

# A Strategic Framework for Selecting Logistics Service Providers in Heavy Manufacturing Using the Analytic Hierarchy Process (AHP)

A Leading Power Electronics Manufacturer

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**Abstract:** Selecting an appropriate logistics service provider (LSP) is among the most consequential decisions facing manufacturers of heavy industrial equipment. Unlike standard consumer goods sectors, organizations that produce high-capacity uninterruptible power supply (UPS) systems must contend with specialized cargo handling requirements, elevated transportation costs, regulatory compliance, and sustainability pressures — all of which compound the complexity of provider evaluation. This study develops and applies an Analytic Hierarchy Process (AHP) framework to guide LSP selection at Case Company, a subsidiary of the Legrand Group operating out of Chennai, India. Five decision criteria — compatibility, delivery performance, cost efficiency, management quality, and locational advantage — are identified through managerial interviews and a review of the supply chain decision-making literature. Two shortlisted providers, DP World and SafeExpress, are evaluated against these weighted criteria. The AHP computation yields a final composite score of 0.6519 for DP World against 0.3481 for SafeExpress, with all consistency ratios remaining well below the acceptable threshold of 0.10. Beyond the numerical result, the study highlights how structured multi-criteria decision-making transforms subjective managerial judgment into a transparent, auditable process. Practical implications for logistics managers, and directions for extending the model to additional criteria and alternative providers, are discussed.

**Keywords:** Analytic Hierarchy Process, Logistics Service Provider Selection, Supply Chain Management, Heavy Manufacturing, Outsourcing, SWOT Analysis, Case Company.

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## I. INTRODUCTION

Modern supply chain management has moved decisively beyond the view that logistics is merely a cost centre. In capital-intensive manufacturing sectors, particularly those dealing with heavy, high-value, or technically sensitive products, the choice of a logistics partner bears directly on customer satisfaction, brand reputation, and bottom-line performance. Industrial power solutions — encompassing large-scale UPS systems, transformers, battery banks, and power conditioning modules — represent a segment where these pressures converge with particular intensity.

The power electronics industry in India has expanded significantly over the past two decades, driven by infrastructure spending, the proliferation of data centres, rapid urbanisation, and increasing demand from healthcare and telecommunications sectors. Each of these end-markets

demands uninterrupted, high-quality power supply, and the OEMs that serve them must, in turn, guarantee impeccable delivery performance for equipment that can weigh several hundred kilograms per unit. Against this backdrop, the selection of an LSP is not a routine procurement exercise but a strategic commitment with multi-year implications.

Case Company, a well-established Indian manufacturer of industrial power systems and a member of the Legrand Group, provides an ideal organizational lens through which to examine this challenge. The company distributes UPS systems of varying capacities to customers across India, relying on third-party transportation and warehousing partners to bridge the gap between its manufacturing facility in Chennai and geographically dispersed end-users. The logistics function must therefore balance cost containment with the service levels demanded by mission-critical customers who cannot afford delivery disruptions.

This paper makes two principal contributions. First, it constructs a five-criterion AHP decision model grounded in real managerial preferences elicited from Case Company's production and logistics head. Second, it applies that model to produce a ranked comparison between two competing providers — DP World and SafeExpress — thereby demonstrating how a quantitative decision tool can translate diffuse, often tacit knowledge into a structured and replicable evaluation process. The remainder of the article is organized as follows: Section 2 reviews relevant literature; Section 3 describes research methodology; Section 4 presents SWOT and AHP analyses; Section 5 interprets findings and offers recommendations; Section 6 concludes.

## II. LITERATURE REVIEW

### ➤ *Logistics Outsourcing and LSP Selection*

The strategic rationale for outsourcing logistics has been examined extensively since the early 1990s. Organizations that choose to rely on external providers typically do so to redirect managerial attention toward core competencies, gain access to specialized infrastructure without incurring capital expenditure, and benefit from the scale economies that large logistics firms are able to offer (Razzaque & Sheng, 1998). However, the productivity gains from outsourcing are contingent on selecting a provider whose capabilities genuinely match the user organization's operational requirements — a condition that is far from automatic.

