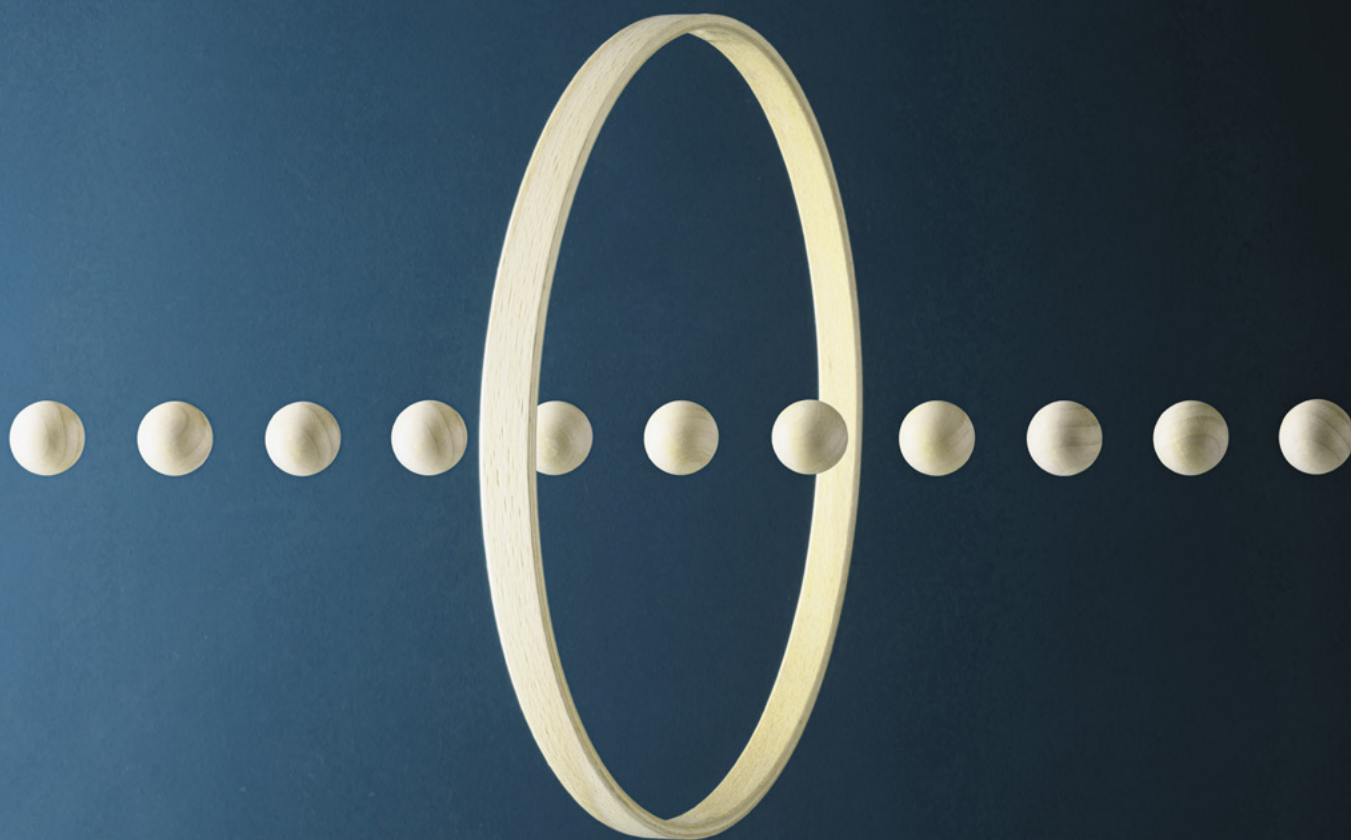


Operations Practice

Transforming quality and warranty through advanced analytics

Industrial companies are leveraging advanced analytics, through artificial intelligence and machine learning, to drive quality and warranty transformations to the next level.

