

Big Data Analytics Empowering Supply Chain Risk Management: A Case Study of JD Logistics

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Abstract. Global supply chains are constantly hit by unpredictable disruptions, including extreme weather and transport congestion, rendering conventional experience-based risk management slow and passive. Lean TPS effectively reduces operational variations yet struggles with fragmented data and limited end-to-end visibility across logistics networks. Relevant empirical research on combining big data analytics and lean risk control within large domestic logistics providers still remains insufficient. This study examines how Big Data Analytics Capability (BDAC) can strengthen Lean/TPS-based risk governance in JD Logistics by improving end-to-end visibility, speeding detection, and enabling proactive, data-driven responses. Using JD Logistics as a focal case, this paper explores how technologies like JD Super Brain and digital twins translate Lean concepts—jidoka, standard work, and Kaizen—into scalable, real-time capabilities across regions and partners. The findings reveal that while BDAC enhances sensing and cadence, persistent gaps remain in emergency escalation, cross-regional handoffs, and learning diffusion. Durable resilience emerges when predictive analytics are tightly integrated with scenario-based standard work, unified data governance, and a network-wide Kaizen pipeline.

Keywords: BDAC, Lean/TPS, JD Logistics, Kaizen, End-to-End Visibility

1. Introduction

Global supply chains are increasingly exposed to disruption and variability, necessitating robust organizational capabilities beyond traditional, experience-based risk management. Lean/TPS provides a principled lens to examine how standardized processes, visual management, and Kaizen-driven improvement can elevate risk governance from reactive firefighting to proactive stabilization. By stressing flow efficiency, just-in-time coordination and continuous problem-solving, Lean offers a concrete mechanism to cut variability and expose deviations early, strengthening end-to-end visibility and execution reliability in multi-actor logistics networks [1]. Bdata analytics functions as an enabling infrastructure that translates lean principles into actionable oversight and rapid learning loops. When data integration, predictive analytics, and evidence-based decision-making are embedded within Lean routines, organizations can sense disturbances sooner, prioritize interventions and execute improvements with disciplined cadence [2].

JD Logistics is employed as a focal case to illustrate how data-informed Lean practices can scaffold agile responses while preserving standard work and continual improvement. This firm

leverages real-time routing adjustments and digital simulations to strengthen risk identification, triage, and recovery processes within a Lean governance context [3]. Therefore, this paper examines how Lean/TPS-based risk governance, augmented by big data analytics capability, can enhance resilience and operational performance in a digitally challenged corporate environment [4].

2. Big Data Analytics Capability as an enabling mechanism

2.1. Lean/TPS and the Toyota way as a risk governance lens

Lean management, rooted in the Toyota Production System (TPS), is a socio-technical operating system aimed at stabilizing flow and ensuring quality by eliminating waste and reducing process variability. Classical TPS highlights three sources of performance loss—muda (waste), mura (unevenness), and muri (overburden), suggesting that operational risk escalates when variability is hidden and abnormalities cannot be surfaced and escalated quickly [5]. TPS is commonly summed up by two pillars: Just-in-Time (JIT), which employs pull control to align production and logistics with actual demand, and Jidoka, which emphasizes built-in quality and rapid problem exposure [6]. In supply chain risk governance, these principles are operationalized through standardized work, visual management (e.g., kanban-like signaling), and Kaizen-based problem solving, which shorten detection-to-response cycles and institutionalize continuous learning [7].

In multi-actor logistics networks, the effectiveness of Lean/TPS is often constrained by limited end-to-end visibility and delayed feedback across organizational boundaries. Accordingly, Big Data Analytics Capability (BDAC) is conceptualized as the enabling mechanism that strengthens Lean's information and feedback infrastructure, transforming visual control, standard work, and Kaizen into a data-driven risk governance loop.

2.2. Big Data Analytics Capability as an enabling mechanism

BDAC functions as the essential enabling mechanism that translates Lean/TPS principles into a data-driven risk governance loop within a multi-actor logistics network. In a Lean regime, the core routines, which are perceived as waste, standardized work, and Kaizen-driven improvement, require timely and reliable information to trigger the right improvement actions at the right time. Data integration strengthens end-to-end visibility across suppliers, carriers, warehouses, and customers, supporting Lean's aim of straight-through processing and rapid escalation of deviations to the appropriate kanban-controlled workflows [5, 7]. Predictive analytics then supplies forward-looking signals that feed Lean's decision cadence, enabling preemptive adjustments such as reallocation of resources, dynamic routing, and agile capacity planning before disturbances propagate through the chain [8]. Finally, data-driven decision execution embeds analytics outputs into standard operating procedures, cross-functional routines, and governance mechanisms, ensuring that insights translate into concrete actions that sustain flow and minimize non-value-added steps [2]. When BDAC is integrated with Lean practices, the previously prescriptive Lean cycle (perceive, analyze, act, and sustain) becomes an evidence-based loop that continually tightens process stability and responsiveness to uncertainty [1]. In practice, the JD Logistics context provides concrete illustrations: BDAC-supported real-time routing and simulation-enabled contingency planning reinforce Lean's emphasis on standardization and continuous improvement while enabling rapid, data-driven adjustments in a complex, multi-partner network. This synthesis—Lean governance augmented by BDAC—yields improved sensing, faster triage, and more reliable execution, thus enhancing resilience and cost efficiency across the supply chain.