Hertz and Alfredsson (2003) draw a useful distinction between transactional and relational modes of logistics outsourcing. Transactional relationships are governed primarily by price and are easily reversible, whereas relational partnerships involve deeper integration of systems, shared performance targets, and mutual investment in operational improvements. Heavy manufacturing firms, whose logistics requirements tend to be non-standard and whose switching costs are high, are generally better served by the relational model — yet identifying a provider capable of sustaining such a partnership demands a rigorous screening process that goes well beyond cost comparison.

Jharkharia and Shankar (2007) proposed a nine-step methodology for LSP selection that encompasses team formation, requirements specification, provider identification, request-for-proposal evaluation, field visits, and contract finalization. They observed that companies frequently collapse these stages into an ad hoc negotiation, sacrificing analytical rigour in favour of speed. Their work, along with that of Gol and Catay (2007), underlines the importance of using multi-criteria decision-making (MCDM) tools to impose structure on a process that is inherently subjective.

### ➤ *The Analytic Hierarchy Process in Logistics Decision-Making*

Saaty (1980) introduced the Analytic Hierarchy Process as a means of decomposing complex decisions into a layered structure of criteria and alternatives, enabling decision-makers to express preferences through pairwise comparisons

rather than direct scoring. The AHP approach has since been applied in a remarkably diverse range of contexts, from energy policy to hospital management, but its adoption in logistics and supply chain research has been particularly vigorous.

Chan and Chan (2004) demonstrated that AHP can be integrated with quality management criteria to guide supplier selection in manufacturing environments. Zaim, Sevkli, and Tarim (2003) applied AHP to warehouse location decisions, while Aguezzoul (2014) conducted a comprehensive meta-analysis of MCDM applications in 3PL selection and found AHP to be the most frequently employed technique. The appeal of AHP rests on three core properties: it accommodates both tangible and intangible criteria within the same evaluation; it quantifies the internal consistency of decision-makers' judgments through the Consistency Ratio (CR); and it generates priority weights that are intuitive and defensible to non-technical stakeholders.

Limitations of the method have also been noted. The standard AHP assumes independence among criteria, an assumption that may not hold when, for example, a provider's locational advantage simultaneously affects both cost and delivery performance. Researchers have responded by extending the framework to the Analytic Network Process (ANP), which allows for interdependencies, though at the cost of considerably greater computational complexity (Saaty, 1996). For the present study, which involves five criteria and two alternatives, the standard AHP model is both appropriate and sufficient.

### ➤ *Criteria for LSP Evaluation*

A recurring finding in the LSP selection literature is that cost, though salient, is rarely the dominant criterion for industrial buyers. Delivery reliability, service quality, flexibility, and the provider's capacity to integrate with the user's information systems consistently emerge as equally or more important (Langley et al., 2002; Boyson et al., 1999). Compatibility — broadly defined as strategic and cultural alignment between user and provider — has been flagged by Mohanty and Deshmukh (1993) as a prerequisite for the collaborative working relationship that complex logistics environments demand.

Management quality, encompassing the professionalism of the provider's leadership, the sophistication of its operational procedures, and its track record of service improvement, is particularly relevant for heavy manufacturing logistics, where non-standard handling requirements necessitate a capable and responsive partner organization. Location, often underweighted in theoretical models, assumes practical significance when transport distances are long, road infrastructure is variable, and the lead times associated with urgent delivery requests need to be minimized.

### ➤ *Decision-Making in Marketing and Operations Contexts*

While this study focuses on operational logistics, it is worth noting that the broader literature on organizational decision-making reveals consistent patterns relevant to LSP

selection. Researchers such as Stumpf and London (1981) highlight that managerial decisions in complex environments are shaped not only by objective criteria but also by organizational culture, decision-maker experience, and the degree to which supportive analytical systems are available. Simon's (1957) concept of bounded rationality — the idea that managers operate with incomplete information and cognitive limitations — further underscores the value of structured decision tools in reducing the risk of suboptimal choices driven by heuristic shortcuts.