This article was a collaborative effort by Phil Duncan, Paul Hackert, Mark Huntington, David Liang, and Evgeniya Makarova.



For companies seeking to improve financial performance and customer satisfaction, the quickest route to success is often a product-quality transformation that focuses on reducing warranty costs. Quality problems can be found across all industries, and even the best companies can have weak spots in their quality systems. These problems can lead to accidents, failures, or product recalls that harm the company's reputation. They also create the need for prevention measures that increase the total cost of quality. The ultimate outcomes are often poor customer satisfaction that decreases top-line growth, and additional costs that damage bottom-line profitability.

The value at stake is significant. In advanced industries—such as automotive and assembly, advanced electronics, semiconductors, and appliances—annual warranty costs can be as high as 5 percent of product revenues, with an average of 2 to 3 percent. Most of that figure weighs directly on net margins. How well a company addresses quality and warranty costs and processes is therefore critical to its overall business performance.

To transform quality and warranty, leading industrial companies are combining traditional tools with the latest in artificial-intelligence (AI) and machine-learning (ML) techniques. The combined approach allows these manufacturers to reduce the total cost of quality, ensure that their products perform, and improve customer expectations. The impact of a well-designed and rigorously executed transformation thus extends beyond cost reduction to include higher profits and revenues as well.

The challenges of capturing and sustaining value in quality

Pressure on the cost of quality is intensifying as the integration of software and hardware increases product complexity. Additionally, customer expectations about product features continue to rise, with bad news about a product amplifying quickly in a hyperconnected world.

Yet even as the pressure increases, the effectiveness of traditional approaches to solve

quality issues (such as “5-why” and Pareto analyses) is decreasing. There are several reasons.

- *Quality issues are becoming more complex.* Today's products have more electronics, software, and complex system integrations. As a result, expertise from a wider range of disciplines is required to diagnose and resolve quality issues.
- *The types of quality issues have proliferated.* The greater number of product customizations and tailored configurations is causing products to fail in unique ways.
- *Intermittent and unpredictable failures have become more common.* The increased integration of electronics and software has made new failure patterns difficult to identify and analyze.
- *Traditional verification and validation (V&V) methods are too slow.* Companies are under pressure to go to market faster, but their traditional processes have not kept pace.
- *The rapid evolution of the Internet of Things and connectivity is making vast quantities of rich, new, and multifaceted data available.* Troves of data are now available to solve quality problems—but few quality teams have the right tools to access, analyze, and leverage the information to generate real insights.

Given these complexities, prepackaged solutions rarely work. Moreover, even when off-the-shelf solutions prove effective in limited contexts, companies typically struggle to scale them across product lines—and may find that their utility declines with successive product releases.

New techniques yield tangible benefits

Augmenting traditional tools with AI and ML techniques allows industrial companies to capture a number of measurable benefits.

Lower costs. Companies have reduced the total cost of quality—and, by generating fewer claims,

have captured a significant portion (often up to 30 percent) of warranty costs. This breakthrough can drive sizable margin improvements in the near term and often 2% to 5% of revenue in the longer term.

Higher reliability. Identifying and mitigating issues and risks earlier and faster ensures that customers see fewer unplanned downtime events and shorter planned downtimes.

Improved reputation. Over time, improving customers' brand perception with high-performing products can increase share of wallet.

Seamless customer experience. Reducing the multiple handoffs, disputes, and resolution steps inherent in claims (whether between functions within a single company or across tiers of suppliers) results in a better end-to-end experience.

Better products. Enhancing root-cause problem solving and codifying lessons learned in the end-to-end warranty process can help product

development teams design better products going forward.

Together, these benefits result in improved financial impact through lower warranty expenses, reduced operating costs, and increased revenue (Exhibit 1).

Traditional approaches provide the foundation

Several traditional quality-improvement approaches are nevertheless a prerequisite for companies looking to transform their product-quality practices. These approaches provide a basic set of tools to solve a wide range of quality issues—and capture significant value when complemented with AI and ML techniques.

