

SUPPLIER SELECTION OPTIMIZATION UNDER DEMAND AND DELIVERY UNCERTAINTY USING EXCEL-BASED DECISION TREE MODELING

1. Project Background and Objective

A mid-sized **UK-based electronics distributor** faced rising variability in component delivery timelines and prices across its three key suppliers. The procurement team needed to decide which supplier would be most profitable **under uncertain demand and risk of late delivery**.

Objective: Use **Excel-based decision tree analysis** to determine the most cost-effective supplier while factoring in demand fluctuation and late delivery penalties.

2. Decision Context and Variables

Decision Alternatives:

- **Supplier A:** High reliability, high cost
- **Supplier B:** Moderate cost, moderate risk
- **Supplier C:** Low cost, high risk

Uncertainties Modeled:

- **Customer Demand:** High or Low
- **Delivery Timeliness:** On-time or Delayed
- **Penalty for Delay:** Fixed £2,000 per order

Payoff Components:

- Unit purchase cost
- Order volume based on demand scenario
- Penalty cost if delayed
- Revenue margin per unit

3. Excel Modeling Structure

Tools Used:

- Excel's IF and NPV functions

- Embedded formulas for conditional costs
- Manual decision tree logic structure
- Scenario-based payoff table

Structure:

- **Nodes:** Decision → Chance → Outcome
- **Branches:** Probabilistic states (e.g., 60% chance of high demand)
- **End Nodes:** Payoff calculated using:

$$\text{Profit} = (\text{Units Sold} \times \text{Margin}) - (\text{Units Ordered} \times \text{Cost}) - \text{Penalty (if any)}$$

4. Input Assumptions

Parameter	Value (Default Scenario)
High Demand	1,000 units (60% chance)
Low Demand	500 units (40% chance)
Revenue per Unit	£100
Penalty for Late Delivery	£2,000
Probability of Delay	A: 5%, B: 15%, C: 30%
Cost per Unit	A: £80, B: £70, C: £60

5. Sample Excel Decision Tree Output

Expected Monetary Value (EMV):

Supplier	EMV (£)
A	17,500
B	18,700
C	16,200

Explanation:

- Supplier B offers the highest EMV despite a moderate risk of delay.
- Supplier A is safest but expensive.

- Supplier C's high risk outweighs its low cost in this scenario.

6. Sensitivity Analysis

Performed using Excel's **Data Table** and **What-If Analysis**, testing:

- Delay penalty from £1,000 to £5,000
- Change in probability of demand or delay
- Margin fluctuations

Insight: If penalty > £3,000 or delay probability rises >20%, Supplier A becomes the safer choice. This guided scenario-based procurement planning.

7. Deliverables Provided

- Excel workbook with:
 - Interactive decision tree
 - Adjustable probability and cost inputs
 - EMV calculator for each supplier
- Visualized decision tree (SmartArt + formulas)
- Sensitivity dashboard using data tables
- PDF report summarizing logic, assumptions, recommendations
- 1-slide summary for internal stakeholder presentation

8. Decision Recommendation and Outcome

- Proceed with **Supplier B** for the upcoming cycle
- Negotiate late-delivery penalty protections
- Monitor demand in real-time to re-adjust next quarter
- Created a reusable Excel framework for other product categories

9. Stakeholder Relevance

- **Corporate Application:** Useful for sourcing, logistics, and category management teams
Enables scenario planning without specialized software

- **Academic Utility:** Applicable in decision science, operations management, and MBA analytics courses as a hands-on Excel exercise

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