This theoretical backdrop aligns with a parallel body of work on marketing decision-making. Gura and Gura (2018), in their study of promotional mix decisions at a major Albanian telecommunications company, observed that marketing executives who rely on well-defined analytical frameworks — rather than intuition alone — produce more consistent and strategically coherent outcomes. Their finding that the ultimate goal of any business decision, whether promotional or logistical, is to create sustainable value provides a unifying perspective that transcends functional boundaries.

### III. RESEARCH METHODOLOGY

#### ➤ Research Design

This study adopts a single-case exploratory design, treating Case Company as a purposively selected organizational context. The case study approach is well-suited to situations in which the research objective is to understand a complex, real-world phenomenon within its natural setting, and in which precise quantitative generalisation is less important than the richness and actionability of insight (Yin, 1994). The decision to focus on a single company is further justified by the depth of primary data required to populate the AHP model with credible, organization-specific pairwise comparisons.

The study integrates qualitative and quantitative methods. Qualitative data — gathered through structured interviews with the company's Production and Logistics Manager, direct observation of warehouse and dispatch operations, and review of internal documentation — informs the choice of decision criteria and provides context for interpreting AHP results. Quantitative analysis takes the form of the AHP computation itself, which converts managerial judgments expressed on Saaty's 1–9 scale into priority weights and composite provider scores.

#### ➤ Data Collection

Primary data were collected over a six-week internship period at Case Company's Chennai manufacturing and distribution site. Semi-structured interviews were conducted with the Production and Logistics Manager, who has more than twelve years of experience in the company's supply chain operations and was directly involved in the original LSP selection decision. Interview questions were designed to elicit the relative importance of competing selection criteria as well as comparative assessments of the two shortlisted providers.

Secondary data sources included academic journals, published case studies, World Bank logistics performance indices, and the company's own logistics performance reports. The two candidate LSPs — DP World, an international logistics operator with a significant pan-India footprint, and SafeExpress, a domestic express logistics specialist — were assessed on the basis of information provided by the logistics manager supplemented by publicly available service capability data.

#### ➤ AHP Computational Procedure

The AHP procedure followed the four-step framework recommended by Tam and Tummala (2001): (i) structuring the decision hierarchy; (ii) constructing pairwise comparison matrices; (iii) computing Eigenvectors and verifying consistency; and (iv) synthesizing global priority scores for each alternative. The decision hierarchy comprised three levels — overall goal, five selection criteria, and two provider alternatives. All pairwise judgments were provided by the Logistics Manager and entered into a 5×5 comparison matrix for the criteria level and three 2×2 matrices for each set of alternative comparisons.

Consistency was verified using the Consistency Ratio formula  $CR = CI / RI$ , where  $CI = (\lambda_{max} - n) / (n - 1)$  and  $RI$  is the average random consistency index for a matrix of order  $n$ . Per Saaty's (1980) guidelines, a  $CR$  below 0.10 is considered acceptable. All matrices in this study satisfied this condition, providing confidence in the reliability of the elicited judgments.

### IV. ANALYSIS AND FINDINGS

#### ➤ SWOT Analysis of Logistics Modes

Before applying the AHP model, a strategic-level SWOT analysis was conducted to compare self-built and outsourced logistics configurations. This analysis draws on data from both the organizational interviews and the broader logistics outsourcing literature.

Table 1 SWOT Comparison — Self-Built vs. Outsourced Logistics at Case Company

Dimension	Self-Built Logistics	Outsourced Logistics
Strengths	Full operational control; direct customer feedback loop; custom handling capability	Access to specialist infrastructure; cost variabilization; management bandwidth freed
Weaknesses	High fixed asset investment; limited scalability; management complexity	Dependency on provider performance; information asymmetry; switching costs
Opportunities	Build proprietary logistics competency; enhance customer loyalty through direct service	Leverage provider network growth; focus capital on core manufacturing R&D

Threats	Rising fuel costs; driver shortage; road infrastructure constraints	Provider opportunism; service inconsistency during peak periods; regulatory changes
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The SWOT analysis reveals that neither mode is unambiguously superior. Self-built logistics confers control but demands substantial investment in assets and capabilities that lie outside Case Company's core competency. Outsourced logistics offers flexibility and cost efficiency but introduces principal-agent risks that can only be managed through careful provider selection and ongoing performance monitoring. The company's current approach — maintaining its own warehouse facility while outsourcing primary transportation — represents a pragmatic hybrid that captures elements of both. This mixed model reduces exposure to peak-period capacity shortfalls while preserving operational visibility over inventory.

