



# Bridging Strategic Analysis and Maintenance Execution: A Proposed SWOT-AHP Integrated Framework for Accelerating Periodic Overhaul Duration at Coal-Fired Power Plants in the Jamali Grid Region

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**Abstract.** This study aims to formulate a strategic decision-making framework for accelerating periodic overhaul duration in coal-fired power plants without compromising operational reliability. This issue is critical because prolonged overhaul duration in the Jamali-area coal-fired power plant fleet is associated with a decline in the Equivalent Availability Factor (EAF). This study adopts an applied qualitative design by integrating SWOT analysis, the Analytical Hierarchy Process (AHP), Internal Factor Evaluation External Factor Evaluation (IFE/EFE), and the TOWS matrix. Data are designed to be collected through in-depth interviews, pairwise-comparison questionnaires, field observations of overhaul activities, and reviews of performance, outage, operating procedure, and procurement documents. The main outcome is a four-stage framework for identifying internal-external factors, assigning priority weights, evaluating strategic position, and formulating overhaul acceleration strategies. The proposed SWOT AHP framework enables management to prioritize critical factors, including maintenance planning, spare-part readiness, contractor coordination, and resource allocation, thereby improving decision-making effectiveness and strategic focus.

**Keywords:** coal fired power plant; EAF; maintenance strategy; periodic overhaul; SWOT-AHP.

## 1. INTRODUCTION

When electricity demand grows but new power stations do not, the plants already connected to the grid must shoulder a heavier burden and that burden inevitably cascades into their maintenance schedules. Indonesia finds itself in precisely this situation. Between 2020 and 2024, total electricity sales by the state utility PLN expanded from 243.58 million MWh to 306.22 million MWh, propelled by both household consumption (up from 112.16 to 130.43 million MWh) and industrial load (up from 72.24 to 92.20 million MWh) (Directorate General of Electricity, 2024). Over the same five-year window, however, Independent Power Producer investment plummeted from USD 2.38 billion to a mere USD 0.40 billion (Directorate General of Electricity, 2024). The arithmetic is straightforward: a 26-percent rise in demand against an 83-percent collapse in new-build investment leaves existing assets above all, the PLTU fleet that accounts for 19,863 MW of PLN's 47,409 MW total installed capacity (Directorate General of Electricity, 2024) as the primary guarantors of grid reliability.

For a fleet operating under such pressure, periodic overhaul the scheduled full-scope maintenance event during which a unit is taken offline for comprehensive component restoration occupies a paradoxical role. On the one hand, overhaul is indispensable: cumulative degradation of boilers, turbines, generators, and auxiliaries can only be reversed through

planned intervention (Dhillon, 2006). On the other hand, every day a unit sits in overhaul is a day of lost generation and foregone revenue, a trade-off that Verma et al. (2011) characterize as the central dilemma of maintenance management. The metric that captures both sides of this trade-off is the Equivalent Availability Factor (EAF) the share of calendar time during which a unit stands ready for dispatch at full or derated capacity (NERC, 2018). A high EAF signals that maintenance is both effective (the unit runs well when it is on) and efficient (it does not stay offline longer than necessary).

By that standard, the Jamali-area PLTU fleet managed by PT PLN Nusantara Power is moving in the wrong direction. Table 1 summarizes the fleet’s recent track record: EAF slid from 91.29 percent in 2020 to 84.54 percent in 2024, while aggregate overhaul duration expanded from 254 to 513 days over the same period (PLN Nusantara Power OM-1 Performance Report, 2025). The near-mirror-image movement of these two indicators strongly suggests that protracted outage execution rather than unplanned failure is the primary driver of availability loss. Provisional 2025 data offer a tentative confirmation: a shorter aggregate duration of 443 days coincided with an EAF rebound to 88.30 percent, although causality cannot be inferred from two data points alone. The strategic salience of this issue was formally acknowledged at the first-semester 2026 management conference of PLN Nusantara Power’s Coal Operations Directorate, where periodic maintenance acceleration was designated a priority *breakthrough* initiative (PLN Nusantara Power, 2026).

**Table 1.** Fleet-Level Overhaul Duration and EAF, Jamali-Area PLTU (2020–2025).

Year	Aggregate OH Duration (Days)	EAF (%)
2020	254	91.29
2021	561	85.50
2022	456	85.60
2023	465	85.23
2024	513	84.54
2025*	443	88.30

Source: Compiled from PLN Nusantara Power OM-1 Performance Report (2025).

