

WHITE PAPER

FORGE© FRAMEWORK

Focused Organisational Response, Growth and Exploitation

Deterministic Response Management with Bounded Functions and Backcasting

Part 3 of the CORE© Framework
(Continuous Opportunity and Risk Dynamics Engine)

Adrian Clements

March 2026

Version 4.0 – For Peer Review

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1. Abstract

This white paper presents Part 3 of the CORE© framework. FORGE© is a deterministic response management system for crystallised risks – the traditional arena of Enterprise Risk Management, enhanced with the temporal dynamics and quantitative rigour of the CORE© mathematical foundation.

The transition from severity and frequency to RiskTime (established in CORE Part 1) opens many new possibilities for the risk manager in dialogue with leadership teams. The inclusion of velocity and acceleration delivers, as a direct consequence, three distinct decision horizons: when the event is crystallising into an actual risk or opportunity; when the appetite boundary will be reached; and the last date when decisions and resources need to be committed.

As a consequence of these calculations, we automatically measure the company stress level and the Resilience Index. FORGE© introduces:

- **Response TTS (R-TTS):** The bounded variant of TTS with capped functions preventing numerical overflow in crystallised risk scenarios.
- **Urgency Index:** Calibrated response intensity combining severity, velocity, and remaining time.
- **Resilience Index:** Measurable organisational defensive capacity across four dimensions.
- **Backcasting Integration:** Milestone generation working backward from the desired future state.
- **Accountability Metrics:** Response efficiency, decision quality, resource utilisation, and milestone achievement.
- **Antifragility (Prosilience):** The opportunity-side equivalent of Resilience Index.

Validation demonstrates effective crisis management across diverse risk scenarios with clear, actionable outputs.

Keywords: Crisis response, bounded functions, backcasting, urgency index, accountability, decision making, decision horizons, RiskTime, Resilience Index, Antifragility (Prosilience) Index, inertia.

2. Introduction

FORGE© operates in the domain of clarity and execution – the traditional arena of Enterprise Risk Management. Once RADAR© detects and confirms an emerging risk (see Part 2), or when a risk is directly identified, FORGE© takes over with deterministic calculations, clear accountability, and measurable milestones. The philosophy shifts from probabilistic detection and ambiguity into a decisive response/attack mode.

As with RADAR, there are two aspects to the analysis: the actual trajectory scores (Risk and Opportunity) on one side, and the interpretation of these numbers on the other. The key difference is that in FORGE, the functions are bounded to prevent numerical instability in extended crisis scenarios.

3. FORGE© Extensions – Response TTS (R-TTS)

As with the early warning approach, FORGE starts with the CORE© mathematical foundation of likelihood, impact, and velocity, enhanced with amplification, inertia, and criticality factors (see CORE Part 1, Section 3 for full derivation).

There are again two axes to consider.

Axis 1 – Magnitude and Trajectory: The R-TTS extends the base TTS with a deeper analysis rather than a broader one.

Axis 2 – Decision Guidance: The interpretation layer that tells decision-makers what the R-TTS number means and what action is required.

Axis 1, for crystallised risks FORGE applies bounding functions to prevent the calculations running away during extended crisis management:

$$R-TTS = [L(t) \times I(t) \times \log_2(1+V) \times (1+A \times \min(\exp(\alpha t), 20))] / \sqrt{(1 - \min(v/v_m, 0.95))^2} \times [1 + \beta \times \sigma((\psi - \psi_c)/\delta)]$$

The differences from the base CORE TTS formula are as follows:

3.1 Bounded Velocity: $\log_2(1+V)$

Replaces the unbounded V term in the base TTS. The logarithmic compression reduces oversensitivity to extreme velocity values. At V=10, this produces approximately 3.5 instead of 10, preventing single-parameter dominance of the R-TTS score.