Build a comprehensive data set and categorize root causes.

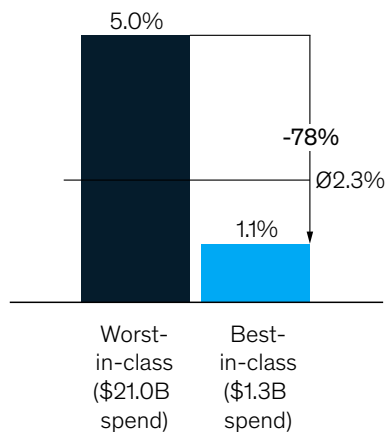
By categorizing causes into design, supplier, manufacturing, and other issues (such as distribution and installation), a company can assign appropriate teams and apply the right approaches to address each cause.

Exhibit 1

Warranty transformations deliver financial impact through 3 levers.

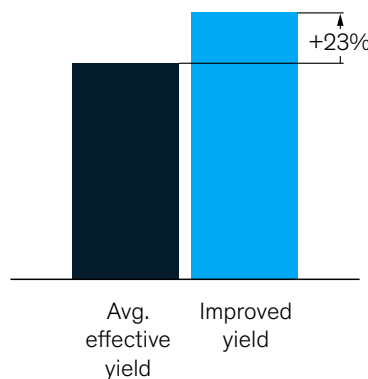
1 Lower warranty expenses

Automotive case example: Opportunity to increase EBITDA by 1-4%



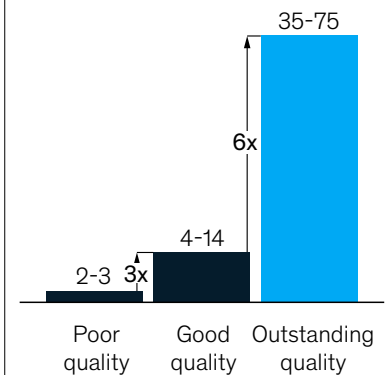
2 Reduced operating costs

Metals case example: Opportunity to increase ROIC by 15-30%



3 Increased revenue

Automotive case example: Opportunity to increase likelihood of repeat buyers by up to 18X



Source: McKinsey

Transform warranty sharing and supplier accountability. To ensure that suppliers share responsibility for claims, a company can consider adding new terms and conditions in supplier contracts, and aligning incentives accordingly. A company can also be prepared to run recovery sprints when negotiating about how to address supplier-caused issues. These actions help companies recover a fair share of costs from the suppliers that cause the issues (Exhibit 2).

Implement robust root-cause analysis. These analyses allow a company to identify and address the true root causes behind quality issues, and simultaneously build the capabilities of quality-improvement teams.

Enhance performance management. A company can create visibility around warranty data by closely tracking quality-improvement progress through cascaded KPIs (such as time to identify and time to fix), visual dashboards, and performance meetings.

Manage cross-functional collaboration with senior leadership support. Collaboration is essential to change mind-sets and behaviors, such as thinking that warranty cost cannot be managed due to

difficulties in identifying root causes, interpreting old claims, or analyzing duty cycles. It is also helpful to facilitate cultural changes within the organization that promote a more quality-focused mind-set.