Previous scholarship has tackled maintenance optimization from various angles Verma et al. (2011) modeled turbine-interval decisions using Gamma-process degradation, Setiyawan et al. (2020) married AHP with goal programming for project-selection at a coal plant yet a conspicuous gap persists. Studies that frame overhaul duration as a strategic-management problem, one shaped simultaneously by internal organizational capabilities and external environmental forces, remain rare (Suriyanti et al., 2020). The practical consequence of this

gap is that overhaul planning at many utilities continues to rely on engineering intuition rather than structured, priority-weighted strategic analysis (Dekker, 1996).

This article responds to that gap by proposing a four-stage analytical architecture SWOT factor mapping, AHP priority weighting, IFE/EFE positional evaluation, TOWS strategy matching designed expressly for the problem of periodic maintenance acceleration. Two research questions guide the design: (1) How should an integrated SWOT AHP framework be structured to identify and rank the strategic determinants of overhaul duration? (2) Through what mechanism can those ranked determinants be translated into actionable, sequenced maintenance strategies via the TOWS matrix? A candid note on scope is warranted: because the fieldwork is currently underway, this paper presents the conceptual blueprint and methodological architecture of the framework. Empirical results including factor lists, priority vectors, IFE/EFE scores, and ranked TOWS strategies will be reported in a subsequent publication upon completion of the data-collection phase.

## **2. THEORETICAL FOUNDATIONS**

### **Strategic Management as a Lens for Maintenance Decision-Making**

At its core, strategic management is concerned with aligning organizational resources to environmental realities in pursuit of sustainable competitive advantage. Hitt et al. (2015) frame it as a comprehensive cycle of commitments, decisions, and actions aimed at building strategic competitiveness; David (2011) distills the cycle into three recursive stages formulation, implementation, and evaluation that ensure strategy remains responsive rather than static. Porter (1996) adds a complementary perspective by arguing that genuine strategy demands the creation of a distinctive competitive position through a deliberately chosen configuration of activities. What unites these viewpoints is the insistence that strategic choices are not one-off events but ongoing, evidence-informed processes that require systematic scanning of both internal strengths weaknesses and external opportunities–threats. Periodic overhaul acceleration fits squarely within this paradigm: the decision of how to shorten outage duration without sacrificing reliability engages multiple organizational functions simultaneously procurement, human resources, engineering, finance, and risk management each subject to distinct internal constraints and external contingencies.

## **Maintenance Management in Coal-Fired Power Generation**

The European maintenance standard EN 13306 (2017) conceptualizes maintenance as a life-cycle management function rather than a purely corrective activity, encompassing technical, administrative, and managerial dimensions. Heizer & Render (2014) and Jacobs and Chase (2018) elaborate this view by linking maintenance directly to production continuity, arguing that an organization's ability to sustain uninterrupted output hinges on the effectiveness of its maintenance regime. In a PLTU environment, periodic overhaul represents the most resource-intensive form of scheduled maintenance: the unit must be fully shut down so that boilers, turbines, generators, feedwater systems, coal-handling equipment, and condensers can undergo deep inspection, cleaning, calibration, and component replacement (Goodway, 2026; Dhillon, 2006). Because the unit generates zero output for the entire outage window, every additional day of overhaul translates directly into lost megawatt-hours and depressed EAF. Yet cutting corners to shorten the window risks premature component failure and even costlier unplanned outages. Navigating this tension demands a structured decision framework that can weigh competing objectives speed, quality, cost, safety against one another in a transparent, replicable manner.

## **Operational Performance Measurement in Power Plants**

Slack et al. (2010) propose five generic performance objectives quality, speed, dependability, flexibility, and cost that together define the competitive profile of any operations system. In the specific arena of electricity generation, dependability takes center stage because grid stability hinges on predictable unit availability. The metric that operationalizes dependability for individual generating units is EAF, defined as the proportion of calendar time during which a unit can be dispatched at either full or derated capacity (NERC, 2018). Cross-country benchmarks reveal substantial variation: National Energy Administration of China (2025) reports a 2024 national average of 92.04 percent for coal units above 100 MW, whereas Eskom in South Africa managed only 62 percent in the same year despite targeting 80 (Ahmadi et al., 2024). The Jamali-area fleet's 2024 figure of 84.54 percent occupies an intermediate position above the African benchmark but meaningfully below the Chinese reference, indicating that the fleet possesses structural improvement potential that a well-designed maintenance strategy could unlock.

