

# Emergency production dispatching under sudden disruptions: A tripartite evolutionary game approach

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## ABSTRACT

Sudden disruptions, including equipment failures, supply interruptions, and extreme events, can quickly make shop-floor schedules infeasible. Yet emergency production dispatching is often treated as a stand-alone rescheduling problem that overlooks coordination and enforcement. This study frames disruption response in industrial parks as a coupled production-control and governance problem and develops a tripartite evolutionary game model involving a local coordination authority, manufacturing firms, and an upper-level government. The model examines how proactive dispatching, cooperative rescheduling, and supervision co-evolve under bounded rationality. Using replicator dynamics, Jacobian stability analysis, and numerical simulations, we identify the conditions under which cooperative emergency dispatching becomes stable. The findings are based on a simulation-based evolutionary game model rather than on calibrated industrial case data. Results show that resource support, cooperation gains, and credible penalties promote proactive dispatching, whereas high adjustment costs weaken firms' willingness to cooperate. Rising monitoring costs reduce the attractiveness of strict supervision, while effective horizontal cooperation partly substitutes for vertical enforcement. From a practical perspective, emergency dispatching is more effective when firms' adjustment burdens are reduced, repeated cooperation is rewarded, passive behavior is credibly disciplined, and supervision remains effective but sustainable.

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