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Conventional Production Planning as a Business Continuity Strategy Under Explosive License Disruption: A Case Study of a Marble Quarry in Saraburi Province, Thailand

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Abstract

This study examines how a marble quarry in Saraburi Province, Thailand maintained production continuity when a compounding regulatory crisis — comprising the simultaneous expiration of an explosive permit (P.5), parliamentary dissolution, a caretaker government, and an escalating border dispute — converged in December 2025. A mixed-method, single embedded case study design was employed, combining quantitative blast records with qualitative process data drawn from emergency team minutes, Daily Review Meeting (DRM) records, and an after-action review (AAR). Findings indicate that same-day business contingency plan (BCP) activation and systematic blast parameter optimization enabled the mine to produce 14,744.38 metric tons over seven working days, exceeding the minimum daily target 14.04-fold, while maintaining a powder factor of 0.095 kg/ton. Only 34.95% of the resulting stockpile was consumed during the 28-day license gap, providing 82.28 days of operational reserve. The DRM mechanism facilitated within-crisis learning that contributed directly to production outcomes. Post-crisis AAR led to a revised BCP incorporating a compounding crisis scenario, a 90-day early-warning trigger, and a permanent minimum stockpile policy. These findings suggest that conventional blasting practices, when systematically integrated with a BCP framework, can serve as an effective business continuity strategy under regulatory license disruption. The study proposes a preliminary integrative framework — the License Crisis–Proactive Production with Organizational Resilience (LCPP-OR) model — as a basis for further research in mining operations facing political and regulatory uncertainty.

Keywords: Crisis management; Business continuity management; Blasting optimization; Political uncertainty; Mining; Organizational resilience

Introduction

The marble and ground calcium carbonate (GCC) mining industry occupies a strategically important position in Thailand's upstream industrial supply chain. GCC products serve as essential raw materials for the paint, plastics, paper, and rubber sectors, making continuous quarry production a prerequisite for broader manufacturing operations. Like most hard-rock quarries, GCC mines depend entirely on drilling and blasting as their primary production method, and the legal authorization to use explosives — the explosive purchase, possession, use, and transport permit (P.5) — is therefore a non-negotiable operational

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requirement. Under normal conditions, this permit is renewed annually through routine administrative channels, and the process presents no significant operational risk.

However, this assumption of administrative continuity is not unconditional. When the permit-issuance mechanism is disrupted by external forces beyond the operator's control, the consequences are immediate and severe. Mining operations that rely on blasting as their only viable production method face a direct revenue gap from the moment access to explosives is interrupted (Taarup-Esbensen, 2021). Despite this vulnerability, the existing literature on business continuity management (BCM) in the mining sector has concentrated almost entirely on disruptions arising from natural hazards or community opposition (ISO 22301, 2019; Silver et al., 2017), and has not adequately addressed disruptions caused by regulatory failure during political transitions.

Thailand's experience in late 2025 illustrates this gap precisely. On December 12, 2025, a parliamentary dissolution placed a constitutionally constrained caretaker government in power, halting high-discretion administrative approvals, including explosive permit renewals (Department of Provincial Administration, 2021a; Pongsudhirak, 2008). Simultaneously, an escalating border dispute prompted security agencies to tighten controls over all categories of explosive materials under Thailand's Firearms, Ammunition, Explosives, Fireworks, and Imitation Firearms Act B.E. 2490 (Department of Provincial Administration, 2021b). The combined effect constituted a compounding crisis — a convergence of multiple independent disruptions (Brzoska, 2012) — in which normal permit-renewal timelines of 30–60 days were extended indefinitely through no fault of the operator. Parallel incidents at quarry operations in Nakhon Ratchasima and Mukdahan provinces (Green News Agency, 2025; Mukdahan Provincial Public Relations Office, 2025) confirm that this vulnerability is systemic across Thailand's mining sector, not an isolated occurrence.

A marble quarry in Saraburi Province provides the clearest documented case of this crisis type. On the day of dissolution, the operation's P.5 permit was due to expire in ten days. With no precedent to draw on and no predefined BCP scenario for this combination of circumstances, senior management activated the business contingency plan on the same day and implemented a production response using only the blasting engineering capabilities already available within the organization. This case is selected because it is the first known instance in Thailand where an operator's complete response to a compounding regulatory crisis — from BCP activation through post-crisis after-action review (AAR) — has been fully documented with quantitative production data, making systematic analysis possible.

Four research gaps motivate this study. First, BCM frameworks applicable to the mining sector do not include scenarios for regulatory paralysis arising from political transitions or border security emergencies. Second, there is no empirical evidence on whether conventional blast parameter adjustments can be scaled effectively to build sufficient safety stock under extreme time pressure. Third, the role of a daily review mechanism (DRM) in enabling within-crisis learning and real-time plan adjustment has not been examined in a BCM context. Fourth, the conditions under which post-crisis AAR leads to substantive BCP revision — as opposed to procedural documentation — remain poorly understood. This study addresses these gaps through a mixed-method, single embedded case study of the Saraburi operation,

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with the aim of providing both empirical evidence and practical guidance for mining operators facing regulatory uncertainty in politically volatile environments.