## **SWOT Analysis: Strengths, Limitations, and the Case for Hybridization**

Few strategic tools enjoy the ubiquity of SWOT analysis. David & David, (2017) position it as the foundational instrument for mapping an organization's internal profile (strengths and weaknesses) against its external landscape (opportunities and threats), and Hitt

et al. (2020) underscore its role as a bridge between environmental scanning and strategy formulation. Empirical evidence confirms its wide reach: Ghazinoory et al. (2011), surveying 557 SWOT-themed publications, found applications spanning corporate planning, national policy, and sectoral analysis. Helms & Nixon (2010), reviewing a decade of peer-reviewed usage, likewise affirmed SWOT's enduring appeal in academic strategy research.

The tool's Achilles' heel, however, is its silence on relative importance. A SWOT matrix can tell a maintenance manager that workforce competency is a strength and spare-part dependency is a weakness, but it cannot tell her which factor deserves more urgent attention or greater resource allocation. Suriyanti et al. (2020) articulate this limitation precisely: SWOT lacks an inherent mechanism for quantifying the relative significance of identified factors or for ranking decision alternatives in a systematic way. It is this very limitation that motivates the integration of SWOT with a quantitative prioritization method specifically, AHP.

### **Analytical Hierarchy Process: Transforming Expert Judgment into Quantified Priorities**

Developed by Saaty during the 1970s, AHP addresses multi-criteria decision problems by decomposing them into a hierarchy of goal, criteria, and alternatives, then eliciting pairwise preference judgments on a nine-point intensity scale (Saaty, 1980). Two properties make AHP particularly well suited to complement SWOT. First, its pairwise-comparison protocol converts qualitative expert assessments "spare-part lead time matters somewhat more than workforce training" into normalized numerical weights, thereby injecting quantitative rigor into what would otherwise remain an impressionistic exercise. Second, the built-in Consistency Ratio (CR) threshold of 0.10 serves as a self-policing mechanism: any comparison matrix that fails the consistency test must be revised before its weights are accepted, safeguarding the logical integrity of the output (Saaty, 1980). Kurttila et al. (2002) were among the first to demonstrate that layering AHP onto SWOT produces a hybrid that outperforms either parent method in analytical depth. Suriyanti et al. (2020) validated the hybrid in a power-generation context, showing that AHP-weighted SWOT factors yield higher-quality strategic plans for operation and maintenance companies by curbing the subjective bias inherent in unweighted factor lists.

### **From Weighted Factors to Positioned Strategies: IFE/EFE and TOWS**

Once factors carry AHP-derived weights, they can be assembled into the Internal Factor Evaluation (IFE) and External Factor Evaluation (EFE) matrices outlined by David & David, (2017). Each factor's weight is multiplied by a responsiveness rating to produce a weighted score; the summation of all internal scores yields an IFE total, and the summation of all external scores yields an EFE total. Scores above 2.5 signal favorable conditions; scores below 2.5 signal vulnerability. These totals jointly define the organization's strategic quadrant on the

Internal–External (IE) matrix, providing a diagnostic snapshot of where the organization stands before any new strategy is adopted.

The final analytical layer is the TOWS matrix, introduced by Wehrich (1982) as a strategy-generation engine that systematically matches internal factors with external factors across four quadrants: SO (exploiting opportunities with strengths), WO (addressing weaknesses through opportunities), ST (countering threats with strengths), and WT (mitigating weaknesses to avoid threats). When combined with AHP weights, the TOWS output can be ranked: strategies whose constituent factors carry the highest aggregate priority receive the top positions, giving decision-makers not just a menu of options but a clear implementation sequence. Suriyanti et al. (2020) demonstrated exactly this sequence SWOT mapping, AHP weighting, IFE/EFE positioning, TOWS formulation in their study of power-plant operation and maintenance strategy, producing three prioritized strategy categories (backward integration, market development, and service development). Oreski (2012) reached a convergent conclusion, arguing that AHP-backed TOWS strategies are more defensible than those generated through unweighted SWOT alone.

