How Resilience Emerges and Evolves in Business Process Management Systems: A Process Theory of Disruption, Recovery, and Learning

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Abstract

This dissertation examines how resilience emerges and evolves through repeated disruption–recovery episodes in Business Process Management (BPM) systems. Drawing on Dynamic Capabilities Theory and Non-Equilibrium Thermodynamics, the study develops a three-phase framework consisting of pre-breach flexibility, transition-zone intervention, and post-stabilization learning. The empirical analysis uses longitudinal event-log data from a live ServiceNow BPM environment containing 141,712 operational incidents. Generalized linear models, logistic regression, and survival analysis examine relationships among disruption intensity, boundary-condition breaches, recovery performance, and temporal adaptation. Preliminary findings suggest that disruption intensity primarily influences breach activation, operational load amplifies disruption effects, and recovery performance improves across repeated disruption–recovery episodes. Future research focuses on transition-zone dynamics, resilience measurement, and simulation-based extensions to investigate resilience mechanisms not directly observable in administrative BPM data.

Keywords

business process management, organizational resilience, dynamic capabilities, process theory, event-log analysis

1. Research Problem and Motivation

Business Process Management (BPM) research emphasizes process standardization, automation, compliance, and control [2, 11]. These mechanisms support predictable execution under routine conditions, but predefined workflows, escalation procedures, and automated controls may become insufficient when disruptions exceed formal process capacity.

Organizations then rely on ad hoc coordination, improvisation, reassignment, and temporary workarounds. BPM research often treats such behavior as deviation, inadequate design, or insufficient standardization [11], providing limited explanation of how organizations recover after formal process logic fails.

Organizational resilience research presents a related gap. Although resilience is widely recognized as an important capability, its conceptualization and measurement remain contested [1, 8]. Studies often infer resilience from recovery or performance outcomes, providing less insight into the mechanisms through which adaptation occurs during disruption and develops over time.

This dissertation addresses these gaps by developing a process-level theory of resilience in BPM systems that integrates Non-Equilibrium Thermodynamics (NET) and Dynamic Capabilities Theory (DCT). NET explains how increasing disturbance can move systems beyond stable operating conditions into far-from-equilibrium states. In BPM environments, boundary-condition breaches represent destabilization, while transition zones represent temporary reorganization during which teams create responses that restore stability. The transition zone is therefore the central construct in which resilience-related adaptation becomes observable through intervention, coordination, and recovery activity.

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DCT explains how organizations transform successful responses into enduring capabilities through learning and reconfiguration. Together, NET and DCT explain complementary stages of resilience emergence: destabilization and reorganization, followed by learning and capability development.

2. Research Question and Theoretical Framework

This dissertation asks: How does resilience emerge and evolve through repeated disruption-recovery episodes in BPM systems? Consistent with Gregor's theory for explaining [4], the intended outcome is a process-level explanatory theory of disruption, recovery, and organizational learning in BPM environments.

Dynamic capabilities operate across the framework: sensing supports recognition of disruption, seizing guides transition-zone intervention, and reconfiguring incorporates lessons into BPM structures and routines [3, 12]. NET complements this logic by explaining movement from stable conditions toward far-from-equilibrium states in which novel responses emerge [10].

The framework consists of pre-breach flexibility, transition-zone intervention, and post-stabilization learning. Flexibility absorbs routine variation within operating boundaries. A boundary-condition breach initiates a transition zone in which frontline teams use ad hoc intervention to restore performance. Following recovery, organizations evaluate responses, incorporate lessons into routines, and develop adaptive capacity through repeated disruption-recovery cycles.

Resilience is conceptualized as an enacted, evolving capability rather than a static attribute or single outcome [1, 6]. Repeated disruption, intervention, recovery, and learning may increase disruption tolerance, improve recovery performance, and strengthen operational effectiveness over time.

Figure 1 summarizes the framework derived from NET, DCT, and organizational resilience literature.