Research Objective

1. To examine how a marble quarry organization responds to a compounding regulatory crisis through Business Contingency Plan activation and cross-functional crisis management.
2. To evaluate the effectiveness of integrating conventional blast parameter optimization with a BCP framework as a production continuity strategy under explosive license disruption.
3. To assess the BCP effectiveness in bridging the license gap through proactive stockpile management and supply-demand balance during the explosive license disruption period.
4. To examine how post-crisis after-action review contributes to organizational learning and substantive revision of the Business Continuity Plan under a compounding regulatory crisis.

Literature Review

Understanding how a mining operation maintains production continuity under a compounding regulatory crisis requires integrating insights from four bodies of literature that have not previously been examined together: blasting engineering, business continuity management, the effects of political uncertainty on regulatory administration, and the dual-use materials control literature. Each stream contributes a necessary component of the analytical framework, but none is sufficient on its own.

Blasting engineering as a production continuity instrument

The blasting engineering literature establishes that production volume in hard-rock quarries is directly controllable through blast design parameters — specifically burden and spacing geometry, drill-hole depth and count, and powder factor (Konya & Walter, 1991; Jimeno et al., 2019). Critically, this relationship is not linear: Nikkhah et al. (2022) and Ouchterlony and Sanchidrían (2019) demonstrated that systematic parameter adjustment can produce disproportionate gains in yield per blast, and Shehu et al. (2023) and Zhang et al. (2023) confirmed that such gains persist through downstream processing stages. This body of work implies that an operator with accumulated blasting expertise has, in principle, a technically feasible instrument for rapidly scaling output when external circumstances demand it. However, none of these studies situates this capability within a crisis context or examines whether parameter-level tools can substitute for strategic planning under time pressure. The present study treats blast parameter optimization as a deployable BCM resource, not merely an engineering efficiency tool.

Business continuity management and the safety stock concept

The BCM literature, anchored by ISO 22301 (2019), treats operational continuity as a function of preparedness: identifying critical activities, quantifying recovery time objectives, and maintaining buffer resources sufficient to bridge any disruption gap. In the mining context, Taarup-Esbensen (2021) established that structured BCM significantly improves disruption risk identification and mitigation, while Bibi and Valdecantos (2024) demonstrated that supply chain resilience is particularly critical for resource-dependent industries exposed to geopolitical volatility. Silver et al. (2017) safety stock concept provides the inventory management logic that connects these two ideas: a pre-built stockpile calculated from demand variability and lead time functions as a physical buffer against supply interruption. Together, these works establish that BCM in mining is not purely procedural — it has a material, quantifiable expression in the form of stockpile reserves. What remains absent from this literature, however, is any treatment

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of the specific condition in which the disruption originates not from physical hazards or community opposition, but from the collapse of the state's permit-issuance mechanism during a political transition.

Political uncertainty and the limits of administrative discretion

Julio and Yook (2012) established that political uncertainty around elections systematically depresses corporate investment decisions, a finding attributable to the anticipation of policy change and constrained regulatory capacity. In the Thai institutional context, Pongsudhirak (2008) provides the constitutional mechanism: caretaker governments formed after parliamentary dissolution are expressly prohibited from making commitments that bind a successor administration, including high-discretion approvals such as explosive permit renewals. This constraint does not operate through intent but through legal structure — even a cooperative administrator cannot lawfully process such an application in the relevant period. Critically, this literature treats political uncertainty as an investment-level variable and does not examine its consequences for operators who hold time-sensitive regulatory licenses.
The present study extends this logic from the macroeconomic to the operational level, treating the caretaker constraint as a direct determinant of permit availability.

Dual-use materials control and regulatory paralysis

The border security and arms control literature introduces a second independent mechanism that, when combined with a political transition, generates qualitatively different conditions. Brzoska (2012) demonstrates that states routinely escalate controls over dual-use materials — substances with both commercial and potential conflict-related applications — during periods of international tension, and that industrial explosives fall within this category regardless of their declared commercial purpose. Under Thai law, the Firearms, Ammunition, Explosives, Fireworks, and Imitation Firearms Act B.E. 2490 (Department of Provincial Administration, 2021a) explicitly authorize the suspension of permit processing when security considerations arise, with no defined processing timeline. The result, when combined with a caretaker government's limited discretionary authority, is what Brzoska (2012) terms regulatory paralysis: a condition in which full legal compliance offers no guarantee of operational continuity because the administrative mechanism itself is unavailable.