Rationale: In RADAR, extreme velocity is a detection signal that should amplify the score. In FORGE, where the risk is already confirmed, extreme velocity should inform urgency but not dominate the management calculation.

Calculation: $\log_2(1+V) = \ln(1+V)/\ln(2)$. For V=1: result = 1.0. For V=5: result = 2.58. For V=20: result = 4.39. The compression is progressive – moderate velocities are minimally affected while extreme velocities are significantly dampened.

3.2 Bounded Amplification: $\min(\exp(\alpha t), 20)$

Caps exponential growth at 20× to prevent numerical overflow in extended crises. Without this cap, a risk with $\alpha=0.3$ monitored over 12 quarters would produce $\exp(3.6) = 36.6$, distorting the R-TTS score beyond meaningful interpretation.

Calculation: Compute $\exp(\alpha t)$ normally. If the result exceeds 20, substitute 20. The amplification term then becomes $1 + A \times \min(\exp(\alpha t), 20)$. This preserves the full dynamics for the first several periods while preventing runaway scores.

3.3 Soft-Capped Lorentz: $\min(v/v_max, 0.95)$

Prevents the singularity in the inertia factor by capping the speed ratio at 0.95, which limits the maximum factor to approximately 3.2. This replaces the theoretical singularity (approaching infinity as $v \rightarrow v_{max}$) with a bounded maximum.

Calculation: $1/\sqrt{(1 - \min(v/v_{max}, 0.95))^2} = 1/\sqrt{(1 - 0.9025)} = 1/\sqrt{(0.0975)} = 3.20$. This is the maximum value the inertia factor can reach in FORGE, regardless of actual propagation speed.

3.4 Sigmoid Criticality: $\sigma((\psi - \psi_c)/\delta)$

Replaces the power-law criticality term $(\psi/\psi_c)^\gamma$ with a sigmoid function for smooth transitions. The sigmoid $\sigma(x) = 1/(1+\exp(-x))$ provides a gradual S-curve transition rather than the sharp phase-transition behaviour used in RADAR.

δ (delta) – Transition Width Parameter: Controls how rapidly the sigmoid transitions around ψ_c . Small δ produces a sharp, abrupt transition; large δ produces a gradual, diffuse transition. This calibrates the sensitivity of the enhancement to proximity to criticality.

Rationale: In RADAR, the sharp power-law is desirable because it amplifies early warning signals. In FORGE, where crisis management requires calibrated resource escalation, the smooth sigmoid prevents abrupt regime changes that could trigger over-reaction.

Calculation: If $\psi=4.0$, $\psi_c=5.0$, $\delta=1.0$: $\sigma((4.0-5.0)/1.0) = \sigma(-1.0) = 1/(1+\exp(1)) = 0.269$. If $\psi=6.0$: $\sigma((6.0-5.0)/1.0) = \sigma(1.0) = 1/(1+\exp(-1)) = 0.731$. The transition is smooth and bounded between 0 and 1.

3.5 Comparison: RADAR vs FORGE Functions

Component	RADAR (Unbounded)	FORGE (Bounded)	Rationale
Velocity	V (raw)	$\log_2(1+V)$	Prevent single-parameter dominance
Amplification	$\exp(at)$ (unbounded)	$\min(\exp(at), 20)$	Cap growth at 20×
Lorentz/Inertia	$v/v_{max} \in [0,1)$	$\min(v/v_{max}, 0.95)$	Prevent singularity, max 3.2×
Criticality	$(\psi/\psi_c)^\gamma$ (power-law)	$\sigma((\psi - \psi_c)/\delta)$ (sigmoid)	Smooth resource escalation

4. Backcasting Integration

Backcasting works backward from the desired future state to identify required present actions, generating actionable milestones with clear TTS targets.