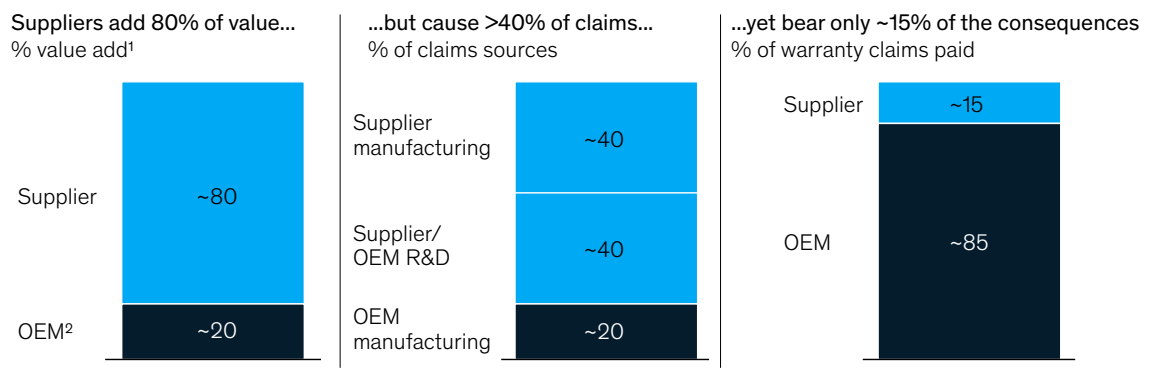
AI and ML can help capture, scale, and sustain value

A company can use new AI and ML techniques to enhance these traditional approaches, address the increased complexity of quality issues, and capture additional value. Five levers, in particular, can enable step changes in quality cost performance:

- *Create AI models to identify micro trends* (such as similar root-cause issues), enabling teams to identify quality issues many months before they turn into claims and affect customers.
- *Build digital workflows and a quality-issue tracking system* to accelerate supplier recovery, prevent recurrence of issues, measure fix effectiveness, and track corrective actions.
- *Use ML-based predictive analytics to prioritize quality problems* based on projected customer and internal impact, to focus remediation efforts and capacity on the most important issues.

Exhibit 2

Companies can recover a fair share of quality costs from suppliers.



There is typically a ~10% warranty cost-reduction opportunity from aligning responsibilities and cost sharing, and an additional ~10% warranty cost-reduction opportunity from improved collaboration

¹Sales revenue, less cost of purchases of inputs and supplies (operating expenditures) required for production

²Original-equipment manufacturer

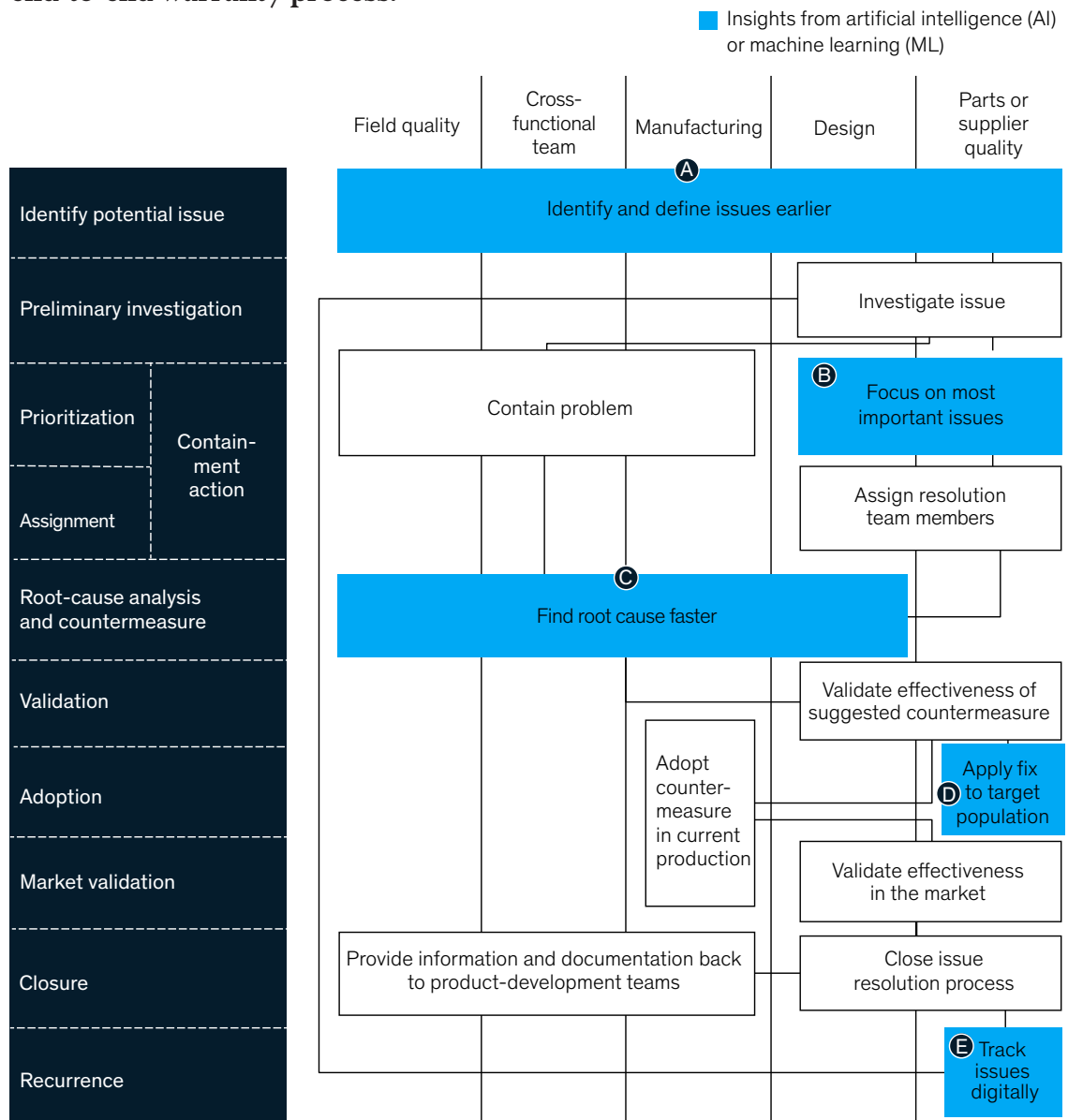
Source: IHS Economics; McKinsey analysis

