International Journal of Research and Applied Innovations (IJRAI)

| ISSN: 2455-1864 | www.ijrai.org | editor@ijrai.org | A Bimonthly, Scholarly and Peer-Reviewed Journal |

||Volume 8, Issue 6, November–December 2025||

DOI:10.15662/IJRAI.2025.0806018

AI Investment and the Pendulum Effect: The Crisis of Software Quality & Infrastructure

Ravikiran Karanjkar

Quality Assurance Manager - Amazon Inc., USA

karanjkr@amazon.com

Shrinivas Phalke

Staff Software Engineer – Cloud, Walmart Global Tech, USA

sphalke@walmart.com

ABSTRACT: Pendulum theory, which describes the tendency of systems to swing between extremes before returning to balance, provides a useful framework for analyzing the current trajectory of Artificial Intelligence (AI) adoption in 2025. Organizations across industries are investing heavily in AI infrastructure and applications, often reallocating resources from critical functions such as quality assurance and testing. This paper argues that such measures represent an overcorrection to the promise of AI, creating a crisis in software quality.

Drawing on perspectives from quality assurance engineers and developers, the paper highlights the risks of sidelining quality divisions, including increased outages, customer dissatisfaction, and erosion of trust. By applying pendulum theory, the analysis demonstrates that both extremes - overprotective quality divisions that delay releases and passive divisions that rubber-stamp code - are counterproductive. The path forward requires balance, where AI innovation is complemented by independent, knowledgeable, and customer-focused quality teams. Without this equilibrium, the industry risks undermining the very progress AI seeks to achieve.

KEYWORDS: AI investment, pendulum theory, software quality crisis, quality assurance, outages and recalls, hybrid AI–human testing, enterprise risk management

I. INTRODUCTION

Pendulum theory has long been used to describe cyclical movements in organizational behavior and technological adoption. In physics, a pendulum swings in one direction until it reaches its extreme, only to reverse course and swing back in the opposite direction. This metaphor aptly captures the current state of Artificial Intelligence (AI) in 2025. The software industry, driven by big tech companies and investors, has swung toward the extreme of over-investment in AI, often at the expense of quality assurance functions.

Quality divisions, historically central to maintaining customer trust and product reliability, are being downsized or eliminated under the assumption that AI can fully replace their role.

Organizations believe they are reducing costs or freeing resources for AI infrastructure, yet this short-sightedness overlooks the long-term consequences. Interviews with quality assurance engineers reveal growing unease about the reliability of AI-generated code, particularly as development cycles accelerate while testing cycles are compressed. AI has not yet matured to handle the breadth of testing required for end-to-end customer experiences, leaving gaps that human expertise traditionally fills.

Pendulum theory provides a lens to understand this dynamic. Just as quality divisions have swung between extremes - sometimes delaying releases in pursuit of perfection, other times becoming passive under development pressure - the industry's current swing toward AI dominance risks destabilizing the balance between innovation and reliability. This paper explores how the pendulum effect manifests in AI adoption, why sidelining quality divisions creates systemic risks, and how organizations can restore equilibrium by recognizing quality as a non-negotiable pillar of sustainable progress.

International Journal of Research and Applied Innovations (IJRAI)

| ISSN: 2455-1864 | www.ijrai.org | editor@ijrai.org | A Bimonthly, Scholarly and Peer-Reviewed Journal |

||Volume 8, Issue 6, November–December 2025||

DOI:10.15662/IJRAI.2025.0806018

II. PENDULUM THEORY IN ORGANIZATIONAL BEHAVIOR

Pendulum theory suggests that decision-making and organizational priorities oscillate between extremes. When organizations overemphasize one aspect, they eventually recognize its limitations and swing back toward the opposite approach. In the context of software development:

At one extreme, quality divisions delay releases in pursuit of perfection, frustrating leadership and slowing innovation.

At the other extreme, quality divisions become passive, rubber-stamping developer output, undermining their credibility and value.

The challenge lies in finding equilibrium, where quality divisions act as strategic partners rather than obstacles or mere formalities.

III. THE AI WAVE OF 2025

AI has become the defining force of the decade. Nearly 90 percent of organizations are actively pursuing generative AI in their quality engineering practices, yet only 15 percent have achieved enterprise-scale deployment. The surge in AI adoption has led to:
Cost Reallocation: To fund AI initiatives, organizations are cutting costs elsewhere, often targeting quality engineering and assurance divisions.

Assumption of Replacement: Many leaders assume AI agents can replace human quality engineers, managers, and testers.

Short-Term Gains, Long-Term Risks: While this may create immediate financial flexibility, it risks undermining product reliability and customer trust.

