: A 360-Degree Approach to Develop Talent and Accelerate Analytics Culture

Data and Analytics Essentials: Data Observability

The State of Data Quality Solutions: Augment, Automate and Simplify

Tool: Playbook for Effective Data Governance

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responsibilities of individuals or teams involved in the monitoring process.

| Foster skills and competencies | Foster an in-house data literacy program to establish a common culture and data language across business functions. Spot and incentivize internal "local" data stewards through periodic knowledge assessments (see Toolkit: Data and Analytics Governance Role Descriptions). Establish a feedback loop where data stewards coach their local teams and report common barriers to be addressed to IT (see A Day in the Life of a Data and Analytics Steward). | Reduce burden on central data and analytics teams by developing analytics talent across organizations. Sensitize all stakeholders and not only those who have technical or D&A skills. |

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- Identify gaps in these standards by applying regulatory/compliance requirements and business priorities/objectives. Establish a definition of "what good looks like" or required levels of "fitness."

- Set thresholds (or acceptable ranges) and targets (or benchmarks) for each DQ metric. While thresholds define acceptance level, targets drive continuous improvement.

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• Build flexibility in data architecture to accommodate new data sources and changes in requirements related to data ingestion, processing and storage. For example, when industrial IoT or other sensors are added to existing assets or regulatory requirements change like General Data Protection Regulation (GDPR). Or add a quick reference guide (QRG) that details the process of creating and modifying certain records, for example, | • Traceability of raw data source and its guardian throughout its life cycle. This makes it easier to relate data models and derived values back to origins in case of data loss, change of business context or addition of new data.

• Quicker root cause analysis and resolution of DQ issues. |

	workflow for new SKU creation or existing SKU modification.	
Focus on governance	■ Identify regulatory/compliance standards, privacy/security and required workflows impacting your organization. ■ Set a priority list based on the business outcomes and risk severity for each of the critical data assets identified earlier. Decide which policy types must be applied to those assets. ■ Publish periodic reports on DQ metrics, Conduct and publish periodic audits reports and performance reports on DQ metrics. Use Tool: Playbook for Effective Data Governance to kick-start/boost effectiveness in your data governance program.	■ Measurement of organizations' digital dexterity, data literacy and overall data maturity. ■ Refine DQ improvement roadmap based on the output. ■ Hierarchy or relationships between the DQ dimensions to establish a framework for organizing and contextualizing the data.

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Continuous DQ monitoring	▪ Configure automated DQ checks based on	▪ Rapidly identify, quarantine, assign, escalate

preconfigured, custom-made monitoring rules, or adaptive rules, and alert violations. Previously defined targets and thresholds, prepopulated fields with default values, and workflows that dynamically fill certain fields based on certain business context will be used for this purpose.

■ Define and deploy business-context-specific rules for specific data values and overall data validation. These rules can be embedded either in DQ monitoring tools or in third-party applications.

■ Automate reporting and review results to identify trends, patterns or anomalies that provide key insights on data health. Maintain these monitoring dashboard, log files or audit trail for compliance requirements.

and resolve DQ issues within specific contexts. For more details, see The State of Data Quality Solutions: Augment, Automate and Simplify.

■ Improves communication, transparency, pervasive monitoring and effective case management (see Magic Quadrant for Data Quality Solutions).

| Data remediation | ■ Prioritize root cause analysis of DQ issues, reported earlier, based on severity of its impact on business outcomes.

■ Start from data origin, collection process, transformation/integration processes or data entry methods to identify the sources of errors or data inconsistencies and course of action. This may involve tools and rules related to data | ■ Easily rectify DQ problems.

■ Bring the data into compliance with predefined DQ standards or business requirements. |

cleansing, data standardization, data enrichment or data integration processes. If required, correct the data maps.

- Document the entire process and monitor the impact of changes for a selected time duration to avoid recurrence or take swift actions in case similar issues are identified elsewhere.

Source: Gartner (August 2023)

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