- Leverage ML-/AI-based causal models to accelerate root-cause problem solving, particularly for uncommon or intermittent quality issues.
- Use unsupervised ML to identify products likely to fail, allowing companies to fix only targeted populations (that is, groups of products that are made or used in a specific way) and reduce the number of required field actions.

Scaling and sustaining value capture is more likely when a company fully integrates its solutions into its quality processes so that they are adopted by end users (Exhibit 3). Additionally, the most successful companies generally focus on building internal capabilities, not just solutions, so that insights can evolve with each new-product release.

Exhibit 3

It's important to integrate artificial intelligence and machine learning into the end-to-end warranty process.



Putting advanced analytics into action

Some companies have already begun to leverage advanced analytics to capture value in their businesses. In one example, an agricultural original-equipment manufacturer (OEM) with a global footprint for R&D, manufacturing, and sales had experienced significant increases in warranty costs associated with new-product launches. It also suffered from long lead times for field-issue identification, as well as variable product maturity across brands and regions.

Within four months, the company was able to deploy an advanced-analytics engine that provides daily updates from quality sensors and automated statistical analyses. The automated analytics engine and alarm-generation functions are backed by leading indicators, expert knowledge, and performance management. Big data—generated from hundreds of thousands of warranty claims, more than 5,000 parts, and several years of field data—is fed into the cloud server on a daily basis. The company has used these advanced-analytics tools and capabilities to reduce the time to identify systemic field issues by nearly half, and warranty costs by approximately 15 percent. It plans to expand the application of the tools and capabilities to more than three-quarters of its product portfolio within the next few years.

In similar fashion, an automotive manufacturer used advanced analytics to refine the entire product-development journey, while improving right-first-time performance and reducing warranty costs. Faced with a high incidence of rework and delays in parts development, the company experienced a significant number of warranty claims and increasing program costs.