Synthesis and analytical framework

The four literature streams converge on a single gap: no prior study has examined how a mining operator navigates the intersection of all four conditions simultaneously — a permit about to expire, an unavailable administrative mechanism, a border-security escalation affecting explosive controls, and a ten-day operational window. The existing BCM frameworks do not include compounding regulatory crisis scenarios. The blasting engineering literature has not been applied to crisis-driven production scaling. The political uncertainty literature has not been extended to permit-dependent operations. And the dual-use materials literature has not examined operator-level responses. This study addresses all four gaps through a single embedded case study, using blasting records and qualitative process data to examine whether conventional production management practices, systematically deployed within a BCP framework, can constitute an effective business continuity strategy under these conditions.

Research Methodology

Research Design

This study employs an explanatory sequential mixed-method design (Creswell & Plano Clark, 2018) within a single embedded case study framework (Yin, 2018). Quantitative blast production records are analyzed first to establish what outcomes occurred; qualitative process data are then used to explain the organizational decisions behind those outcomes. Integration occurs at the interpretation stage. This design is appropriate because the crisis was a singular,

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non-replicable event requiring both measurable outcome data and organizational reasoning to be understood. Analysis is structured across two layers: the organizational level (BCP activation, decision-making, and adaptation) and the operational level (production and explosive-use outcomes).

Theoretical Framework

Three frameworks anchor the organizational dimension: Crisis Decision-Making Theory (Weick, 1988), examining how warning signals triggered emergency resource mobilization; the Sensemaking Framework (Weick et al., 2005), examining how executives interpreted ambiguity to enable collective action; and the Organizational Resilience Framework (ISO 22316, 2017), assessing the capacity to absorb, adapt, and learn. Three nested units of analysis are applied: BCP activation and team structure (organizational level); DRM mechanics and plan adjustments (process level); and production outcomes and AAR-derived learning (outcome level).

Research Scope and Informants

The study spans three phases: pre-crisis (January–November 2025), crisis period (December 12–22, 2025), and post-crisis, including the AAR (December 23, 2025–January 2026). The unit of analysis is a marble quarry operation in Saraburi Province, Thailand. Seven key informants participated directly in the crisis response: the Deputy Managing Director (1), mine engineers (2), blasting operations supervisors (2), and legal and administrative personnel (2). All were present at the December 12 emergency meeting. Qualitative data were derived from internal documents, meeting records, and field notes rather than formal interviews, supplemented by member checking to verify interpretive accuracy.

Data Collection and Triangulation

Data-source triangulation (Denzin, 1978) was applied across four sources: (1) quantitative production records — nine crisis-period blasting logs, 15 days of stone transport records, and 65 normal-period blast events; (2) crisis management documents — the BCP Execution Summary Report and DRM minutes; (3) AAR records — lessons learned, organizational strengths and weaknesses, and proposed BCP revisions; and (4) field notes — observational records of team interactions and real-time decisions. Credibility was further strengthened through member checking with the DMD and two senior engineers.

Data Analysis

Analysis proceeds at four levels. Level 1 — Organizational phenomenon: content analysis and process tracing (Beach & Pedersen, 2013) of meeting minutes and the AAR construct a decision timeline and identify factors shaping crisis response. Level 2 — Production plan effectiveness: daily output is compared against the 150 MT minimum target using descriptive surplus analysis. Level 3 — Comparative performance: yield per blast, powder factor, and blast frequency are compared between the crisis and normal periods using descriptive statistics. Because samples are unequal and non-randomly drawn, differences are reported as marked or substantial rather than statistically significant, as inferential testing assumptions are not met. Level 4 — Supply–demand balance: the stockpile-to-consumption ratio and sustainable operating days without explosive access are calculated. Qualitative AAR data are analyzed using Thematic Analysis (Braun & Clarke, 2006) and integrated with quantitative findings to explain mechanisms behind measurable outcomes.

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Research Results

BCP Activation and Crisis Response

On December 12, 2025, following the parliamentary dissolution announcement and recognition of escalating border tensions, senior management assessed the situation and formally activated the Business Contingency Plan (BCP). The activation decision rested on two overlapping risk factors: (1) the P.5 permit due to expire in ten days, and (2) a high probability of renewal delays caused by the administrative vacuum and tightened security measures. On the same day, the Deputy Managing Director convened a cross-functional emergency team of seven members — two mine engineers, two blasting operations supervisors, two legal and administrative personnel, and the DMD — and defined four concurrent response measures: (1) accelerated stockpile production through blast site prioritization; (2) blast parameter scaling to raise yield per blast above normal-period levels; (3) designation of stockpile zones and a daily tracking system; and (4) daily permit-status reporting and coordination with local administrative officials.