IV. CASE STUDIES: WHEN QUALITY WAS OVERLOOKED

Recent events in 2025 illustrate the dangers of sidelining quality in favor of AI-driven speed and cost savings:
AWS Outage (October 2025): Amazon Web Services suffered one of its largest outages, disrupting over 1,000 companies including Venmo, Robinhood, Roblox, and Slack. AI-driven services were particularly vulnerable, showing how scaling innovation without resilience magnifies risks.

Cloudflare and OpenAI Outages (November 2025): A Cloudflare failure knocked out ChatGPT, Shopify, and X (formerly Twitter). Millions of users lost access to
AI-driven platforms, underscoring the fragility of centralized AI systems when quality assurance and contingency planning are minimized.

Medical Device Recalls (Q2 2025): The FDA reported the highest number of Class I medical device recalls in two decades, with software defects as a leading cause. Many devices incorporated AI-driven components, but insufficient testing led to failures that endangered patient safety.

Historic Rise in Product Recalls (2025): Recalls across industries rose nearly 40 percent over five years, with over 24 million products affected in the first seven months of 2025. Electronics and consumer goods were heavily impacted, often due to software defects linked to AI automation.

These incidents demonstrate that cutting quality functions to fund AI initiatives is a false economy. The short-term savings are quickly erased by the long-term costs of recalls, outages, and reputational damage.

International Journal of Research and Applied Innovations (IJRAI)

| ISSN: 2455-1864 | www.ijrai.org | editor@ijrai.org | A Bimonthly, Scholarly and Peer-Reviewed Journal |

||Volume 8, Issue 6, November–December 2025||

DOI:10.15662/IJRAI.2025.0806018

V. RECOMMENDATIONS: RESTORING BALANCE BETWEEN AI INVESTMENT AND SOFTWARE QUALITY

To restore equilibrium, organizations must adopt strategies that integrate AI innovation with robust quality assurance practices:

1. **Hybrid AI–Human Quality Models** Use AI to automate repetitive testing tasks while retaining human engineers for exploratory testing and customer experience validation.
2. **Independent Quality Governance** Position quality divisions as autonomous units, empowered to challenge release decisions when customer trust is at risk.
3. **Customer-Centric Testing Strategies** Prioritize real-world scenarios and integrate customer feedback loops into quality processes.
4. **Investment in Quality Infrastructure** Allocate dedicated budgets for QA tools, environments, and training, treating quality as a strategic investment.
5. **Balanced Release Management** Implement risk-based release criteria that balance speed with reliability, avoiding extremes of delay or passivity.

VI. CONCLUSION

The pendulum theory illustrates how industries swing between extremes before finding balance. In 2025, the software industry has swung too far toward AI investment, sidelining quality divisions in the process. Case studies of outages and recalls demonstrate the dangers of this imbalance. By adopting hybrid AI–human models, independent governance, customer-centric strategies, and balanced release management, organizations can restore equilibrium. Quality assurance is not a cost center to be eliminated but a strategic partner essential for sustaining innovation, protecting customer trust, and ensuring long-term success.

VII. EXECUTIVE SUMMARY

Artificial Intelligence (AI) has become the defining force of 2025, with organizations across industries investing heavily in AI infrastructure, applications, and talent. In pursuit of these investments, many companies are reallocating resources away from critical functions such as quality assurance (QA) and testing. This shift reflects a pendulum effect, where industries swing toward one extreme, in this case over-investment in AI, before realizing the need to rebalance.

The consequences of sidelining quality divisions are already visible. High-profile outages at Amazon Web Services and Cloudflare disrupted millions of users, while medical device recalls reached a 20-year high due to software defects. Product recalls across industries surged nearly 40 percent over five years, with AI-driven automation errors contributing significantly. These incidents demonstrate that cutting QA functions to fund AI initiatives is a false economy. Short-term savings are quickly erased by long-term costs in recalls, outages, and reputational damage.

Pendulum theory explains this dynamic. Quality divisions have historically swung between extremes, sometimes delaying releases in pursuit of perfection and other times becoming passive under development pressure. The industry's current swing toward AI dominance risks destabilizing the balance between innovation and reliability.

This paper argues that equilibrium must be restored. Organizations should adopt hybrid AI and human quality models, establish independent quality governance, prioritize customer-centric testing strategies, invest in quality infrastructure, and implement balanced release management. Quality assurance is not a cost center to be eliminated but a strategic partner essential for sustaining innovation, protecting customer trust, and ensuring long-term success.