### **3. RESEARCH METHODOLOGY**

#### **Rationale for a Four-Stage Architecture**

Accelerating PLTU overhaul is not a single-variable optimization problem. It involves trade-offs among technical readiness, spare-part logistics, workforce deployment, contractor coordination, safety compliance, and external pressures such as grid-dispatch obligations and regulatory constraints. No single analytical instrument can encompass all these dimensions simultaneously. The four-stage architecture proposed here adapted from Suriyanti *et al.* (2020) and tailored to the maintenance-duration context is designed so that each stage compensates for the analytical blind spot of its predecessor. SWOT provides panoramic factor coverage but no ranking; AHP provides ranking but requires a predefined factor set; IFE/EFE provides positional context but no strategy content; TOWS provides strategy content but requires weighted inputs. Chaining the four methods converts their individual limitations into collective strength.

**Table 2.** Four-Stage Analytical Architecture: Logic of Sequential Integration.

Stage	Method	Core Question	Input	Output
1	SWOT	What factors shape overhaul performance?	Interviews, observation, documents	Categorized factor list
2	AHP	How important is each factor relative to others?	Stage 1 factor list + expert pairwise judgments	Priority weight vectors
3	IFE/EFE	Where does the organization currently stand?	Stage 2 weights + responsiveness ratings	Strategic-position coordinates
4	TOWS	Which strategies should be pursued, and in what order?	Stages 1–3 outputs	Ranked strategy alternatives

Source: Author's construct, adapted from Suriyanti et al. (2020).

### Stage 1 Factor Mapping Through SWOT

The opening stage is exploratory and qualitative. Drawing on in-depth interviews with two Vice Presidents (Operations & Maintenance; Reliability), field observation of overhaul activities, and review of internal performance documents, the researcher and key informants will co-construct a comprehensive inventory of strategic factors. Anticipated categories include but are not confined to the following: internal strengths such as accumulated overhaul expertise and integrated asset-management systems; internal weaknesses such as long spare-part procurement cycles and reliance on original-equipment-manufacturer (OEM) components; external opportunities such as performance-linked incentive schemes from the parent utility and the growing maturity of predictive-maintenance technologies; and external threats such as currency volatility affecting imported components, tightening environmental regulations, and the advancing age profile of the fleet's installed base. Crucially, this stage delimits what the relevant factors are without yet pronouncing on how much each one matters a question deferred to Stage 2.

### Stage 2 Priority Weighting Through AHP

Once the factor inventory is finalized, an AHP hierarchy will be constructed with "periodic overhaul acceleration" as the apex goal, the four SWOT categories as second-tier criteria, and specific factors as third-tier sub-criteria. All nine informants spanning policy, functional-management, and technical-operations levels will independently complete pairwise-comparison questionnaires using Saaty's (1980) nine-point scale. Individual comparison

matrices will be aggregated using the geometric-mean method recommended by Forman and Peniwati (1998) to produce a group-consensus matrix. Every aggregated matrix will be tested against the  $CR \leq 0.10$  threshold; matrices that fail will trigger a second round of elicitation with the relevant informants. The resulting priority-weight vectors quantify, for the first time in the analytical sequence, the relative importance of each factor as judged collectively by the expert panel.

### **Stage 3 Positional Evaluation Through IFE and EFE Matrices**

The AHP weights from Stage 2 will populate the weight column of the IFE matrix (for strengths and weaknesses) and the EFE matrix (for opportunities and threats). Each factor will additionally receive a responsiveness rating on a 1-to-4 scale reflecting how effectively the organization currently addresses that factor. The product of weight and rating yields a weighted score; the sum across all factors in each matrix yields a total IFE score and a total EFE score. Following the interpretive convention of David & David, (2017), totals above 2.5 indicate a favorable internal or external posture, while totals below 2.5 indicate areas of concern. The paired IFE–EFE coordinates will be plotted on the Internal External (IE) matrix to identify the strategic quadrant that best characterizes the organization’s current readiness for maintenance acceleration.

### **Stage 4 Strategy Formulation and Ranking Through TOWS**

The culminating stage feeds all preceding outputs into the TOWS matrix. Following Wehrich’s (1982) matching logic, strengths are paired with opportunities to produce SO strategies (aggressive, capability-leveraging actions), weaknesses are paired with opportunities to produce WO strategies (remedial actions exploiting favorable conditions), strengths are paired with threats to produce ST strategies (defensive actions drawing on existing capabilities), and weaknesses are paired with threats to produce WT strategies (damage-limitation actions). The distinctive feature of this framework is that each generated strategy inherits a quantitative priority score derived from the AHP weights of its constituent factors. Ranking strategies by aggregate score transforms the TOWS output from a flat menu into a prioritized implementation roadmap answering not only what the organization could do, but which actions deserve first claim on finite managerial attention and resources.