3. Case analysis: JD Logistics

In Lean/TPS governance, the framework is not abstract but actionable, enabling real-time coordination across JD Logistics' multi-region network. Implementing jidoka, kanban, standard work, and Kaizen requires three governance layers: strategic risk/compliance, operational real-time management, and a learning loop through AARs and Kaizen.

3.1. Lean/TPS-oriented risk governance: process design and control logic

In the context of JD Logistics, risk governance can be viewed as an operations system that aims to preserve stable flow, reduce variability, and surface abnormalities early—objectives that align with Lean/TPS logic. Under Lean, operational risk is not treated only as exogenous disruption. It is also viewed as an outcome of process instability and hidden deviations that accumulate into service failures. In this sense, the core managerial question becomes how logistics processes are designed to prevent muda (waste), reduce mura (unevenness), and avoid muri (overburden), while ensuring that deviations from standard work are quickly detected and escalated [5, 6]. As a large-scale logistics provider, JD Logistics operates across warehousing, line-haul transportation, and last-mile delivery, where flow continuity depends on synchronized capacity, reliable routing, and stable execution. According to JD Logistics' recent ESG reports, this Lean/TPS-oriented control logic is formalized through a multi-tiered governance structure, including board-level oversight and dedicated risk management committees. This structure emphasizes defining standard operating procedures for key workflows (sorting, loading, dispatching), implementing visual control and performance transparency to make abnormalities visible, and maintaining a structured improvement cycle where recurring deviations trigger standardized responses. In practice, this functions as a managerial "early-warning and containment" mechanism, ensuring risk policies are translated into daily frontline execution.

3.2. BDAC-enabled visibility and fast response: evidence of operational effectiveness

While Lean/TPS provides the governance logic, the execution of Lean routines in a multi-actor supply network depends on the speed and granularity of information. In JD Logistics, the deployment of the JD Super Brain and digital twin technologies acts as the critical BDAC enabler, accelerating the Lean cycle of detection–escalation–countermeasure–standardization [3, 9]. From the BDAC perspective, the operational effectiveness of JD's risk control manifests in three linked outcomes. First, data integration supports end-to-end visibility across orders, capacity, and node performance. The JD Super Brain provides real-time panoramic monitoring, enabling earlier abnormality detection than manual kanban systems [1]. Second, predictive algorithms and digital simulation supply forward-looking signals, acting as a "pre-kanban" warning. JD's corporate disclosures highlight how digital twins simulate network stress tests, helping managers dynamically reroute and reallocate resources before variability materializes into physical congestion [8]. Third, when these analytics are embedded into exception-handling SOPs, decision execution becomes faster and more consistent. Operationally, these effects drastically shorten the detection-to-response cycle. Instead of ad hoc firefighting, JD utilizes automated escalation protocols. By integrating climate and operational risk data into this digital framework, JD maintains a closed-loop approach where responses are mathematically optimized and instantly deployed across the network.

3.3. Lean performance logic: flow stability, waste reduction, and learning effects

The Lean/TPS lens enables a managerial interpretation of why JD's BDAC-driven initiatives matter beyond mere "technology upgrading." Specifically, improvements in risk control are valuable insofar as they stabilize flow and reduce non-value-added work across the logistics value stream. Flow instability under Lean creates a cascade of waste, including unnecessary inspections, needless expediting, and rework in sorting. This waste accumulation and the amplification of regional variability are prevented by JD's BDAC-enabled early detection. Moreover, Lean emphasizes learning as an institutional capability. In JD Logistics, data-driven dashboards and traceability of abnormal events serve as the foundation for digital Kaizen. Following major disruptions, JD employs data-backed After-Action Reviews (AARs). Because deviations and responses are immutably recorded, root-cause analysis is grounded in objective data rather than individual recall, allowing validated countermeasures to be standardized rapidly across the network [6]. Furthermore, BDAC reduces coordination friction by providing shared situational awareness across disparate teams, upholding the Lean principle of "respect for people" by giving frontline workers clear, actionable, and aligned priorities during crises [2, 6].