➤ *AHP Criteria Prioritization*

Five criteria emerged from the managerial interview as the primary drivers of LSP evaluation at Case Company: compatibility (the alignment of the provider's systems, culture, and service philosophy with the company's requirements), cost efficiency (total logistics expenditure relative to service delivered), management quality (leadership, process maturity, and continuous improvement orientation), delivery performance (on-time and damage-free delivery rates), and location (proximity to the manufacturing site and key customer clusters).

Table 2 Pairwise Comparison Matrix — Selection Criteria

Criterion	Compatibility	Cost	Management	Delivery	Location
Compatibility	1	5	7	1	2
Cost	1/5	1	1	1/3	1/5
Management	1/7	1	1	1/5	1/2
Delivery	1	3	5	1	2
Location	1/2	5	2	1/2	1

Table 3 Derived Priority Weights for Selection Criteria

Selection Criterion	Eigenvector Weight	Rank
Compatibility	0.3606	1st
Delivery Performance	0.3090	2nd
Location	0.1949	3rd
Cost Efficiency	0.0689	4th
Management Quality	0.0666	5th

The consistency verification for the criteria matrix yields  $\lambda_{max} = 5.0006$ ,  $CI = 0.00015$ , and  $CR = 0.000134$ , comfortably within the acceptable threshold. The weights reveal that compatibility and delivery performance together account for approximately 67% of the total decision weight, signalling that Case Company prioritizes operational alignment and service reliability over pure cost considerations. This finding is consistent with the literature on industrial buyer behaviour, which shows that procurement decisions for high-value, technically sensitive goods are governed primarily by reliability and fit rather than price alone (Boyson et al., 1999).

The relatively modest weight assigned to management quality (6.66%) should not be interpreted as irrelevance; rather, it reflects the logistics manager's view that management capability is a threshold criterion — providers that fall below a minimum standard are screened out before the formal AHP evaluation — rather than a differentiating one among pre-qualified candidates.

➤ *Alternative Evaluation and Final Selection*

Table 4 Pairwise Comparisons of Alternatives by Criterion

Criterion	DP World vs. SafeExpress	DP World Weight	SafeExpress Weight	CR
Compatibility	DP World strongly preferred (7:1)	0.875	0.125	0.000
Cost Efficiency	Equal preference (1:1)	0.500	0.500	0.000
Management Quality	DP World moderately preferred (3:1)	0.750	0.250	0.000
Delivery Performance	Equal preference (1:1)	0.500	0.500	0.000
Location	Equal preference (1:1)	0.500	0.500	0.000

DP World's dominant advantage on compatibility reflects its existing integration with Case Company's ERP system, its experience handling heavy electrical equipment, and its proven capacity to provide dedicated vehicle allocation during peak production periods. SafeExpress,

while competitive on cost and delivery timelines for standard shipments, lacks the specialized handling infrastructure and the account management depth that the company's logistics profile demands.

Table 5 Final Composite Scores — AHP Result

Provider	Composite AHP Score	Rank	Verdict
DP World	0.6519	1st	Recommended LSP
SafeExpress	0.3481	2nd	Secondary Option

The composite score calculation follows the standard AHP synthesis: multiplying each criterion weight by the corresponding alternative weight and summing across all criteria. DP World achieves 0.6519 versus SafeExpress's 0.3481, confirming the validity of the company's actual selection decision while also demonstrating that the AHP framework would have generated the same recommendation had it been applied prospectively.

## V. DISCUSSION AND MANAGERIAL IMPLICATIONS

### ➤ *Interpreting the AHP Outcome*

The AHP result is not simply a confirmation of an existing preference. Rather, it renders that preference transparent and traceable — a property with considerable organizational value. When logistics partnerships are renegotiated, when performance disputes arise, or when macroeconomic shifts alter the relative importance of cost versus service, the weighted criteria model provides a stable reference point for reassessment. Managers who can articulate why their chosen provider was selected, in terms of weighted criteria and documented comparisons, are better positioned to manage those partnerships strategically over time.