Throughout the operational period (December 12–22, 2025), a Daily Review Meeting (DRM) was held at the close of each working day. The DRM agenda covered actual production against targets, blast parameters for the following day, cumulative stockpile levels, and permit renewal status. Three parameter adjustments were recorded in DRM minutes during this period: on December 13–14, drill-hole count per event was increased in response to an assessment that initial blast volumes were insufficient for the targeted stockpile; on December 16, the factory-hill summit blast face was prioritized over pit benches based on observed yield differentials; and on December 19, drill-hole depth was reduced following a recorded powder factor reading of 0.388 kg/MT, above the operational average, to control explosive consumption and maintain safety compliance. Prior to permit expiration on December 22, 2025, the emergency team submitted a BCP Execution Summary Report to senior management confirming nine blast events over seven working days, a total stockpile of 14,744.38 metric tons, standard powder factor levels, and a projected reserve sufficient to sustain plant operations for over 80 days.

Production Output Against Crisis-Period Targets

Across seven working days (December 13–20, 2025), nine blast events produced a total of 14,744.38 metric tons at an average daily rate of 2,106.34 metric tons — 14.04 times the 150 MT daily minimum threshold. All blast days exceeded the defined threshold. Results are presented in Table 1.

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Table 1 Daily Stone Production Against Target During Crisis Period (December 13–20, 2025)

Working Date	Blast Events	Total Output (MT)	Target (MT/day)	Assessment	Variance (MT)
Dec 13, 2025	2	761.40	150	Pass	+611.40
Dec 15, 2025	2	1,827.85	150	Pass	+1,677.85
Dec 16, 2025	1	3,061.80	150	Pass	+2,911.80
Dec 17, 2025	1	3,343.68	150	Pass	+3,193.68
Dec 18, 2025	1	2,624.40	150	Pass	+2,474.40
Dec 19, 2025	1	2,531.25	150	Pass	+2,381.25
Dec 20, 2025	1	594.00	150	Pass	+444.00
7-Day Total	**9 events**	**14,744.38**	**1,050**	**All Pass**	**+13,694.38**

Note. MT = metric tons. Target represents the minimum daily output required to meet contractual delivery obligations. Variance = Total Output minus Target. Source: Field collection data, Quarry Company.

Operations unfolded in two phases. Phase 1 (December 13–15) consisted of site preparation — two blast events per day to open access routes and ready blast faces — yielding lower per-day totals. Phase 2 (December 16–20) shifted to single, larger blast events averaging 2,431 MT per day, with a peak of 3,343.68 MT on December 17.

Production Efficiency Comparison: Crisis Period vs. Normal Operations

Table 2 presents a comparison of key production indicators between the crisis period (December 12–22, 2025, nine blast events) and the normal operational period (January–November 2025, 65 blast events, 53,911.70 MT total output).

Table 2 Production Efficiency Indicators: Crisis Period vs. Normal Operations

Indicator	Normal Period (Jan–Nov 2025)	Crisis Period (Dec 12–22, 2025)
Total blast events	65	9
Total production (MT)	53,911.70	14,744.38
Average yield per blast (MT/event)	829.41	1,638.26
Change in average yield (%)	—	+97.52
Average powder factor (kg/MT)	N/A	0.095
Total explosive cost (THB)	N/A	54,060.82
Unit explosive cost (THB/MT)	N/A	3.67

Note. MT = metric tons. Powder factor is reported in kg/MT (kilograms of explosive per metric ton of rock produced). Normal-period powder factor records were not available in a format suitable for aggregation and are therefore not reported. Percentage change in average yield is calculated as [(crisis mean − normal mean) / normal mean] × 100. Differences between periods are reported as observed magnitude differences; inferential statistics are not applied given the unequal and non-randomly drawn samples. Source: Field collection data, Quarry Company.

Average yield per blast in the crisis period was 1,638.26 MT, compared with 829.41 MT in the normal period — a difference of 97.52%. This difference coincided with changes in three blast parameters: drill-hole count increased from the normal-period range of 2–4 holes to 12–25 holes per event; hole depth increased from 3–4.5 meters to 6 meters; and burden and spacing were adjusted to support high-volume production. The crisis-period average powder factor of 0.095 kg/MT was within standard engineering benchmarks for marble quarrying. Total explosive expenditure over the seven-day crisis period was THB 54,060.82, equivalent to THB 3.67 per metric ton.

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Supply–Demand Balance During the License Gap

Over the 28 days following permit expiration (December 23, 2025–January 19, 2026), stone transport occurred on 15 working days, totaling 5,153.07 metric tons. Table 3 presents the supply–demand balance.

Table 3 Supply–Demand Balance During the License Gap (December 23, 2025–January 19, 2026)

Item	Volume (MT)	Percentage (%)
(A) Stockpile produced — supply	14,744.38	100.0
(B) Actual consumption — demand	5,153.07	34.95
(C) Remaining stockpile (A − B)	9,591.31	65.05
Sustainable operation period (days)	82.28	—

Note. MT = metric tons. Sustainable operation period is calculated as (C) ÷ average daily consumption rate of 184.04 MT/day. The actual license gap was 15 days; the new P.5 permit was received on January 6, 2026. Source: Field collection data, Quarry Company.