4.1 Milestone Framework

FORGE generates four standard milestones from any crystallised risk’s peak TTS:

- **Containment:** $TTS_{peak} \times 0.7$ – Stop spread, limit growth. The first priority is to prevent the risk from getting worse.
- **Stabilisation:** $TTS_{peak} \times 0.3$ – Halt deterioration. The risk is no longer growing; active management is bringing it under control.
- **Recovery:** $TTS_{baseline} \times 2$ – Return to function. Operations are restored, though not yet at pre-incident performance.
- **Resilience:** $TTS_{baseline} \times 1.2$ – Exceed previous baseline. The organisation emerges stronger than before the incident.

4.2 Required Reduction Rate

$$\text{Rate} = (TTS_{current} - TTS_{target}) / \text{Periods_Remaining}$$

Function: Benchmark for measuring response effectiveness. Rates >5 TTS/period are classified as aggressive. This rate provides the quantitative basis for resource allocation and timeline commitment.

The use of “containment” in FORGE differs from “Freedom” in RADAR. Containment Status measures control level after risk materialises – like entropy reduction returning to equilibrium. Within the emerging risk approach (RADAR) there are multiple options that a risk can take; once it has crystallised (FORGE) the remaining question is how controlled is it. Containment is scalar, not multidimensional.

Example: Data breach at 70% containment: 30% of risk still uncontrolled. Palmer Noise = $0.1 + 0.3 \times (0.30) = 0.19$, giving 19% execution uncertainty.

5. Accountability Metrics

FORGE provides four accountability metrics that make crisis response measurable and improvable:

5.1 Response Effectiveness

$$\text{Response_Efficiency} = \text{Actual_Time} / \text{Required_Time} \quad (\text{Target: } <1.0)$$

A dimensionless ratio comparing actual system response time to the theoretically required response time. Scores above 1.0 indicate the system took longer than required; below 1.0 indicates faster-than-required response. An organisation with consistent Response Efficiency above 1.0 across multiple incidents has a structural problem that requires process, authority, or cultural intervention. **This can be called decision-making inertia.**

5.2 Decision Quality

$$\text{Decision_Quality} = \text{Outcome_Score} / \text{R-TTS_at_decision} \quad (\text{Target: } >0.8)$$

A ratio of achieved outcome quality to the risk severity at the moment the critical decision was made. High R-TTS at decision time means the decision was made under severe pressure; achieving a high Outcome Score despite that pressure indicates genuine decision quality. Decision Quality penalises organisations for making poor decisions when the situation was manageable, and rewards good decisions made under genuine pressure.

5.3 Resource Utilisation

$$\text{Resource_Util} = \text{Deployed} / \text{Available} \quad (\text{Target: } 0.7\text{--}0.9)$$

Below 0.7 suggests either the response was over-resourced or resources are not being deployed effectively. Above 0.9 means the organisation is near its capacity limit with no margin for deterioration. The 0.7–0.9 target zone preserves a 10–30% buffer for unexpected escalation.

5.4 Milestone Achievement

$$\text{Milestone_Rate} = \text{Achieved} / \text{Total} \quad (\text{Target: } >0.85)$$

Did we hit the checkpoints we committed to? A rate below 0.85 is not just a performance indicator – it is a mathematical warning that the final TTS target will not be reached on the committed timeline. This transforms strategic risk response from a best-efforts activity into a governed programme with measurable deliverables.

6. Decision Guidance – Axis 2

Similar to RADAR the FORGE calculation stage has calculated a threat number which represents a relativistic magnitude of how relevant the risk is that we have identified. What we now need to do is interpret this number using other criteria so we can understand how this number relates to me and my company.

This interpretation includes urgency, resilience, and containment index. As always we wish to improve decision quality so there is an independent measure of this which represents an overall improvement in maturity.

6.1 Urgency Index

How urgently does this need attention right now? Not just how bad it is, but how bad it is combined with how fast it is moving, discounted by how much time remains before the impact is locked in.

$$U(t) = R-TTS(t) \times (1 + V(t)) \times (1 - T_remain/T_total)$$

Components: R-TTS provides severity, (1+V) multiplies by velocity factor, and time pressure increases as the deadline approaches. A moderately severe risk with very little time left scores higher on Urgency than a severe risk with plenty of response time remaining.