### **Research Design, Site, and Informant Architecture**

The study adopts an applied qualitative design consistent with Bell et al. (2019) definition of research directed at solving a specific managerial problem. The research site is PT PLN Nusantara Power, headquartered in Surabaya, which manages the Jamali-area PLTU fleet with a combined installed capacity of 3,991 MW. Data collection spans January through

June 2026 and proceeds through four complementary instruments: semi-structured depth interviews (targeting the two VP-level informants), AHP questionnaires (administered to all nine informants), field observation of ongoing overhaul activities, and systematic review of internal documents (three-year performance reports, EAF logs, outage records, standard operating procedures, procurement contracts).

The nine informants are organized into three tiers to ensure that strategic, functional, and operational perspectives are all represented. The first tier (strategic policy) comprises the VP of Operations & Maintenance and the VP of Reliability; the second tier (functional management) comprises the corporate-level managers of Outage, Maintenance, Operations, and Reliability; the third tier (technical operations) comprises the plant-level managers of Maintenance, Reliability, and Operations. This three-tier architecture follows the multi-stakeholder logic advocated by Suriyanti et al. (2020), who emphasized that strategy quality in the power-generation context depends on integrating assessments from individuals who occupy different positions along the decision-implementation chain.

#### **Validity Safeguards: Triangulation Design**

Methodological credibility rests on three interlocking triangulation dimensions (Moleong, 2018; Creswell & Creswell, 2018). Source triangulation cross-references information from nine informants occupying three organizational tiers and validates verbal claims against documentary evidence such as outage logs and procurement records. Method triangulation converges four data-collection techniques interviews, AHP questionnaires, field observation, and document review so that a finding supported by only one technique is flagged for further verification rather than accepted at face value. Theory triangulation interprets emerging findings through multiple conceptual lenses, including the strategic-management framework of David (2011), the sustainable-operations perspective of Suriyanti et al. (2020), and the axiomatic properties of AHP (Saaty, 2008), thereby guarding against single-theory confirmation bias.

## **4. DISCUSSION**

### **What the Secondary Data Already Reveal**

Although the empirical application of the proposed framework has not yet been executed, the secondary data assembled during the research-design phase already furnish a meaningful preliminary diagnosis. The five-year trajectory shown in Table 1 exhibits a pattern that is difficult to attribute solely to equipment aging: overhaul duration nearly doubled

between 2020 and 2024, whereas EAF declined by roughly seven percentage points. If deteriorating equipment were the sole culprit, one would expect unplanned outages not planned overhaul duration to be the primary driver of availability loss. The fact that *planned* maintenance windows are expanding suggests that the root causes lie in the *management* of the overhaul process: scheduling inefficiencies, protracted procurement timelines, workforce bottlenecks, contractor-coordination gaps, or some combination thereof. The 2025 provisional reversal shorter duration, higher EAF tentatively reinforces this interpretation, though a single year of improvement cannot establish causality. These preliminary observations provide the empirical motivation for the proposed framework and shape the research propositions articulated below.

### **Research Propositions**

Three testable propositions have been formulated to guide the forthcoming empirical phase. They are grounded in the literature reviewed in Section 2 and informed by the secondary data presented in Table 1. Each proposition will be evaluated against the framework's outputs once fieldwork is complete; they are advanced here as informed theoretical expectations, not as foregone conclusions.

Proposition 1. The SWOT mapping will reveal that managerial and logistical factors including spare-part procurement lead time, maintenance-planning system maturity, and workforce deployment practices rank among the most critical determinants of overhaul duration, outweighing purely technical equipment-condition variables. *Rationale:* If equipment degradation were the dominant factor, it would manifest primarily through unplanned outages rather than through elongated planned maintenance windows. The observed pattern suggests managerial rather than mechanical causation.

Proposition 2. AHP pairwise comparisons will yield internally consistent priority vectors ( $CR \leq 0.10$ ) in which internal-weakness sub-factors receive higher aggregate weights than external-threat sub-factors. *Rationale:* Overhaul duration is substantially within the organization's sphere of influence; external threats (currency fluctuation, regulatory change) constrain but do not directly determine how long a unit stays offline.