The 5,153.07 MT consumed during the gap represented 34.95% of the total stockpile. At the observed average daily consumption rate of 184.04 MT, the remaining stockpile of 9,591.31 MT was sufficient to sustain uninterrupted operations for 82.28 days — exceeding the actual 15-day license gap by a substantial margin.

After-Action Review Findings

Following receipt of the new P.5 permit on January 6, 2026, management convened an AAR to examine what the original BCP had anticipated and what it had not. The review identified the following organizational strengths: the cross-functional team was mobilized within hours of crisis recognition, and the accumulated blasting engineering expertise was immediately available for deployment. The following weaknesses were identified: BCP activation depended on senior executive judgment because no predefined trigger criteria existed for this combination of circumstances; the original BCP contained no scenario covering simultaneous government transition and border tensions; and crisis-period coordination with regulatory agencies relied on routine communication channels rather than dedicated emergency pathways.

The AAR codified five lessons from the crisis response: (1) BCP execution was heavily dependent on the specialized expertise of specific personnel, representing a key-person dependency risk; (2) the 150 MT/day minimum target, while met, produced a stockpile 4.91 times the required level, indicating that target-setting assumptions may warrant revision for similar future scenarios; (3) the DRM would benefit from a standardized reporting template with predefined KPIs and clear accountability assignments; (4) dedicated communication channels with government agencies are needed for crisis periods; and (5) border security escalation warrants treatment as a distinct scenario variable rather than a generic external risk. From these lessons, the AAR meeting defined four measures for a revised BCP: (1) addition of a compounding crisis scenario with a three-tier severity scale and differentiated response protocols; (2) an early warning system requiring quarterly permit-status reports and an automatic BCP activation trigger when the permit has fewer than 90 days remaining; (3)

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a permanent minimum stockpile policy of 3,000 MT with automatic alerts; and (4) an institutional relationship network with relevant agencies at provincial and central government levels.

Discussion

Objective 1: Organizational response under a compounding regulatory crisis

The findings show that on December 12, 2025, the organization moved from crisis recognition to BCP activation within hours, assembling a seven-member cross-functional team the same day. This sequence is consistent with Weick's (1988) argument that effective crisis response requires enacted sensemaking — the willingness to act on an incomplete picture rather than defer action until certainty is available. The cross-functional team composition, which combined blasting engineering, logistics, and legal expertise simultaneously, is also consistent with the collective sensemaking principle described in ISO 22316 (2017), which emphasizes that organizational resilience depends on the integration of diverse expertise rather than sequential specialist consultation. These observations are drawn from a single case and should be treated as illustrative rather than confirmatory; the degree to which the sensemaking pattern observed here generalizes to other organizations or crisis types remains an open question.

The DRM records show three documented parameter adjustments during the operational period, each producing a recorded change in the following day's output. Weick et al. (2005) describe this capacity to adjust under uncertainty — revising action based on observed outcomes rather than predetermined scripts — as a characteristic of adaptive management. From the perspective of the Organizational Resilience Framework (ISO 22316, 2017), the organization appears to have traversed all three resilience cycle phases: absorbing the crisis shock without operational collapse, adapting production processes and decisions in response to field data, and initiating structured learning through the AAR. Whether this trajectory reflects a durable organizational capability or circumstances specific to this case cannot be determined from a single event.

Objective 2: BCP integration with conventional blasting practices

The 97.52% increase in average yield per blast during the crisis period, compared with the normal-period average, substantially exceeds the 15–25% yield increases reported in parameter optimization studies under non-crisis conditions (Nikkhah et al., 2022; Shehu et al., 2023). One possible interpretation is that the difference reflects not only parameter changes but also the DRM-driven site selection decisions — specifically, the prioritization of the factory-hill summit face, which was identified on December 16 as producing higher yields than the pit benches. However, because the normal and crisis periods differ in multiple respects beyond blast parameters, including seasonal conditions, geological variation across blast sites, and team motivation factors, this interpretation is suggestive rather than definitive.

The crisis-period average powder factor of 0.095 kg/MT fell within standard engineering benchmarks for marble quarrying (Ouchterlony & Sanchidrían, 2019), and the unit explosive cost of THB 3.67 per metric ton was lower than typical normal-period rates. These outcomes are consistent with the view that systematic blast parameter management under the BCP framework supported efficient production, though the direction of causality between the BCP structure and the efficiency outcome cannot be established from this data set alone.