Urgency Range	Response Mode	Typical Timeframe
$U < 10$	Standard	Days to weeks
$10 \leq U < 50$	Accelerated	Hours to days
$50 \leq U < 200$	Crisis	Immediate to hours
$U \geq 200$	Emergency	All resources deployed

Calculation Example: If R-TTS=25, V=3.0, T_remain=2 months, T_total=12 months: $U = 25 \times (1+3.0) \times (1 - 2/12) = 25 \times 4.0 \times 0.833 = 83.3$. This places the risk in Crisis mode, requiring immediate-to-hours response.

6.2 Resilience Index

Resilience is a company factor and not associated with individual risks or opportunities. A company’s Control Effectiveness, Team Capability, Response Capacity, and System Redundancy describe what the institution can bring to bear on any crisis – they do not change depending on whether the crisis is a cyber breach or a regulatory failure.

Resilience = potential energy – stored capacity to return to equilibrium after perturbation.

Resilience has four measurable components:

6.2.1 Control Effectiveness (CE)

$$CE = 1 - \prod(1 - s_i \times q_i)$$

Enter strength (s) and implementation quality (q) for up to six controls. A control rated 0.80 strength but only 0.40 quality (exists on paper, poorly deployed) contributes only 0.32, not 0.80. The product formula correctly models compound protection from independent control layers.

Calculation Example: Three controls with (s₁=0.8, q₁=0.7), (s₂=0.6, q₂=0.9), (s₃=0.7, q₃=0.5). Effective contributions: 0.56, 0.54, 0.35. CE = 1 - (1-0.56)(1-0.54)(1-0.35) = 1 - (0.44)(0.46)(0.65) = 1 - 0.132 = 0.868.

6.2.2 Response Capacity (RC)

$$RC = (\text{Budget_Available} / \text{Budget_Required}) \times (1 / \text{Decision_Lag_days}) \times \text{Historical_Success_Rate}$$

Captures three independent bottlenecks: funding adequacy, mobilisation speed, and institutional track record. A large budget with a 90-day investment committee approval cycle is worth far less than a smaller budget committable in a week.

6.2.3 Team Capability (TC)

$$TC = (\text{Expertise} / 5) \times (\text{FTE_Deployed} / \text{FTE_Required})$$

A fully staffed expert team gives TC = 1.0. A half-staffed team of mixed capability might give 0.35. This quantifies the execution gap.

6.2.4 System Redundancy (SR)

$$SR = (1 - 1/R_factor) \times \text{MIN}(1, \text{RTO} / \text{ART})$$

Single point of failure gives SR = 0. Three independent pathways give SR = 0.67, further penalised if **Actual Recovery Time** routinely exceeds the stated objective (**Recovery Time Objective**).

6.2.5 Combined Resilience Index

This represents in a single number the combination of all four elements defined as making up the company resilience factor. Weight factors are provided but can be calibrated based on company and sector.

$$RI = 0.35 \times CE + 0.30 \times TC + 0.25 \times RC + 0.10 \times SR$$

Weights reflect empirical importance: controls and execution quality dominate; infrastructure redundancy matters but is compensable.

Calculation Example: CE=0.87, TC=0.70, RC=0.55, SR=0.67. RI = 0.35(0.87) + 0.30(0.70) + 0.25(0.55) + 0.10(0.67) = 0.305 + 0.210 + 0.138 + 0.067 = 0.719. This

indicates a reasonably resilient organisation with room for improvement in response capacity.