The finding that compatibility is the single most heavily weighted criterion warrants further reflection. In the power solutions industry, where delivery often requires coordination of specialist craning equipment, site access permissions, multi-person installation teams, and safety compliance documentation, a logistics partner that understands and anticipates these requirements is genuinely worth a premium. The AHP model captures this intuitively-held belief and gives it a quantitative expression.

### ➤ *Extending the Framework*

The five-criterion, two-alternative model developed here is intentionally parsimonious, matching the informational context available during the study period. Future applications of the framework at Case Company could usefully incorporate additional criteria, including sustainability performance (carbon emissions per tonne-kilometre), IT capability (real-time tracking and electronic documentation), financial stability (creditworthiness and insurance coverage), and reverse logistics capability (battery collection and end-of-life equipment handling).

Adding more alternatives — whether through market entry of new providers or geographic expansion of the company's operations — would increase the discriminative power of the model without changing its fundamental structure. The four-step AHP procedure scales readily to larger matrices, provided that the number of pairwise comparisons remains manageable (generally no more than

seven to nine criteria per level is recommended to preserve cognitive tractability).

### ➤ *Sustainability Considerations*

A recurring theme in the industry background is the tension between sustainability aspirations and the operational realities of heavy cargo transport. Electric and CNG-powered commercial vehicles, while environmentally attractive, currently face payload limitations that make them unsuitable for transporting large UPS systems without significant modification. The AHP framework can assist here too: by including a sustainability criterion and weighting it according to corporate policy, managers can evaluate providers not only on today's service capabilities but on their roadmap toward greener operations.

DP World's global sustainability commitments and its investments in alternative-fuel fleet technologies make it a more credible long-term partner for Case Company as the Legrand Group pursues its stated environmental targets. This factor, while not formally included in the present model, would likely reinforce the existing recommendation if incorporated in a future iteration.

### ➤ *Connecting Operational and Strategic Decision-Making*

The parallels between LSP selection and other organizational decision contexts are instructive. Gura and Gura (2018), studying promotional decision-making in the Albanian telecommunications sector, note that structured frameworks reduce the risk of decisions being made "for the sake of activity rather than for strategic purpose." The same risk exists in logistics outsourcing: without a systematic evaluation framework, organizations may default to renewing existing provider contracts simply because changing is complicated, rather than because the current provider remains the best available option.

The lesson that emerges across both contexts — whether choosing a logistics partner or designing a promotional campaign — is that the quality of organizational decisions improves when managers combine analytical rigour with domain-specific knowledge. The AHP model, properly calibrated to the organization's strategic priorities, provides precisely the kind of structured analytical support that mitigates the bounded rationality constraints identified by Simon (1957) and ensures that decision outcomes reflect intentional strategy rather than organizational inertia.

## VI. CONCLUSION

This study has developed and applied an AHP-based framework for logistics service provider selection in the heavy industrial UPS manufacturing sector. Drawing on primary data from Case Company, Group of Legrand, it has demonstrated that the AHP method can successfully translate

expert managerial judgment into a structured, transparent, and computationally rigorous selection decision.

The analysis identified compatibility and delivery performance as the dominant selection criteria, collectively accounting for approximately 67% of the total decision weight. DP World emerged as the preferred provider with a composite score of 0.6519, supported by its superior compatibility rating and moderate advantage on management quality. All consistency ratios fell well within acceptable limits, confirming the reliability of the elicited judgments.

Beyond the specific case, the study contributes a replicable methodological template that logistics managers in similar industries can adapt to their own provider selection challenges. It also highlights the strategic value of making the LSP selection process explicit and systematic: an organization that knows why it chose a particular provider is better equipped to manage, renew, or revise that partnership as market conditions evolve.

Future research directions include the application of a hybrid AHP-ANP model to capture interdependencies among criteria, the incorporation of sustainability metrics as formal evaluation criteria, and longitudinal tracking of provider performance against the pre-selection expectations encoded in the AHP weights. As India's power solutions sector continues to grow and as logistics markets become more complex, the need for rigorous, evidence-based provider evaluation will only intensify.

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