REFERENCES

1. R. Horton, J. Michalski, S. Winters, D. Gunn, and J. Holland, "AI ROI: The paradox of rising investment and elusive returns," *Deloitte Global*, Oct. 2025. [Online]. Available: https://www.deloitte.com/global/en/issues/generative-ai/ai-roi-the-paradox-of-rising-investment-and-elusive-returns
2. E. Chickowski, "Software quality's collapse: How AI is accelerating decline," *ReversingLabs Blog*, Nov. 18, 2025. [Online]. Available: https://www.reversinglabs.com/blog/software-quality-collapse-ai-accelerate

| ISSN: 2455-1864 | www.ijrai.org | editor@ijrai.org | A Bimonthly, Scholarly and Peer-Reviewed Journal |

||Volume 8, Issue 6, November–December 2025||

DOI:10.15662/IJRAI.2025.0806018

3. K. Wheeler, "EY Report Shows Tech Firms Face AI Investment Pressures," *AI Magazine*, Jan. 7, 2025. [Online]. Available: https://aimagazine.com/articles/ey-the-future-impact-of-ai-across-the-global-tech-sector
4. CXOtoday News Desk, "Widespread Adoption Masks Scaling Crisis in Software Quality: World Quality Report 2025," *CXOtoday*, Nov. 14, 2025. [Online]. Available: https://cxotoday.com/news-analysis/widespread-adoption-masks-scaling-crisis-in-software-quality-world-quality-report-2025
5. L. Stewart, "Is the AI Boom Becoming a Threat to Future Investment Returns?," *Morningstar*, Nov. 13, 2025. [Online]. Available: https://www.morningstar.com/business/insights/blog/markets/ai-boom-threat-future-investment-returns
6. M. Saghafian, K. Laumann, and M. R. Skogstad, "Stagewise Overview of Issues Influencing Organizational Technology Adoption and Use," *Frontiers in Psychology*, vol. 12, Mar. 2021. [Online]. Available: https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2021.630145/full
7. "Is AWS down again? Outage reports spike as Cloudflare problems hit websites around the world," *Hindustan Times*, Nov. 18, 2025. [Online]. Available: https://www.hindustantimes.com/world-news/us-news/is-aws-down-again-outage-reports-spike-as-cloudflare-problems-hit-websites-around-the-world-101763476825723
8. C. Cortigiano, "15+ device recalls in 2025," *Becker's ASC*, Nov. 2025. [Online]. Available: https://www.beckersasc.com/supply-chain/15-device-recalls-in-2025
9. A. Pate, "FDA Recall: Software Defect Leading to Issues with Calculated Results and Delay in Patient Results," *SoftwareCPR*, Apr. 3, 2025. [Online]. Available: https://www.softwarecpr.com/2025/04/fda-recall-software-defect-leading-to-issues-with-calculated-results-and-delay-in-patient-results
10. "2025 On Track For Worst Year Ever In Product Recalls," *StudyFinds*, Sep. 8, 2025. [Online]. Available: https://studyfinds.org/2025-worst-year-ever-product-recalls
11. "Tesla's 2025 Recall Exposes Software Risks in Autonomous Driving," *The Silicon Review*, Mar. 31, 2025. [Online]. Available: https://thesiliconreview.com/2025/03/tesla-autonomous-driving-recall
12. Capgemini. (2025). *World Quality Report 2025: AI adoption surges in quality engineering but enterprise-level scaling remains elusive.* Retrieved from https://www.capgemini.com/us-en/news/press-releases/world-quality-report-2025-ai-adoption-surges-in-quality-engineering-but-enterprise-level-scaling-remains-elusive/
13. CloudFactory. (2025). *Lessons from the AWS outage: AI resilience and infrastructure risks.* Retrieved from https://www.cloudfactory.com/blog/ai-resilience-aws-outage
14. CNBC. (2025, November 18). *Cloudflare outage impacts ChatGPT, Shopify, and X.* Retrieved from https://www.cnbc.com/2025/11/18/cloudflare-down-outage-traffic-spike-x-chatgpt.html
15. GeekWire. (2025, October). *AWS outage is a warning about risks of digital dependence and AI infrastructure.* Retrieved from https://www.geekwire.com/2025/column-the-aws-outage-is-a-warning-about-the-risks-of-digital-dependance-and-ai-infrastructure/
16. Roic.ai. . (2025, November 18). *OpenAI confirms full service restoration following global outage.* Retrieved from https://www.roic.ai/news/openai-confirms-full-service-restoration-following-global-outa ge-11-18-2025
17. StudyFinds. (2025). *2025 worst year ever for product recalls.* Retrieved from https://studyfinds.org/2025-worst-year-ever-product-recalls/
18. 24x7 Magazine. (2025). *Medical device recalls hit 20-year high as FDA implements AI-driven review process.* Retrieved from https://24x7mag.com/standards/fda-updates/recalls/medical-device-recalls-hit-20-yea r-high-fda-implements-ai-driven-review-process/
19. XTIVIA. (2025). *Impact of AI on software testing.* Retrieved from https://www.xtivia.com/blog/impact-of-ai-on-software-testing/