6.3 Containment Index

Measures how well the crystallised risk is being controlled during response.

$$CI = RI/10$$

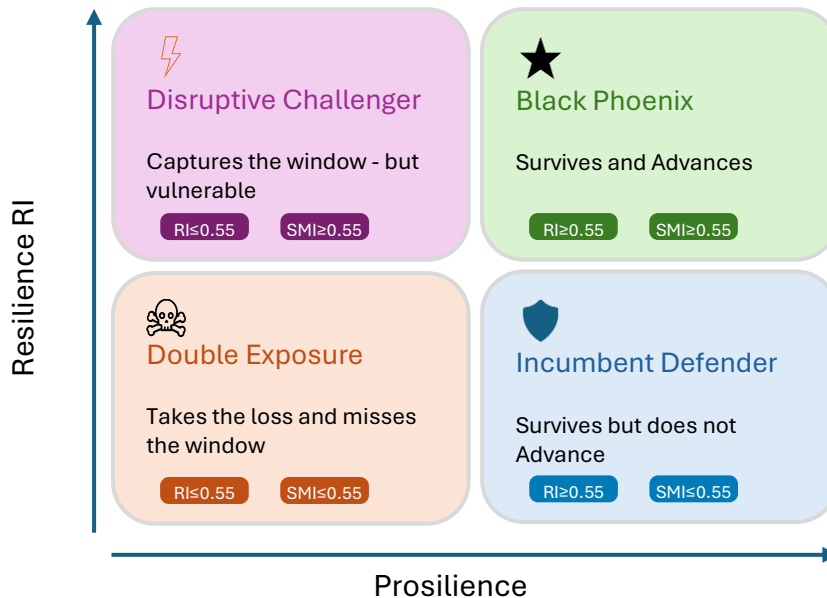
It feeds into the Palmer Noise coefficient and governs milestone pacing in backcasting, but does not recalculate the R-TTS.

$$\text{Palmer noise coefficient } 0.1+0.3 \times (1-CI)$$

Decision Quality Score (DQ) A governance metric across five control dimensions (Ownership, Limits, Assessment, Controls, Monitoring). This is captured in a form input sheet in excel or software program. It is a post-hoc quality check on response decisions, not a formula input.

6.4 Strategic Interpretation

The combination of Resilience Index (RI) and Antifragility (Prosilience) Index (See Section 7) creates four strategic profiles:



6.4.1 Black Phoenix (High RI, High Prosilience)

The organisation absorbs the disruption through high resilience, then captures the strategic opportunity through high kinetic readiness. The same external shock that destroys competitors becomes a growth catalyst. This is the CORE ideal posture.

Canonical Example: Berkshire Hathaway / 2008 Financial Crisis – absorbed no direct losses (high RI), then deployed pre-positioned dry powder to acquire Goldman Sachs preferred shares at 10% and GE bonds at distressed prices (high Prosilience).

6.4.2 Disruptive Challenger (Low RI, High Prosilience)

Strong kinetic energy directed toward the opportunity, successfully capturing strategic value during the disruption. But low resilience means exposure to the next shock.

Canonical Example: Netflix vs Blockbuster – captured the streaming opportunity decisively (high SMI) but carried significant operational risk during the pivot period (low RI).

6.4.3 Double Exposure (Low RI, Low SMI)

The worst strategic position. The organisation suffers full damage (low RI cannot damp the trajectory) while simultaneously failing to capture the opportunity (low Prosilience cannot amplify OTS). The CORE framework's most critical warning state.

Canonical Example: Lehman Brothers / 2008 – collapsed under mortgage exposure with no effective risk controls and no capability to reposition. Both RI and Prosilience were effectively zero at the moment of crystallisation.

6.4.4 Incumbent Defender (High RI, Low SMI)

The organisation weathers the crisis successfully – controls hold, team responds, resources are adequate. But while managing the disruption it fails to recognise or act on the strategic window it creates. It exits the crisis intact but no stronger.

Canonical Example: JPMorgan Chase / 2008 – survived well through strong risk controls (high RI) but did not aggressively reposition to capture post-crisis opportunities (low Prosilience).