Over the course of three months, the company launched a comprehensive effort to identify all potential sources of delays and designed targeted initiatives to address each cause. These initiatives included enforcing stricter rules for process adherence to facilitate virtual builds (simulations and models that are virtual versions of the product), systematically understanding how changes in one

part affect other parts, and building advanced-analytics algorithms to inform product development. To train the algorithms and understand interactions, the company used more than three years of historical data from its product-development programs, supplemented by dozens of additional data sources covering more than 1,000 individual components. The application of advanced analytics enabled the company to raise right-first-time performance for new-parts development to more than 80 percent.

These examples showcase how companies can use AI and ML levers to unlock significant value in quality and warranty processes. They also demonstrate that companies can launch tactical initiatives in a matter of months. Although it may take a few years for warranty-related improvements to scale up their financial impact, these initiatives show that even near-term benefits can be compelling enough to justify investments in AI- and ML-driven improvements.

How to get started

Applying AI and ML to transform quality and warranty processes requires an approach that is structured, data-driven, and systematic. Companies can take three steps to initiate a full end-to-end quality transformation informed by warranty considerations.

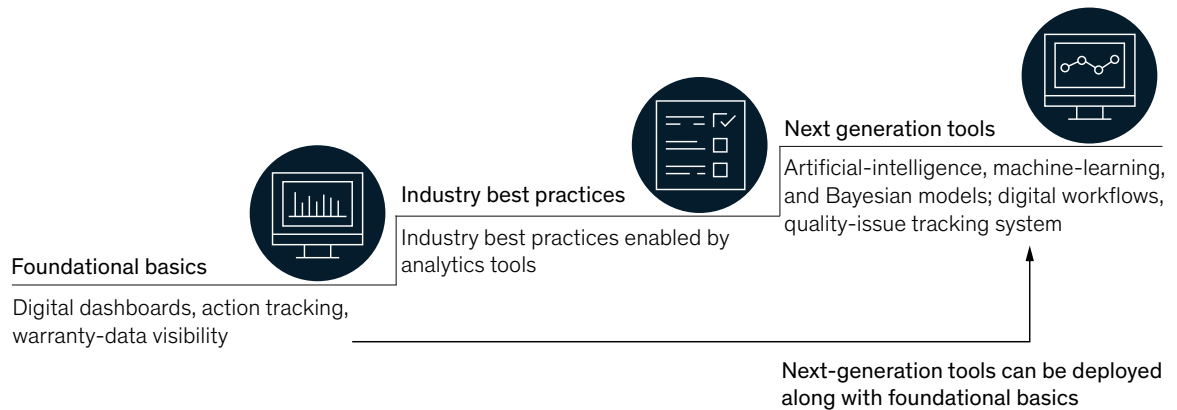
Assess current practices on the warranty maturity curve. Determine if the organization is effectively implementing foundational basics (for example, digital dashboards, action tracking, and warranty-data visibility), industry best practices (such as robust advanced-analytics software packages), or next-generation tools (AI/ML and Bayesian models, digital workflows, and quality-issue tracking systems) (Exhibit 4).

Determine the total impact potential. Assess the current baseline of warranty spending and compare it with benchmarks. This entails reviewing the models and tools currently in use, the total cost of quality and warranty-claim spending, cycle times for root-cause analysis and issue resolution, and opportunities to integrate AI/ML into existing quality processes.

Exhibit 4

Artificial-intelligence and machine-learning tools can be applied at any warranty-maturity level.

Example solutions for varying levels of warranty-management maturity



Build the implementation roadmap. Tailor a tactical implementation plan as needed to achieve the full potential based on the company's current status and its aspiration for the future. Assign teams with the appropriate expertise to implement the initiatives.

value to the bottom line, it is possible to see savings impact in as little as three months. By deploying these next-generation tools to complement traditional, foundational quality approaches, companies can unlock significant value, outperform financially relative to peers, and take quality and warranty performance to the next level—and drive customer satisfaction in the longer term.

Although companies typically need six to 18 months to execute a full-scale transformation and drive

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