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Supply Chain Optimization

HIGH-END MEDICAL IMAGING EQUIPMENT

Introduction

High-end medical imaging equipment, such as MRI, PET-CT, and robotic surgery systems, is among the most advanced products in the global healthcare industry. These devices comprise thousands of precision parts sourced and manufactured across multiple continents. Their supply chains involve unique challenges in sourcing, quality control, logistics, regulation, and after-sales service. Optimizing the supply chain for such products is crucial to reduce costs, enhance reliability, ensure compliance, and improve patient access worldwide.

Importance of this problem

Cost savings	Reduce material, production, and logistics expenses
Faster delivery	Shorter time-to-market and hospital installation
Compliance	Reduce risk of regulatory delays/penalties
Risk management	Lower supply, geopolitical, and transport risks
Quality control	Fewer defects, higher reliability
Inventory efficiency	Lower storage and working capital costs
Better service	Less downtime, higher hospital satisfaction
Responsiveness/customization	Meet specific country/hospital needs efficiently
Sustainability	Greener, more responsible operations
Strategic advantage	Win market share and tenders with a better chain

Everyone deserves the opportunity to live a healthy, fulfilling life, regardless of where they are born or what they can afford. Access to advanced medical imaging is not just a matter of technology or economics—it is a fundamental question of justice and human dignity. By optimizing the supply chain for life-saving equipment like MRI and PET-CT scanners, we are not merely improving efficiency; we are helping to bridge the gap between privilege and need. Each improvement means more lives diagnosed early, less suffering, fewer financial burdens on families, and a stronger, healthier society. This project is driven by the conviction that quality healthcare should not be a luxury for the few, but a right for all

Model building and constraints ideas

Objective Function Example

Total Cost = Sourcing Cost (magnets, electronics, coils, cryogenics, labor, software)

- Logistics Cost (shipping, insurance, customs, last-mile delivery)
- Regulatory Compliance Cost (per country)
- Installation & Calibration Cost
- Expected Risk Cost (helium shortage, power outage, transport loss, regulatory delay, IP violation)

Sample decision variables

Variable Name	Description	Type	Example Values
Assembly_Country	Country where final MRI assembly is done	Discrete	Germany, US, India
Magnet_Supplier	Supplier for superconducting magnet	Discrete	Siemens_DE, Toshiba_JP
Electronics_Supplier	PCB and power electronics supplier	Discrete	Samsung_KR, Flex_SG
Coil_Supplier	RF/gradient coil supplier	Discrete	Philips_NL, Medcoil_IN
Cryogenics_Supplier	Cryogenic system provider	Discrete	Sumitomo_JP, Oxford_UK
Software_Localization_Country	Country where software customization is done	Discrete	India, US, Germany
Import_Duty_Magnet	Import tariff on superconducting magnet in assembly country (%)	Continuous	2.5%, 5%, 7%
LeadTime_Magnet	Shipping lead time for magnet (weeks)	Continuous	3, 4, 7
Helium_Shortage_Risk	Probability of helium shortage during year (%)	Continuous	10, 20, 5
Power_Outage_Rate	Annual power outages at assembly site (hours)	Continuous	8, 12, 3

Sample constraints

- Each MRI must be assembled in exactly one country
- All regulatory and safety requirements in destination markets must be met
- Lead time from order to installation ≤ market requirement (e.g., 6 months)
- Spare parts must be deliverable within X days to hospitals in all markets
- Budget or cost limits (optional, per scenario)
- Any particular element or let say He supply risk cannot exceed a given threshold

Sample questions

- Which country should you assemble in?
- How many MRI units to be produced in each location?)
- Which supplier to use for a component?
- How much to ship by air versus by sea?
- Final warehouse location ?
- Time constraints ?

THANK YOU