7. FORGE Opportunity Score

7.1 Antifragility (Prosilience)

Prosilience is the metric that connects risk management to strategy. When RADAR has identified that a risk or opportunity is no longer ambiguous it is handed over to FORGE. The effectiveness of the company's management system and structure then dictates how much risk is taken or how much of the opportunity is captured. The Prosilience reading tells the board simultaneously: 'Here is our defensive capacity (RI) and here is our offensive capacity to turn this disruption into competitive advantage (Prosilience).'

Where Resilience Index measures defensive capacity (potential energy), Prosilience measures offensive capacity (kinetic energy – energy already in directed motion). An organisation with high RI but low Prosilience is defensively strong but strategically slow. High Prosilience but low RI is the classic disruptor profile.

SMI has four components:

- **Market Positioning Strength (MP):** Are we already in the right place to capture this? In every documented successful opportunity capture, proximity to the disruption was the necessary precondition. Weight: highest (equal with SC).
- **Strategic Capital Availability (SC):** Do we have the money to move, can we release it fast enough, and have we done this before? $SC = (\text{capital_ratio}) \times (1/\text{lag}) \times (\text{track_record})$. Weight: highest (equal with MP).
- **Innovation and Execution Capability (IC):** Can we actually build and deliver what the opportunity requires, fast enough to matter? Slightly lower weight because execution capability can be partially acquired through M&A or partnership within the window timeframe.
- **Strategic Flexibility (SF):** Can the organisation actually change direction when the opportunity requires it? Lowest weight because its presence amplifies the other three, but its absence is usually a symptom of weak IC or SC.

7.2 Value Capture Management Index

When focusing on opportunities, one of the key parameters stressed by the strategy department is value creation. Changing the narrative means utilising and building on the ability to measure and record key learnings.

Risk Concept	Opportunity Equivalent	Interpretation
Containment Status	Capture Status	How much value secured (0–1)
Recovery Index	Value Capture Rate	Velocity of benefit realisation
Residual Risk	Unrealised Potential	Expected $\times (1 - \text{Capture_Status})$
Time to Stability	Time to Full Capture	Expected / Execution_Rate

7.2.1 Capture Status

$$\text{Capture_Status} \in [0, 1]$$

How much of the opportunity have we actually secured so far? At 0.0 the organisation has not yet begun to convert. At 0.70 it has secured 70%. At 1.0 the opportunity has been fully captured. This is the FORGE progress metric for opportunities – the equivalent of containment percentage for active risk management.

7.2.2 Value Capture Rate

$$\text{Value_Capture_Rate} = d(\text{Capture_Status})/dt$$

How fast are we converting this opportunity into secured value? A high rate means the organisation is capturing value faster than expected. A falling rate is the early warning that execution is stalling. A high Capture Status with a declining Capture Rate is the most dangerous combination.

7.2.3 Unrealised Potential

$$\text{Unrealised_Potential} = \text{OTS_expected} \times (1 - \text{Capture_Status})$$

How much of the opportunity are we still leaving on the table? Declining Unrealised Potential at an appropriate rate means the strategy is on track. Static or rising Unrealised Potential despite effort means the capture approach is failing.

Example: Total opportunity value = €50M, Capture Status = 0.60. Unrealised Potential = €50M × 0.40 = €20M. At current Capture Rate, approximately €31M will be secured before the window closes, leaving €19M on the table.

7.2.4 Temporal Opportunity Freedom Index

$$F_{\text{opportunity_temporal}} = 1 - (\text{time_elapsed} / \text{window}) \times (1 - \text{capture_progress})^2$$

How much time and flexibility remains to adapt the capture strategy? Early capture dramatically increases remaining freedom, while delayed action causes the window to close non-linearly. The squared term means organisations that fall behind find that freedom to catch up disappears faster than time does – a 30-day delay in the second month costs more strategic optionality than a 30-day delay in the first month.