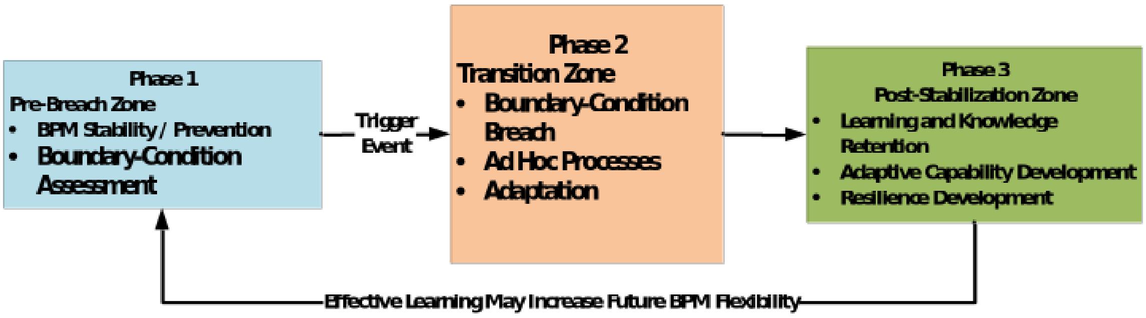

Figure 1: Three-phase conceptual framework.

3. Research Design and Progress Update

This dissertation uses a longitudinal event-log design in a live ServiceNow BPM environment that records incidents, escalations, assignment changes, and resolution outcomes. Event logs permit direct observation of disruption and recovery processes rather than reliance on retrospective assessments [13].

The dataset contains 141,712 incidents and traces workflow execution, escalation, reassignment, workload conditions, and recovery outcomes. It supports identification of repeated disruption types, boundary-condition breaches, and recovery episodes. Although event logs cannot directly capture learning, coordination quality, or managerial cognition, they provide observable behavioral evidence for evaluating relationships proposed in the framework.

Disruption intensity is operationalized using administrative severity indicators. Boundary-condition breaches are failures to maintain performance within established limits, including SLA thresholds. Recovery performance is measured using incident resolution time and related resolution dynamics.

The analyses test observable behavioral implications of the proposed process theory rather than directly measuring all underlying learning and coordination mechanisms.

Generalized linear models examine recovery duration, logistic regression examines boundary-condition breaches, and survival analysis evaluates temporal changes across repeated episodes. Together, these methods distinguish disruption severity, breach activation, recovery performance, and temporal adaptation.

Initial analyses establish the feasibility of using BPM event-log data to examine disruption, recovery, and temporal adaptation. Key limitations remain: administrative severity indicators are compressed, and event logs provide only partial visibility into learning, coordination, and other latent resilience mechanisms. These limitations motivate further theoretical refinement and simulation-based extensions.

4. Preliminary Findings

First, disruption intensity primarily influences boundary-condition breach activation rather than post-breach recovery. Higher intensity increases breach likelihood but does not fully explain recovery duration once recovery begins, supporting a distinction between failure activation and recovery dynamics.

Second, operational load amplifies disruption effects: the relationship between disruption intensity and breach probability strengthens under elevated workload, indicating that failure risk depends on both disruption conditions and operational demand.

Third, disruption behavior is nonlinear. Breach probability shows diminishing marginal effects at higher disruption levels, suggesting dynamics more complex than a simple linear relationship.

Fourth, recovery performance improves over time. Later incidents resolve more quickly after accounting for disruption intensity and operational conditions. Although this pattern does not directly observe learning, it is consistent with the proposition that repeated disruption-recovery experience may be associated with improved response capability.

Collectively, the findings show that BPM event logs capture meaningful disruption and recovery dynamics. However, event logs observe disruption, escalation, and recovery outcomes more directly than learning, coordination quality, and other latent resilience mechanisms. Therefore, the next phase focuses on strengthening the connection between observable recovery behavior and the adaptive processes proposed by the framework.

5. Dissertation Roadmap, Open Questions, and Research Challenges

Several challenges remain. Severity coding compresses variation in disruption intensity, event logs provide only partial visibility into transition-zone behavior, and the single-site setting limits immediate generalizability. Together, these issues constrain construct validity and the dissertation's ability to directly observe the learning and coordination mechanisms proposed in the framework.

The next phase will refine transition-zone mechanisms, distinguish flexibility from resilience, and examine whether repeated disruption-recovery cycles contribute to boundary expansion and greater disruption tolerance. Simulation-based extensions will examine mechanisms not directly observable in administrative data. Although the single-site design emphasizes theory development rather than statistical generalization, the resulting process theory will generate propositions for examination across BPM environments and industries.

Declaration on Generative AI

The author used Generative AI tools for spelling and grammar checking.

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