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Objective 3: BCP effectiveness in bridging the license gap

The stockpile produced during the crisis period (14,744.38 MT) substantially exceeded the quantity consumed during the 28-day license gap (5,153.07 MT), leaving 9,591.31 MT — equivalent to 82.28 days of operations — at the close of the gap period. This outcome is consistent with Silver et al. (2017) safety stock concept: a pre-built buffer calculated against a worst-case lead time substantially reduced operational risk. Taarup-Esbensen (2021) notes that mining sector disruptions arising from external factors often result in losses that cannot be recovered in the short term; the present case suggests that pre-crisis stockpile building may offset this risk, though the generalizability of this finding depends on industry type, regulatory context, and the duration of the expected disruption.

The actual consumption rate (34.95% of stockpile over 28 days) was markedly lower than worst-case projections. Several possible explanations could account for this, including seasonal demand patterns in the year-end period, existing factory inventory, and delivery schedule management. These explanations are speculative, as consumption data were not disaggregated by cause in the available records, and they should be treated as candidate hypotheses for future investigation rather than confirmed findings.

Objective 4: After-action review and organizational learning

The AAR produced five codified lessons and four concrete BCP revisions, including the addition of a compounding crisis scenario, an automatic 90-day activation trigger, a permanent minimum stockpile policy, and an institutional relationship network. The movement from identifying a gap (no predefined compounding crisis scenario) to revising the underlying assumption of the BCP (that permit renewal would always be administratively available) is consistent with what Argyris and Schon (1978) describe as double-loop learning — revising governing assumptions rather than correcting specific errors. The 90-day trigger represents a shift from reactive to predictive management logic, which Weick and Sutcliffe (2005) associate with high-reliability organizations. However, these observations are based on documented outputs of the AAR process rather than on longitudinal follow-up; whether the revised BCP has been operationalized, tested, or would perform as intended in a future crisis remains unknown.

Study Limitations

Several limitations constrain the interpretive scope of this study. First, the findings are drawn from a single case in a specific industry and regulatory context; they cannot be generalized to other quarry types, permit regimes, or political environments without further comparative evidence. Second, the crisis-period quantitative data comprise only nine blast events, which is insufficient for inferential statistical analysis. Third, the primary qualitative data sources are internal organizational documents — meeting minutes, the BCP Execution Summary Report, and the AAR — which may reflect organizational framing rather than a fully independent account. Fourth, causal explanation is inherently limited in a single-case design; relationships between BCP activation, DRM adjustments, and production outcomes are described as associations rather than established mechanisms.

Conclusion

This study examined how a marble quarry in Saraburi Province, Thailand, maintained production continuity when a compounding regulatory crisis — simultaneous permit expiration, parliamentary dissolution, and border security escalation — converged in December 2025. Three findings emerge from the analysis. First, same-day BCP activation by a cross-functional team, combined with a DRM operating throughout the crisis period, enabled systematic production planning and real-time parameter adjustment in the absence of any predefined crisis scenario for this combination of circumstances. Second, conventional blast

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parameter optimization produced a stockpile of 14,744.38 MT over seven working days — substantially exceeding the minimum target — while maintaining powder factor levels within standard benchmarks and achieving a unit explosive cost of THB 3.67 per metric ton. Third, the post-crisis AAR generated documented revisions to the BCP architecture, moving from reactive to trigger-based activation logic and adding scenario coverage for compounding crises. These findings suggest that conventional production management practices, when systematically deployed within a BCP framework, can constitute a viable business continuity strategy under regulatory license disruption. The study also illustrates how a compounding crisis — where two independent disruption mechanisms converge — can expose gaps in BCM frameworks that were designed for single-source disruptions. The proposed LCPP-OR framework offers a preliminary structure for integrating blasting engineering practice with organizational crisis response, though its applicability across other contexts requires validation through comparative research.

Recommendations

Recommendations for Practitioners

Mining operators in jurisdictions where explosives permits are subject to administrative discretion should incorporate compounding crisis scenarios — specifically the combination of political transition and border security escalation — into their BCP scenario libraries, with predefined multi-function team composition and automatic activation triggers that do not depend on individual executive judgment. DRM protocols should include standardized KPI templates and binding accountability assignments so that the mechanism can function independently of specific personnel. A permanent minimum stockpile policy, calculated against a worst-case license gap duration, should be established as a standing operational requirement rather than a crisis-period response.

Policy Recommendations

Regulatory agencies should consider establishing a provisional renewal status for explosive permits already in the renewal queue at the time of parliamentary dissolution, allowing continued operation while formal approval is pending. Provisions that enable suspension of permit processing during border security conditions should include a screening mechanism that distinguishes between commercially classified industrial explosives and materials posing a genuine security risk, with defined maximum processing timelines for the former category.

Recommendations for Future Research

Three directions are indicated by this study's limitations. First, comparative case studies across mine types and regulatory jurisdictions are needed to test whether the LCPP-OR framework's components — BCP activation timing, DRM mechanics, and safety stock calibration — transfer to contexts other than marble quarrying in Thailand. Second, quantitative modelling of the optimal BCP activation trigger point, incorporating permit delay probability, accelerated production cost, and disruption cost, would provide operators with an evidence-based decision tool. Third, longitudinal follow-up of organizations that have conducted post-crisis AARs is needed to determine whether double-loop learning outcomes are durable or revert over time in the absence of repeated crisis exposure.