4. Existing problems

Despite aligning with Lean/TPS and BDAC in theory, JD Logistics faces concrete execution gaps during crises. The next subsections zoom in on how inconsistencies in emergency escalation, resource deployment, cross-regional handoffs, and learning mechanisms undermine flow stability and create waste under disruption. This transition sets up a focused analysis of the following problems.

4.1. Insufficient standardization of emergency escalation

A key existing problem is the insufficient standardization of emergency escalation across regions and partner interfaces. Although JD Logistics publicly discloses a tiered emergency response mechanism for extreme weather, with a three-level framework and a full-process approach (pre-event, in-event, post-event), the real challenge lies in translating this top-level design into uniform ground practice [10]. Without consistent escalation thresholds, decision rights, and playbooks across all nodes, *jidoka*—Lean's abnormality detection and rapid containment—becomes fragmented [6]. This fragmentation can trigger delayed containment, forcing frontline teams to improvise under pressure and thereby generate additional *muda* (rework, duplicated communications) and *muri* (overburden during crises) [11]. The evidence indicates intent and governance, but also highlights the need for enterprise-wide crisis playbooks and cross-functional drills to achieve repeatable, scalable response under multi-actor conditions.

4.2. Emergency resource readiness gaps

Another problem is whether emergency resources are pre-positioned and deployable with a clear pull-based logic during disruptions. JD Logistics reports substantial emergency reserves—over 2,000 key livelihoods supply categories—intended to support rapid response [10]. While this demonstrates preparedness aligned with Lean's design principle, the deployment cadence and allocation rules must be standardized to avoid congestion at some nodes and shortages at others during major disruptions [12]. Without a unified prioritization scheme and synchronized

upstream/downstream cues, pre-positioned resources can become a source of bottlenecks, increasing rework and delaying recovery. In order to transform readiness into really agile execution, this gap underscores the need to codify resource deployment SOPs, cross-partner coordination norms, and synchronized crisis "war-room" rhythms—areas where JD is actively deploying digital twin and Super Brain technologies [13-15].

4.3. Cross-regional coordination and handoff frictions

Lean/TPS requires end-to-end flow control, yet cross-regional handoffs often introduce friction under disruptive conditions. JD's flood-response case in Rongjiang (Guizhou) demonstrates rapid regional mobilization and same-day dispatch, signaling strong detection and initial reaction [16]. However, handoffs across regions, routes, and interfaces can still incur misalignment without standardized handoff protocols, common data definitions, and synchronized KPIs. Inconsistent interface responsibilities and varied escalation criteria across partners can cause delays or divergent actions, undermining standardized work and risking increased muda and mura during crises [6, 12]. The evidence points to a capable crisis response in some instances while revealing a structural need for uniform cross-region playbooks and real-time coordination channels powered by upgraded large models [13, 14].

4.4. Kaizen deployment gaps (from incident response to enterprise-wide standards)

Lastly, Lean/TPS resilience depends on converting crisis learnings into updated standards and widespread Kaizen. Even with the aid of intelligent logistics planning capabilities, JD materials describe closed-loop governance and post-event reviews, but scaling such learning to enterprise-wide standardization across planning, execution, and partner interfaces remains challenging [3, 10, 15]. Without systematic after-action reviews (AARs) and formal SOP updates, improvements risk remaining localized rather than diffusing through the network. This undermines the Kaizen cycle, as lessons learned during emergencies fail to translate into durable, organization-wide changes. The JD disclosures signal intent, yet the evidence indicates the need for a formalized learning-to-standard pipeline that ensures countermeasures are vetted, standardized, trained, and proliferated across units and partners [11].

5. Managerial implications and avenues for improvement

Based on the execution gaps identified in JD Logistics, the core managerial implication is that advanced BDAC infrastructure must be tightly coupled with evolved Lean/TPS governance to be truly effective during crises. Rather than relying solely on technological upgrades, logistics networks must address the fragmentation of standard work across organizational boundaries. First, to ensure consistent jidoka (abnormality detection) and seamless cross-regional handoffs, management must establish enterprise-wide data governance and unified escalation thresholds to create a single source of truth. Second, traditional "Standard Work" must adapt to the digital era by becoming scenario-based, insights from digital twins and predictive models should directly inform modular crisis playbooks that guide frontline resource deployment without overburdening (muri) the staff. Finally, to close the learning loop, organizations must formalize their Kaizen practices. Post-event analytics and after-action reviews must systematically drive network-wide SOP revisions and shared KPIs, ensuring that localized emergency workarounds are translated into durable, enterprise-wide resilience.