Proposition 3. Among the four TOWS quadrants, SO strategies those that deploy existing organizational strengths to exploit external opportunities will receive the highest aggregate priority ranking. *Rationale:* The fleet already possesses valuable assets (experienced personnel, established vendor relationships, performance data) whose potential is not yet fully activated; the most impactful acceleration moves are therefore likely to be those that unlock latent capability rather than those that attempt to build capability from scratch.

### **Anticipated Contributions**

The study is designed to deliver value on two fronts. On the theoretical front, it extends the SWOT AHP integration validated by Kurttila et al. (2002) in forestry and by Suriyanti et al. (2020) in power-generation business strategy into a neighboring but distinct domain: the operational-level problem of overhaul-duration management. By demonstrating how the same analytical architecture can be repurposed from business-strategy formulation to maintenance-execution strategy, the study broadens the applicability envelope of the SWOT AHP paradigm and offers a methodological template that scholars in other capital-intensive industries (petrochemicals, mining, transportation) may adapt to analogous challenges.

On the practical front, the framework is engineered to replace intuition-driven overhaul planning with a transparent, priority-weighted decision process. If the propositions hold, the resulting strategy roadmap will enable Jamali-area PLTU management to channel resources toward the factors that expert consensus identifies as most consequential, shorten overhaul windows in a targeted manner, and ultimately recover several percentage points of EAF each of which translates into additional megawatt-hours of dispatchable generation for the Jawa Madura Bali interconnected grid. For policy-makers and sector regulators, the identification of critical external factors (regulatory constraints, supply-chain dynamics, long-term contractual opportunities) may inform the design of more supportive frameworks for maintenance optimization across the national fleet.

### **Scope Boundaries and Acknowledged Limitations**

Several boundaries should be noted. First, as a conceptual paper, this article does not report empirical results; the propositions advanced above require validation through the fieldwork currently in progress. Second, the scope is confined to pulverized-coal (PC) boiler-type PLTU units in the Jamali service area; generalization to other combustion technologies (gas turbines, combined-cycle) or geographic regions would require separate investigation. Third, reliance on expert judgment introduces inherent subjectivity, although the AHP consistency test and three-tier triangulation design are engineered to constrain this risk. Fourth, external variables such as meteorological conditions, real-time grid-load fluctuations, and macroeconomic shocks are acknowledged as contextual influences but are excluded from the analytical scope in order to maintain methodological focus on the factors that the organization can directly manage.

## 5. CONCLUSION

This article has presented the conceptual architecture of an integrated SWOT AHP IFE/EFE TOWS framework tailored to the problem of accelerating periodic overhaul duration at coal-fired power plants. The motivation is both empirical and theoretical: on the empirical side, a documented decline in the Jamali-area fleet's EAF from 91.29 percent (2020) to 84.54 percent (2024), moving inversely with ballooning overhaul durations, signals that maintenance-execution management not equipment condition alone constitutes the primary improvement lever. On the theoretical side, the strategic-management literature has paid surprisingly little attention to overhaul acceleration as a structured decision problem, leaving practitioners without the analytical scaffolding that other strategic domains take for granted.

The proposed four-stage sequence addresses these shortcomings by channeling SWOT's breadth of factor coverage through AHP's quantitative rigor, contextualizing the resulting weights via IFE/EFE positioning, and generating a ranked portfolio of strategies through TOWS matching. Three research propositions have been formulated to guide the forthcoming empirical phase, each grounded in the observed data pattern and in the theoretical literature. The fieldwork involving nine expert informants across three organizational tiers at PT PLN Nusantara Power will test these propositions and produce the factor inventories, priority vectors, positional scores, and strategy rankings that this conceptual paper has laid the groundwork for.

Looking beyond the immediate study, the framework opens several avenues for future research. Incorporating fuzzy-set extensions into the AHP stage could accommodate the inherent imprecision of linguistic expert judgments more gracefully. Layering Monte Carlo simulation onto the priority-weighting stage would yield probability distributions rather than point estimates, enabling risk-adjusted strategy selection. Longitudinal replication across successive overhaul cycles would permit researchers to assess whether the prioritized strategies translate into measurable, sustained EAF gains. Finally, comparative application to PLTU fleets in different regulatory or geographic environments or to non-coal generation technologies would test the framework's generalizability and clarify its boundary conditions.

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