New Knowledge

This study proposes the LCPP-OR framework (License Crisis–Proactive Production with Organizational Resilience) as a conceptual contribution derived from the Saraburi case. The framework was not imposed on the data; its five components correspond directly to observable phases of the organizational response documented in BCP activation records, Daily

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Review Meeting (DRM) minutes, production logs, and the After-Action Review (AAR) report. It is offered as a case-derived preliminary framework for future comparative research, not as a generalizable model.

Authers selects to presenting the finding as on Figure 1. The LCPP-OR Cycle: License Crisis–Proactive Production with Organizational Resilience and explain in Table 4. Five sequential phases are connected by directional arrows. A feedback arrow from Phase 5 to Phase 1 represents improved preparedness following AAR-driven BCP revision. A dashed box at the Phase 3–4 boundary highlights within-crisis learning as the study's central theoretical contribution. (Source: Saengchamnong, Tepinn, & Kaewmanee, 2025; Cloude, 2026). Authers selects to presenting the finding as on Figure 1.

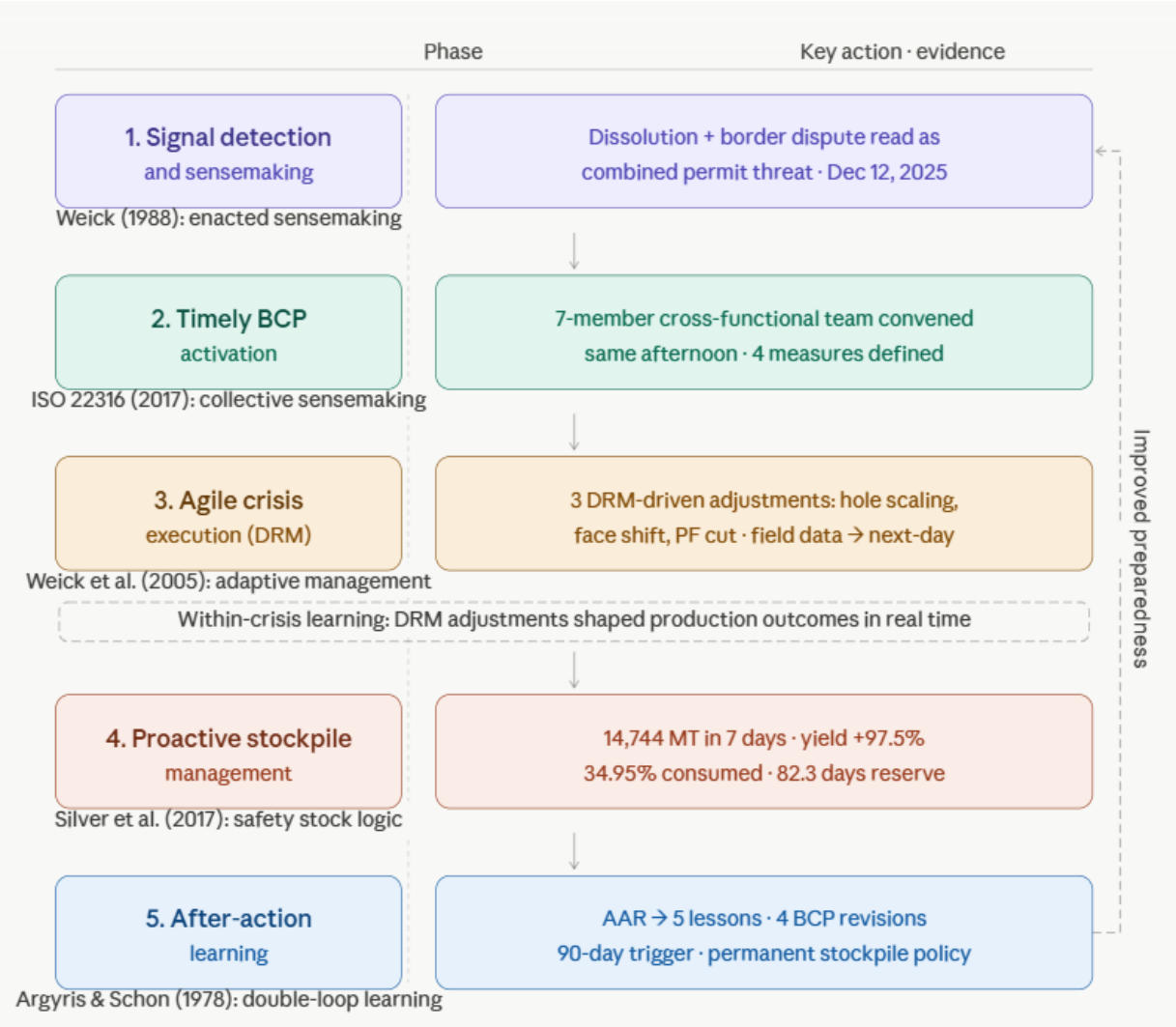


Figure 1. The LCPP-OR Cycle (Source: Saengchamnong, Tepinn, & Kaewmanee, 2026; Cloude, 2026).