7.2.5 Palmer Noise (Opportunity)

$$\sigma_{\text{opportunity}} = 0.1 + 0.3 \times (1 - \text{Capture_Status})$$

How uncertain is the outcome of the opportunity capture effort? In early stages when Capture Status is low, uncertainty is high. As Capture Status rises toward 1.0, uncertainty falls toward the irreducible minimum of 10%. This provides the opportunity-side confidence interval for board reporting.

8. Integration with RADAR©

FORGE© operates with continuous RADAR© support. RADAR© monitors for new emerging risks related to the current crisis, changes in system criticality, entanglement with other risks, and leading indicators of reactivation. If RADAR© detects Phase Index > 2.0 for related risks, it triggers re-evaluation of FORGE milestones.

8.1 Handoff Criteria (RADAR© → FORGE©)

The handoff from RADAR to FORGE is triggered when any two of the following conditions are met:

- EW-TTS > 15 for 2+ consecutive periods
- Ensemble convergence $\sigma/\mu < 0.2$ (uncertainty resolved)
- Freedom Index $F < 0.5$ (strategic options narrowing)
- Velocity variance < 10% over 3 periods

9. Conclusion

FORGE© completes the CORE© framework trilogy by providing the deterministic response management system that translates early warning intelligence into executed strategy. Where RADAR© operates in the domain of uncertainty, ambiguity and detection, FORGE© operates in the domain of clarity, risk and action.

The bounded functions that distinguish FORGE from RADAR are not mere computational conveniences. They reflect a fundamental shift in the management context: once a risk has crystallised, the organisation needs calibrated, stable calculations that support resource allocation and milestone planning, not the amplified sensitivity required for weak-signal detection. The logarithmic velocity compression, capped amplification, soft-capped Lorentz factor, and sigmoid criticality each serve this purpose.

The Resilience Index provides, for the first time, a quantifiable measure of organisational defensive capacity that integrates control effectiveness, team capability, response capacity, and system redundancy into a single, trackable metric. The complementary Antifragility (Prosilience) does the same for offensive capacity, enabling the four-quadrant strategic profiling (Black Phoenix, Disruptive Challenger, Double Exposure, Incumbent Defender) that gives boards a clear picture of their strategic posture during crisis.

The backcasting methodology transforms risk response from a reactive, best-efforts activity into a governed programme with measurable milestones. The Required Reduction Rate provides a mathematical benchmark against which actual progress can be measured, and the accountability metrics (Response Efficiency, Decision Quality, Resource Utilisation, Milestone Achievement) ensure that post-incident learning is based on quantitative evidence rather than narrative judgement.

The opportunity capture framework – Capture Status, Value Capture Rate, Unrealised Potential, and Temporal Opportunity Freedom – extends FORGE's capabilities beyond crisis management into strategic value creation. This addresses the longstanding criticism that enterprise risk management is purely defensive and disconnected from strategy.

Together with CORE© (Part 1) and RADAR© (Part 2), FORGE© provides a complete lifecycle framework: from the theoretical foundation of RiskTime and the TTS/OTS formulations (CORE), through probabilistic early warning detection (RADAR), to deterministic crisis response and opportunity capture (FORGE). This three-part architecture ensures that no risk falls into a gap between detection and action, and that every stage of the risk lifecycle is supported by rigorous, calibrated mathematics translated into practical decision support.

The framework is designed for calibration to specific organisational contexts and industrial sectors. The parameters (α , β , γ , δ , ψ_c , v_{max}) are not fixed constants but calibration points that should be tuned through historical stress testing and validated against the organisation's own experience. This calibration process itself generates

valuable insight into the organisation’s risk dynamics and decision-making effectiveness.

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Notes on Reference Scope: References marked with an asterisk (*) indicate sources specifically used for parameter calibration. Where a reference appears in more than one framework component, this reflects genuine cross-framework applicability.