6. Conclusion

This study shows that Big Data Analytics Capability (BDAC) can power Lean/TPS risk governance by elevating end-to-end visibility, accelerating detection, and enabling proactive, data-driven responses within JD Logistics, however, data alone cannot guarantee resilience. The JD case demonstrates how technologies like JD Super Brain and digital twins translate Lean principles—jidoka, standard work, and Kaizen—into scalable, real-time capabilities across a multi-actor, multi-region network, reducing muda, mura, and muri when disturbances occur. However, only when BDAC is closely linked with unified governance, scenario-based standard work, and a formal Kaizen pipeline that spreads improvements across planning, execution, and partner interfaces does the best evidence of long-term resilience emerge. The next frontier for risk management lies in strengthening governance architecture as an enabler of network-wide learning and coordinated action, not merely expanding analytic capability.

References

- [1] Christopher, M., & Peck, H. (2004). Building the resilient supply chain. *The International Journal of Logistics Management*, 15, 1–14. <https://doi.org/10.1108/09574090410700275>
- [2] Dubey, R., Gunasekaran, A., & Childe, S. J. (2019). Big data analytics capability in supply chain agility: The moderating effect of organizational flexibility. *Management Decision*, 57, 2092–2112. <https://doi.org/10.1108/MD-01-2018-0119>
- [3] JD Logistics. (2023). ESG report 2023. https://www.jingdonglogistics.com/esg_annual_report/ESGReport_2023_EN.pdf
- [4] Davison, R. M., & Ou, C. X. J. (2017). Digital work in a digitally challenged organization. *Information & Management*, 54, 129–137. <https://doi.org/10.1016/j.im.2016.05.005>
- [5] Ohno, T. (1988). *Toyota production system: Beyond large-scale production* (1st ed.). Productivity Press. <https://doi.org/10.4324/9780429273018>
- [6] Liker, J. K. (2004). *The Toyota way: 14 management principles from the world's greatest manufacturer*. McGraw-Hill.
- [7] Womack, J. P. (2007). The machine that changed the world: The story of lean production — Toyota's secret weapon in the global car wars that is revolutionizing world industry [New ed.]. *Simon & Schuster*.
- [8] Akter, S., Wamba, S. F., Gunasekaran, A., Dubey, R., & Childe, S. J. (2016). How to improve firm performance using big data analytics capability and business strategy alignment? *International Journal of Production Economics*, 182, 113–131. <https://doi.org/10.1016/j.ijpe.2016.08.018>
- [9] JD Logistics. (2024). "JD Logistics Super Brain" upgrade! First reveal of the panorama of digital intelligence supply chain technology behind "Fast, Accurate, and Stable". *News Center – JD Logistics*. <https://www.jingdonglogistics.com/cn/news/157>
- [10] JD Logistics. (2025). 2025 environmental, social and governance report. https://www.jingdonglogistics.com/esg_annual_report/2025%E5%B9%B4_%E7%8E%AF%E5%A2%83_%E7%A4%BE%E4%BC%9A%E5%8F%8A%E6%B2%BB%E7%90%86%E6%8A%A5%E5%91%8A.pdf
- [11] Hines, P., Holweg, M., & Rich, N. (2004). Learning to evolve: A review of contemporary lean thinking. *International Journal of Operations & Production Management*, 24, 994–1011. <https://doi.org/10.1108/01443570410558049>
- [12] Holweg, M. (2007). The genealogy of lean production. *Journal of Operations Management*, 25, 420–437. <https://doi.org/10.1016/j.jom.2006.04.001>
- [13] Xinhua Net. (2025, September 26). JD Logistics releases "Super Brain Large Model 2.0" and "Alien Wolf", accelerating the construction of "AI+". *Xinhua Net*. <http://www.xinhuanet.com/auto/20250926/d37949e7deb94cb18e6c93828560b6e0/c.html>
- [14] Science and Technology Daily. (2024, November 19). Empowered by digital twin technology, JD achieves a 12% reduction in logistics fulfillment time. *Science and Technology Daily*. https://www.stdaily.com/web/gdxw/2024-11/19/content_260549.html
- [15] EO Intelligence. (2024, November 20). Comprehensive upgrade of JD Logistics Super Brain, integrating digital twin technology to drive intelligent logistics planning. *EO Intelligence*.

<https://www.iyiou.com/news/202411201083219>

- [16] JD Logistics. (2026, March 5). Business review: Corporate social responsibility (Response to severe flooding in Rongjiang, Guizhou). *Hong Kong Exchanges and Clearing Limited*.
<https://www.hkexnews.hk/listedco/listconews/sehk/2026/0305/2026030500918.pdf>