Table 4 LCPP-OR Framework: Components, Evidence, and Theoretical Anchors

Phase	Component	Evidence from Saraburi case	Theoretical anchor
1	**Signal detection and sensemaking**	Parliamentary dissolution + border escalation recognised as combined permit threat; BCP activated same day (Dec 12, 2025).	*Weick (1988) — enacted sensemaking*
2	**Timely BCP activation**	7-member cross-functional team convened same afternoon; 4 concurrent response measures defined before day end.	*ISO 22316 (2017) — collective sensemaking*
3	**Agile crisis execution (DRM)**	3 DRM-driven adjustments: hole scaling (Dec 13–14), face shift (Dec 16), powder factor cut (Dec 19). Field data → next-day decisions.	*Weick et al. (2005) — adaptive management*
4	**Proactive stockpile management**	14,744 MT in 7 days; yield +97.5%; powder factor 0.095 kg/MT. 34.95% consumed in 28-day gap; 82.3 days reserve remaining.	*Silver et al. (2017) — safety stock logic*
5	**After-action learning**	AAR → 5 lessons, 4 BCP revisions: compounding crisis scenario, 90-day trigger, permanent stockpile policy, institutional network.	*Argyris & Schon (1978) — double-loop learning*

Note. *DRM = Daily Review Meeting; BCP = Business Contingency Plan; AAR = After-Action Review; MT = metric tons. Evidence is drawn from internal organizational documents and field records (Dec 12, 2025 – Jan 6, 2026). Theoretical anchors serve as interpretive lenses, not confirmatory tests.*

Phase Descriptions

Phase 1 (Signal detection and sensemaking). On December 12, 2025, the Deputy Managing Director reframed the permit expiration deadline as a production emergency upon recognising that parliamentary dissolution and border security escalation together rendered normal renewal timelines unavailable. This interpretation preceded any formal confirmation of delay and is consistent with Weick's (1988) enacted sensemaking: acting on an incomplete picture rather than waiting for certainty.

Phase 2 (Timely BCP activation). A seven-member cross-functional team was assembled within hours, drawing simultaneously on mine engineering, blasting operations, logistics, and legal expertise. Four concurrent response measures were defined before the day ended. The team structure reflects the collective sensemaking principle of ISO 22316 (2017), in which resilience depends on integrating diverse expertise rather than sequential specialist consultation.

Phase 3 (Agile crisis execution). Three DRM-driven adjustments were documented: drill-hole count was scaled up on December 13–14 after the team determined initial blast volumes were insufficient; the factory-hill summit face was prioritised on December 16 following observed yield differentials; and drill-hole depth was reduced on December 20 after a powder factor spike of 0.388 kg/MT was recorded the previous day. Each adjustment was made in response to field data observed the same day and produced a measurable change in the following day's output—an example of the adaptive management described by Weick et al. (2005).

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Phase 4 (Proactive stockpile management). Blast parameter optimization produced 14,744.38 MT over seven working days—exceeding the minimum target 14.04 times—while maintaining a powder factor of 0.095 kg/MT. Only 34.95% of the stockpile was consumed during the 28-day license gap, leaving 82.28 days of reserve. The outcome is consistent with Silver et al.'s (2017) safety stock logic: a pre-built buffer calculated against a worst-case lead time substantially reduces operational risk.

Phase 5 (After-action learning). The AAR codified five lessons and produced four BCP revisions—adding a compounding crisis scenario, establishing a 90-day automatic trigger, creating a permanent minimum stockpile policy, and building an institutional relationship network. The revisions changed the underlying assumptions of the BCP, not only its procedures, consistent with the double-loop learning framework of Argyris and Schon (1978). The feedback arrow from Phase 5 to Phase 1 in Figure 1 represents this improvement in preparedness.

Central Theoretical Contribution

The framework encodes the observation that within-crisis learning—occurring through the DRM during the operational period—appears to have influenced quantitative production outcomes directly, rather than only through post-crisis reflection. BCM frameworks typically treat the AAR as the primary learning mechanism. Whether this pattern holds beyond this case requires comparative investigation and is advanced here as an observation, not a confirmed finding.

Scope

The framework applies to a marble quarry under Thai explosive permit law during a specific combination of political and security conditions. Its transferability to other mine types, regulatory regimes, or crisis configurations requires systematic comparative research.

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